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HAM RADIO:

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- Golden Anniversary of Hamming

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PLUS:

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- Voice-Powered Radio Transmitter
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See page 42

The NEW TV Antennas
How to Buy and Install Them

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Here is an immediate and growing need for trained technicians in Industrial-Military Electronics, Radio-TV Servicing and Communications. Better than average jobs with high pay, interesting work, bright futures wait you in the fast growing industry of the 1960's. Join thousands of NRI graduates now benefiting from career opportunities in this Electronic Age.

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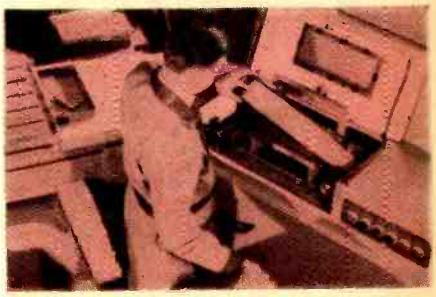
National Radio Institute, Washington 16, D. C.

Industrial ELECTRONICS

The NRI course in Electronics-Principles, Practices, Maintenance prepares you for a career as an Electronic Technician in industry, business, government, the military. Computers, telemetry, automation, missiles, rockets all employ the same basic Electronic principles . . . and that is what this NRI course stresses with illustrated lessons, special training equipment.



Commercial FCC LICENSE

You must have an FCC License if you want to operate or service transmitting equipment used in TV and Radio Broadcasting, aviation, marine, microwave, facsimile or mobile communications. Even a service Technician needs an FCC License today to work on C-Band Radio equipment. From Simple Circuits to Broadcast Operation, this new NRI course trains you quickly to take Government exams.

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In NRI's Communications course you get *actual experience* as NRI trains you for your choice of Communications fields. Commercial methods and techniques of Radio-TV Broadcasting; teletype; facsimile; microwave; radar; mobile and marine radio; navigation devices; multiplexing are some of the subjects covered. You work with special training equipment.

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NRI's time-tested course in Servicing not only trains you to fix radios, TV sets, hi-fi, etc., but also shows you how to earn spare-time money starting soon after enrolling. Fast growth in number of sets means money-making opportunities for you in your own spare-time or full-time business, or working for someone else. Special training equipment at no extra cost. Mail postcard.

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Audio & Hi-Fi

Theory & Practice

Science Fair Project

Regular Departments

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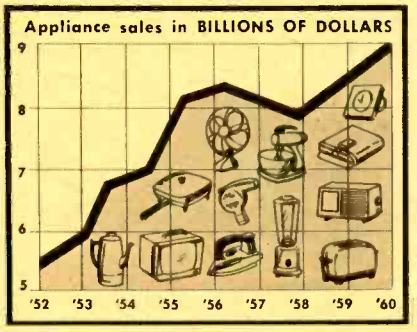
Record-Shattering Boom in Electrical Appliances Opens Up Exciting Profit Chances for Men Who Can Repair Them

OVER FOUR HUNDRED MILLION electrical appliances are in use right now in American homes—and are increasing at the rate of 76 MILLION a year! No wonder that men who know how to service them properly are making $3 to $5 an hour—in spare time or full time. FREE BOOK tells how you can quickly and easily get into this profitable field.



(Above) Based on chart in Electrical Merchandising Week Magazine.

Just look at how dependent American homes have become on electric appliances!

Here are some of today's common appliances, and the number of U.S. homes containing each.

Air Conditioners (Room)	6,500,000
Bed Coverings	10,800,000
Clocks	40,268,000
Coffee Makers (automatic)	27,000,000
Freezers	11,200,000
Frypan Skillets	20,600,000
Heaters, Portable (Elec.)	14,415,000
Heating Pads	19,925,000
Hotplates	12,105,000
Irons (Standard)	44,850,000
Steam Irons	28,200,000
Mixers	27,000,000
Ranges	17,200,000
Refrigerators	49,605,000
Sandwich-Waffle Comb.	17,615,000
Shavers	34,500,000
Toasters	40,195,000
Vacuum Cleaners	36,700,000
Washers	47,100,000

EARN WHILE YOU LEARN

with this
APPLIANCE TESTER
—Yours at No Extra Charge

Course includes all parts to assemble a portable, sturdy Appliance Tester. Use it to locate faulty cords, short circuits, poor connections, etc. in a jiffy; find defects in house wiring; measure electricity used by appliances; many other uses. Helps you earn while you learn.

THE "ELECTRICAL APPLIANCE BOOM" is in full swing. For example, annual sales of coffee makers have zoomed in the last decade from 900,000 to 4,750,000. Room air conditioners have gone from 200,000 a year to 1,800,000 a year. In just the last five years Americans have bought 26 million electric fans, 9 million electric heaters, 5 million deep-fat fryers!

The coming of the auto created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

We Tell You Everything You Need to Know

If you'd like to get started in this fascinating, profitable, rapidly growing field—let NRI give you the home training you need in Servicing Electrical Appliances. Here's your chance to build up "a little business of your own" without big investment – open up an appliance repair shop, become independent. Or keep your present job, turn your spare time into extra cash.

You can handle this work anywhere – in a corner of your basement or garage, even on your kitchen table. And you can earn $3 to $5 an hour – get back the cost of the course before you finish it. No technical experience, or higher education necessary. We tell you and show you everything you need to know, in plain English and clear pictures. And the training costs you less than 20¢ a day!

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Our 24-page Free Book tells about America's "Electrical Appliance Boom" – how we train you to "cash in" on it. Free Sample Lesson shows how simple and clearly illustrated our instruction is – how it can quickly prepare you for a profitable future. Mail coupon, letter, or postcard to: *National Radio Institute, Dept. KC2, Washington 16, D.C.* (No obligation – and no salesman will call on you.)

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FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York 36, N. Y.

● *CB Offer*

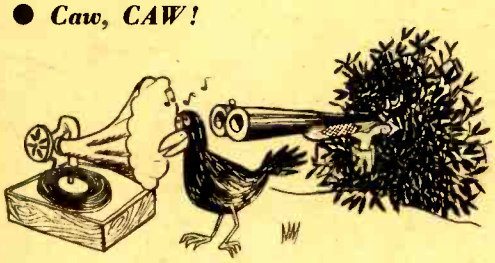
We of the Johnstown CB's have started a monthly newsletter for our members and any others interested. We would like to exchange copies of our paper for those put out by other similar organizations.

Any individual CBer who wants a free copy can obtain it by sending me a stamped, self-addressed business envelope.

Ronald Gombar
Secretary
Johnstown CB's
Box 852
Johnstown, Pa.

Any other CB clubs want to exchange newsletters? Just get in touch with Mr. Gombar. And if you want EI to list your publication exchange offer, send us a note.

● *Caw, CAW!*



I don't really know much about electronics but I would like to build a transistor portable phonograph for use in hunting crows. What I need must be able to play a record with enough volume to call and fool crows for miles around. Can you help me?

Lawrence Kreuser
Green Bay, Wis.

Not much, we're afraid, Larry. You could try one of the transistorized portable PA systems and a crow call that you can buy at any sporting goods store. You might not fool the crows—but you'll at least have fun scaring your neighbors.

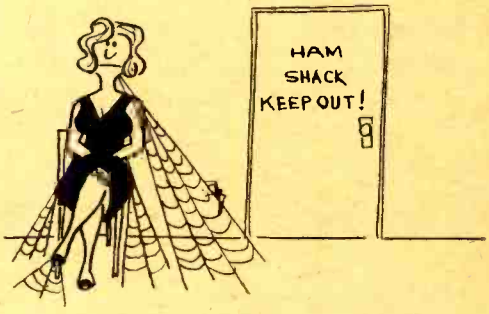
● *Real-Live Antenna*

Not long ago I was monkeying with my tape recorder with the power on and as I bumped a wire, the thing started picking up WJJD here in Chicago. When I took my finger away the station went off. What gives?

Beecher V. Ruh
Chicago, Ill.

It's an old story, Beecher. The bias on one of the microphone preamp tubes was such that it enabled the tube to operate as a detector. Your finger fed the signal into the circuit and your body was the antenna. The recorder's high-gain amplifier did the rest.

● *Cindy's Complaint*



The following verse is for the benefit of the electronics-age girl friend. She'd like to show more interest but you men seem to think the effort is too great and women are stupid. Give a gal a chance!

Tubes and wires, mikes and switches
Always give me nervous twitches.
Coax cable, signal check
Make a girl a nervous wreck.
"Tap that tube and check another"
And you feel just like his brother.

Cindy O'Connell
Utica, N. Y.

[*Continued on page* 106]

PICK YOUR OWN SUCCESS STORY FROM THIS PAGE

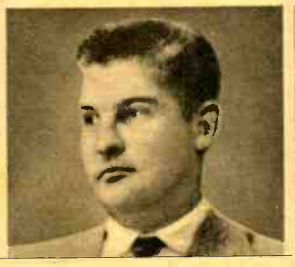
Wins $3000 contest—"After my I. C. S. courses I secured a new position," says Mr. Cecil Rhodes. "My income has more than doubled and I recently won a $3000 sales contest."

From clerk to Assistant Estimator, thanks to I.C.S. "Any way you look at it," writes Mrs. Edna James, "the time and money one spends for I. C. S. Courses will be repaid a thousandfold."

These are the true stories of people who seemed trapped in routine, low-pay shaky jobs. Handicapped by lack of proper training, they couldn't get the things they wanted out of life—more money, a job they liked, security and happiness.

They are a small sample of the thousands of men and women—young and old—who turn to I. C. S. for help. Their will-to-learn plus I. C. S. training have changed the course of their lives.

Are you discouraged with your job and pay and feel you can't improve yourself because of lack of specialized education? Well, these men and women were in the same boat. With I. C. S. training, one of these success stories could be about *you*.



"As a college graduate, I found I.C.S. very valuable." Robert Lee took the I. C. S. Course in Advertising, is now Promotion Manager for a large corporation. "I. C. S. got me started on the way up," he says.

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- ☐ Carpentry and Millwork
- ☐ Heating
- ☐ Painting Contractor
- ☐ Plumbing
- ☐ Reading Arch. Blueprints

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- ☐ Commercial Art
- ☐ Magazine Illus.
- ☐ Sign Painting and Design'g
- ☐ Sketching and Painting

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- ☐ Automobile
- ☐ Auto Body Rebuilding and Refinishing
- ☐ Auto Engine Tuneup
- ☐ Auto Electrical Technician
- ☐ Diesel Engines

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- ☐ Aviation Engine Mech.
- ☐ Reading Aircraft Blueprints

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- ☐ Advertising
- ☐ Bookkeeping and Cost Accounting
- ☐ Business Administration
- ☐ Business Management
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- ☐ Purchasing Agent
- ☐ Real Estate Salesmanship
- ☐ Salesmanship
- ☐ Salesmanship and Management
- ☐ Traffic Management

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- ☐ Analytical Chemistry
- ☐ Chemical Engineering
- ☐ Chem. Lab. Technician
- ☐ General Chemistry
- ☐ Oil Field Technology
- ☐ Pulp and Paper Making

CIVIL ENGINEERING
- ☐ Civil Engineering
- ☐ Construction Engineering
- ☐ Highway Engineering
- ☐ Professional Engineer (Civil)
- ☐ Reading Struc. Blueprints
- ☐ Sanitary Engineer
- ☐ Sewage Plant Operator
- ☐ Structural Engineering
- ☐ Surveying and Mapping
- ☐ Water Works Operator

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- ☐ Architectural Drafting
- ☐ Drafting & Machine Design
- ☐ Electrical Drafting
- ☐ Electrical Engineer Drafting
- ☐ Industrial Piping Drafting
- ☐ Mechanical Drafting
- ☐ Sheet Metal Drafting

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- ☐ Electrical Appliance Servicing
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- ☐ Electric Motor Repairman
- ☐ Elec. Engr. Technician
- ☐ Elec. Light and Power
- ☐ Practical Electrician
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- ☐ Supervision

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- ☐ Gas-Elec. Welding
- ☐ Heating and Air Conditioning
- ☐ Industrial Engineering
- ☐ Industrial Instrumentation
- ☐ Industrial Safety
- ☐ Machine Shop Practice
- ☐ Mechanical Engineering
- ☐ Plumbing and Heating
- ☐ Professional Engineer
- ☐ Quality Control
- ☐ Reading Shop Blueprints
- ☐ Refrigeration and Air Conditioning
- ☐ Tool Design ☐ Tool Making

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- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Radio-TV Servicing
- ☐ TV Technician

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- ☐ General Railroad

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2 Complete guide to PROFESSIONAL SERVICE METHODS

Radio & TV TROUBLESHOOTING AND REPAIR is a complete 822-page guide to *professional* service methods . . . the kind that help you handle jobs faster more profitably. For beginners, this giant book with its 417 clear illustrations is an easily understood course in locating troubles fast and fixing them *right*. For experienced servicemen, it is an ideal way to develop better methods and shortcuts; or to find fast answers to problems. You learn troubleshooting of all types from "static" tests to dynamic signal tracing methods. Step-by-step charts demonstrate exactly what to look for. A big television section is a down-to-earth guide to all TV service procedures. Price $10.00 separately.

CASH IN ON APPLIANCE REPAIRS!

ONLY $6.75 FOR THE COMPLETE TRAINING

Save on repair bills! Earn in spare time!

When you consider the prices charged for electrical appliance repairs these days you'll quickly recognize the tremendous money-making opportunities open to trained men in this literally tremendous field!

At only a small fraction of prices charged for mail-order training courses, this 370-page, low cost book teaches you step-by-step how to repair practically any home electrical appliance. Troubleshooting charts help you locate faults quickly. Book even explains how to make your own inexpensive test tools and trains you in modern appliance refinishing methods. *Includes specific service details on: Std. & automatic washers; ironers; toasters; ranges; cleaners; mixers; hot plates; razors; clocks; motors; water heaters; bottle warmers; waffle irons, and many more. Price $6.75.*

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Handle ANY Job from minor repairs to complete rewinding.

It pays to train for something different! ELECTRIC MOTOR REPAIR is a complete guide that helps you cash in on this growing field. Shows how to handle all repair jobs (including complete rewinding) on practically ANY AC or DC motor or generator in common use —from fractional horsepower to giant industrial motors. Special duo-spiral binding brings text and related how-to-do-it diagrams side by side so that you learn fast, easily and right. It's the ideal book whether you want to train for a good-pay motor repair job or simply want to fix motors as a sideline or hobby! 560 pages; over 900 pictures. Price $9.25.

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Eliminate needless testing!

Just turn the dial of the pocket-size PIX-O-FIX TROUBLE FINDER GUIDE! When the picture in the PIX-O-FIX window matches the image on the TV screen —presto!—you've got your clue. PIX-O-FIX shows the likely causes of the trouble—indicates the receiver section involved—then gives clear repair instructions. Two PIX-O-FIX units Nos. 1 and 2 cover 48 different TV troubles. Together, they're a comprehensive guide to quick "picture analysis" servicing of any TV. Price only $3.95 for the two.

Get your COMMERCIAL OPERATORS LICENSE!

Train for radio's best paid jobs!

This famous book makes it easy to train for your FCC commercial license as an operator aboard ship, in aviation, broadcasting, telecasting, etc. LICENSE MANUAL FOR RADIO OPERATORS is a quick, easily understood guide that covers *ALL EIGHT* FCC examination elements—not just some of them. Reviews almost 2200 exam questions. Covers everything you'll need to know to pass your examination for 1st or 2nd class radio-phone license holder with flying colors! Price $6.75.

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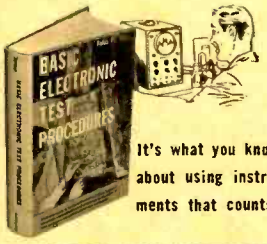
Guide to ELECTRONIC TEST PROCEDURES!



It's what you know about using instruments that counts!

Rufus P. Turner's 316-page BASIC ELECTRONIC TEST PROCEDURES manual with more than 190 illustrations, pattern photos and procedure diagrams teaches you to test any circuit, equipment or component in a fraction of the usual time. It is a complete course in *professional* testing techniques! For instance, you learn to check for distortion by the 'scope, rejection filter, harmonic distortion meter, wave analyzer or oscillator methods. You learn to measure resistance with a current meter, a volt-ammeter, voltmeter, ohmmeter, or via the bridge method—and so on.

Includes Current checks; measuring Power, Capacitance, Resistance, AF, RF Phase, Distortion & Modulation; testing Tubes and Semiconductors; testing Amplifiers; checking Sensitivity, RF Gain, Fidelity, AVC Voltage, etc. Even includes industrial electronic test procedures. Price $8.50.

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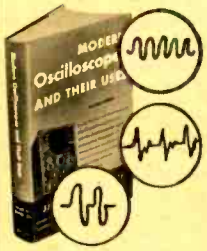

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(Above offers expire Oct. 15, 1962)

...electronics in the news

Giant Midget . . . Even the gents who dreamed up the publicity shot at left would have to admit their wrist-radio takes a mighty strong wrist. But the size of the equipment still is striking, considering what it is. On her right wrist the little gal is carrying a five-watt *single-sideband* transmitter and her left hand holds a companion receiver. The Delco Radio people in Kokomo, Ind., did away with the usual bulk and high cost of SSB by using some new RF transistors and high-Q tuning elements enclosed in ferrite shields. Delco's SSB midget may cause quite a stir in handi-talkie circles, particularly the Citizens Band. SSB apparently is legal on CB (see the CB CORNER in this issue).

—o—

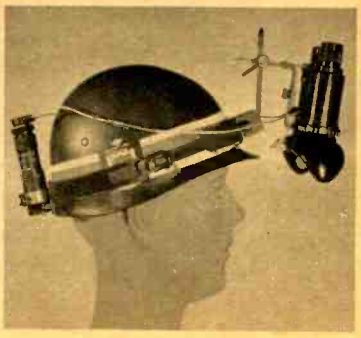
DEW East . . . Stretching 1,200 miles from Baffin Island in Canada, across Greenland to Iceland is a vast new radar sentry system called DEW East. It is an extension of our older DEW (Distant Early Warning) Line—which begins in the Aleutian Islands—to detect enemy aircraft and air-breathing missiles coming across the North Atlantic. DEW East uses a tropospheric scatter radio communications system with 120-foot dish antennas to link its seven stations. Our photo shows a DEW East station in icy Greenland.

—o—

Light Fantastic . . . Although those streaks in the picture we show may look like a study of afternoon sun falling through the bars of the county jailhouse, they represent quite a photographic fèat. The streaks were recorded by an electronic Image Converter Camera built by Space Technology Laboratories and they show the 186,000-mile-per-second flight of light. Each streak represents a mirror at a different distance from the camera. Through a sweeping action, the photo shows how light from a single source took longer to reach the film as the distance of its flight increased.

—o—

Cat Eyes . . . The Army Engineers at Ft. Belvoir, Va., have updated the World War II sniperscope until the infrared device now consists of a binocular and a midget power supply mounted on a helmet (see photo) which enables soldiers to work or fight in pitch darkness. The binocular actually is a pair of image tubes sensitive to infrared. The soldier has an IR "flashlight" or transmitter on his belt. When he shines its invisible rays on any object the binocular picks up the reflected energy and converts it to visible images.



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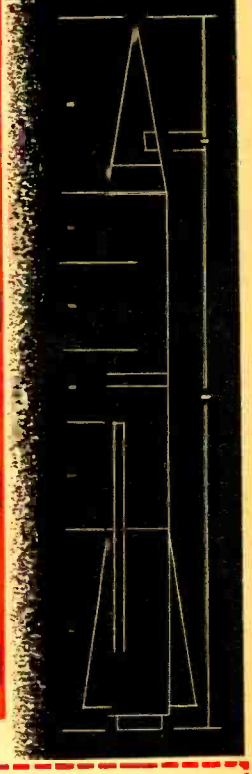

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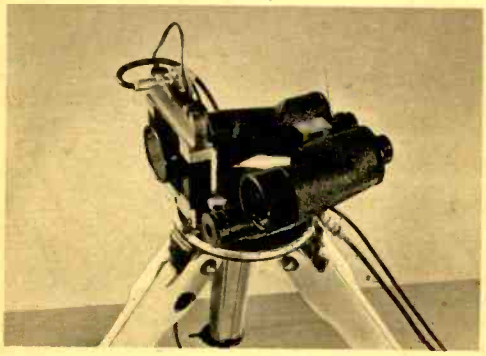
. . . electronics in the news

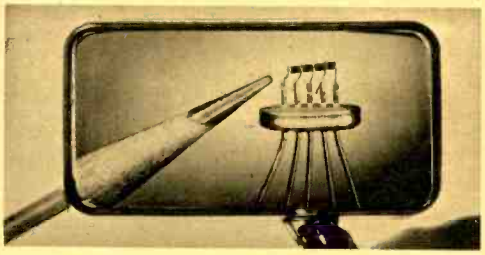
The Eyes Won't Have It . . . Reconnaissance crews and artillery spotters on the battlefield now face a new hazard when they use high-power binoculars. If the lenses pick up the light of a nuclear blast they magnify it and funnel it directly to the retina, causing injury or blindness. Electro-Optical Systems has devised an apparatus called a



stressed plate shutter which mounts in front of the objective lens and shuts out the light before it hits the retina. The shutter consists of a chunk of plate glass with a polarized sheet on either side and mounted between two small beams. The beam-ends are held together by stacks of piezoelectric ceramic wafers. A detector picks up a nuclear blast and gives the piezoelectric wafers a shot of voltage. The wafers shrink in size, causing the beams to squeeze the glass. That in turn changes the polarization of the light going through and effectively cuts it off. All this happens in .0001 second. After the blast the shutter "reopens" quickly to reveal the after-effects.

—o—

The Chargistor . . . That name may sound like a new credit card system,



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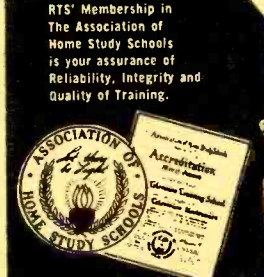

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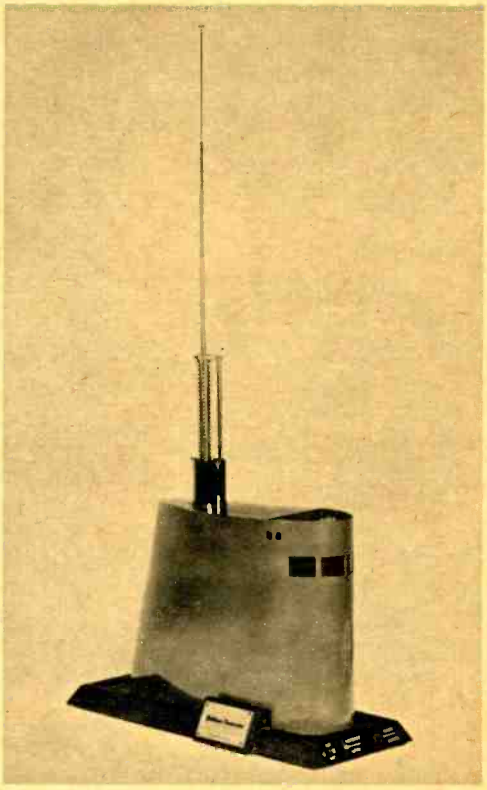
...electronics in the news

but it really refers to an experimental semi-conductor which has several control elements. A normal transistor has only one. Developed by IBM, the Chargistor has five working elements, three of which act like the grids of tubes, controlling electron flow. It can handle up to 200 volts, or twice as much as a transistor can take.

—o—

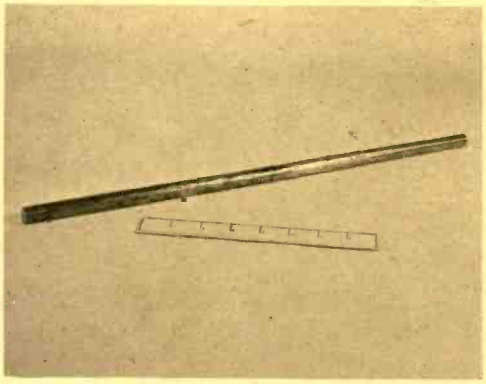
Sub Whip . . . A whip antenna for use on the conning towers of nuclear submarines has been designed by Hoffman Electronics (see photo). The antenna is retractable, disappearing into the sub in 40 seconds, and has the ability to

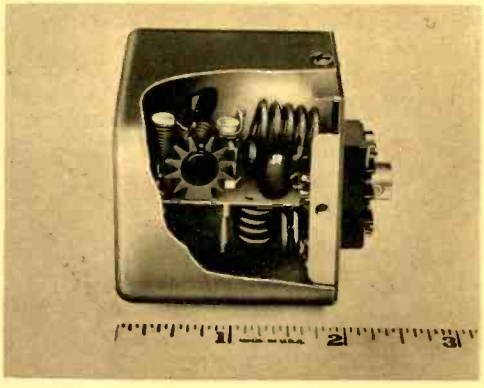


handle 5,000 watts anywhere between 2 and 32 mc. The trick is a tunable loading coil at the base and arrangements whereby the whip element itself can be fully or partially extended—either step enabling the operator to change the antenna's electrical wavelength at will.

. . . electronics in the news

Bug-Size Beacons . . . Two unusually small radio beacons were announced recently. A wand-like Trailmarker (see top photo) by General Precision is only a foot long and a half-inch in diameter. A few dozen of them dropped in featureless terrain mark out an electronic trail.





The wand has no power supply, using the energy from an interrogating transmitter as its power source. The lower photo shows a 2x2-inch Sperry transmitter useful in rescue work and other beacon jobs. It has a 200-mile range and puts out half a watt on 242 mc.

—o—

Back-Talk . . . The rising use of closed-circuit television in schools has created a need for a means of answering students' questions during a TV lesson. Community Engineering Corp., State College, Pa., now has devised a system to equip classrooms with overhead microphones and call buttons wired to a

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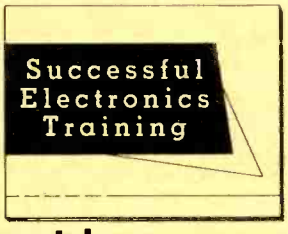

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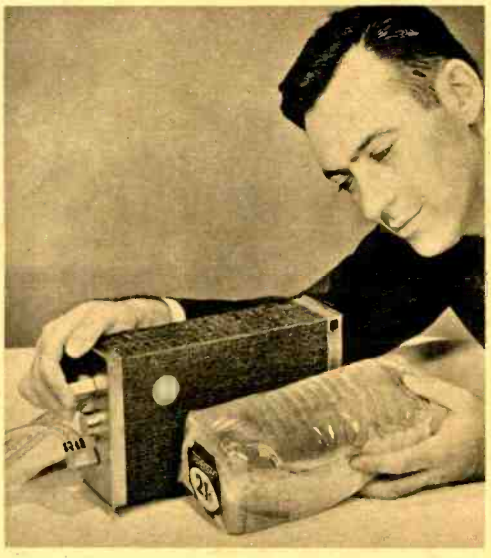
...electronics in the news

control console within the instructor's reach. A student with a question presses

a button to alert the instructor and his voice is then picked up by the mikes.

—o—

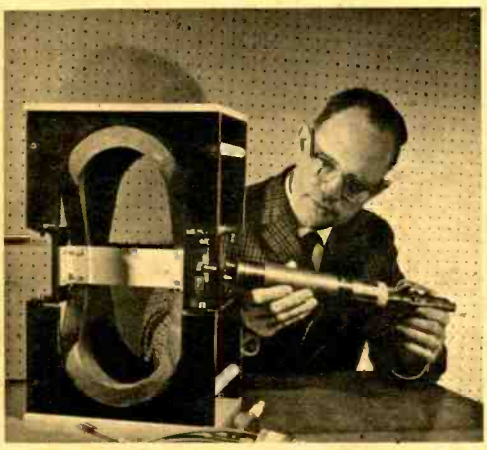
Bread, MADDAM? . . . The Burroughs Corp. has taken a sock at the increasing size and complexity of computers by producing a single-purpose baby computer that measures only 3x6x11 inches. The MADDAM (for Macro-Module and



Digital Differential Analyzer Machine) contains 5,500 components, weighs only 13 pounds and can perform several thousand mathematical calculations per second. Just the thing when your checkbook needs balancing.

...electronics in the news

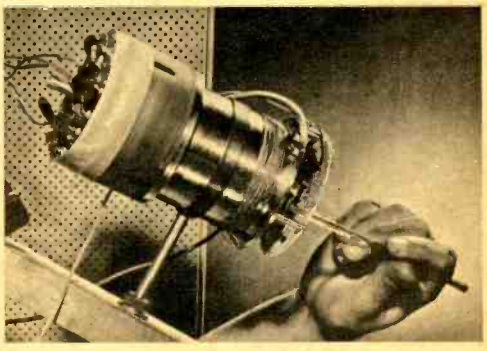
This Is a Tube? . . . To produce continuous-wave RF energy of 50 to 60 kmc (*kilo*megacycles), Bell Laboratories engineers use the odd structure below. It is a traveling wave tube. The U-shaped elements are new-fashioned horseshoe



magnets of enormous strength that focus electron streams in the cylinder, which is being inserted here into a hole between the pole pieces. The Bell experimenters are using the TWT to develop a millimeter wave transmission system (mm waves run from about 30 to around 100 kmc in frequency).

—o—

Time Check . . . Can you imagine a clock so accurate that it loses or gains only one second in 300 years? That's



the pedigree of a new space-age timepiece, the Rubidium Frequency Standard, made by FMA, Inc., El Segundo, Calif., for precision lab work.

...electronics in the news

ITEMS . . . Project West Ford, a satellite program that put a belt of 350 million tiny wires in orbit around the earth, gave its USAF mentors a headache right off: they had difficulty locating the orbit. The ¾-inch-long wires are sort of a man-made ionosphere since their job is reflecting high-frequency radio waves. But the wires are more predictable.

Goodyear Aircraft Corp. has built an instrument so sensitive that it can detect a current of one-trillionth *of an ampere.*

Trans-National Electronics of Montclair, N. J., is marketing the off-spring from a Japanese wedding of a tone arm and a stethoscope, called a Stereoscope. The mechanical gadget gives you "direct-coupled" stereo. No amplifier distortion here!

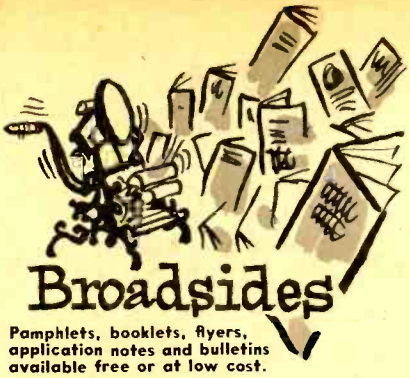
Bacteria batteries, using the minute current given off when bacteria attack organic matter, have been developed by Magna Products of Santa Fe Springs, Calif. Such bio-power might one day operate beacons at sea.

Russia has almost completed a huge radio telescope whose two arms form a cross on the ground. Each arm is about 3,280 feet long and 131 feet wide and consists of a row of towers. Atop each tower is a thin parabolic arm that looks like one rocker off grandpa's chair. All these individual rocker arms can be focused at one spot in the sky.

Researchers at Bell Labs have come up with a unique new material that is like ferrites (see MIGHTY MIDGETS OF ELECTRONICS, July '61 EI) only better. It is a crystal structure that is an electrical insulator but also ferrimagnetic. Unfortunately, the substance's name is even more unique—yttrium iron garnet. How do you pronounce it? Don't. Just say YIG.

Bendix's marine department in North Hollywood is distributing a free guide listing the location and frequency of all broadcast and aircraft beacon stations.

A method of breaking rocks that is cheaper than dynamite and easier to control than convicts is being tested by GE at Salem, Va. They're using huge doses (25 kw) of RF energy to crack big stones wide open via thermal stress.



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

Acoustic Research's first comprehensive catalog features their line of **acoustic suspension loudspeakers.** In addition to price and technical information, AR lists the minimum amplifier power needed to drive each speaker. Available free from AR at 24 Thorndike St., Cambridge 41, Mass.

Thirty-five types of 12-pin multifunction **Compactron devices** are described in a booklet available free from the General Electric Receiving Tube Dept., Owensboro, Kentucky. The GE devices are designed to function in place of conventional tubes and transistors.

Want to know why it is desirable that your amplifier's frequency range extends beyond your own hearing range? Ever wonder what blend control actually is? Then write to Harman-Kardon, Inc., Plainview, L. I., N. Y., for a free **question-and-answer brochure** that gives you these answers, plus some more—and a good bit about their Citation hi-fi kits.

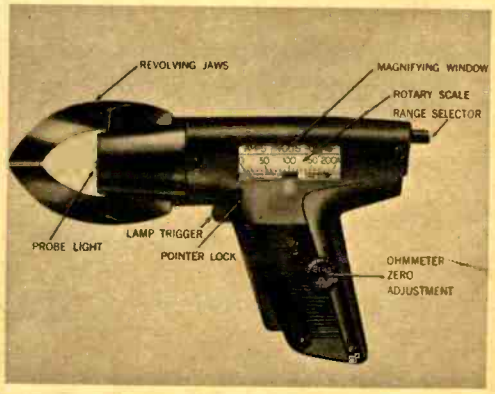
A chart of Sylvania replacements for **oscilloscope cathode ray tubes** of almost 100 manufacturers is available from Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

WEESKACFAACP is the title of Itek's light discourse on their line of **crystal filters.** If you're interested in the theoretical and practical limits of crystal filter design—and curious about the title—write to Itek Electro-Products Co., 75 Cambridge Pkwy., Cambridge, Mass. for a free copy.

Centralab's Catalog 100 tells all about their switches, controls and packaged circuits. Two control taper charts are included for quick reference. Free from Centralab, Electronics Div. of Globe-Union, 900A. Keefe Ave., Milwaukee, Wis.

Electronic Marketplace

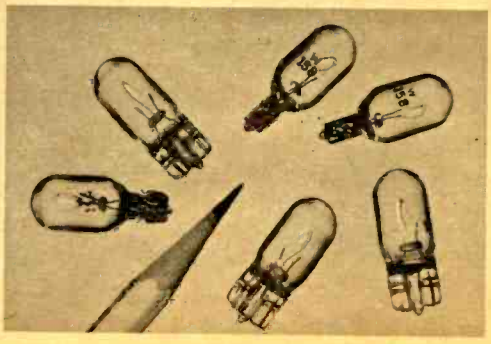
Shooting Trouble . . . Federal Pacific's new pistol-shaped meter is made to order for wild and woolly hobbyists and servicemen. The one-hand Pistolometer reads up to 600 amperes or 600 volts and



5,000 ohms resistance. A rechargeable battery fits in the handle. Furnished with a sturdy holster carrying case. A pistol-packin' gent couldn't ask for anything more. Federal Pacific Electric Co., 50 Paris St., Newark, N. J.

—o—

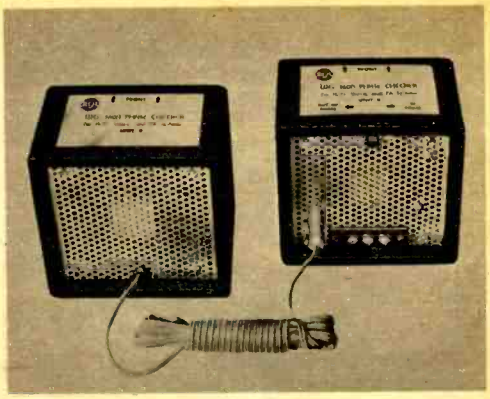
Baseless Bulbs . . . Westinghouse has neatly done away with conventional threaded or bayonet bases on a new



miniature indicator lamp that has the contact leads sticking out of a glass wedge at the end of the envelope. The wedge can be inserted in a special socket with contacts that match the protruding leads. Westinghouse Electric Corp., Bloomfield, N. J.

—o—

Check Your Phasing . . . Are you getting grey while slaving over your expensive stereo system because you can't get it to sound right? Chances are, your speakers are not phased properly. Getting them to work well together is easy if you use RCA's new WG-360A phase checker. The phase checker has two sensitive "receptors" (actually, high-impedance intercom type speakers) and is amazingly similar to EI's STEREO OMNIMETER project (January '61 EI). The phasing of your stereo speakers is indicated by voltage readings developed by the two "receptors," which can be read on a VOM, VTVM or scope. About $15. RCA, Harrison, N. J.

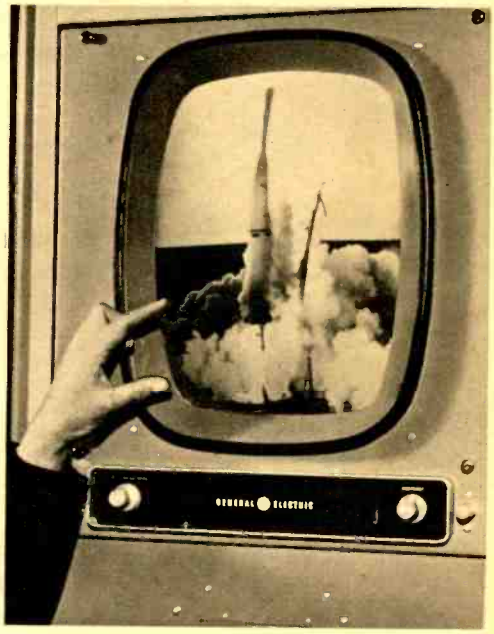


—o—

Custom Camera . . . One day a bright young GE engineer must have been sitting around watching rocket launchings on the blockhouse's closed-circuit TV set when the idea struck him: rockets and TV picture tubes don't have the same shape! Rockets are tall and slim. Picture tubes are short and fat. The result? GE now makes a CCTV set with a vertical picture tube! If you want one,

Marketplace

just ask for a Kookie Kanaveral Kamera. Now how about some more specially shaped tubes to watch such things



as Buddy Hackett (bulging in the middle), Lawrence Welk (square) or Jayne Mansfield (varied)?

—o—

An Eye For A Tube . . . GE is offering four new cadmium sulphide photoconductive cells of varying sizes to perform a variety of jobs. The cells react electronically to varying light intensities

and can control camera diaphragms, street and auto lamps, TV contrast and even toys. General Electric, Schenectady 5, N. Y

Marketplace

The Powermeg . . . is a transistorized power megaphone that can throw your voice 500 or so feet. The 2½-pound portable operates on four D batteries and

has a volume control. Additional features are a carrying strap and 50 feet of mike extension cord. Its case is made of durable plastic. About $13. Edmund Scientific Co., Barrington, N. J.

—o—

Life Insurance . . . You can't get an insurance policy on your tubes, but ATR has a good substitute. Their new plug-in tube protector is a thermal device that cushions filaments during the damaging initial surges of electric current. The

gadget assures longer life for TV sets, radios and hi-fi amplifiers. It is plugged into the 117-volt outlet and the equipment power cord into it. About $4. ATR Electronics, Inc., St. Paul 1, Minn.

[*Continued on page* 112]

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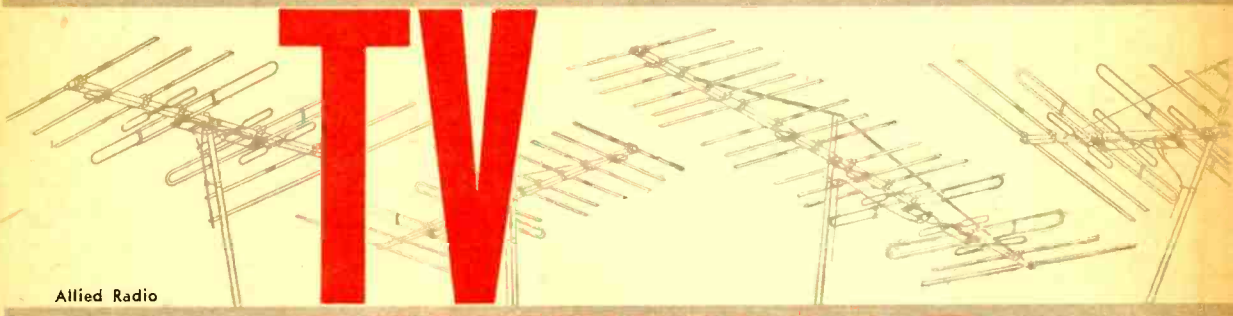
THE NEW TV ANTENNAS



Allied Radio

How to buy and install an antenna that will give you a snappy picture whether you live in the city or country.

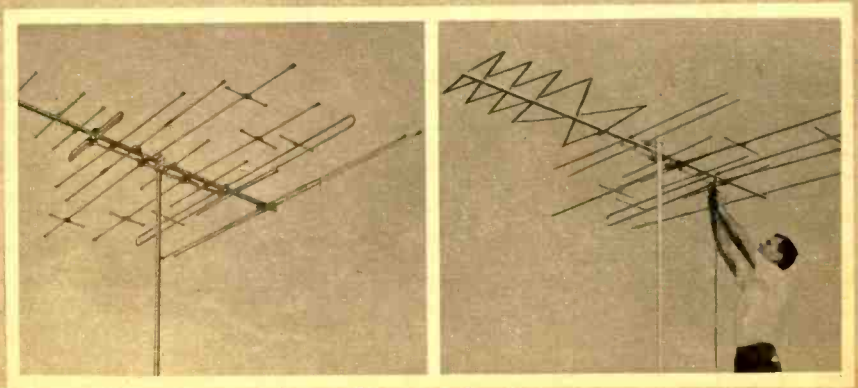
By Paul Daniels

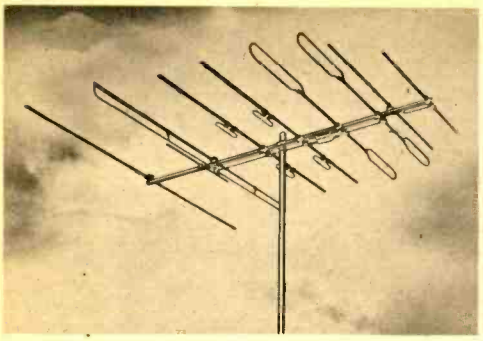
OVER the last decade we've seen television antennas go through some strange contortions. They started out with small dipoles and have grown into huge centipede-like yagis and herringbone designs that would do any herring proud.

But the biggest news in the TV antenna field is not some new shape or pattern in the receiving elements. The big news is in the accessory line, the little pieces of equipment that help the antenna do a better job.

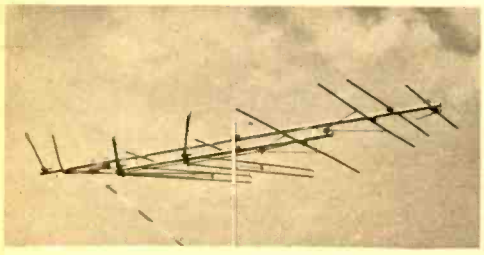
TV and FM booster amplifiers have been around since the early days of not-so-sensitive TV sets but they were once made unnecessary by newer and more sensitive receivers. Now the little power rigs have

Two high-gain TV antennas made by JFD Electronics are the Fireball (left) and the Satellite-Helix. Fireball is priced at $37.50 and the Satellite-Helix carries list of $49.50.





The Taco Topliner has eight working elements on the low end of the band; by splitting, they turn into 19 on the high end. The price is $37.95.



T-Bird Electra by Taco comes with boom-mounted transistor amplifier, two-set coupler. Finish is anodized gold. Price range is $80 to about $110.

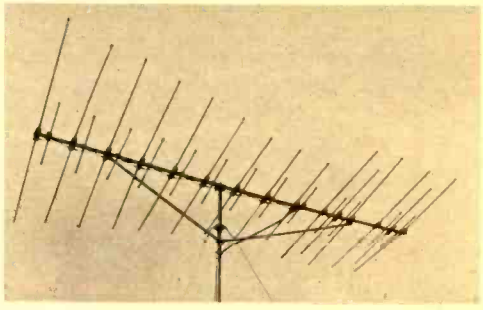
made a comeback and are used in deep-fringe areas with large antennas to give television reception to thousands of families who previously couldn't get any station. Signal amplifiers also are needed by many people who live in one- or two-station cities and must look to transmitters in neighboring towns for telecasts not carried locally.

Signal amplifiers have undergone a change since they last were popular. The new ones are mounted right on the mast or boom of the antenna and amplify the signal before it is weakened and picks up noise during its trip through the downlead. Both transistor and tube types are available, each offering something the other does not. Power for the boosters comes from a pack that normally is mounted on the back of the set and arrives via the same twinlead that carries the signal down. Filters keep the two separated.

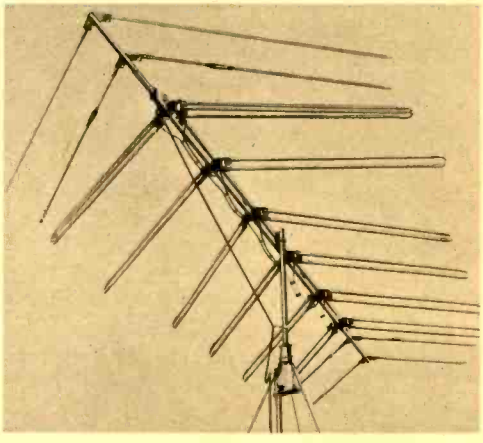
A new accessory is tunable signal traps that cut out interference from adjacent channels. These are handy when you want to pick up a distant station but have a local station on the channel next to it. This situation normally leads to interference on the weaker station's channel, and sometimes on the stronger station's channel.

Also in the accessory line you'll find couplers that permit you to hook as many as four TV sets to one antenna, and new types of indoor antennas that run from improved rabbit-ears to models that consist of metallic ribbons imbedded in a plastic or cardboard sheet that is put in the attic or under the rug.

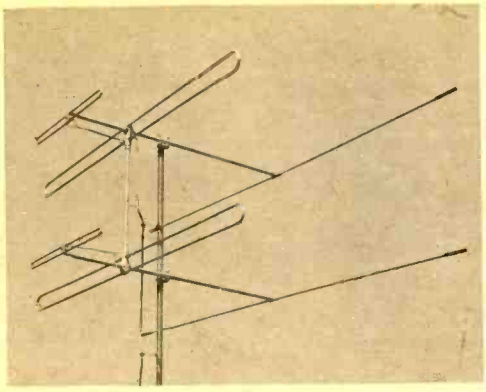
Most of the improvements in actual antenna design over the last several



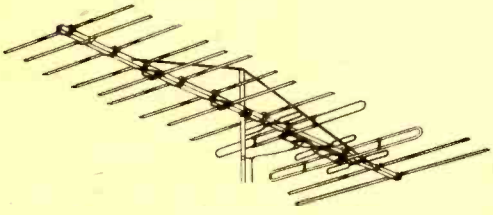
Channel Master's newest antenna is 28-element Crossfire for deep-fringe reception. Elements are gold-coated. Largest model has $59.95 price tag.



Super 10 T-W by Channel Master has 10 elements in herringbone configuration. Top of the line is priced at $59.95. Note the rotor (extra cost) in photo.



Nothing new, but a popular antenna that has sold by the millions is this Amphenol Inline dipole. Arrays can be single or stacked, as shown here.



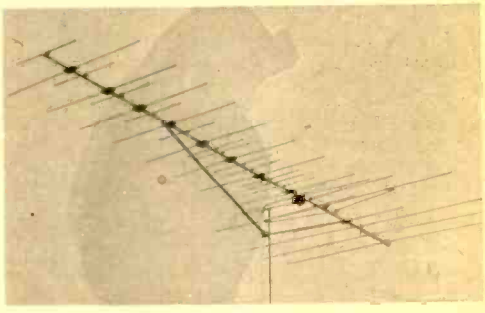
The Finco Atlas Duo-Twin-Drive has six elements on low band, what amounts to 27 on high band. Price begins at $58, or $63 with an amplifier.

years have been of the quiet, evolutionary type rather than revolutionary. At one time it was difficult to get high-gain signals on all VHF channels (2 through 13) with one antenna. Most popular models sold today do the job easily. The solution was simply to add as many elements as necessary to get the required gain. The big yagis for fringe areas now have 30 or more elements.

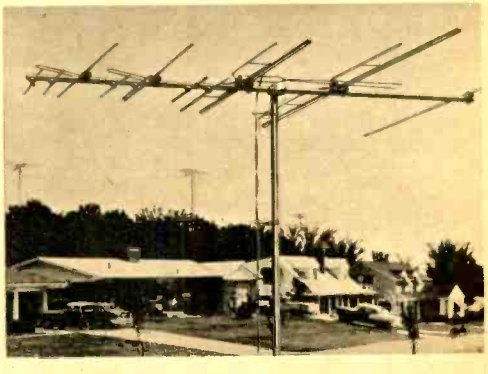
There is no antenna on the market that will give you a flat (or equal) response on all 12 channels, partly because of the simple fact that signals on the higher-frequency channels are weaker when they arrive. However, some models get fairly close to this ideal. The formula they use is an old one—a little less than half the elements are cut to the correct length to receive the low-band channels and the same number are cut for the high band. The other elements in big arrays are dual-purpose and matching units that give the antenna the desirable 300-ohm output impedance to match the downlead.

The much-advertised gold color of the new antennas does, in fact, serve a useful function. It is a protective coating that prevents corrosion of the elements and hardware. And nowadays the protective coating is applied *after* the antenna is assembled and all the required metal-to-metal contacts are made. At one time the process came before assembly and the coating, an insulator, had to be scraped off at all contact points.

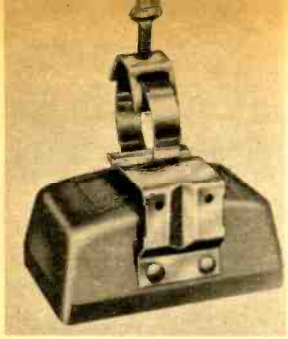
Most of the antennas we picture with this article are the more expensive models designed for fringe-area reception. Less expensive ones are available, of course, for televiewers in the primary reception areas where large arrays are not required.

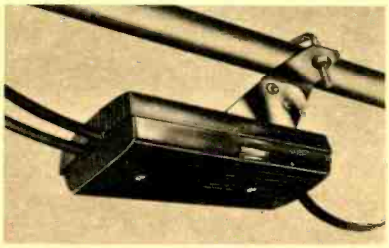


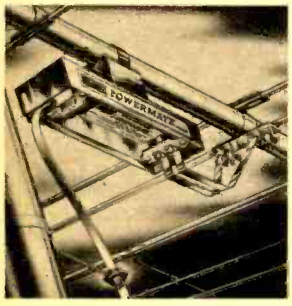
Deepest fringe areas are the spot for Winegard SP-55X, which has 30 elements and comes with a boom-mounted amplifier. List price is $104.95.

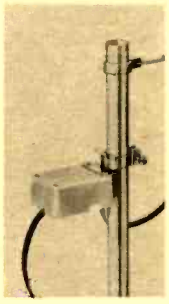


Winegard's Color-Ceptor antenna has 11 elements in low-priced model and 18 in top-of-line array. Priced from $31.50 (for model shown) to $47.50.









Antenna amplifiers soup up a signal before it enters downlead. A good one costs $30 to $40. Models shown are by (top to bottom) Winegard, Channel Master, Jerrold and Blonder-Tongue Labs.

Nearly all the newer models are easier to prepare for mounting than were the older antennas. They are packaged like collapsed umbrellas and the elements merely snap-lock into place. Any fairly handy do-it-yourselfer can mount his own antenna today.

But do you need a new antenna? If you are getting a clear, sharp picture on your receiver and there are enough channels to satisfy you, obviously you don't need a new one. On the other hand, if your picture has snow or ghosts, rolls frequently, or you are unable to receive all the stations in your area, you *do* need a new antenna.

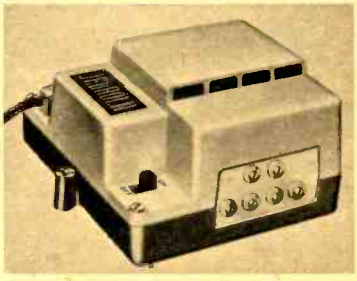
What about antennas for color TV and for UHF reception? As far as color is concerned, you can confine your worries to buying the set. No special antenna is required. One that gives you a good black-and-white picture will do as well with colorcasts.

Because of recent encouragement and expressions of opinion by the Federal Communications Commission regarding UHF television, there has been a reawakening of interest in those long-dead channels. Among other actions, the FCC is financing a new UHF station in New York City.

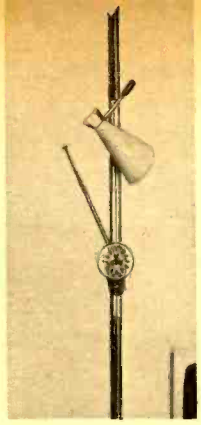
The function and operation of UHF antennas are the same as for VHF models but they obviously must operate at higher frequencies, and have to be purchased and mounted especially for the job. A VHF antenna will not give satisfactory (if any) results on UHF channels. And, of course, most TV sets today are of the VHF variety. A converter costing $25 to $30 is required to bring in UHF programs.

How big (and expensive) an antenna you need depends upon how much signal from the TV station gets out to your house. If you live 100 miles from a TV transmitter but your house is on a high hill in direct line-of-sight you have no major problem. If you live only 35 miles away but behind that hill, you have a problem.

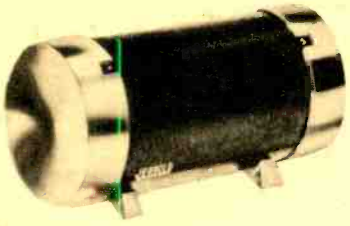
Problem locations need multi-element arrays, sometimes more than one antenna with each designed for a spe-



Special couplers permit you to hook more than one TV set to your antenna. Some of the units include an amplifier, as shown in bottom photo.



Oddball indoor antenna is mounted on a modern lamp pole. Sold at $19.95 by Snyder Co., Philadelphia.



Jerrold's Trap-Ease is a tunable signal trap that will cut out interference from adjacent TV channels. The list price is $19.95.

A dressed-up version of old rabbit-ears design is the tunable Magic Genie by JFD Electronics Corp.

cific channel, tall masts and booster amplifiers. Homes within 25 miles of a transmitter normally can use any of the good wideband or all-channel antennas on a 6-foot mast.

If you have few channels in your area and want to go hunting for distant stations you will need an expensive high-gain, directional, all-channel model with many elements (ten or more). You also may want a rotator to point the antenna in any desired direction.

If you have many local stations but in different directions you may need two or more simple antennas coupled together.

If many stations are available and all are in the same direction a single, moderately priced all-channel rig will do.

When you buy any antenna make certain that it has strong insulation blocks, a sensible snap-lock arrangement to hold the elements in place and strong elements that don't fold out of shape or open at the seams when you bend them.

Be prepared to spend $75 or more if your home requires a deep-fringe model. If all you need is a good all-channel antenna you need not pay more than about $25. Single-channel antennas cost around $10.

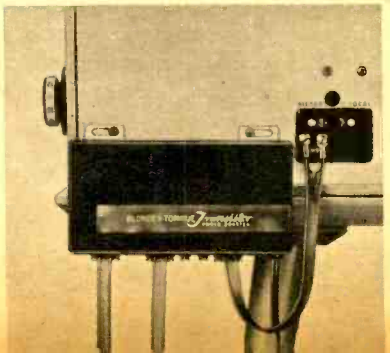
How you mount the antenna depends on your house. If you have a flat roof you can use a tripod mount, or you can mount the antenna on the parapet or side of the house. If you have peaked roof to contend with you can use a ridge mount or chimney straps.

Here are some mounting tips:

1. Snap all elements **firmly** into position.
2. Be sure to point the front of antenna toward the station.
3. Mount as high as practicable.
4. Don't put your antenna too close to another all-channel one.
5. Use 300-ohm twinlead.
6. Twist the downlead one turn every foot.
7. Use standoff insulator screws or nails to secure downlead.
8. Don't have excess downlead.

A good antenna system, once it is installed properly, will give years of trouble-free service.

Signal amplifiers mounted on the back of TV set boost input to first stage. They can drive more than one receiver, requires top-quality downlead.

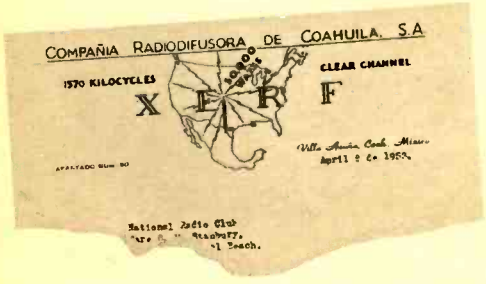


THE LISTENER

Notes for the short-wave listener and DXer

By C. M. Stanbury II

DOWN MEXICO WAY . . . Back in the Thirties old Doc Brinkley, the goat-gland quack, proved that you could do some odd things on American radio and get by with them, providing your transmitter was located just over the Rio Grande in Mexico. Brinkley held forth on XERA, across the border from Del Rio, Tex.



Mexican station XERF, home base for an offbeat preacher, upped power after date of this QSL.

Ciudad Acuna, a town also opposite Del Rio, now is the location of XERF, broadcasting on a clear channel of 1570 kc with the tremendous power of 250,000 watts. Where XERA had its Doc Brinkley, XERF has an evangelist named Dan Gilbert. Though the two men cannot be exactly equated, preacher Gilbert also has his eccentricities. He rails against space exploration, against the Demon Rum and against a few other choice subjects you don't usually hear mentioned in church. Some people call him a hate merchant.

"The Scripture plainly teaches," says brother Gilbert, "that the moon shall be kept from the corruption of man's uncleanness." He refers to Dr. Wernher von Braun as "an ex-Nazi swallowing the Kennedy-Stevenson moonshine."

Where Brinkley was confined to a Mexican station (and eventually to jail), re-broadcasts of Gilbert's messages can be heard on a few regional outlets in this country and some other border stations. But XERF is Gilbert's home base, and some odd things have happened to the station since he's been around.

As DXers, we're not interested in whether Gilbert is right or wrong, but the content of his sermons certainly is unlike anything else you're likely to hear on the air.

One of the strange ingredients in the XERF story is that the border powerhouse suddenly went off the air in the middle of last summer. A group of visiting National Radio Club members tried to find out why and were told the reason was tube failure. That seemed plausible until it was learned the XERF's transmitter was an RCA job installed in 1959, and we all know that RCA does pretty well at supplying its customers. Could the blackout have anything to do with Reverend Gilbert?

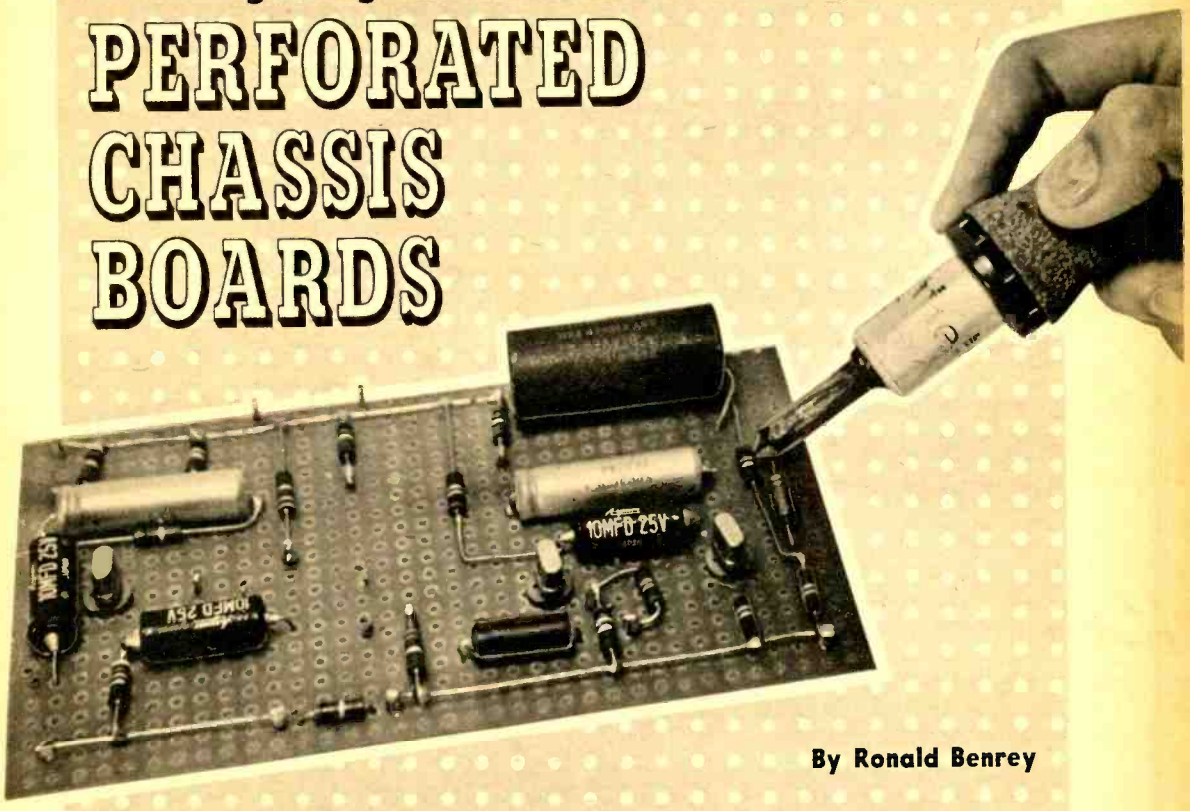
Studios of 250,000-watt XERF, Ciudad Acuna, across the Rio Grande River from Del Rio, Tex.

A similar shut-down occurred at XERF in 1960 and that time a veteran

[*Continued on page* 104]

getting the most out of

PERFORATED CHASSIS BOARDS



By Ronald Benrey

RAPID GROWTH in popularity of transistors and the miniaturization techniques that came with them have created a demand for a suitable chassis system. Although printed-circuit board is widely used in industry, among experimenters, the perforated chassis board is by far the most popular method of mounting components. Unfortunately, the hobbyist doesn't always use the boards wisely; in fact a large number of unsuccessful projects can be traced to their misuse.

Small components can be secured to perforated chassis boards by miniature nuts and bolts, clamps, etc., or by the leads of the parts themselves. The latter method is possible because of the light weight of most miniature components. Interconnections are made using push-in terminal lugs (flea clips) as junction and solder points. Thanks to the great number of adjacent holes, a lug pattern can easily be made to suit any circuit, and by simply removing the clips, the same chassis board can be re-used many times. A variety of clip types are available for temporary connections and experimental work.

Sizes and Shapes

Boards can be easily shaped to suit a particular application. You can save money by buying large boards and cutting off sections for individual projects. A fine-toothed coping or jew-

eler's saw, using light pressure to prevent splitting will serve nicely. Cut along a row of holes whenever possible. Airplane-type tin snips also can be used to cut the boards. With a little practice you can learn to break the board (over a desk edge) along the row of holes desired.

The best way to make large holes is to enlarge one of the small holes with a drill, then widen this pilot hole with a tapered reamer. Chassis punches can be used on high-quality phenolic board but in general it's best to *ream* large holes, not punch them. Odd shapes are easily cut with a nibbling tool such as the inexpensive Adel type shown.

Perforated boards are not very strong and tend to crack under strain. Consequently, they should not be used to support heavy components such as standard-sized transformers. Lack of mechanical rigidity also makes them unsuitable for high-frequency equipment requiring a non-flexible chassis.

Heat-producing components should not be mounted too close to the heat-sensitive phenolic material. However, as most transistor build-it articles describe low-frequency devices using lightweight and cool-running components, the above disadvantages are unimportant to the home experimenter.

Miniaturized vs Open Construction

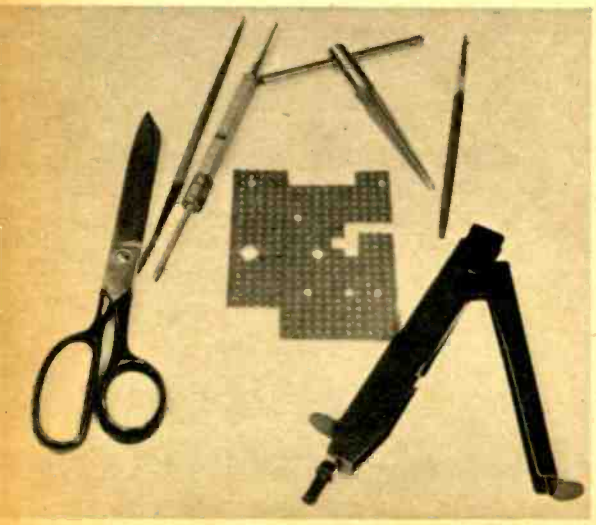
There are two basic approaches to using the perforated chassis board.

Maximum miniaturization implies the use of the smallest possible board, miniature and subminiature components, tight layout and elimination of such "luxuries" as transistor sockets, insulation and comfortable working space. And unless you're really skilled, damage to components during soldering and mistakes in component polarity run wild. You'll find that troubleshooting a miniaturized circuit is often more difficult than building it. Component prices go sky-high as size decreases. Unless a device cries for miniaturization, stick to the open construction technique.

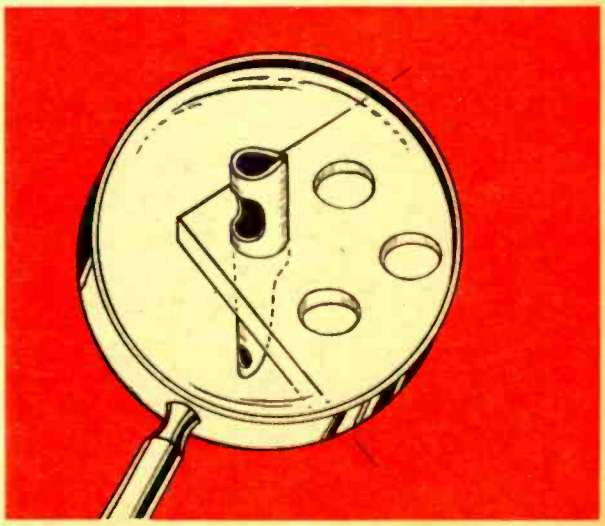
The correct approach is shown in the photos. Note the use of buss bars at the top and bottom edges and the squared-off components and leads of the transistorized preamp. Although there are about 30 major components in a fairly small area, everything is out in the open, and there is no doubt about polarity—and no danger of a short circuit. In addition, all the components are mounted so their values may be read.

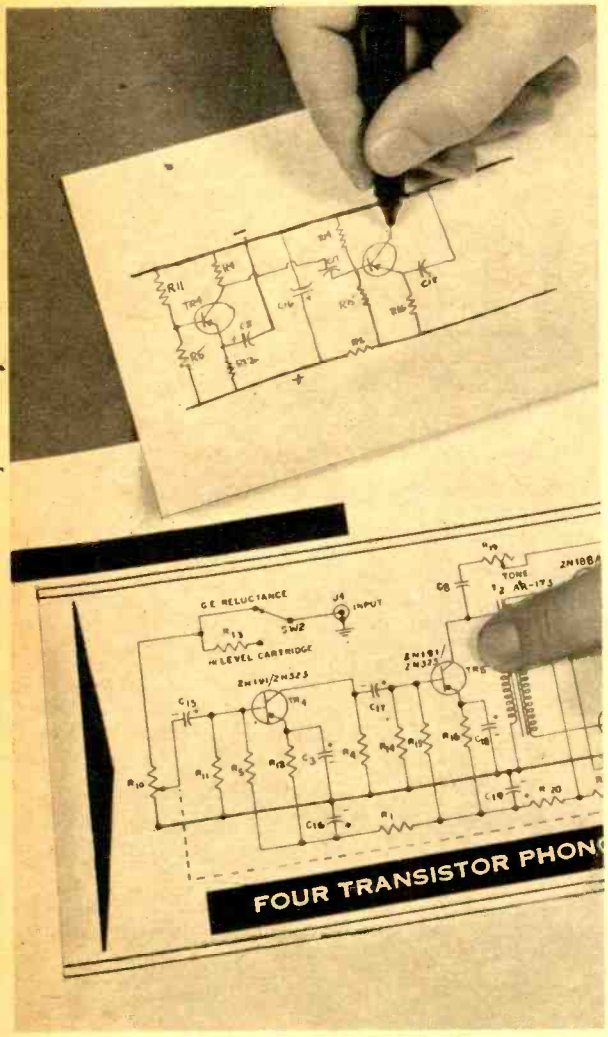
Since it is easier to do it right the first time it doesn't make sense to build a rat's nest instead of an electronics proj-

A few simple tools will suffice for cutting out even the most complicated shape chassis board.



Several types of small push-in terminal lugs are designed for use with perforated chassis boards.





It frequently pays to redraw a schematic to adapt it to the perforated board construction technique.

ect. First of all, have all components in front of you before you begin. The components themselves can serve as templates and you can experiment to determine most efficient placement and the locations for the lugs.

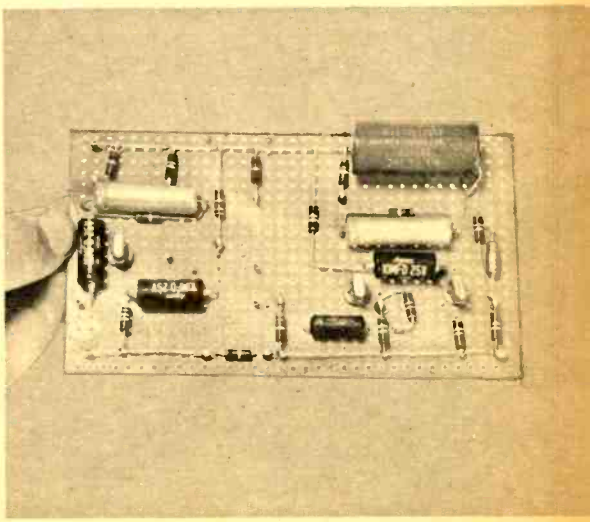
If working from a construction article, you can assume that the author tried several chassis arrangements before he selected the final layout. When working from a schematic diagram, it might be helpful to redraw the schematic (if it isn't already in that form), as is shown above. Otherwise, simply duplicate the diagram on the chassis board, placing the components in the same relative positions as they appear on the diagram. While some concessions must be made for bulky parts, this method usually works well.

The actual wiring depends a great deal on the type of device being built. Amplifiers, for example, should have short, direct connections to eliminate stray pickup. High-voltage power supplies, on the other hand, demand wide spacing and careful isolation to avoid arcing and leakage.

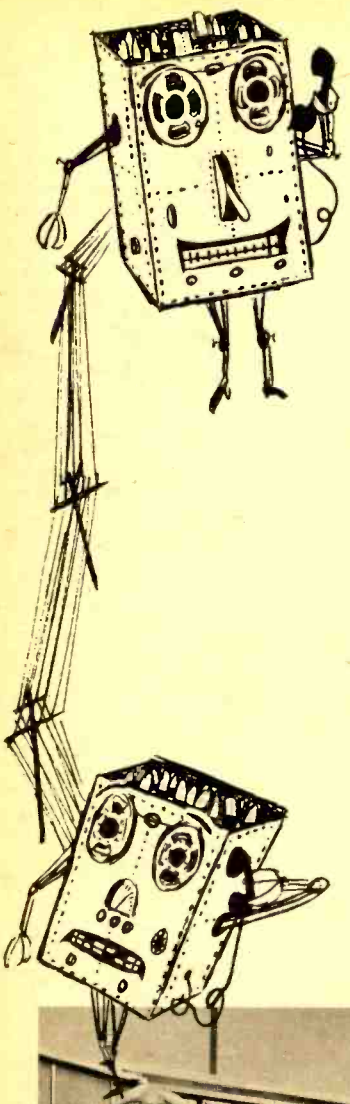
Pay attention to the author's comments such as: "keep the input and output well separated" or "mount this component in an upright position."

Flea clips, as mentioned before, serve nicely as terminal points, and provide secure hitching posts for component leads. Use color-coded wire, making each separate circuit a different color. This makes it easier to keep track of the individual sections and cuts down on the chance of a wiring error.

This discussion can be summed up in two words: planning and neatness. Keep them in mind when working with perforated chassis boards and you will have at your disposal a versatile chassis system perfect for a multitude of applications.



A completed project. All the components are accessible and their values can be read at a glance.



HEY!

There's a Computer on The Phone!

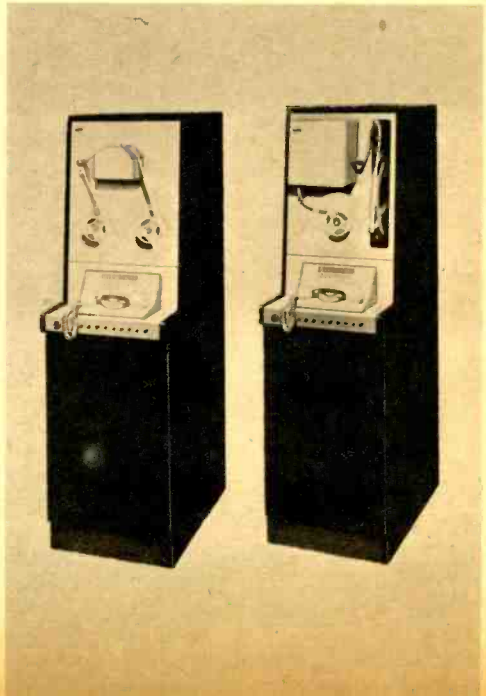
Thinking machines send thousands of words per minute via phones like yours and mine.

By Jay Arthur

IT IS the middle of the night. In a small Iowa city the branch sales office of a giant corporation is lit eerily by red flickers from a neon sign outside the window. Suddenly the ghostly quiet is broken. There is a low-key hum and in the darkness a pilot light winks on. A pair of tape reels turn slowly and stop.

In the corporation's headquarters, high above the din of New York traffic, a telephone rings and is quiet, though no one is there to pick up the receiver. A tape transport whirs into life. Back in Iowa, the reels are whirling rapidly now. For a few minutes the small city in the Mid-West and the big city in the

Social Security data flow between Kansas City and San Francisco via the RCA equipment at left below. At right is Bell System's Dataspeed transmitter, receiver. Regular phone lines are used.



A building-block approach is taken by ACF Electronics in putting together data transmission equipment. More modules, such as the one held by the engineer, mean more complex computers.

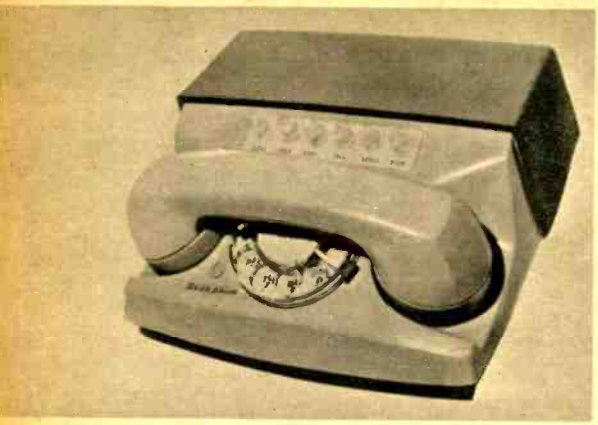
East are linked by matching tape reels spinning in synchronization. Then both stop. In Iowa the pilot light winks out. In New York the machine works a while longer, spews out a bunch of white cards and then it, too, is silent.

Though it may sound as if a couple of renegade machines are hatching up some dastardly plot, our little drama pictures nothing more than a mundane business transaction. The only unusual ingredients are the hour and the participants. The machines are computers, and the work they are doing—automatic, high-speed data transmission—represents the hottest new phase of the electronic-brain business. The medium used is regular telephone lines, and the new computers are able to carry on their own peculiar form of conversation over telephone sets exactly like those you and I have at home.

To find out what the computers in our drama really accomplished, let's backtrack a bit. Late in the afternoon out in Iowa a dozen or so salesmen trekked back to the branch office with their orders. As usual, the orders were to be sent to corporation headquarters, and from there the stock would be shipped. At one time they would have gone by mail. Perhaps a week later a salesman might find the warehouse had no more Model X's and an order could not be filled for a month.

But the procedure is quite different

Every computer would speak the same language if the COBOL idea catches on. Word means COmmon Business Oriented Language, has standard terms for all data, here studied by IBM programmers.



Baby of data transmission field is the Data-Phone which was designed by the Bell Telephone Labs.

in the case at hand. One by one the salesmen feed their orders into the office's little computer and go home. The computer squeezes all the information on a reel of magnetic tape—customer names and addresses, what is ordered and how much, the price, where delivery is desired, etc.—and then waits for a late-night hour, after the telephone rates go down and traffic is light on the trunk lines.

At a predetermined time the machine turns itself on and its slowly revolving reels make a direct-dial long-distance call to New York headquarters, where the ringing phone is answered by another computer. Speeding up its reels, the branch office's electronic brain sends along its orders at upwards of 5,000 words a minute. The data is recorded in the East.

The headquarters machine, having received orders from a dozen or so branches, types out invoices that go to the warehouse, perhaps makes up bills for the customers, makes note in corporation records that so much stock is being shipped and carries out other bits of bookkeeping. If it finds an order for 100 pieces of equipment when only 50 are on hand it automatically notifies the branch that there will be a delay, tells the factory to start producing more of the item and perhaps orders supplies for the job.

A list of the refinements possible in data-transmission computers would be a long one. For instance, if for some reason the Iowa brain gets a wrong number and Mrs. Jones in Little Rock says, "Hello," the computer, knowing this is not the right signal it is getting, and with the aid of a taped message says, "Excuse me, I have the wrong number," and tries New York again after notifying the phone company of the error so it will not be charged with a Little Rock call.

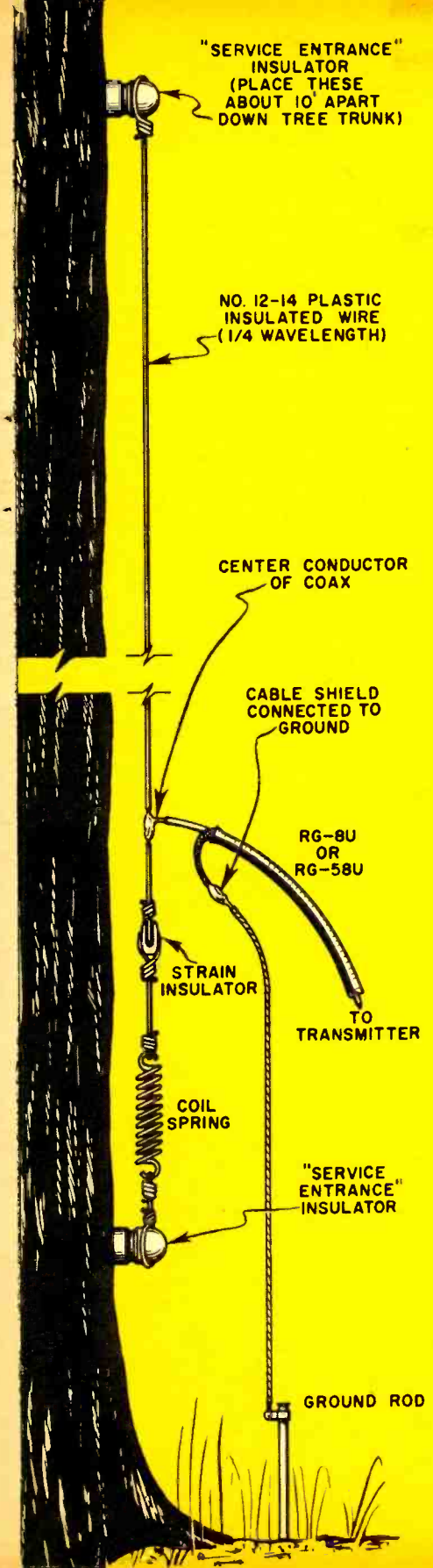
Although high-speed data transmission is a relatively new service for big businesses, developments are coming so fast it is difficult to dream up a project that some brain can't carry out. There are standard equipment setups but more often a large corporation merely explains exactly what must be accomplished and the computer manufacturer puts together the units needed for the job, no matter how complex or how offbeat (the wrong-number bit would have to be classified as the latter).

As a matter of fact, the computers in these installations can be used all day to do their primary job—computing. The data transmission task is just a sideline. And between rounds with the big brains the telephones, too, serve their normal purpose.

The key to data transmission lies in the ability of a computer to transform its usual "bit" language into tones that can be transmitted over telephone lines. At the receiving end, a computer speaking the same language demodulates the signals and converts them to magnetic charges on a tape, holes in a punched card or tape, or English printed on a roll of paper. Some machines can transmit and record at the same time.

Teletypes have long used telephone lines to transmit messages. The use of computers changes the "language" somewhat but, more importantly, it speeds up the process to fantastic figures, and that reduces toll costs. Equipment now being designed could transmit as many as 100,000 words a minute between any two towns in the world having phone service. One big *if* remains. Most telephone circuits today can't carry that much data. We

[*Continued on page* 99]

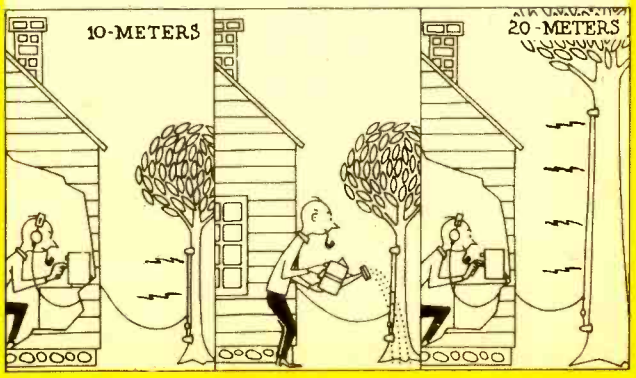


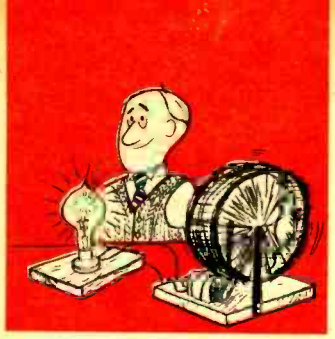
It's anti-TVI!...EI's hidden

ARBOREAL ANTENNA

IF YOU HAVE a tree of fair height on your grounds and a bunch of neighbors who are TV-suspicious of all hams, you will appreciate EI's hidden Arboreal Antenna, which will give you good radiating power without ever tipping off the nervous nellies. Our AA is merely a nondirectional vertical antenna stretched up a tree trunk and having some characteristics of a long-wire (because of the insulator on either end). Its truly unique (or devilish) quality is the black plastic insulation covering its radiating wire, and making it hard to see. Our diagram should tell you all you want to know. The service entrance insulators are brown porcelain with a hole and a screw base. They are screwed directly into the tree trunk. With longer antennas, one of these insulators should be put in every 10 feet and the wire dropped through the hole (not secured). The coil spring at the bottom stretches when the tree bends in the wind. Simply thread the wire down through any branches and don't worry about touching them (the wire is insulated). Unless you have very tall trees and suction cups on your feet we recommend a *quarter*-wave radiating element (62′ 3″ for 80 meters, 31′ 1″ for 40 meters, etc.). Quarter-wave radials buried in the ground at the base like spokes will improve performance.

—Howard S. Pyle, W70E





YOUR LAST CHANCE

TO WIN $100 in EI's Electricity Contest

HAVE *you* entered EI's Electricity Contest? All you have to do is write your answer to our question, "What is electricity?" and send it to the address listed below.

This is your last chance to win our big cash prize of $100! In order to be eligible for the final award your entry must be received by March 1, 1962.

The awarding of our final prize will mark a full year that EI's Electricity Contest has been conducted. In the following issue we will publish the answer to our question as given by a well-known authority in the field.

Remember, when you prepare your answer you can use any source material desired, but your entry must be in your own words. Follow the rules below.

Above all, make certain that your answer *clearly* expresses your idea of the nature of electricity and that your phrases are original.

As we noted when announcing our contest a year ago, there is no one definition of electricity that is universally accepted. A famous man once said, "Everybody knows what electricity does but no one knows what it is." Send us your definition—today!

Rules: Entries will be judged on aptness of thought, clarity of expression and originality. Entries must be typewritten and double-spaced and may be no longer than two pages of 8½ x 11-inch paper. Ideally, a definition should be short. Print your name and address on your envelope and the first page of your answer. One entry per envelope. EI's Editors are the judges. Entries will not be acknowledged or returned.

Prizes: $100 will be paid the writer of the best definition. One winning definition will be published in each issue of EI. In case of ties, duplicate prizes will be awarded. Other entries of merit also may be published and will be paid for at the rate of $10 each.

Mail entries to: EI Electricity Contest, 67 W. 44th St., New York 36, N. Y.

Our Latest Winning Entry

What is Electricity?

"The electrons surrounding the nucleus of an atom are made up of concentrations of electro-magnetic waves of a certain frequency. When some force causes the frequency of its electrons to change, an atom is able to emit or absorb energy, depending on whether the change is to a lower or to a higher frequency. The energy involved is electricity. When the frequencies (or energy state) of the electrons of one atom are raised and it is thus caused to emit energy, and the electron frequencies of another atom are lowered so it can absorb energy, there is said to be a potential between the two atoms. The emitting atom is said to have a negative polarity and the absorbing atom a positive polarity. The energy that flows between them is called an electric current. The number of atoms involved in such a transfer of energy may be infinite."

Bobby Nix
Tallahassee, Fla.

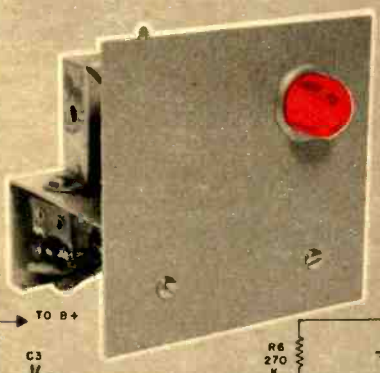
STEREO FM BEACON

Spotlight those elusive stereo broadcasts with an easy-to-build Beacon that works with any tuner or multiplex adaptor. We also present plans for adding filters and a cabinet to EI's stereo FM adaptor.

By Harry Kolbe
Contributing Editor, Audio

THE QUESTION, "Are you *sure* you're getting stereo?" is answered automatically if you have an adaptor or tuner that signals when stereo is received. For those whose equipment does not include such a useful function, here are plans for a universal add-on Stereo Beacon.

The Beacon may be built as a separate unit on a small chassis



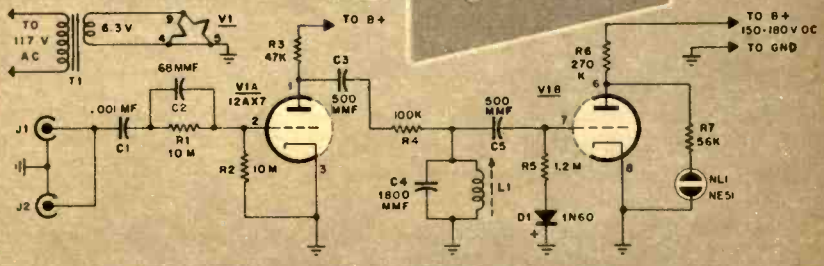


Fig. 1—One-tube Beacon may be constructed on a small chassis with panel as shown or built into last issue's multiplex adaptor. B-plus voltage is taken from either the tuner or adaptor. Filament voltage is supplied by transformer.

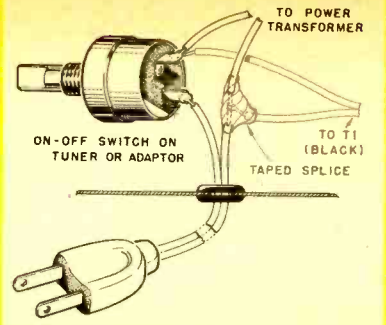
R1,R2—10 megohms, ½ watt, 10%
R3—47,000 ohms " "
R4—100,000 ohms " "
R5—1.2 megohms " "
R6—270,000 ohms " "
R7—56,000 ohms " "
C1—.001 mf, 600v., disc capacitor
C2—68 mmf " " "

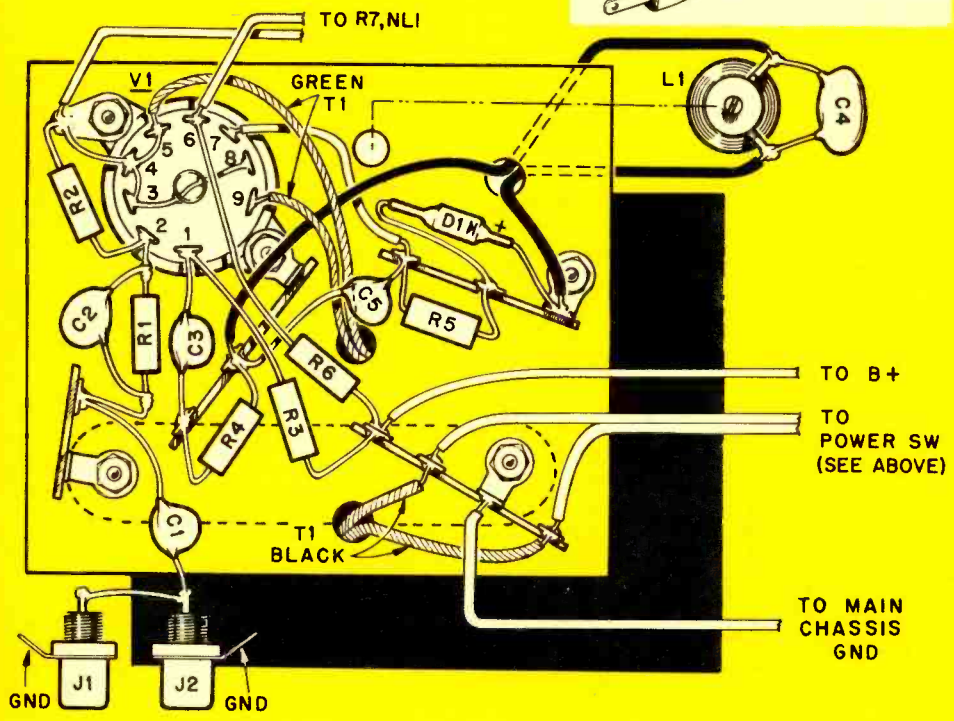
C3,C5—500 mmf, 600v., disc capacitor
C4—1,800 mmf " " "
V1—12AX7 or ECC83 tube
D1—1N60 crystal diode
T1—Filament transformer 6.3 v. @ 1 amp.
NL1—NE51 neon lamp in pilot lamp assembly with clear jewel

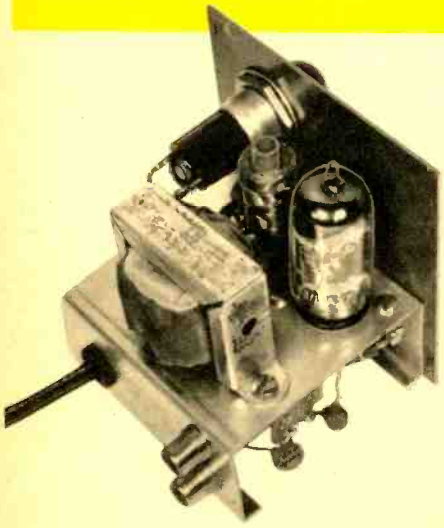
(as shown) or, if there is room, can be put into an existing tuner or adaptor. If you have built EI's stereo adaptor (January '62 issue) with the printed circuit board there will be room to build the Beacon on the same chassis.

Power for the Beacon is tapped either from the FM tuner or adaptor: 150 to 180 volts of B-plus are necessary. 117 volts AC is tapped off after the tuner on/off switch to feed filament transformer T1. The Beacon uses a separate filament transformer

Fig. 2—The Beacon is shown on a flat surface rather than built in a chassis to permit its construction directly into an FM tuner or EI's multiplex adaptor. Coil L1 mounts in the hole to the right of the tube socket. Transformer T1 mounts in dotted line area on opposite side of chassis.







Completed Beacon, less the B-plus supply. Coil L1 is mounted between pilot lamp assembly and V1.

because the added filament drain on the tuner supply might overload its power transformer. The tuner's B-plus supply will not be overloaded since the Beacon requires only 1.5-2 ma.

The two input jacks (J1, J2) on the Beacon are wired in parallel. A low-capacity shielded cable connects J1 to the tuner's multiplex jack; J2 is connected to the multiplex adaptor input. If the Beacon is built directly on the chassis of a tuner or an adaptor, the jacks may be eliminated and the Beacon connected directly to the appropriate points both for signal and B-plus voltage.

Component layout is not critical; however, some care must be taken in the location of coil L1 if the Beacon is built in an existing unit. Keep L1 away

from audio circuitry which may pick up the amplified 19-kc pilot signal.

The only slightly tricky step in construction is the modification of L1, a standard TV width control. L1's coil form is about a half-inch too long for our purposes and must be shortened.

Taking care not to damage the winding, pull the mounting clip off the coil form. The tuning slug will come off with it. Apply small amounts of cement solvent to the fiber collar that holds the two terminal lugs. Be careful not to get solvent on the coil windings. The cement holding the collar soon will soften enough to allow the collar to be moved. Slide the collar along the coil form to within ⅛" of the coil and re-cement. Cut off about ½" of the section now exposed. Re-insert the slug assembly and push the mounting clip back on the form. L1 is now mounted by pushing it through the $\frac{5}{16}$" hole until the mounting clip clicks firmly in place.

Adjustment of the Beacon: After the four power connections are made (see pictorial), a shielded cable is connected between J1 on the Beacon and the tuner's multiplex jack. Turn on the tuner and tune in a station that you are sure is broadcasting stereo. Now adjust the slug of L1 until the neon indicator goes on.

The circuit relies on the 19-kc signal that always accompanies a stereo broadcast to fire neon bulb NL1. The signal from the tuner's multiplex jack is fed through a high-pass filter consisting of C1, C2 and R1. This filter attenuates audio frequencies below 19 kc. V1A, which has a high input impedance to avoid loading down the tuner detector, amplifies frequencies of 19 kc and up.

V1B is so biased that it is normally drawing enough current to keep the voltage at its plate slightly below the voltage necessary to fire or sustain neon indicator NL1 (60 v.). When the 19-kc signal appears at the grid of V1B it is rectified by D1, which puts a relatively high negative potential on the grid. The high negative grid voltage cuts off V1B and the plate voltage rises high enough (70 v.-110 v.) to fire NL1. Flickering of the bulb while tuning should be ignored.

FILTERS AND CABINET

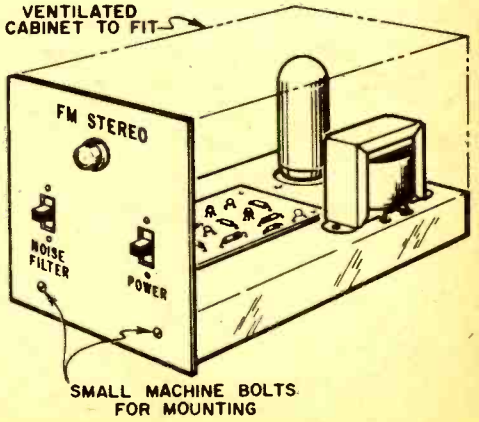
for your Stereo FM Adaptor

For that cooler, cleaner stereo—add a filter to your multiplex adaptor.

Although a number of commercial adaptors do not include filter circuits, our tests have indicated that they are almost mandatory. Let's look at the reasons. All MX adaptors operate with a high-level 38-kc internal signal. In some units, the 38-kc signal is the amplified and doubled pilot carrier broadcast by the FM station. In other adaptors, the 38 kc is generated by an oscillator synchronized by the FM station's pilot carrier.

Within the adaptor the 38-kc level may be as high as 30 or 40 volts and despite de-emphasis, an appreciable 38-kc signal may appear at the output in addition to the stereo signal. Although the 38-kc signal can't be heard, amplifiers and tweeters can respond to it. It could overload the amplifier or even burn out

Fig. 3—Cabinet for the MX adaptor and the Beacon may be constructed to suit requirements of user. A suggested cabinet for the printed-circuit version of the adaptor would have a metal front panel ½" wider than the chassis. The cabinet would be built of ¼" plywood bolted to the chassis sides. The cabinet sides should be about 1" higher than the tallest component used in the adaptor.



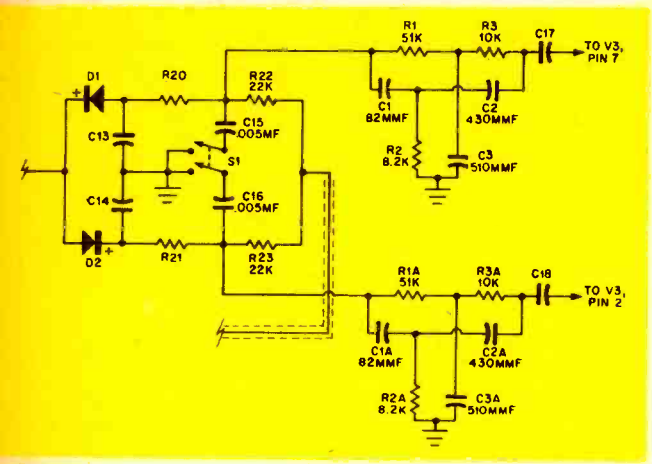


Fig. 4—Part of original MX adaptor schematic showing changes. The new components required are listed below.

NEW COMPONENTS

Resistors: ½ watt, 5%
R1,R1A—51,000 ohms
R2,R2A—8,200 ohms
R3,R3A—10,000 ohms
R20,R21,R22,R23—22,000 ohms
Capacitors
C1,C1A—82 mmf, 5% silver mica
C2,C2A—430 mmf, 5% " "
C3,C3A—510 mmf, 5% " "
C15,C16—.005 mf @ 200v. tubular or disc
S1—DPST toggle or slide switch
Misc.—5-lug terminal strips with center lug grounded

a tweeter's voice coil. And when tape-recording stereo broadcasts, the output of the adaptor or its harmonics could beat with the recorder's internal bias oscillator and cause beat notes or birdies to be heard on the tape.

Several filter systems were tried and for our purposes, the best design turned out to be a modified twin-T filter. This filter not only incorporates a null over the 38-kc region but also provides de-emphasis. Not as critical or expensive to build as other types, the two filters (one for each channel) may be constructed using 5% tolerance resistors and capacitors.

Note that the printed circuit board supplied by the Audio Workshop includes the filters and necessary matrix circuit changes, but not *the Stereo Beacon circuit.* However, the Beacon may be constructed on the chassis specified without crowding.

Since the stereo FM broadcasts have an inherently lower signal-to-noise ratio than mono, a switchable high-frequency noise filter has also been added to the adaptor. In a weak signal area, a restricted high-frequency response may be less objectionable than noise. The noise filter consists of two capacitors, C15 and C16 (one for each channel), which when switched in by S1 provide a high-frequency roll-off starting at 5 kc.

Construction steps are as follows:

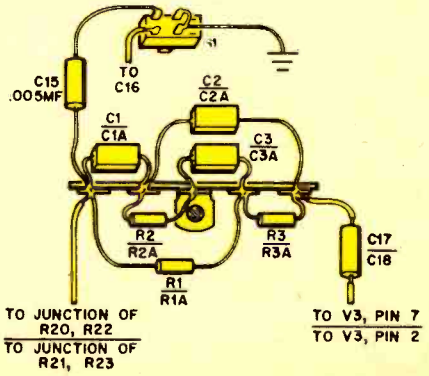
(1) Mount Noise Filter switch S1 on chassis apron on the side of output jacks J2, J3 opposite power switch SW1.

Important: Before unsoldering any connections, use a heat sink to protect diodes D1 and D2 against heat damage.

(2) Remove the original C15 and C16 capacitors (.001 mf) from the circuit and discard. (3) Disconnect the leads of C17 and C18 going to matrix terminal strips (see pictorial on page 83, Jan. '62 EI). A 4" length of black hook-up wire is connected to the lug in place of C17. A 4" length of red hook-up wire is connected in place of C18. (Leave the other lead of each capacitor connected to its respective tube socket pin.) (4) Remove the original 1% resistors R21, R22, R23, R24 from the matrix terminal strips and discard. Substitute the new values of R21, R22, R23, R24 (see Parts

[*Continued on page* 110]

Fig. 5—New filter strip to be added to original adaptor. Note that two of these must be built.



POWERLESS WIRELESS

Your own voice furnishes the energy to transmit itself via a new transistor transmitter circuit. Clever rig has many Citizens Band applications.

THE young engineer standing in front of the oscilloscope below is holding in his hand a little radio transmitter that has one of the most unusual circuits you're likely to see in quite a few moons. You'll find no batteries or other conventional power source in this rig, yet it transmits the human voice up to two miles. The man in the picture is George W. Bryan, Jr., who has been working some 20 years for the Signal Corps Research and Development Laboratories at Ft. Monmouth, N. J. He is the designer of the transmitter and has just received a patent on its circuit. In the device, the voice supplies the energy to transmit itself, furnishing power both to generate a radio-frequency (RF) carrier and to modulate it. Familiar voice-powered telephones have been achieving basically the same thing with wires for several years but this is the first time the trick has been turned with radio equipment. The 24-ounce transmitter is so small that Bryan built it in the shell of an old telephone handset. Further miniaturization is expected to put the flyweight apparatus in a plastic case the size of a penny match box. The Army sees the voice-powered radio as excellent equipment for soldiers in the field, each of whom could carry a personal transmitter in his pocket. Cost of the

units would be so low that when one went on the blink it would simply be discarded and another issued.

Since the best operating frequency of the transmitter is about 30 mc, it has promise of many applications on the 27-mc Citizens Band for farmers, hunters, businessmen and even reporters. Also mentioned are uses as rescue gear in planes and lifeboats.

Experimental models, developing about 2 milliwatts, have achieved operating ranges from a few to several hundred yards. Maximum range possible, Bryan says, is some two miles.

The transmitter's circuit (see schematic below) contains several novel aspects. A moving-coil microphone, when energized by the voice, supplies AC power to step-up transformer T1. At the transformer output there is a standard voltage doubler rectifier circuit (capacitors C1 and C2, diodes D1 and D2) designed to convert the AC to usable DC voltage.

In a standard doubler configuration C2 would be of high value to store the peak voltage impressed upon it. However, in this application C2 has a low value. To get at the reason, let's move on to Q1, a transistor used here as a zener diode because of its extremely low breakdown voltage. Its base-emitter junction provides the zener action.

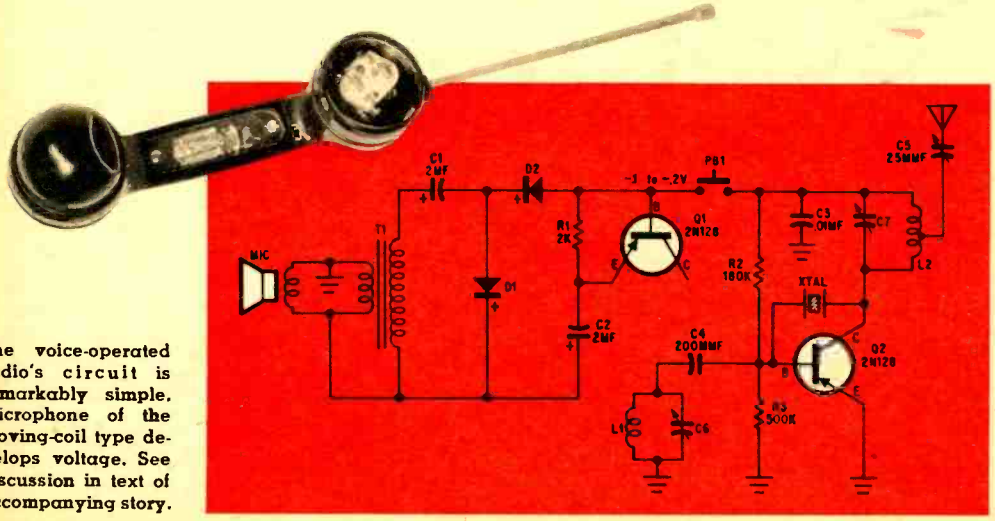
When the negative voltage at the base of Q1 rises above a certain low level, Q1 conducts and charges C2. Because of C2's low value it charges quickly (a necessary requirement since the voltage peaks are likely to be sharp). When the voltage falls below Q1's breakdown point C2 discharges through R1—but slowly, because of the resistor's high value—to stabilize the voltage available. This is likely to be —.1 to —.2 volts, as shown in the schematic.

Modulation is applied in series with the ground return of the power supply. The path can be traced through the primary of T1. The voice-supplied voltage coming directly from the microphone either bucks or adds to the voltage developed in T1's secondary, and thus modulates it.

The oscillator output circuit, Q2, is conventional, although designed for minute operating voltages. L1-C6 and L2-C7 are parallel resonant at the crystal frequency and their values are determined by that frequency. C4 couples the base tuning components to Q2 without upsetting the base bias established by R2 and R3.

C3 is an RF bypass capacitor and C5 an antenna trimmer. The antenna can be a quarter-wave dipole or a fractional-wave monopole. Pushbutton PB1 is optional.

A 3-ounce companion receiver is now being designed. It is to be powered by a tiny battery which would be recharged, not surprisingly, by power from the transmitter's microphone. A crystal receiver also could be used.



The voice-operated radio's circuit is remarkably simple. Microphone of the moving-coil type develops voltage. See discussion in text of accompanying story.

The Ham Shack

By Robert Herbert, W2DJJ

PERVERSE PERFORMANCE . . . On a trip into upstate New York recently I was working mobile on 10 meters and in an hour raised a whole string of stations from Florida to South America. Obviously, the band was open. I pulled into a filling station and the attendant's eyes lit up when he saw the whip.

"You a ham?" he asked. "Anything doing?"

"Going great guns right now," I replied, turning up the volume. Need I finish the story? Not a signal anywhere. I called CQ, and CQ and CQ. Nothing.

And the attendant? Probably thinks all hams are full of hot air now.

—o—

Good Buys? . . . Every few days I receive inquiries from budget-conscious beginners about the usefulness for ham purposes of surplus military transmitters being sold at bargain prices. (Curiously, few receivers are offered. In fact, there are many "Wanted To Buy" ads for certain Signal Corps receivers of *pre*-World War II vintage.)

Most surplus transmitters were just not designed for present-day amateur purposes and revamping them is technically difficult and economically unfeasible. The original instruction books are usually missing, which means you have to dope out the circuits yourself.

Admittedly, some equipment looks good. A neighbor lad recently showed me a Navy transmitter he had picked up. Obviously unused, it contained silver-plated coils, motor-driven switches and tuning contacts for remote control, a bank of husky crystals (all out of the ham bands), a huge dynamotor and oversize parts made by the best manufacturers. The hitch: it required 60 amperes at 12 volts DC and was built like a Patton tank. The owner finally removed the tubes and meters, clipped out some capacitors and ditched it.

Who Are You? . . . At club meetings, ham conventions, field days and other occasions when hams get together the job of identifying people you have worked over the air would be simpler if everyone wore a lapel tag of some kind with his call letters and name on it. Apparently several other people feel the same way because two new types of lapel tabs for hams (and CBers) have just been put on the market.

A black phenolic plate (see photo) is made by Chuck Baer, K9TVA, 6429 N. Glenwood Ave., Chicago 26, Ill. It measures ¾x2¼ inches and has white lettering which can be seen clearly across a smoke-filled room. The price is $1.50.

An aluminum lapel tag, also priced at $1.50, is put out by the Mahler Research Foundation, GPO Box 1159, New York 1, New York.

—o—

Birdies in the Music . . . It's an old story for hams to be accused of breaking up TV and radio reception when they weren't even home. A new twist is the case of a ham whose signals really were getting into a neighbor's hi-fi system—not into his tuner but into his tone arm! Much probing revealed that the modulated RF signals were picked up by the unshielded arm containing a crystal cartridge. The crystal acted exactly like a crystal detector, circa 1906. It rectified the signals nicely and passed them on

[*Continued on page* 102]

postscript

TO EI's FM TUNER REPORTS

ALL manufacturers represented in EI's FM tuner kit report (November '61 issue) were sent advance copies and invited to comment. Along with complimentary letters, we received some which raised technical questions that we felt would be of interest to our readers. The unedited letters and our replies are printed below.

DYNACO

We can understand the problems in a comparative analysis as broad as your coverage of FM tuners in the November EI, and our comments are not intended to detract from what is generally an excellent report.

We were quite perplexed at the Dynatuner's relatively poor signal-to-noise ratio of only 50 db, which is much below specification. When the tuner used by EI was returned to us at our request, it was found that a defective 6AT8A tube caused this, and when this was replaced, we found an 18 db improvement, over measurements made on the tuner as it was received. Our figures correlate fairly well with your test lab's, and when the signal-to-noise ratio improved, the harmonic distortion also dropped appreciably, which was expected.

The customer, of course, would have no way of spotting this defective tube, since the tuner apparently functioned satisfactorily, but we do exercise stringent inspection to exclude sub-standard parts from our kits, and we do not feel that the tuner's performance should be downgraded on this basis, when tube replacement is so easy.

The number of tubes in the Dynatuner, in a compact package, does create a good deal of heat, and you are quite correct in pointing out that adequate ventilation is necessary. The actual temperature rise should be compared with other tuners housed in similar metal enclosures, though, and no great difference will be found. Dyna has, however, been supplying for some time a different cover with about 30% more open area, even though operation with either the FMA-2 amplifier or the FMX-3 multiplex integrator with the old cover does not raise the temperature of the components anywhere near their rating.

It is important that the techniques of home alignment given in the manual be followed exactly, particularly where a weak signal is required. A too-strong signal will not give optimum alignment. It is not advisable to align the Dynatuner by conventional "sweep" techniques if best performance is to be realized.

Robert H. Tucker,
Director of Sales

When the tuner was returned to us by Dyna after replacement of the defective tube we re-tested it and obtained an excellent signal-to-noise ratio of 71.5 db. Our new figures and Dyna's were in close agreement and substantiated Dyna's claimed performance figures in every area checked. We agree with Dyna that their tuner's performance should not be downgraded because of the chance inclusion of a noisy tube in the kit we tested.

We find that quality control of kit components presents a knotty problem for the manufacturer. With a factory-wired tuner, amplifier, etc., the quality of individual components is checked when the assembled device using the

components is tested. With kits, on the other hand, the manufacturer can protect himself only by purchasing high-quality parts from reliable companies and then spot-checking the components as they are received. Obviously, if the kit producer were to test every component going into every kit, the cost of the job would push the kit price beyond that for a wired unit.

For our test, EI did not align the tuner by conventional sweep techniques (which we found to be inadequate to realize the full potential of high-quality tuners), but instead aligned the units for minimum distortion, using the instruments listed in the original article.

LAFAYETTE RADIO

Thank you for this opportunity to comment on your recent evaluation of the Lafayette KT-650 tuner kit. As your report indicates, we have been somewhat conservative in our specifications. Our own tests have indicated that the KT-650 is consistently better than our initial claims and hence we are taking cognizance of that fact in our new specifications for the unit.

It has always been Lafayette's policy to give our customers actual and conservative ratings on our products. We do not base our performance data on a lab prototype. Rather, our specifications are determined by what the consumer can expect from *his* unit.

Present models of our KT-650 actually have an average sensitivity of 5 microvolts for 30 db and better, depending on the care exercised in assembly and alignment. This, coupled with its outstanding low distortion, makes the KT-650 one of the best valued tuners of the premium class market.

One final comment is that your "home alignment" results on the tuner do not match our field experience. When the home builder carefully follows our clear step-by-step alignment instructions, the tuner should achieve (if not surpass) our claimed sensitivity.

Peter K. Studner,
Director of Manufacturing

H. H. SCOTT, INC.

A set of pages concerning a review of kit tuners in your November 1961 issue of Electronics Illustrated has just come to my attention. The work performed by your reviewer(s) is certainly a very creditable and obviously laborious job. Congratulations on this account.

However, I have to take issue with you on the accuracy of some of the results which you have obtained. Fortunately, you have listed the model and type numbers of the test equipment used so that the total possible error in test results may be established.

It was stated that a Measurements FM signal generator, model 210-A, was used for tests. The instructions for this generator show that the RF output voltage (at 100,000 microvolts only) is accurate to ± 5%. Therefore, the sensitivity figures measured would be in error by at least that much, although your figures indicate the *relative* sensitivity of the various tuners tested.

The instructions for the generator also show that the harmonic distortion of the generator is rated at 1% with no rating for intermodulation distortion. Unless the generator used can be proven to have considerably lower distortion, including its modulation system, all test results obtained are in error by a total amount of 1.15% (1% from the generator rating and 0.15% from the arbitrary subtraction by the reviewers). Since all distortion figures cited

[*Continued on page* 100]

HOW WE TALK TO THE

By Art Zuckerman

THE DRAMA is familiar to nearly every American: "10..... 9..... 8..... 7..... 6..... 5..... 4..... 3..... 2..... 1..... IGNITION!" The rocket lifts slowly out of a cloud of vapor and roars into the sky, carrying with it a man cocooned in a tiny capsule He is an astronaut, and in a matter of seconds he will be some 120 miles above the earth.

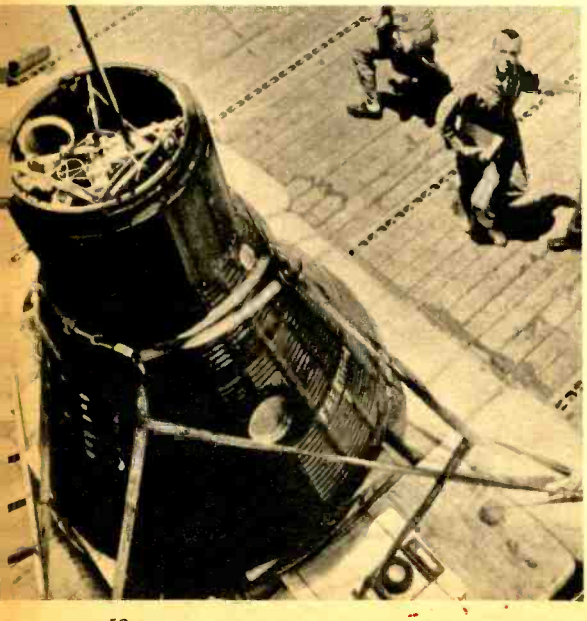
The man who rides a Mercury capsule is alone and far from his natural surroundings, but he's also the most thoroughly observed human being in history. During every second of his flight he is tied firmly to earth by an immense cable of electromagnetic waves.

On the ground, millions of radio pulses are turned into an up-to-the-second report on the capsule and its occupant. Scientists sitting in front of equipment consoles know the vehicle's attitude, temperature and cabin oxygen, they know the astronaut's pulse, breathing and blood pressure—they know everything of value about the satellite and the man.

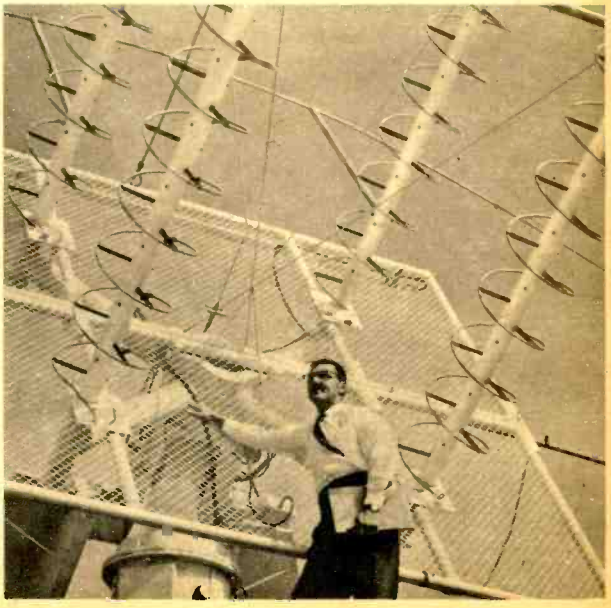
The invisible fingers of radar trace the capsule through space and computers convert the signals into speed and direction. Tracking stations are alerted automatically when the capsule nears, are advised when and where the Mercury chariot, traveling 17,000 miles an hour, will pop up over the horizon. The astronaut himself is in constant voice communication with the ground. It all adds up to one of the most complex communications systems ever built. It is a system that cannot be allowed to fail because the life of a man is in the balance.

How can you rule out failure? When engineers want to make sure a system will go all the way they fall back on a principle known as redundancy. If you have two items instead of one, they say, chances are that one of them will do

Astronaut Alan Shepard, our first man in space, looks at his Mercury capsule after epic flight.



The capsule's voice and telemetry signals are picked up by steerable helix antennas like this.

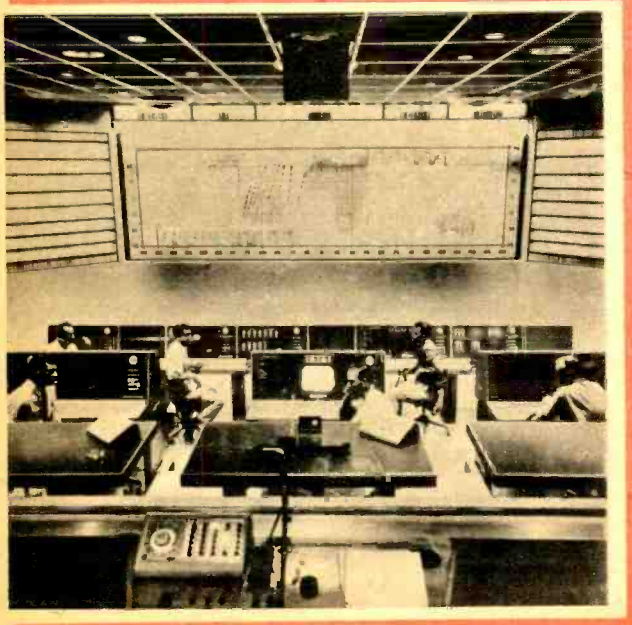


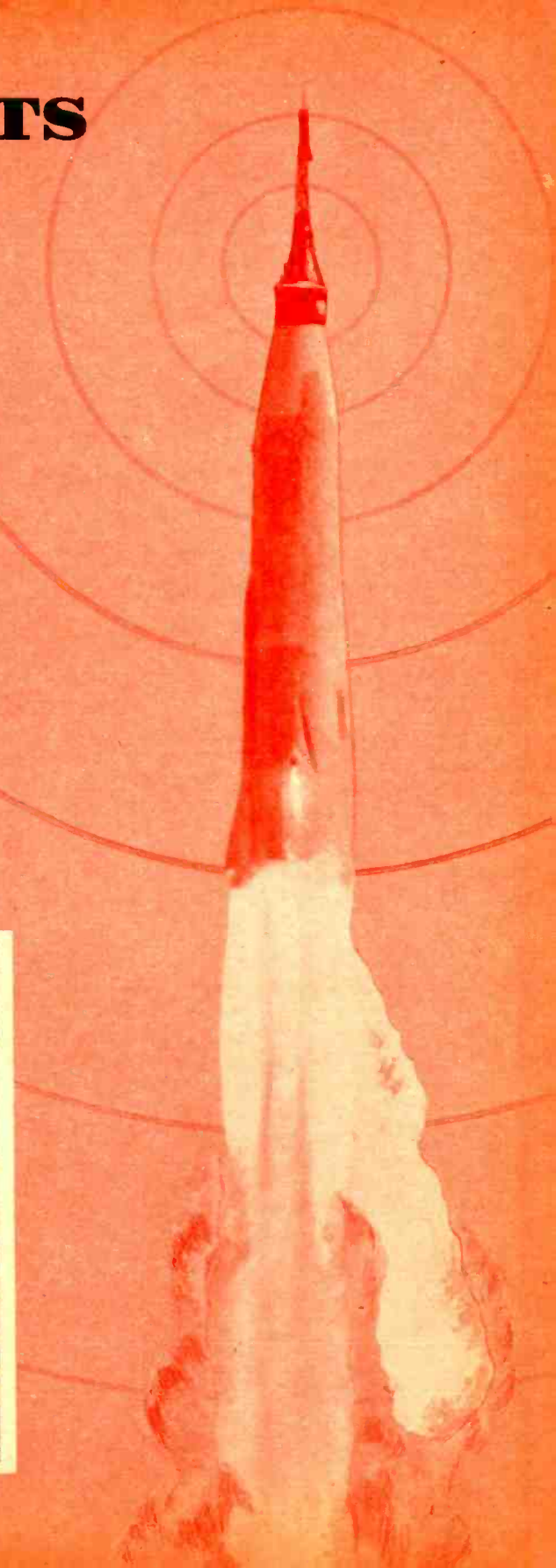
ASTRONAUTS

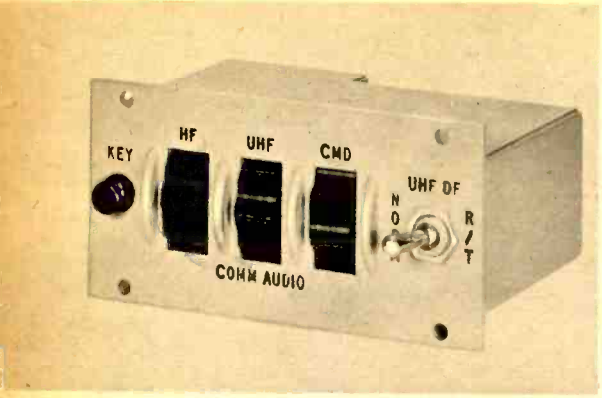
the job. For this reason, much of the Mercury capsule equipment comes in pairs, one set the primary unit, the other the backup (in this case also referred to as "rescue" gear). In addition, most of it is dual function, making rigs designed for one job double in brass if necessary. Virtually all components are miniaturized, of course. Most transmitter-receivers and similar apparatus fill no more than 30 cubic inches each (a box measuring 2½x4x3 inches contains 30 cubic inches).

Then there is the matter of human engineering. Try operating a radio with your hands in heavy gloves. It's almost impossible. So the volume controls for the astronaut's voice receivers are three vertical thumbwheels in a small panel, which also has a push-button for sending Morse code and a function-selecting toggle switch. To change from receive to transmit you normally have to push a button. Not

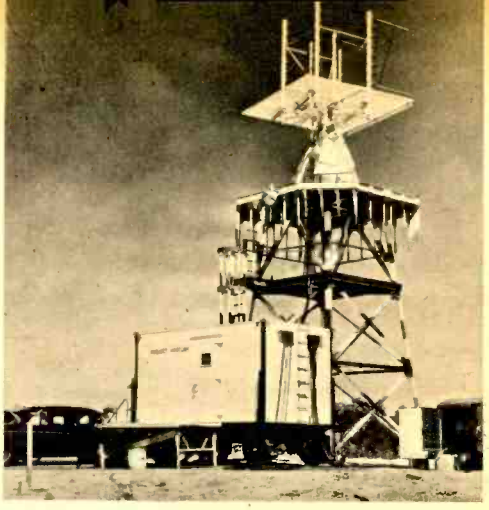
Focal point of oft-photographed control room at Canaveral is data display on orbiting capsule.







Capsule's tiny audio control panel has vertical thumbwheels, Morse code button, function switch.



One of four "command" tracking stations in the 18-station net is at Muchea, Western Australia.

the astronaut. He just starts talking. A voice-operated relay does the rest. (The capsule also does have an auxiliary mike button on the abort handle.)

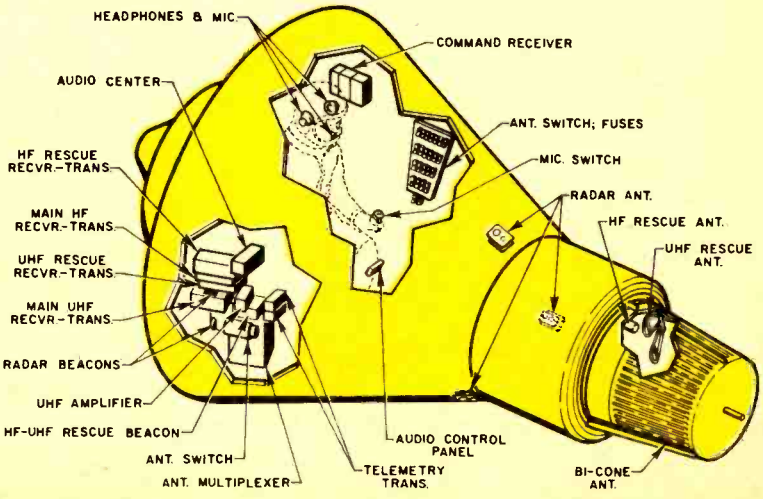
Probably best known amongst Project Mercury's communications systems are its voice radio channels, because tapes of astronaut-to-ground conversations have been played on television and radio. The capsule has two types of voice radio, ultra high frequency (UHF) and high frequency (HF). UHF has become an air-to-ground standard, while HF radio sacrifices a degree of reliability for greater range. Both types are used in most Mercury shots. The UHF frequency is 296.8 mc. The HF transmissions may be on any of several frequencies between 4 and 26.5 mc.

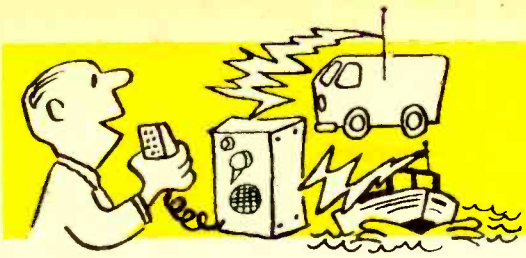
Next in importance comes the command radio, which permits four command tracking stations (at Cape Canaveral, Bermuda, Hawaii and Muchea, Australia) to control all capsule functions in case the astronaut can't. The voice and command units are the items duplicated in the capsule under the redundancy theory. An emergency voice channel is built into the command radio as an extra precaution.

By means of telemetry signals the capsule disgorges everything it knows about itself and its pilot. Two FM transmitters working on 225.7 and 259.7 mc, do the job. Through multiplexing (putting more than one signal on the same carrier), the two transmitters send out 80 separate channels of information. And the telemetry rig can

[*Continued on page 112*]

Cutaway drawing shows main components in the Mercury communications system. UHF and HF antennas are in stowed position. Note "redundant" radio units.





CB CORNER

Citizens Band News and Comments

by Len Buckwalter, 1W5733

SIDEBAND CB . . . Watch for a big ruckus over the appearance of single-sideband (SSB) equipment on the Citizens Band. SSB, among other things, will increase transmitter power by approximately eight times, turning 5 watts into 40! How can any CBer get away with that? Well, strangely enough, it appears to be legal under present FCC regulations. But before scrapping your present equipment there are some other aspects you should consider. We'll cite a few of them.

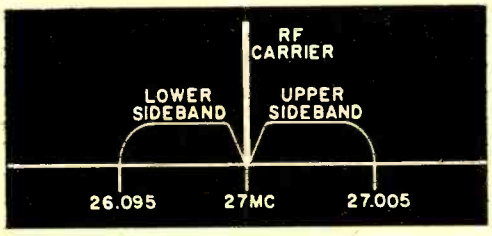


Fig. 1. Conventional AM signal: modulation in identical sidebands but none in the RF carrier.

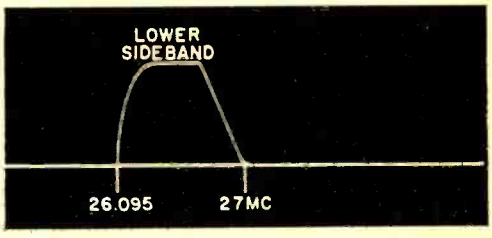


Fig. 2. SSB signal: power of carrier and the upper sideband are added to the lower sideband.

From a technical standpoint, SSB falls under the heading of "amplitude modulation." This is the approved system for putting voice power on a radio-frequency carrier in the Citizens Band. SSB's tremendous efficiency becomes apparent when it is compared with conventional AM.

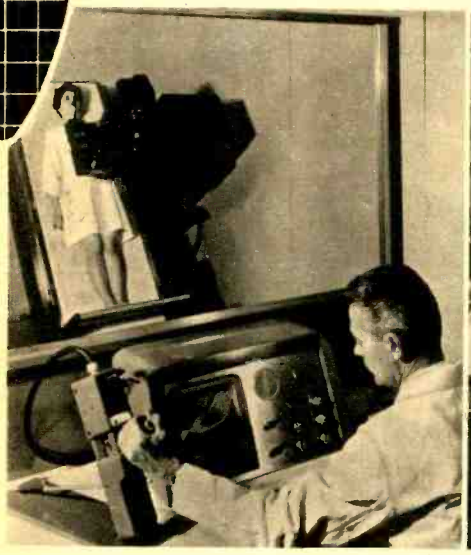
Let's say your transceiver has a 5-watt input. If it's well matched to a good antenna, approximately 3 watts are transmitted. But 2½ of these watts serve virtually no useful purpose at the receiving station. Take a look at Fig. 1. The part of the signal labeled RF carrier completes its job *before* it ever reaches the transmitting antenna. Its only function is to mix with audio modulation to produce two sidebands. The sidebands are the true carriers of the audio (voice information). Furthermore, one sideband is extraneous, being a mirror-image of the other. As shown in the drawing, the sidebands appear just above and below the frequency of the RF carrier.

It is revealing to see what part of this "triple" signal is used at the receiving end. Starting with 3 watts off the antenna we find that the RF carrier consumes 2 watts and each sideband takes ½-watt. The significant part of the signal, then, amounts to a mere half-watt—or a single sideband. You can see this illustrated by the S-meter on any receiver. It gives a steady reading on the carrier of a received signal because no modulation rides on it. With a selective receiver the needle begins to bounce merrily in step with the amplitude of the incoming audio when the tuning dial is moved just above or below the carrier. In these regions the receiver is picking up the upper or lower sideband.

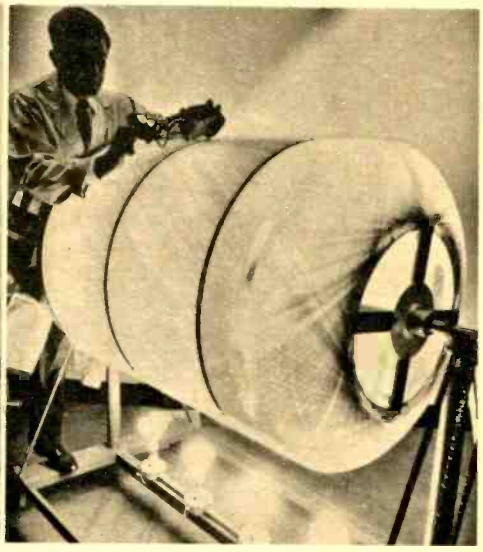
The SSB technique transfers most of the RF power to one sideband. Neither the carrier nor the other sideband reaches the antenna. They are filtered or phased out in an early transmitter stage. Instead of a half-watt of useful signal, as before, "voice" power now is concentrated and raised to nearly 3 watts (see Fig. 2). No wonder commercial radio-telephone circuits which cross the continent changed to SSB more than

[*Continued on page* 101]

EI Picturescope



Wedding of remote-control fluoroscope and closed-circuit TV gives a doctor X-ray eyes to see such things as this young lady's stomach.



It may look like a lot of boloney but the man really is testing a new FAA aircraft guidance antenna made up of fine wires on a plastic form.

Now nearing completion at the Argonne National Laboratory just outside Chicago is a new atom smasher. The doughnut-shaped building has one 5,000-ton magnet and eight 500-tonners. Protons will come out of linear accelerator in right foreground at 800 million electron volts, be boosted to 12.5 billion EV by the big ring. The straight name of the smasher is Zero Gradient Proton Synchrotron —or just call it ZGS.

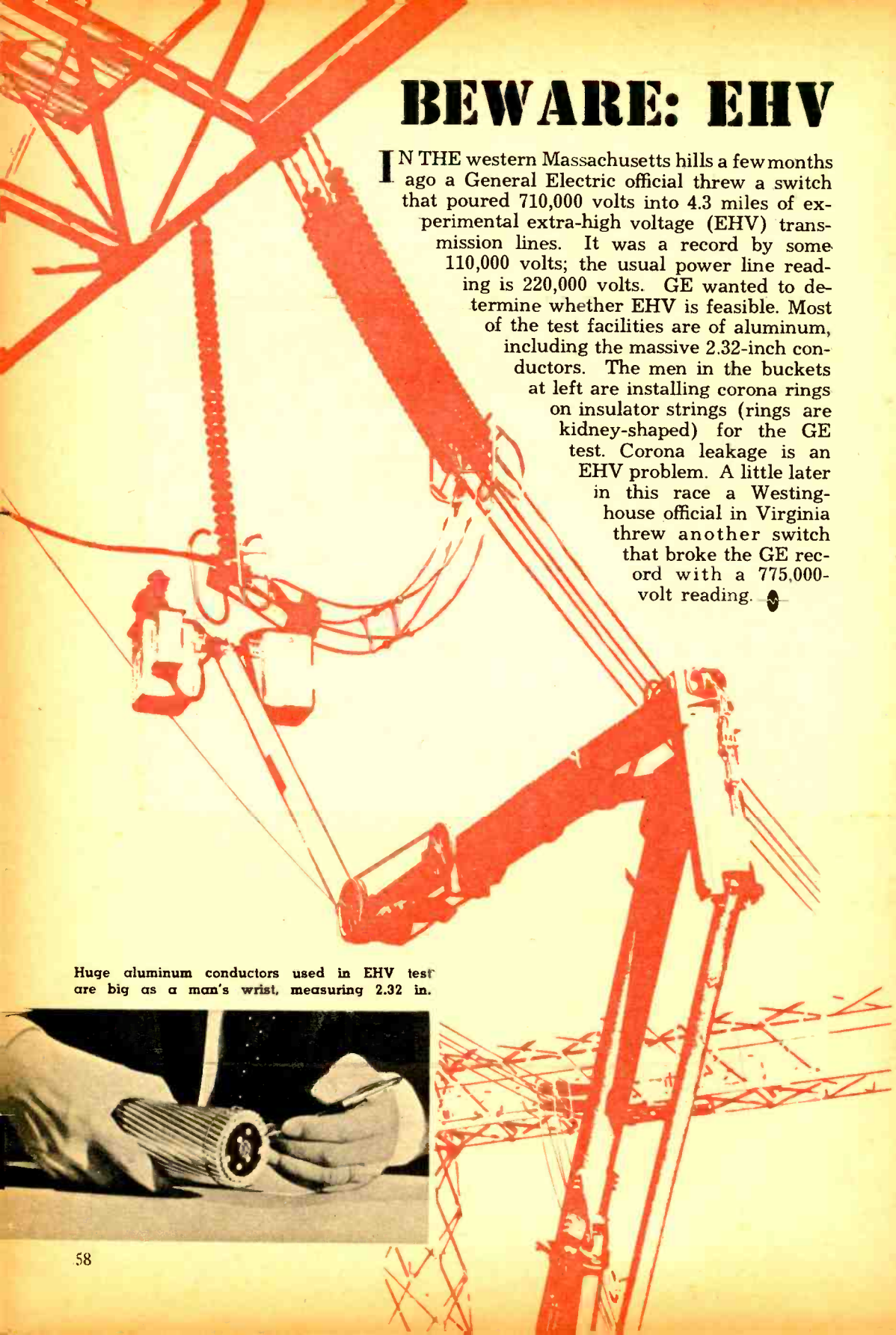
The 150-ft. reflector of the biggest radio telescope in U. S. is moved into place on Stanford University campus in California.

The Army is experimenting with a suitcase-size X-ray machine that would allow medical corpsmen to "shoot" wounded comrades right on the field. The soldier at left holds the business end of the rig. Required high-voltage power pack is in case.

"Old George did it because he hated cherry pies. Ain't that right, teach? Over." And so it may go. These are little two-way radios dreamed up by some Texans for Texas-size classrooms. Each pupil gets one that's just like teacher's own.

BEWARE: EHV

IN THE western Massachusetts hills a few months ago a General Electric official threw a switch that poured 710,000 volts into 4.3 miles of experimental extra-high voltage (EHV) transmission lines. It was a record by some 110,000 volts; the usual power line reading is 220,000 volts. GE wanted to determine whether EHV is feasible. Most of the test facilities are of aluminum, including the massive 2.32-inch conductors. The men in the buckets at left are installing corona rings on insulator strings (rings are kidney-shaped) for the GE test. Corona leakage is an EHV problem. A little later in this race a Westinghouse official in Virginia threw another switch that broke the GE record with a 775,000-volt reading.



Huge aluminum conductors used in EHV test are big as a man's wrist, measuring 2.32 in.

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HI-FI RECORD GUIDE

by Warren DeMotte

THE LATEST recording of Scheherazade is a veritable humdinger. The performance is by L'Orchestre de la Suisse Romande under Ernest Ansermet (see cut) but the recording engineers steal the honors. They have captured every tonal color of this prismatic score. The sound of the orchestra is miraculously true and vivid and has appropriate weight. I have never heard recorded strings so gutty and silken, nor the bass drum whacked so realistically. Despite the splendid sound, room has been found on the record for Borodin's rousing Polovtsian Dances from Prince Igor, complete with chorus, making this the only Scheherazade with a disc-companion.

The Russian repertoire is also tapped for a disc devoted to four great scenes from Moussorgsky's opera, Boris Godounoff. Conducted by Thomas Schippers and featuring basso George London as the Czar driven to madness and death, this is a brilliant and dramatic representation of the magnificent music.

Ed McCurdy, accompanied by Erik Darling, tours through our song history in A Treasure Chest of American Folk Song. This two-record album, released at the price of one record, covers four aspects of American folk songs: New England, the South, the Pioneers and Occupations. Thirty-four songs are delivered with spirit and sincerity, making this one of the finest folk offerings around in many a long day.

Collectors who enjoy recordings taped on location will welcome Martha Schlamme at the Gate of Horn. She is a charming purveyor of international folk songs, and she skillfully leads her Chicago audience into enthusiastically clapping hands and singing along with her.

Nathan Milstein is at his superb best as the soloist in the Brahms Violin Concerto. Joined by the Philharmonic Orchestra under Anatole Fistoulari, the popular violinist provides a vital exposition of the grand score, playing with expressive understanding and beguiling tone.

After a long absence from the concert platform, Abram Chasins has come into the recording studio for a series of solo piano appearances before the microphones. The first fruit is A Chopin Collection, comprising five major compositions by that composer. His musicianly playing has textbook clarity, laced with profundity and intensity. It is rare, indeed, that one who writes and talks so well about music is also capable of playing it with authority and style.

An engaging Chopin program is also offered by Van Cliburn on his first solo recital record, released since my last column was set in type. His playing is romantic and lyrical, and his rich tone is effectively projected.

On quite another level is the record of Roger Williams in his Greatest Hits.

[*Continued on page* 108]

an orbit for OSCAR

THE HITCHHIKING HAM

'Hi,' says the transmitter in a satellite conceived and built by hams for a spectacular ride in space.

By George Jacobs, W3ASK

AMATEUR radio operators have always been known for elaborate and sometimes weird projects they undertake. Without a doubt the most spectacular dream ever hatched by the ham fraternity is Project OSCAR—the design and construction of an artificial earth satellite to be carried into orbit as a hitchhiker on an Air Force rocket. OSCAR (for Orbital Satellite Carrying Amateur Radio) was conceived a little over two years ago as a space research project to make use of the tremendous reservoir of technical know-how represented by the amateurs of this country and the world. An organization known as the Project OSCAR Association was formed (and now has more than 600 members) and the satellite was methodically designed and built (and the government's approval obtained). Most of the actual work was done during spare-time hours by a small group of California hams who are professional engineers and technicians in missile and space programs. As it finally took shape, the OSCAR satellite is a 12-pound rectangular box about a foot long with an outer covering of gold-plated magnesium (see photo at the head of this article).

Within OSCAR's casing is a transistorized 100-milliwatt beacon transmitter consisting

OSCAR satellite is examined by four hams before getting a check-out ride in plane at 10,000 ft.

of a crystal oscillator, doubler and power amplifier designed to put out a signal on 145 mc, in the 2-meter ham band. The antenna is a simple monopole 19 inches long working electrically against the casing. The rig's mercury batteries will last about three weeks.

But once you've got an amateur radio satellite built, in orbit and transmitting, what message should it send? The answer came in a round-about way. Dots take less power than dashes and would make the batteries last longer, so dots were decided on. The eventual decision was that OSCAR should transmit a continuous series of H's and I's (. . . . .), making up the word "hi," an international greeting that also happens to be ham talk for laughter.

Of course, there is much more to the OSCAR program than getting a transmitting satellite into orbit. Hams all over the world were asked to listen for the signals and to make "tracking" reports to the OSCAR Association (Box 183, Sunnyvale, Calif.). The Association has the responsibility for data reduction —making the thousands of report figures into meaningful observations. All reports from hams (and anyone else who wishes to monitor the 145-mc signals) must be made on a standard form supplied free by the Association.

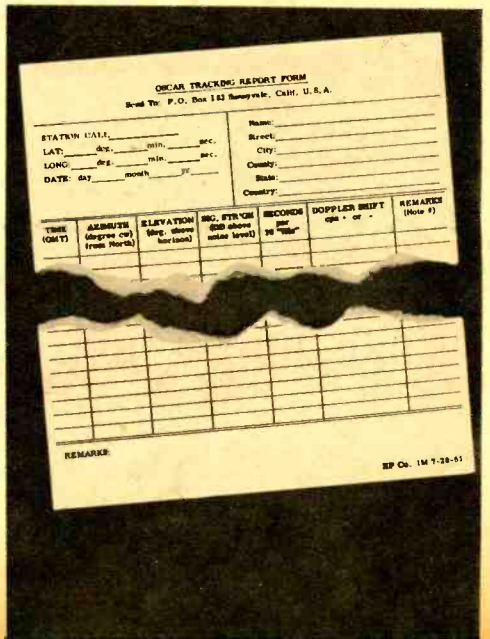
The most basic part of an OSCAR report naturally concerns the time the signals were first heard and when they faded, and signal strength. OSCAR's transmitter is sensitive to the temperature inside the casing so that a count of the number of seconds it takes to receive ten hi's gives the satellite's internal temperature. Also to be observed is the Doppler Shift in the signals (the rising and falling of the apparent frequency or tone as the satellite approaches and passes on).

OSCAR's orbital path passes over or near virtually every spot on earth four times in every 24 hours. The time of passage from horizon to horizon is put at 12 minutes.

What is the real purpose of OSCAR, other than to show it could be done? For one thing, reports on its signals provide valuable information about the propagation of 145-mc signals in space. The temperature readings help determine whether theoretical calculations by scientists are correct. The whole project, of course, will arouse amateur interest in space communications. And Project OSCAR marks the first time that private citizens have ever taken part in an outer space venture in cooperation with their government.

Put another way, OSCAR is expected in a modest way to further the world's knowledge concerning space and space propagation. But what next? Hams already are looking beyond OSCAR I to other, more complicated OSCARs that will be even more spectacular.

Reports on reception of signals from the amateur satellite must be made on the special form below.


OSCAR TRACKING REPORT FORM

Send To: P.O. Box 183 Sunnyvale, Calif. U.S.A.

STATION CALL_____

LAT: ___deg. ___min. ___sec.

LONG: ___deg. ___min. ___sec.

DATE: day_____month_____yr

Name:

Street:

City:

County:

State:

Country:

TIME (GMT)	AZIMUTH (degrees cw from North)	ELEVATION (deg. above horizon)	SIG. STRGTH (DB above noise level)	SECONDS per 10 "hi's"	DOPPLER SHIFT cps + or -	REMARKS (Note #)

REMARKS:

RP Co. 1M 7-28-61

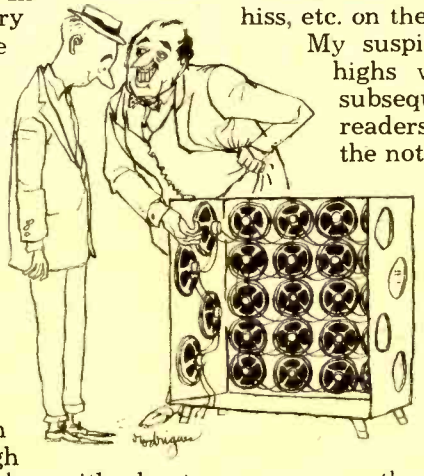
Tech Editor's Test Bench

by Larry Klein

Loudspeakers, Silk Purses and Sows' Ears

AMONG THE hi-fi fraternity, there's been a lot of talk recently about multiple speaker systems. Several articles (see list below) have told how to mount 10, 20 or 30 cheap speakers in a baffle. These systems are supposed to be equal or superior to conventional systems using one good speaker. The idea seems to be that if you only use *enough* sows' ears, you *can* make a silk purse.

The concept behind these multi-speaker systems is that if all these little speakers share the power delivered by the amplifier, each individual speaker handles only a fraction of the total power and hence cannot possibly be driven into distortion. In addition, so the theory goes, the treble response of the system should be good because of the light cones of the 5" speakers which should have no trouble producing highs. As far as the bass end is concerned, a phenomenon known as mutual radiation impedance (MRI) should cause all the little speaker cones to work together and push as much bass as though they were a single speaker with about a 4-foot wide cone.



And to add egg to the beer, the authors claim that the MRI factor will also lower the speaker's resonance, thereby extending the system's bass response.

Audio, "Hi-Fi Performance from Small Speakers," Dec. '59; "The Series-Parallel Speaker Array," Nov. '60.
Popular Electronics, "Sweet Sixteen," Jan. '61; "Sweeter With a Tweeter," Apr. '61.
Popular Science, "The More the Mellower," Oct. '61.

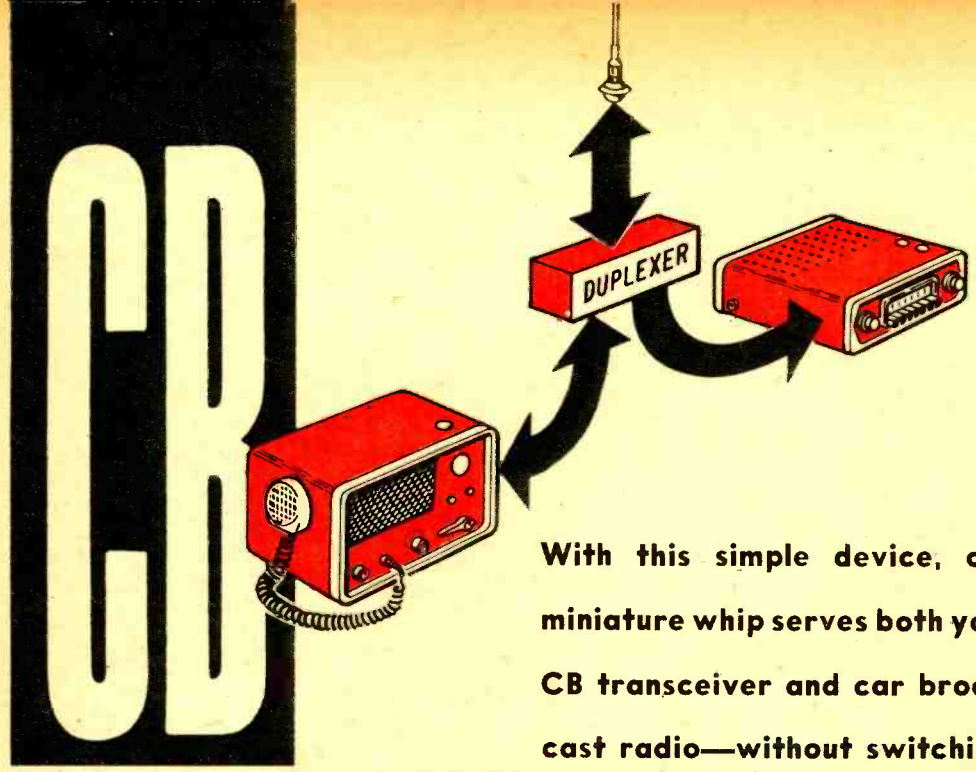
But just how well does this theory hold up? How do the systems sound? Let's take a look at some of them. One of the more popular multi-speaker systems, published by *Popular Electronics*, consisted of 16 five-inch speakers. The speakers specified are a type designed for replacement use in AC/DC radios. This indicates several things about them. For one, they are designed for a frequency response which cuts off at about 7 or 8 kc at the top end and about 100 cycles at the bottom. This limited range is to prevent (in AC/DC table radio use) their reproducing hum from the half-wave rectifier at the bass end and the miscellaneous AM static, noise hiss, etc. on the treble end.

My suspicion about the lack of highs was confirmed when a subsequent PE article told their readers how to add a tweeter to the not-too-sweet-sixteen.

Now, about the bass end? What these systems *will* produce is one big resonant peak at about 100 cps (which is the average resonant point of the speakers used). This boom-boom quality will be quite satisfying to those who can't tell the difference between a hi-fi system and a candy-store juke box.

Does this mean that the idea of the multi-speaker system should be thrown out the window? Not necessarily. It's possible to get fairly good sound from such a rig *providing* more expensive speakers with a fundamental resonance at least as low as 60 cps are used.

[*Continued on page* 99]



With this simple device, one miniature whip serves both your CB transceiver and car broadcast radio—without switching!

ANTENNA DUPLEXER

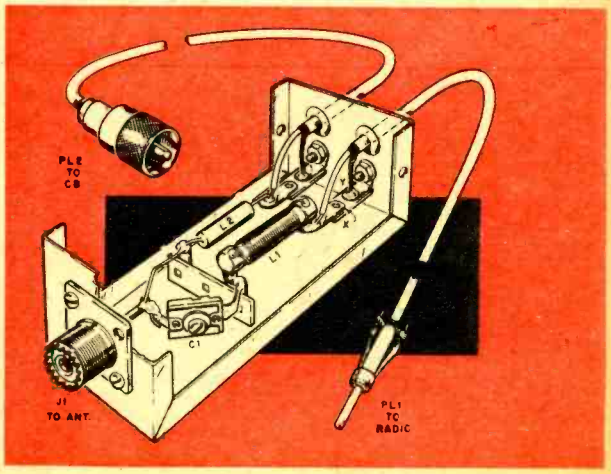
By Herb Friedman, 2W6045

DOES YOUR WIFE nag about that 108-inch Citizens Band whip that makes your car look (according to her) like something left over from Dragnet? Do you suffer from those put-it-up-and-take-it-down blues every time you glimpse your garage door? Take heart, CBer! Here is a pair of gadgets that will end your troubles forever!

By using a 48-inch loaded whip and

Fiberglass whip is no longer than standard auto radio antenna and serves both BC and CB sets.

Inside view of Duplexer shows simple construction. See page 110 for closeup detail of tie strips.



EI's Antenna Duplexer you can now have one broadcast-radio size antenna to serve *both* your mobile CB transceiver *and* your auto radio *simultaneously*—and without switching!

The continuously loaded whip (we used Antenna Specialists M-52) is so short—5 feet less than a regular CB whip—that it can be cowl-mounted and actually replaces your existing auto antenna. Besides being a convenience at your home garage door, the loaded whip answers the needs of trucks, taxis, salesmen, servicemen and others who must go under low overheads dozens of times a day.

Mounting the loaded whip is easy because you usually can use the hole left by your broadcast-radio antenna. No extra drilling is required. And this position on the cowl leaves the M-52's radiating area in the clear.

The connecting cable comes wired with connectors at both ends, so a wrench is the only tool usually required for mounting the antenna. Because the mount is similar to a standard auto type, it fits surfaces with a slope up to 30 degrees. In instances where a small auto radio antenna mount was used, it may be necessary to enlarge the mounting hole.

The Antenna Duplexer actually is an isolating network which prevents signals transmitted by the CB rig from entering the regular broadcast radio's circuitry and causing damage. As a matter of fact, with this setup you can transmit on the Citizens Band and simultaneously monitor Conelrad signals (or perhaps listen to rock 'n' roll) on your BC radio. Naturally, the whip and Duplexer are able to serve both receivers at once, and without signal loss or interaction.

Construction is simple and the total cost of the Duplexer should come to less than $4. Its wiring is not critical, but L1 should be centered in the Minibox away from the sides and cover. Because the Duplexer will be subjected to vibration, the few components should be mounted rigidly to terminal strips as shown. Lock washers should be installed with all nuts and machine screws.

Coaxial antenna jack J1 mates with

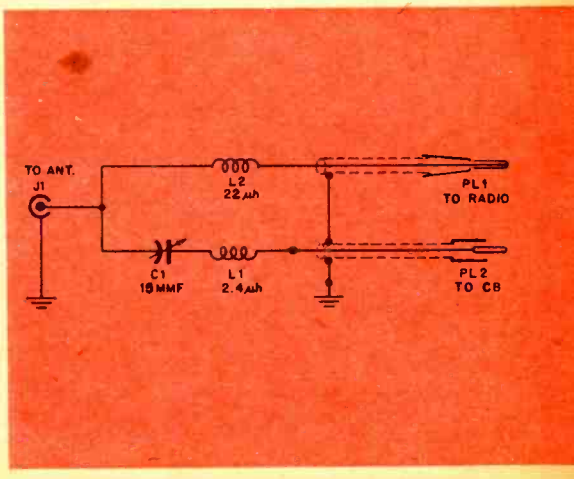
[*Continued on page* 108]

PARTS LIST

C1—1.5-15 mmf trimmer capacitor
L1—2.4 microhenry RF choke (Miller 4528 or equiv.)
or
L1A—1.8 microhenry RF choke (Ohmite Z-144—see text)
C1A—2-30 mmf trimmer capacitor (see text)
L2—22 microhenry choke (National R25-22 or equiv.)
J1—SO-239 coaxial jack to fit ant. lead
PL1—Plug to fit auto radio
PL2—Plug to fit transceiver
Coaxial cable—4' of RG-58A/U
Cabinet—Aluminum, approx. 4"x2⅛"x1⅝"
Terminal strips and rubber grommets

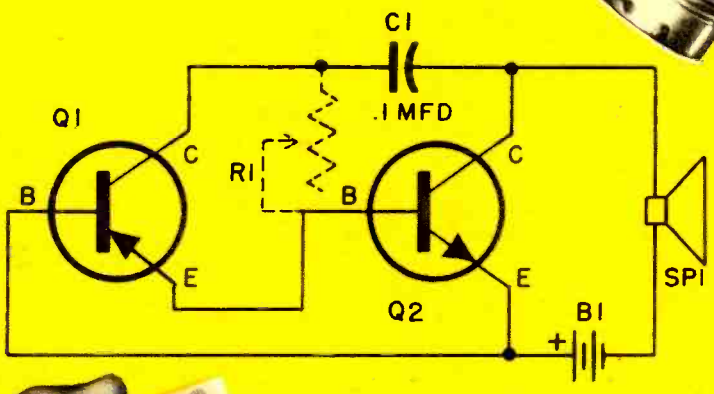
Before installation is completed, the Duplexer is tuned with an SWR meter or with other technique.

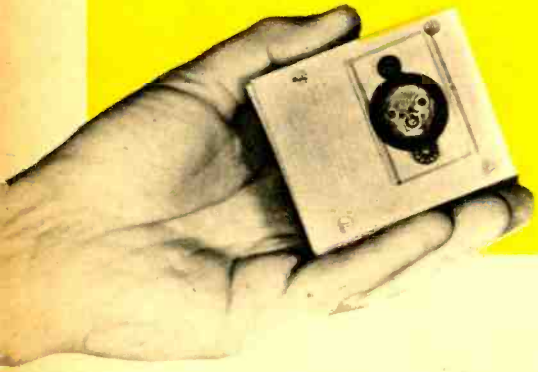
Six components make up the total parts list of the Duplexer. PL2 matches the CB antenna jack.



SCIENCE EI PROJECT

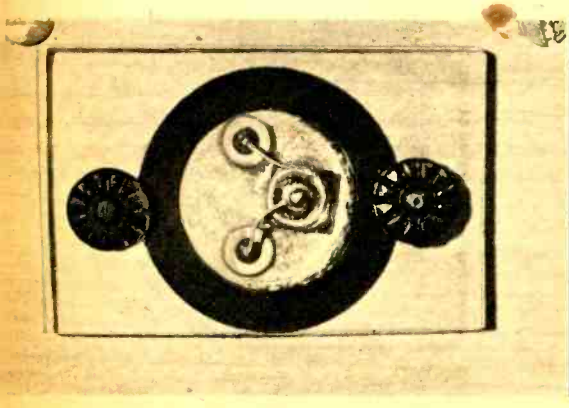
LIGHT-CONTROLLED OSCILLATOR

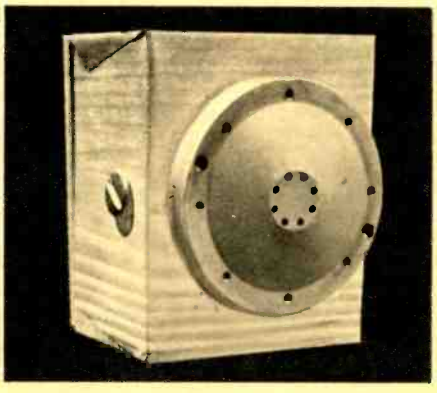




By Martin H. Patrick

Closeup at left shows power transistor Q1 with cover removed. Rubber ring forms tight seal with Lucite, Plexiglass, or glass to protect insides from dirt and damage. Right view shows the speaker.





HERE'S A NOVEL two-transistor circuit that goes into action as soon as a light beam falls on the exposed innards of a power transistor. The oscillator in low light produces a few Geiger-like clicks per second which increase in pitch with increasing light intensity. The gadget can be used as a daylight alarm by placing it on a window sill at night and facing it in the direction of the rising sun. And of course, it makes a fine toy or simple science-fair project for the beginner in electronics.

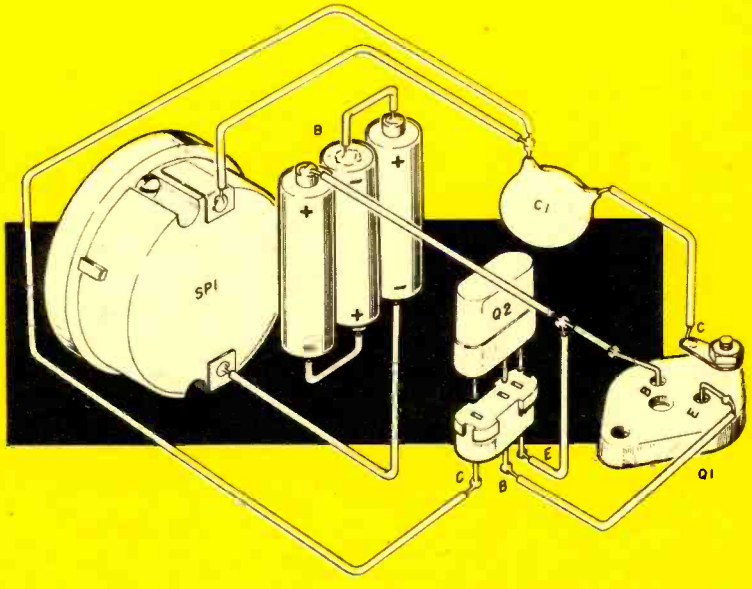
Power transistor, Q1, will have to be modified to a photo-transistor. Use a cheap power transistor and hacksaw off the top being careful not to damage the internal elements. Remove the filings or any other material inside and wash with carbon tetrachloride. So the exposed parts of the transistor will not be damaged, cover it with Lucite, or Plexiglass. The other transistor, Q2, may be any general-purpose type, but *must* be an NPN. Note the unorthodox connection of the battery to Q2 . . . the collector is made negative with respect to the emitter. To limit Q2's collector current, the speaker should be a high-impedance (45 ohm) intercom type. The author's unit shown in the photo on the opposite page makes use of a surplus earphone (which has just about the right impedance) as a sound source.

Frequency of oscillation is determined by the combination of C1, Q2, B1, and the intensity of the light falling on Q1. When brought close to a light source, the oscillator will produce a high frequency note, but if you desire to make this frequency lower, substitute a higher value capacitor (up to 100 mf) for C1. Although the original unit did not incorporate a switch due to the low current drain (about .6 ma.), one may be added between the collector of Q2 and the speaker.

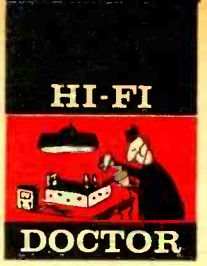
Since many bargain-priced transistors are somewhat unpredictable, it may be necessary to desensitize Q1 to prevent oscillation without light. To do this, connect a 250,000 ohm potentiometer (R1) across the emitter and collector of Q1 and adjust it until the oscillation stops. Measure the resistance of R1 and substitute a ½ watt resistor of the same value in its place.

PARTS LIST

C1—.1 mf low-voltage capacitor (disc or tubular)
R1—250,000 ohm potentiometer (optional, see text)
Q1—power transistor, PNP (2N256, 2N307 or 2N554)
Q2—2N233 transistor
SP1—Earphone or speaker with 45-ohm voice coil (Quam 2AO7Z45, 4A1245, or 5A1Z45)
B1—1-3 1.5-volt batteries



Number of batteries is optional and is determined by experiment. Scrape surface of Q1 at C to insure a good contact with the lug.



QUESTIONS & ANSWERS

STEREO FM

Have the technical problems of FM stereo been solved?

Yes. There have been a few minor bugs in multiplex broadcasts, but the overall quality of FM stereo is far superior to the AM-FM variety.

Are there still AM-FM stereo transmissions?

Virtually none. The pioneer stations who bothered with AM-FM stereo in the first place have been quick to convert to multiplex.

If I delay buying an adaptor, will the price come down?

Not very much. The best adaptors are pretty complicated and there's no way to cut costs significantly. One-tube adaptors are not of comparable quality. If you're on a tight budget, try a kit or EI's universal adaptor.

Is it better to buy an adaptor of the same make as a tuner?

In many cases, yes. Adaptors from the original tuner manufacturer will not only be designed for their tuners, but also will come with specific recommendations for any tuner circuit changes that are needed.

Why do adaptors have "filtering" circuits?

Most multiplex adaptors have an internal 38 kc signal whose harmonics may beat with a tape recorder's bias oscillator when you record programs off the air. The filter circuit is designed to prevent the 38 kc signal from getting out of the adaptor. Even if you don't intend to record stereo, there's the possibility that enough 38 kc may get through to your amplifier to overload your tweeter under normal listening conditions.

Are there adaptors for standard FM table model and console radios?

Yes, but almost exclusively for this year's models. Converting an older model could be a nightmare, and most manufacturers don't suggest it.

Why do some older tuners need their multiplex output circuit changed?

The system adopted for FM stereo requires a flat response of 20-53,000 cps at the tuner's multiplex output jack. Some tuners designed before the present system was adopted did not have a multiplex output designed to handle that wide a frequency range.

Are multiplex signals weaker than ordinary FM signals?

Yes. The chart below indicates the loss in strength of the broadcast signal in terms of its range using a high quality tuner.

Signal Transmitted	Receiving Equipment	Effective Range
Mono	*Mono*	*90 miles*
Stereo	*Mono*	*88 miles*
Stereo	*Stereo*	*61 miles*

On some tuners, stereo reception will cut their effective range in half. Inadequate signals show up as loss of separation and noise.

Will I need an outdoor antenna for FM stereo reception?

If you're reasonably close to the station, you may not. The only answer that can be given is try it and see. If you find you do need an antenna, try a good directional job, perhaps with a rotator. The object is not only to pick up weak signals, but also to eliminate "multipath distortion" from signals that reflect back from beyond your location. When shopping for an antenna, pay as much attention to its front/back ratio as to its gain.

These Generators Have NMP!

That means No Moving Parts, the magic ingredient in our exotic new sources of power.

By Don Hoefler

AMONG the revolutions and evolutions going on in electronics none is quite so lively and so much discussed as the one taking place in the most basic field of all—the generation of electric power.

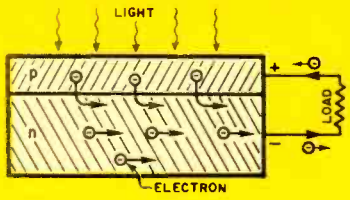
Ever since we began using electricity to run our factories and light our homes we've depended on the fossil fuels, coal and oil, and on water power to generate it. But now scientists by the hundreds are engaged in finding new power sources and in making them practical and efficient. Sometimes you hear the term *exotic* used to describe the devices coming out of research laboratories.

There are two major reasons for this revolution that the researchers are trying to bring about. Man already can foresee the day when fossil fuels will be exhausted and he must look to other sources for his electricity (and certain other needs). And the age of satellites and space travel has outdated cumbersome turbines and turbo-generators. Space stations and man-carrying interplanetary rockets demand new lightweight power sources.

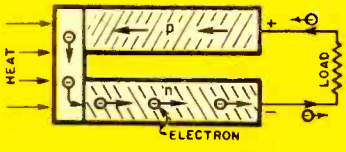
Two striking characteristics of the exotic power sources are the way they do their work and their makeup. Those holding the most promise convert light, heat or chemical energy *directly* into electricity. And all share a common trait of having no moving parts (NMP, we've

United Aircraft Corp.

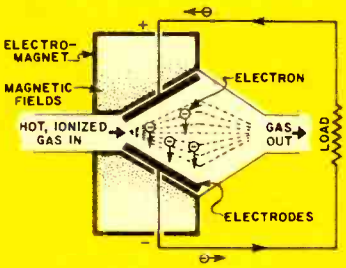
Sunlight gathered by these reflectors heats tiny thermoelectric couples to produce electric power.



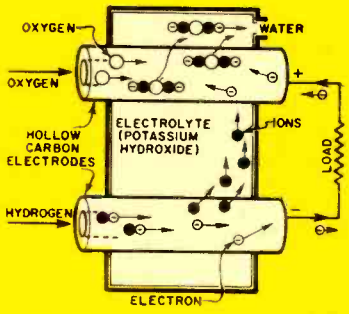
Solar Cell—Light on positive (p) silicon layer releases electrons, which flow into negative (n) silicon, and then into the circuit.



Thermoelectric Generator—Heat on negative semiconductor repels electrons, attracts them in positive type, creating a current.



MHD Generator—Hot, ionized gas flowing through a magnetic field picks up charge (as would any moving conductor), which is then tapped off by electrodes. Result is flow of direct current to outside circuit.



Fuel Cell—Two hollow carbon electrodes are placed in electrolyte. Hydrogen fed into one loses electrons, which then flow through circuit. Hydrogen ions next flow through electrolyte to second electrode and combine with incoming oxygen and the returning electrons to form water waste.

called this definitive characteristic).

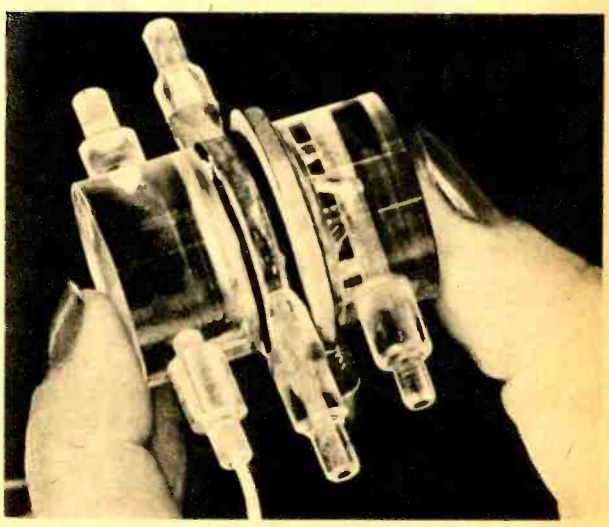
With the exception of one device, the fuel cell, none is as efficient as the equipment you'll find at any power house. Their biggest common drawback is the need for rare and expensive materials in their construction. A large fraction of the researching going on is concerned with producing these materials cheaply or finding less-expensive substitutes.

Best known and farthest advanced among the new generators is the *solar cell.* It converts light directly into electricity and has been around since 1954. Any young science student can tell you that solar cells have been used to power the equipment in several of our satellites and that you can buy solar-powered portable radios anywhere.

The solar cell is one of the simpler NMP devices. It is made up of a thin slice of positive-type silicon joined to a slab of negative-type silicon. Sunlight or artificial light striking the p-type material frees electrons, which migrate to the n section and flow into an electric circuit.

A principal drawback of the solar cell is its low power production and its cost. To get 8 or 9 watts you have to put together enough cells to cover a square foot. However, the output has been im-

Small fuel cell built by Hoffman Electronics has two fuel inlets, two power connections, waste vent.



proved somewhat by what is called a "blue" solar cell, most sensitive to the blue rays of the spectrum, where the most energy is concentrated. A square foot of these cells delivers up to 10 watts.

A close cousin of the solar cell is the *thermoelectric generator*. It, too, uses semiconductor material of the p type in one leg and the n type in a second. But it converts heat to electricity. Heat applied to one end of the n leg repels electrons but attracts them when applied to the p leg. When a circuit is placed between the leg-ends an electric current flows (the opposite leg-ends also must be connected to complete the circuit).

By stacking several thermoelectric slabs and connecting them in series, it is possible to obtain a fair-size power output. One experimental model generates 5 kilowatts. The newest development in the field is a 14-layer thermoelectric generator made entirely of a ceramic, nickel oxide. This permits the use of high temperatures, gives a higher output and makes possible a relatively long life for the device. One flaw in the thermoelectric generator is its efficiency (in effect, the amount of power used to produce more power). Researchers are now trying for a figure of 10% or so.

Thermoelectric generators, although still experimental, are being produced in great quantity. Some even reach the consumer. One company is marketing a little device mounted in the chimney of a lamp which can power a transistor radio. Uncle Sam has just shipped a thermoelectric-powered weather station to the Arctic and several models of these generators for spaceships are under development.

Thermoelectricity has other ramifications, of course. When electric current is fed to the two legs, heat or refrigeration is produced, depending on polarity. And thermocouples long have been used for temperature measurements. As generators, thermoelectric devices hold great promise because they can make use of the heat produced by nuclear reaction.

A slightly different heat-to-electricity device that also may use nuclear heat is the *thermionic converter*. It has family resemblance to the electron tube. Inside a sealed envelope are a cathode and an anode (plate). When the cathode is heated electrons are "boiled out" and flow to the anode and then into an external circuit.

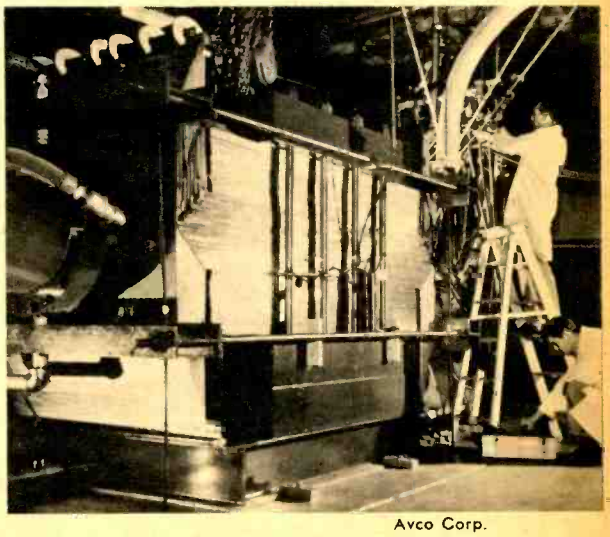
The *fuel cell* turns chemical energy

[*Continued on page* 102]

All-ceramic thermoelectric generator turns out 100 volts when heated in oven to 2,400 degrees.

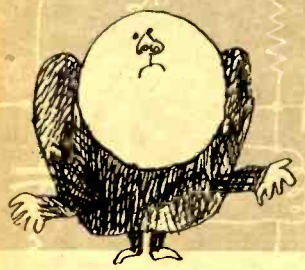
Minneapolis-Honeywell

Huge electro-magnets mark pilot model of an MHD power generator. Pipe at left carries hot gas.



Avco Corp.

what is IMPEDANCE ?

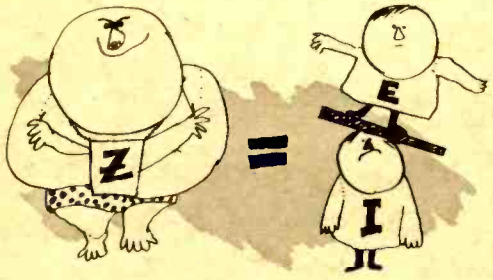


We can pin down the concept by examining some examples of impedance at work in hi-fi.

By John Potter Shields

AMONG ALL the terms used in electronics, *impedance* seems to be one of the hardest to understand. This is despite the fact that you come across the term almost every time you deal with any kind of audio or radio-frequency circuit. Let's see if we can pin down impedance concept by looking at it in terms of what it *does* rather than what it *is*.

As you might suspect, impedance implies impeding something. *Impedance does, in an alternating-current circuit, what resistance does in a direct-current circuit.* In fact, you might simply consider impedance as AC resistance. There is one important difference, however. Resistance is measured with DC voltage (as with an ohmmeter), while impedance must be measured with an AC voltage. And the impedance of a component is determined partially by the frequency of the signal applied to it. To simplify matters, when a manufacturer specifies a certain impedance for a device he's usually talking about its impedance at 1 kc. (Components meant to function at RF frequencies are measured by different standards, but the principles of impedance remain the same.)



Simple impedance problems can be handled the same way as resistance with the help of our old friend, Ohm's Law. You simply substitute Z (the symbol for impedance) for R. Thus, E=IZ, I=E/Z, and Z=E/I. So, when something is said to have a high impedance just consider this to mean a high AC resistance. This approach is a little oversimplified, but works well.

Actually, impedance does mean a bit more because it is a combination of pure resistance and reactance, either capacitive or inductive. Let's break that down. *Capacitive reactance is the opposition presented to AC by a capacitor,* while *inductive reactance is the opposition presented to AC by an inductance* (such as a choke coil or transformer winding).

Let's take a look at some of the practical problems of impedance. What is meant by an amplifier's input and output impedance? An amplifier's input impedance is the resistance seen by the signal source feeding the amplifier. (By signal source we mean a tuner, phono pickup, etc.) An amplifier's output impedance is the resistance to current flowing in its output (speaker) circuit.

Almost all vacuum-tube audio amplifiers have a high input impedance and a low output impedance. In the case of the high input impedance you must remember that most tubes are designed to operate with their control grid negative with re-

spect to the cathode. The cathode bias resistor has most of the responsibility for maintaining this condition. As an example, let's say that the tube in the input stage is operated with a grid bias of —4 volts. This means that tube's grid will always be negative (with respect to the cathode) for any input under 4 volts peak. There will be no current flow in the grid circuit since the grid would have to be positive with respect to the cathode to attract the negative electrons emitted by the cathode. When there's a voltage present in a circuit but no current flow it usually means there's a large resistance (or even an open circuit) present.

In practice, a high-value grid resistor (usually 250,000 ohms to several megohms) is placed from a tube's control grid to ground to serve as a return path for free electrons which accumulate at the grid. Since this grid-return resistor is naturally lower in resistance than the "open grid" impedance, the input impedance of an amplifier is usually the same as the value of this resistor.

Often it's desirable to have a low input impedance, as in the case of a magnetic phono cartridge, which usually must work into impedances of 47,000-100,000 ohms for proper frequency response. If the tube requires a high-value grid resistor a circuit like that of Fig. 1 is used.

Summing up, the input impedance of an amplifier is the resistance "seen" by the signal source feeding it.

Audio amplifiers are designed for low output impedances so they may properly drive the average low-impedance (4, 8 or 16 ohm) loudspeaker. A rule to remember is that for maximum power transfer the impedance of the load receiving the power *must be equal* (matched) to that of the source supplying the power. Thus, since the speaker requires power for operation, the amplifier's output impedance must be equal to the impedance of the speaker's voice coil for maximum power transfer.

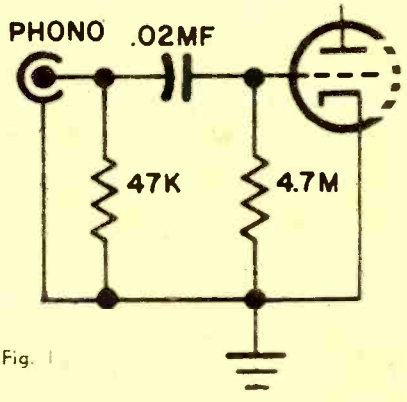


Fig. 1

The above statement brings us face to face with a thorny problem. Since the plate impedance of a vacuum tube is in the thousands of ohms, how can we expect to get maximum power transfer to a low-impedance speaker load? The solution lies in what is known as an impedance-matching transformer or in the case of the audio amplifier, the output transformer.

An output transformer has two windings—primary and secondary. The primary winding, consisting of many turns of fine wire, is connected to the high-impedance plate circuit of the amplifier's output tube or tubes. The secondary, consisting of relatively few turns of heavy wire having low impedance, is connected to the low-impedance voice coil of the speaker. The AC signal appearing at high impedance at the amplifier's output stage is thus changed by transformer action into a signal at low impedance suitable for driving the speaker.

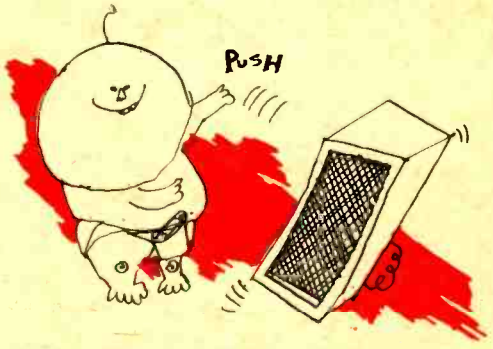
You might wonder why they don't build speakers with high-impedance voice coils. There are several good reasons. The main one is that the voice coil would

A transformer can match different impedances . . .

have to have several hundred turns of fine wire in order to match the high impedance of the usual amplifier's output tubes. This would be expensive, delicate and introduces other electro-mechanical problems. (One company did introduce a 500-ohm voice coil speaker designed to operate with a special amplifier, but it never became popular.)

Matching transformers are common in the audio part of broadcast work. Here they are used not only to match output impedances but whenever audio lines have to run any distance. The impedance problem in broadcast audio with "bridging," "patching" and "matching" is a story in itself.

One important point to remember is that the impedance "looking into" the primary of any transformer is dependent upon the load on the transformer's secondary. This is why it is unwise to put a signal into an amplifier without a speaker or resistor connected across the output terminals. If the amplifier does not have a large amount of negative feedback around the output stage, the output transformer's primary impedance soars. Often the signal voltage developed across this high impedance is enough to arc through the transformer's insulation. Many high-power modulation transformers have built-in spark gaps across the primary which will arc before the transformer's insulation breaks down, should the secondary become unloaded.



Loudspeakers generally have a low impedance . . .

You can see why when you measure an output transformer's primary winding with your ohmmeter the resistance indicated is nowhere near the impedance value stated by the manufacturer. Your ohmmeter, of course, indicates only the DC resistance of the winding—which is generally much lower than the impedance. In order to measure impedance accurately, a device such as an impedance bridge must be used. The transformer's secondary also must be loaded with the correct "terminating" resistance so the proper load impedance will be reflected back to the primary.

Since speakers are no exception to the rule (impedance varies with frequency), a speaker's impedance may rise to several times its nominal value at cone resonance. This brings up an interesting point. If the load impedance (speaker) to which an output transformer is connected varies with frequency, won't the reflected impedance of the transformer's primary also vary? The answer is yes. Thus, the power delivered to the speaker varies as the speaker impedance varies.

One method of reducing this effect (as mentioned earlier) is to apply negative feedback around the output circuit. This is done by taking a portion of the output signal (usually from the voice coil winding of the output transformer) which is 180° out of phase with the input signal and applying it to an earlier stage in the amplifier. Now, when the speaker impedance rises, say at cone resonance, the negative feedback also increases, reducing the gain of the amplifier. If the speaker's impedance should dip at a particular frequency, the feedback decreases and the gain of the amplifier increases. Thus, negative feedback tends to damp out the effects of variations in speaker impedance at various frequencies, much as

[*Continued on page* 99]

GOOD READING

By John Milder

THE LANGUAGE OF SCIENCE. By William Gilman. Harcourt, Brace & World, Inc., New York. 248 pages. $4.95.

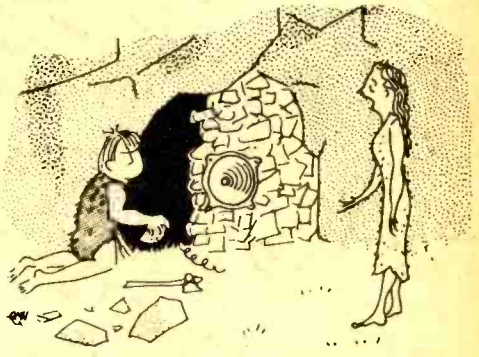
This book ostensibly is a guide for practicing and would-be technical writers. But it is actually much more. If your only "technical" writing consists of a letter to a friend about your latest radio equipment, it is still likely that you can profit from the adv e in these pages. For this book in essence is a delightful refresher course in the art of making yourself understood. It combines a painless review of basic grammar with important, pointed instructions on writing interesting prose. In a sparkling style that is the best advertisement for what he is trying to teach, the author tells you how to gain and hold a reader's attention, how to organize your thoughts and how to express a complicated idea without getting lost in a tangle of words. His chief point throughout is that a highly technical subject is no excuse for murky writing. This reviewer will testify gladly that all but a handful of technical writers can profit from Mr. Gilman's advice. And if you are at all interested in putting words on paper—for money or not—let me recommend this wonderfully readable volume.

AMPLIFIER CIRCUITS. By Thomas M. Adams. Howard W. Sams & The Bobbs-Merrill Co., New York & Indianapolis. 136 pages. $2.95.

This is the second volume in the Sams Basic Electronics Series. Covering both audio and RF amplifiers, the author outlines their operation in simple, straightforward terms. But what is likely to catch your eye is a new illustrative technique. Four-color diagrams of the circuits involved treat electron currents as "moving parts" in a mechanical analogy, making it easy to visualize the movements involved. All of which should make it considerably easier for the novice to come to terms with what's-going-on? schematics.

A TO Z IN AUDIO. By G. A. Briggs. Gernsback Library, Inc., New York. 224 pages. $3.20.

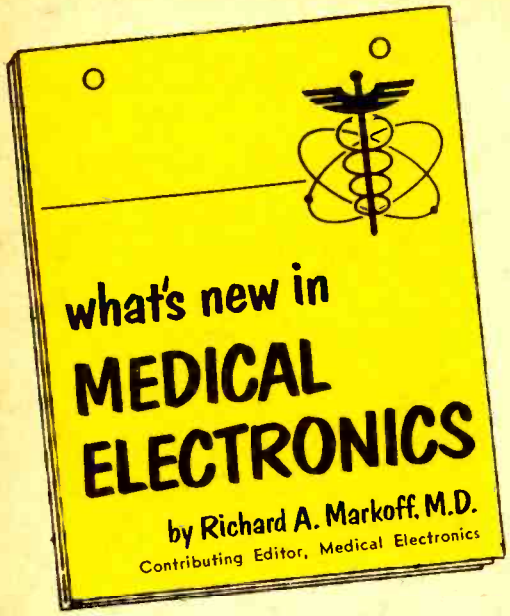
Mr. Briggs' seventh book on audio is a hi-fi glossary—an alphabetical listing of people, places, terms and techniques likely to crop up in any discussion or article on hi-fi. As usual, the maker of Wharfedale loudspeakers is informative and witty. British humor *can* be fun. But the book doesn't pretend to



"It sounded better without the cave."

be an encyclopedia of audio. There are some four hundred entries. Some are one-liners, others cover several pages. Some are explicit and fascinating, others unaccountably vague. The allocations of space undoubtedly are in part a reflection of Briggs' current interests. He spends four pages on the subject of column enclosures for speakers but provides not a single encouraging word on the lost art of building bass reflex enclosures. It should be said, however, that he is not above discussing—and praising—a competitor's speaker system, and this is particularly refreshing at a time when most manufacturers seem to insist that *their* way is the *only* way to high fidelity. Some slight flaws aside, this book should be a must for

[*Continued on page* 101]



ELECTRONIC equipment and techniques in medical practice and research continue to evolve rather rapidly because of some large-scale development programs.

The standard electronic diagnostic instruments have become smaller and easier to use, including electrocardiographs (heart action), electroencephalographs (which record "brain waves"), electromyographs (which record electrical discharges accompanying the contraction of muscles) and chronaxiemeters (which measure the excitability of muscles and nerves).

One new electrocardiograph, made by Minneapolis-Honeywell, weighs only 9 pounds and measures 9¾x4¼x7 inches and is battery-operated. It's really portable!

Aero-Space Laboratories has brought out a ballistocardiograph using a relatively new principle. This apparatus is a kind of bed supported almost without friction on jets of air (balance points are the norm). It measures the pumping action of the heart of a patient lying on it by recording the motions of his body in reaction to the pulsing of his bloodstream (remember Newton's Third Law of Motion: for every action there is an equal and opposite reaction).

In the X-ray field the Picker X-ray Corp. has announced equipment which uses fast-developing (10 seconds) Polaroid film rather than the conventional negative. However, these "quick prints" do not allow detailed study by a physician. For close examination, negatives still are required.

Radiocardiography, a term encompassing wireless electrocardiography at long range, is one of the most ingenious of new diagnostic methods. In this technique the patient wears strapped on to his body a little box that looks like an oversize sugar cube, containing a transistorized radio transmitter whose telemetry signals are keyed by a single pickup electrode attached to the skin. The device, made by RCA, monitors the action of the heart by reading the organ's associated electrical activity. The transmitted data are picked up by a receiver and displayed on a cathode-ray tube or recorded on paper.

A patient so equipped can move about freely while transmitting a continuous record of his heart's activity.

Several types of multiple-patient monitors and recorders to give readings on a variety of physiologic functions have been perfected and are in use in

Ear-tip transducer reads both the diastolic and systolic blood pressures and gives pulse rate.

Ballistocardiograph is a bed supported on jets of air. It measures the heart's pumping action.

hospitals. Such systems have alarms to alert the surgeon and anesthesiologist in the operating room, or the nurse in the recovery room or ward, if an abnormal reading appears.

One of the cleverest pickups for such a recorder is a headpiece developed for the Mayo Clinic. It consists of a temperature transducer clipped into the corner of the mouth, an air-flow detector in front of the mouth and nose, and a little clothespin transducer clipped to the ear. The last device gives diastolic and systolic blood pressure readings and the pulse rate by shining a light through the ear into a photocell.

The Hughes Aircraft Co. has designed a radiation detector (sensitive to alpha, beta or gamma radiation) that is so small it can be put into a catheter and inserted directly into a vein. It measures the concentration of radioactive isotopes in the blood.

The new Atomium Volumetron is an instrument that rapidly determines total blood volume by finding the dilution of administered isotope in the bloodstream.

A Blood Pressure Follower by Winston-Green uses a cuff on a finger or toe to record arterial blood pressure. The cuff's inflation is controlled by a piezoelectric crystal which responds to pulsations in an artery.

In the area of isotopes the emphasis is on the investigation of such diverse problems as the physiologic role of mysterious substances present in the body only in trace amounts and the metabolism of cancer cells.

Electronic developments are relatively fewer in therapy than in diagnosis. There are, of course, new electro-surgical instruments which employ high-frequency AC current to cut and coagulate or dessicate tissue. And some truly amazing advances have been made in cardiac pacemakers.

Radiation detector on tip of instrument stick goes right into patient's vein for isotope measurement.

The little block in the ring detects action of heart, sends data via radio signals to nearby receiver.

the UN's RADIO ENEMIES

DXers hear attacks from many countries but some of the most vicious originate in the U. S.

By C. M. Stanbury II

FEW DXers are surprised when they hear Radio Moscow or one of the satellites attacking the United Nations.

But most of us are not prepared to hear a vicious slash against the UN by an American, particularly a minister. As a result, the radio sermons of Dr. Billy James Hargis must be classed as rather unusual listening for DX fans of the broadcast band.

Dr. Hargis heads an organization known as Christian Crusade, headquartered in Tulsa, Okla. He is heard on some 70 radio stations in this country, plus two Mexican stations and half a dozen TV outlets.

What are you likely to hear in a Hargis sermon? "I challenge the illusion," he once said, "that the United Nations has preserved world peace or

been a protector of freedom. No more cruel hoax was ever hatched in the pits of hell."

Early last year (February 28) the minister was heard on WGUN, Atlanta, with this statement: "It is my honest conviction that the United Nations is a bad influence for the United States."

Dr. Hargis also was author of a famous Air Force intelligence report which attacked the National Council of Churches. It was withdrawn amid loud protests from Council defenders.

During a broadcast in March of last year the minister referred to the New York Times and Washington Post as "radical left-wing publications."

Most readers of those papers would not agree with him. According to people who take the pulse of the country, a large majority of Americans also do not agree with Dr. Hargis in his support of the John Birch Society. So when you catch a Hargis sermon you can be pretty certain you are hearing a controversial program.

Although the Christian Crusade radio net changes from time to time, nearly anyone from Massachusetts to California and from North Dakota to Louisiana can pull in one of the stations. The two Mexican transmitters are so powerful that they can be received over most of the country at night. XERB in Rosarito Beach is on 1090 kc and XEG, Monterrey, on 1050 kc (with 150,000 watts).

Meanwhile, in Canada the country's fourth major political party, Social Credit, has been attempting a comeback after some bleak days, partly on the strength of radio and television programs making oblique war on the UN. "The United Nations has failed to act when action was necessary because of the veto and big-power domination," party spokesmen have said.

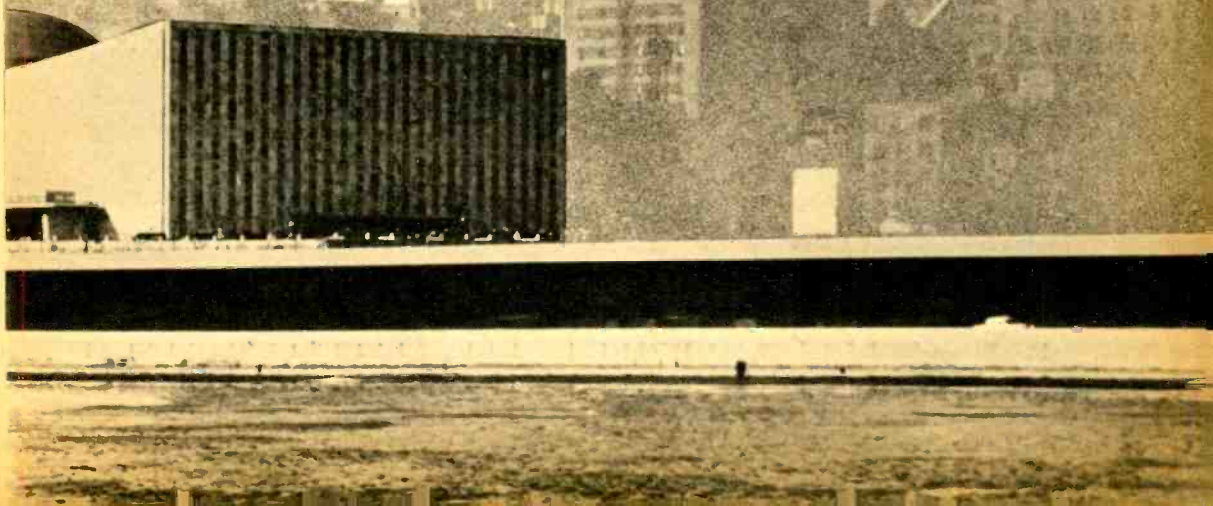
Africa, as might be expected, is both the location of and the bone of contention responsible for a lot of anti-UN propaganda you hear today.

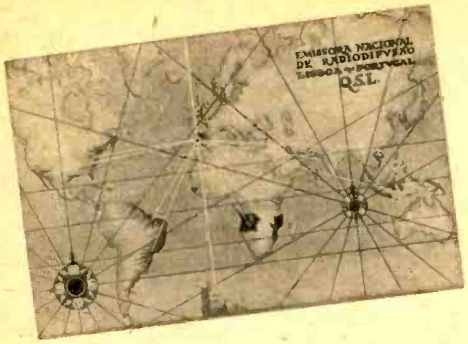
Portugal, after a long haggle in the halls of the big glass building on New York's East River, probably has been more openly hostile to the UN than any other European country. At the heart of this fuss is Portugal's West African possession of Angola. The UN has been critical of the way Portugal is doing things.

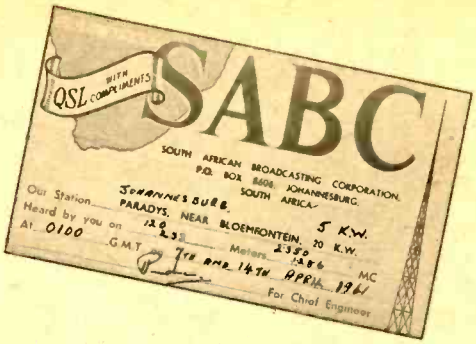
In answer, Radio Lisbon (Emissora Nacional) has called the world body "illogical and dominated by Marxism" and has said, "We will use our own methods to maintain national security."

Portugal is one of the few European countries to permit private broadcasting, but all official statements such as the above are reserved for state-owned Radio Lisbon.

Later, after the Angola affair died down, Lisbon tapered off on its forays against the United Nations. By that time a new enemy had appeared in the person of Radio Katanga. The bitterness shown in broadcasts from the Congo's renegade province made Portugal's propaganda pale in comparison. Katanga, after its secession from the cen-







Two stations, represented here by QSL cards, that carry anti-UN propaganda are Radio Lisbon (Portugal), left, and the South African Broadcasting Corp.

tral government, suddenly came into a powerful transmitter that fired broadsides all over the 25-meter band.

Not content with now-and-then attacks against the UN, Radio Katanga during each station identification used a slogan describing Premier Tshombe as "struggling for freedom against communism." According to the terms Katanga was then using, communism and the UN were synonymous.

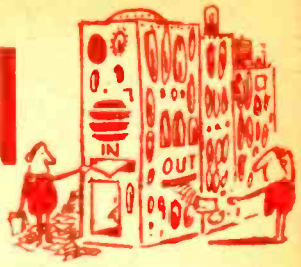
The Katanga broadcasts showed great resourcefulness in picking up quotes of all kinds from other stations and governments that would be useful in making hay against the United Nations.

A radio war of a different type is waged against the UN by South Africa and its South African Broadcasting Corporation. Most of its propaganda is veiled with respectability as "news" but the knife is there behind the screen.

South Africa conflicts with the UN on its racial segregation policy, for which it has been roundly criticized, and on South West Africa, which the government considers an integral part of the country. The UN holds it to be a protectorate. More trouble seems to be in the offing over South West Africa. Meanwhile, SABC is content to play up the UN's weaknesses and difficulties.

Dr. Billy James Hargis (shown in studio) of Tulsa attacks the UN on big net of radio and TV stations. He also publishes magazine Christian Crusade (left).

ELECTRONIC BRAIN



Have a question on electronics? Send it to Electronic Brain, Electronics Illustrated, 67 West 44th St., New York 36, N. Y. Enclose a stamped, self-addressed envelope for prompt reply.

Books For Beginners

Can you suggest some reading matter for a 14-year-old that will help him learn electronics without having to wade through pages of mathematics?

Raymond Lee Woodward
Baltimore, Maryland

There is much good reading matter on a very fundamental level now available. But before starting on electronics, you must be quite sure you have a relatively firm grasp of basic electricity.

As a starter, we should like to suggest *Basic Electricity* published by Holt, Rinehart, and Winston, Inc. at 383 Madison Avenue (Dept. PR111), New York ($6.25). If your background in electronics is good, you would be interested in *Basic Electronics* (same publisher and price).

Another excellent series is published by John F. Rider, Publishers, and is obtainable from any of the large electronics distributors. This series is also called *Basic Electronics*, comes in 5 volumes, and sells for $9.80.

Squaring A Wave

Why is a square wave called a complex wave? How is a sine wave turned into a square?

Thos. D. Harris
Marion, Alabama

It is possible to show theoretically and mathematically that a perfect square wave consists of a fundamental sine wave to which have been added an infinite number of odd harmonics (3rd, 5th, 7th, etc.). In practice, however, it is impossible to produce a perfect square wave. However, waveforms that contain the fundamental frequency plus the odd-order harmonics (up to about the 50th) are acceptable. An "imperfect" square wave of this description would have a rise time in microseconds and its corners would not be perfectly square. Nevertheless, such a square wave, despite its imperfections, is very useful for frequency and transient response checks and for triggering various devices.

Many commercial square-wave generators start with a sine wave and then clip its negative and positive peaks to produce a fairly good square wave. Or a modified flip-flop circuit, known as a Schmitt trigger, may be used.

A square wave produced in this manner is identical to a square wave generated if you could add only odd-order harmonics to a pure fundamental. Despite the fact that clipping a sine wave at first appears as a subtractive process in which something is removed, the process actually causes distortion which *adds* odd-order harmonics to the fundamental.

Nighttime RF

Why is RF propagation so much better at night than during the day?

Christof Sadorf
Ft. Hauchuca, Ariz.

During the day, the sun ionizes the upper layers of the atmosphere intensely, giving them wave-reflecting qualities. This ionized air comes relatively close to the earth and reflects the radio waves back at a relatively sharp angle. Thus, the distance covered is not too great. This is known as "short-skip."

At night, the lower layers of ionized air disappear leaving only the higher reflecting zones. Under these conditions, the reflection angle becomes much larger so that the waves return to earth much farther from their source, producing long-skip distances.

These electrified layers form the earth's *ionosphere*. They are sometimes referred to as parts of the *Heaviside Layer*, named after the scientist who first proved their existence.

TAPE RECORDER DISTORTION

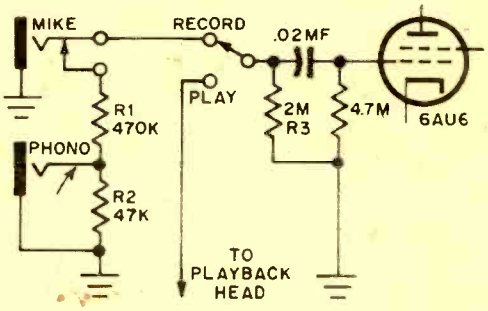
HI-FI CLINIC

I have an inexpensive AC-operated Japanese tape recorder that records very well when I use the microphone. However when I attempt to record from my FM tuner (plugged into the phono jack) the sound is very distorted, even though the recording level indicator does not show overload. What is wrong with my recorder?

Harry Miller
Akron, Ohio

The input circuit of your recorder is shown at right. A microphone plugged into its jack eliminates R1 and R2 from the circuit and the full output voltage of the mike is applied to the grid of the 6AU6. However, note that when a phono is plugged into the indicated jack, a voltage divider is formed among R1, R2 and R3. It would appear from the resistance values used that the phono input is meant for a magnetic cartridge with an output of about 10 millivolts. You can see that a tuner or crystal phono output of .5-1 volt would drive the 6AU6 into distortion. The cure here is just to change the ratio of the voltage divider.

Connect another resistor (470,000—1 megohm) at the point in the schematic indicated by the arrow. This is between



the "hot" contact of the phono jack and the junction of R2 and R1. This will reduce the voltage reaching the grid of the 6AU6 and proper operation will be obtained.

Electrostatic Speakers and Old Amplifiers

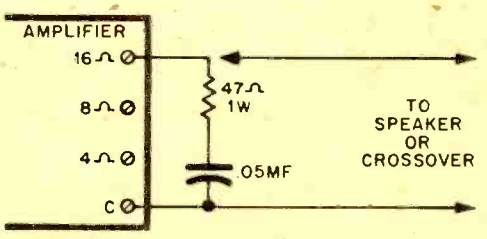
I have just purchased an electrostatic speaker. My amplifier is three years old and I have been told that it is dangerous to connect an electrostatic speaker to an old amplifier. Is this true?

T. Dyer
Oakland, Calif.

Most amplifiers produced in the last five years are satisfactorily stable when connected to the inductive load a cone loudspeaker presents. With an electrostatic speaker, however, the load presented to the amplifier is mainly a capacitive one. Many amplifiers tend to become unstable when presented with a capacitive load. The amplifier would break into oscillation and the high-frequency power could burn out the tweeter.

Luckily this is not a problem common to many amplifiers. However, if you think there is any danger, it would pay to connect a protective network called a "tweeter saver" across the output terminals of your amplifier as shown.

At the low frequencies the network is an open circuit (practically) because of the high impedance of the capacitor. The capacitor, however, will short out



high-frequency oscillation before it reaches the speaker. Note that the R-C combination is connected across the 16-ohm tap regardless of where the speaker connects.

GOLDEN ANNIVERSARY OF AMATEUR RADIO 1912-1962

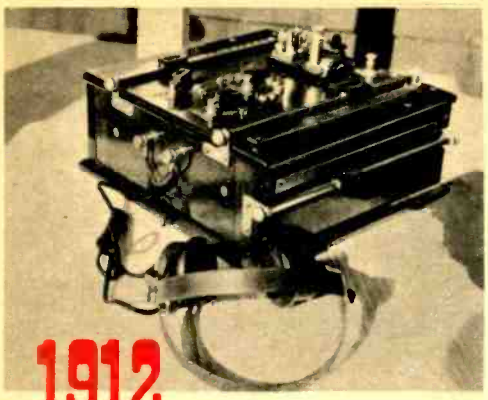
- **Half a century ago an act of Congress created ham radio.**
- **Winner of the first license is still at his key as W1ZE.**

By Robert Hertzberg, W2DJJ and Eli Flam

IT STARTED half a century ago. The air even then was filled with signals from commercial wireless telegraph stations and a couple of thousand unlicensed and unregulated experimenters. Clearly, something had to be done to bring order out of chaos. So in 1912 Congress passed Public Law 264, "An Act to Regulate Radio Communication." The law gave official status and a license to radio amateurs, and consti-

Real OM (Old Man) of hamming is not-so-old Irving Vermilya, who won first amateur license in 1912, although he'd been experimenting with radio since 1901 (see QSL card at left). Irving, W1ZE, is 71, lives in Massachusetts and still pounds his key (right photo). At left he's working mobile in 1935.

An album of memories from 50 years of amateur radio...



1912

United Wireless Telegraph "D" receiver of 50 years ago had three tuning coils with sliders, used a crystal detector. Cabinet was of mahogany.

1919

ARRL's famous Pink Sheet celebrated lifting of World War I ban on hamming. W1AAT owns original copy of this one. Ban lasted two years.

1922

One of earliest QSL cards was sent out by 8DAG in Cincinnati, who was Howard S. Pyle, now a frequent contributor to EI under call of W7OE.

1925

Hallicrafters Super-Skyrider receiver in use at Seattle YMCA ham station 7YC in mid-1920's. Set had a leatherette-covered wooden cabinet.

tuted the birth of a hobby that has fascinated and captivated hundreds of thousands.

On December 12 of that memorable year of 1912 representatives of the Departments of Commerce and Labor, which had been chosen to administer the communication law, began giving examinations for wireless experimenters at the Brooklyn Navy Yard. At 7 o'clock in the morning a 22-year-old chap named Irving Vermilya showed up to take the test—with shaking hands and a butterfly stomach, like every ham since then—and won the first Certificate of Proficiency, thus becoming the No. 1 radio amateur in the country.

In 1962, the Golden Anniversary year of ham radio, we have more than a quarter of a million amateur licensees in the United States. Still active among them is . . . Irving Vermilya, now W1ZE. Irving lives in a cottage overlooking Buzzards Bay at Mattapoisett, Mass. Now 71 and retired, he spends several hours every day in his ham shack, working both phone and CW. Although he prefers to work other New England operators and belongs to some regional nets, W1ZE now and then does a little DXing and is well known to hundreds of other amateurs.

Popular early-Thirties transmitter had triode oscillator working into triode amplifier; note "new" metal chassis just then coming into general use.

Women! One of the first YL's (Young Ladies) in amateur radio was W7FKS of Eugene, Ore., known to all as Mildred. Note the National FB-7 receiver.

Actually, Vermilya was an 11-year veteran of wireless telegraphy when he got his license. His witnessing of a historical event in radio had given him his interest in the hobby in 1901. Young Irving, then living in the New York City suburb of Mount Vernon, was taken on a trip by his pastor to Goat Hill (later Signal Hill) in Newfoundland. The date, coincidentally, was December 12, and Irving watched an Italian engineer named Guglielmo Marconi receive the first transatlantic wireless signal, the letter S, sent from Cornwall in Great Britain. Marconi later gave the minister two coherers and two tappers and Irving ended up with one of each.

In the early days the most important application of wireless was between ships and shore stations and Vermilya was a ship "sparks" before becoming a station engineer. He retired from WNBH-WFMR in New Bedford, Mass.

After interference got so bad that Congress took its 1912 action, hams were no longer able to use any wavelength and power desired, but they still had a lot of freedom. Commercial stations took over 300 and 600 meters and the "tinkerers" were told to stay below 200 meters (1,500 kc).

At that time 1,500 kc was considered pretty useless and anyone who ventured into higher frequencies was some kind of nut. Every ham knows the result. This banishment to the wilds of the "short" waves forced amateurs to do experiments leading to the wide use and popularity of the higher frequencies.

A typical ham station of 50 years ago had a primitive receiver using crystal detectors, slide-adjusted tuning coils and headphones. But the impressive item always was the transmitter. It had a huge, coffin-like transformer putting out 20,000 volts or so, a big bank of capacitors and an open-air spark gap. When the brass transmitting key (the operator became known as a brass-pounder) was pressed, the capacitors discharged through the spark gap with a lightning-like crash that made women and children run for cover.

All communications then were in code, of course. Phone transmissions, made possible by Lee DeForest's Audion tube, did not become popular until after World War I. Meanwhile, hams had decided they needed a national organization to look out for their interests and in 1914 had set up the American Radio Relay League.

Amateur radio at first grew slowly. In 1945 there were only about 50,000 hams. But since then the hobby has mushroomed until today there are more than 250,000 licensees.

Irving Vermilya, although he's moved some 40 times during his career, has never been without his ham gear. But in 50 years he's gone a long way. And so has amateur radio.

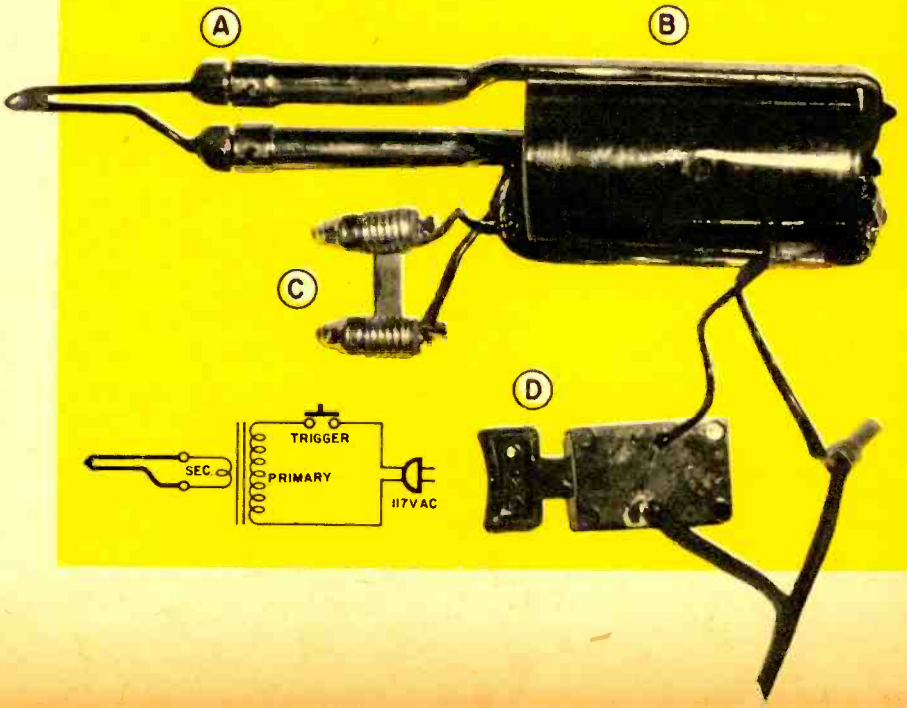
"Stop fooling around, Klutzie...

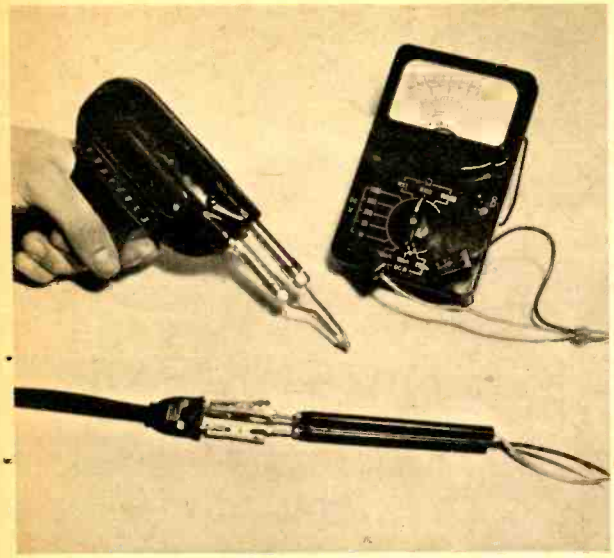
FIX THAT SOLDERING GUN!"

By John A. Comstock

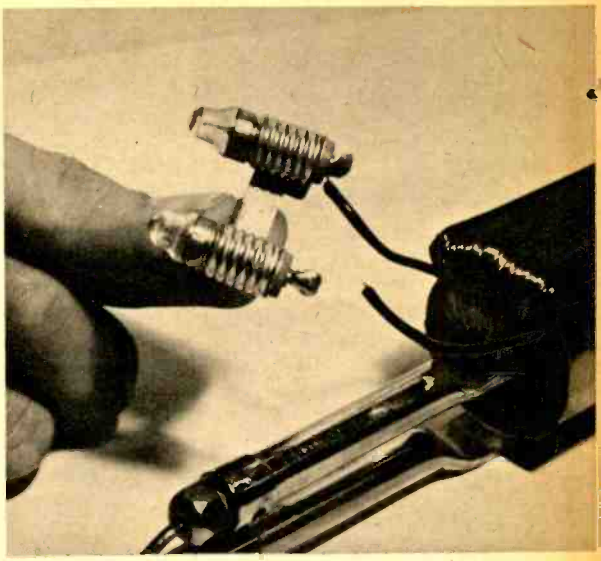
DOES your soldering gun suffer from slow action . . . dim bulbs . . . low heat . . . and intermittent performance? A minor operation, and perhaps a few replacement parts are all that's required to give that trusty old gun a new lease on life.

Four basic trouble spots are: (A) Loose or corroded tip nuts. (B) Open transformer winding. (C) Defective socket, bulb, broken wire or (D) switch.

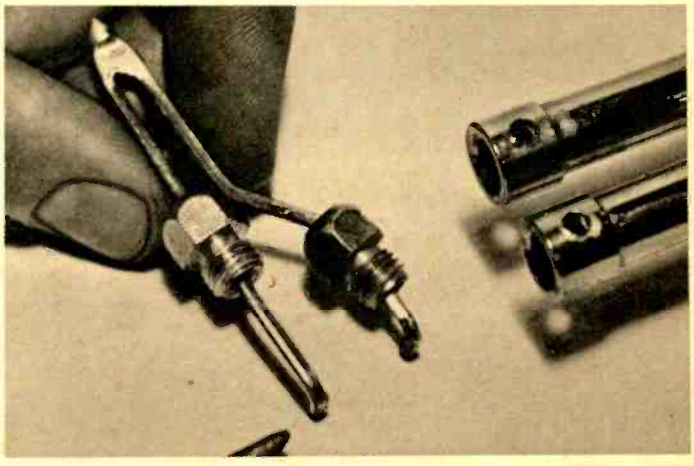




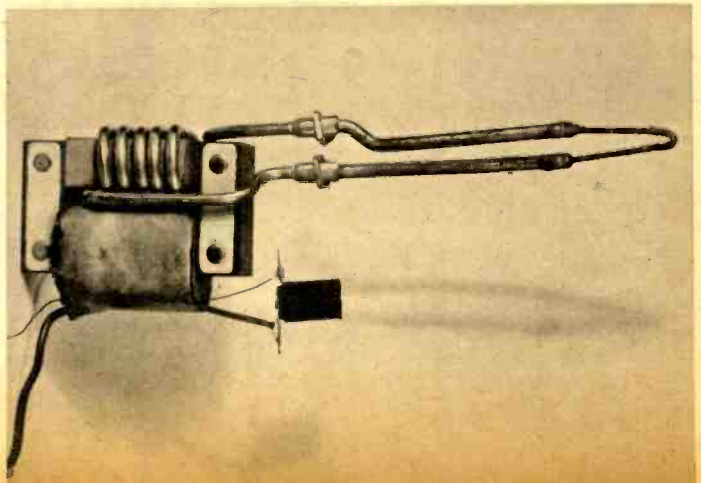
For a quick check, connect an ohmmeter across the gun's plug. Shake and tap the gun to check for an intermittent open in the primary circuit.



Remove a few machine screws and the gun's plastic housing will separate into two parts. Any broken wire connections will then be visible.



Unscrew the tip and file to remove corrosion. Replacement nuts and tips are available from your local dealer.

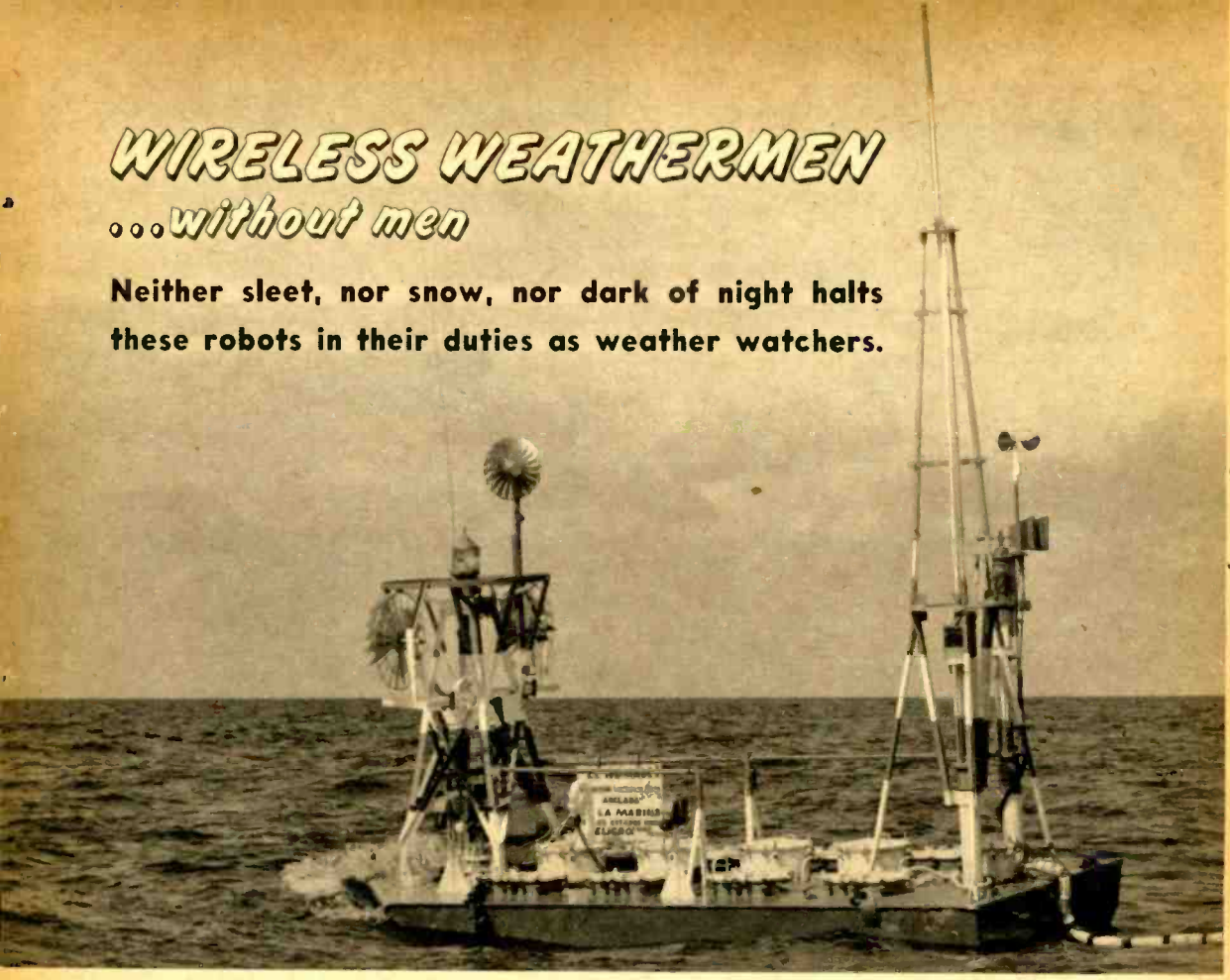


Internal construction of another brand of gun. The five heavy turns of wire is the secondary winding. Two bottom wires connect to switch and the heavy-duty line cord.

WIRELESS WEATHERMEN

...without men

Neither sleet, nor snow, nor dark of night halts these robots in their duties as weather watchers.

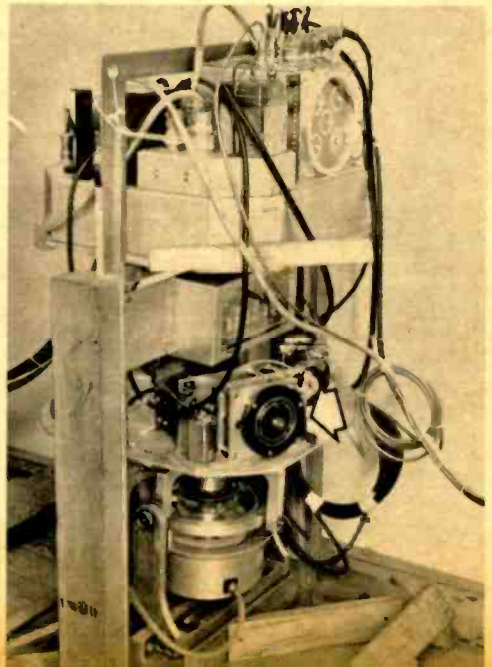


ROBOT weather stations that operate for long periods without human assistance are popping up, quite literally, from pole to pole. The Navy is setting up a nuclear-powered unmanned observatory in Antarctica, and another is making reports from northern Canada, close by the North Pole.

In between, a floating weather station far out in the Gulf of Mexico keeps an eye out for hurricanes, and the Army has developed a robot weatherman that can be put down in any remote location.

This sowing of equipment designed to send back weather data from inaccessible areas of the world is part of a program to make our domestic weather forecasts more accurate. The snow that is biting an Eskimo's face this week may be coating our highways next week. A storm sometimes makes a path thousands of miles long. Previously, we might not have known a storm was

The Gulf weather station above has instruments (below) in well. Arrow points to code machine.



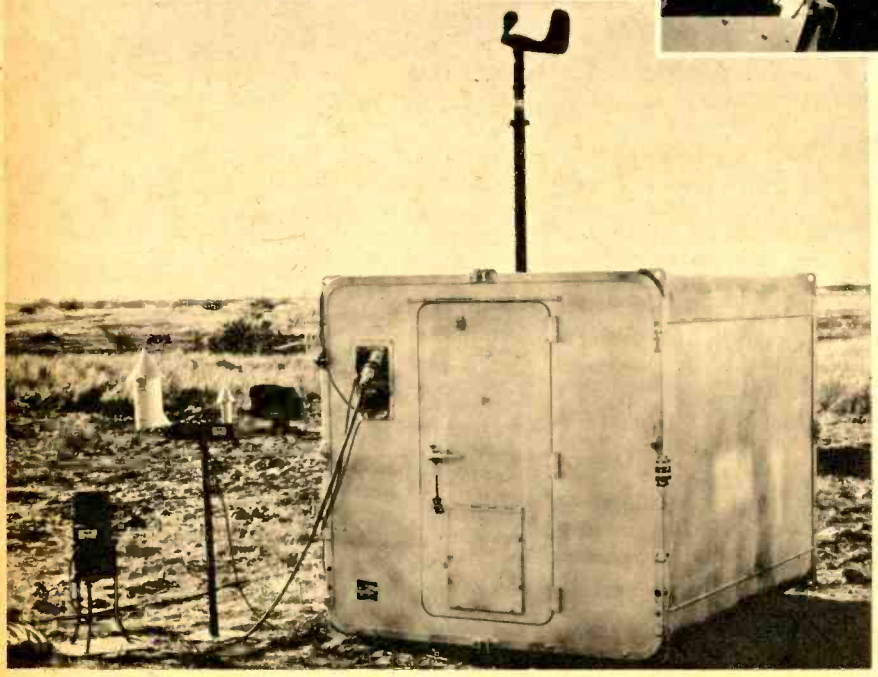
coming from a remote locale because we had no way of getting reports of it. Unmanned observation stations will give us the needed data.

Both military men and civilians are interested in accurate long-range weather forecasts. Military operations are influenced greatly by the elements, and when Joe Smith on Main Street knows what's coming he can at least prepare, even though he can't do anything about it.

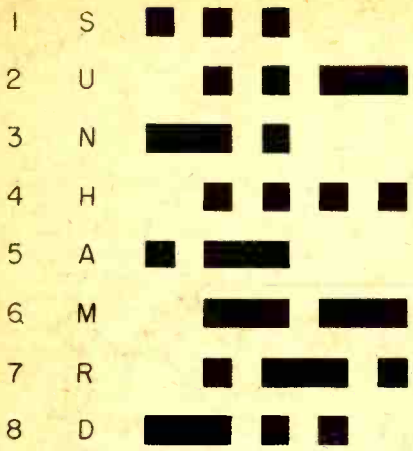
The Navy is the owner of the hurricane-spotting robot weatherman that floats in the Gulf of Mexico. It is called Nomad, although the name is not quite suitable because the rig is held on station by a one-ton mushroom anchor at the end of a 16,370-foot line.

Nomad is a stubby raft 10 feet wide and 20 feet long. Precision sensing instruments on board take a large number of readings and then the data are transmitted to shore during a four-minute period every six hours. When winds are higher than 33 knots the transmissions are made every hour.

Included in Nomad's information are temperature of water and air, barometric pressure, wind speed and other



An Army weather station that can be transported by air is shown on this page. It is remotely controlled and can make weather observations and send the data back to human weathermen for long periods of time without attendance. In the photograph at top a maintenance specialist sends report to his base via radio after making a regular inspection. The sergeant below him is adjusting a rotor in the unit's power supply. Sensing instruments are shown outside shelter in photo at the left.



Part of the code transmitted by Navy weather station in Gulf is shown here.

readings. Fourteen channels of data are transmitted, partly via variable tone and partly using Morse code (ten words per minute). The frequency is 5340 kc. At the beginning of each transmission the station gives its identification, N2S. The signals normally are taped and then decoded for later study. A copy of the code can be obtained from the National Bureau of Standards, which helped the Navy develop Nomad. DXers find the signals of interest.

The Army's portable weather station is an aluminum shelter measuring 7x7x8 feet and weighing something under a ton. Inside are equipment racks enabling the unit to make, record and transmit six or more types of weather observations. Where the Navy's Nomad was powered by huge batteries, the Army robot uses an engine-generator power supply. As additional equipment, the station can be outfitted with detectors to give radiation and fallout readings and other bits of information about its area.

In tests, the Army's weatherman has transmitted its data successfully over several thousand miles. It can give a complete run-down in just 15 seconds and is designed to spew out its figures either on command or on a schedule.

The whole installation can be left unattended up to a year. When a component does go out, there is an alerting device which transmits a message telling which part failed—providing it wasn't some vital ingredient like the generator or the antenna feeder line. A service team then knows just what to bring along to get the rig working properly again.

A new and exotic power source will run an unmanned weather station that is being set up early this year near the Little America V Station in the Antarctic. It is an atomic generator developed for the Atomic Energy Commission by the Martin Company.

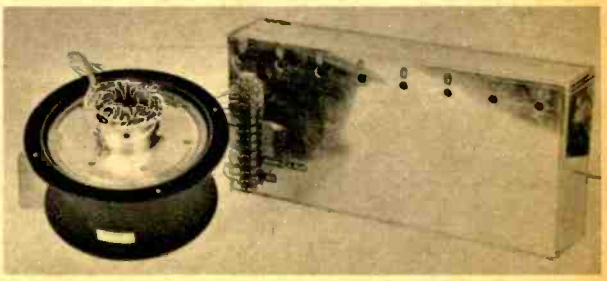
The 10-watt power unit, called SNAP-7C, is a little cylinder 19 inches in diameter and about 21 inches high. Inside are four cavities containing fuel pellets of strontium 90, the substance that makes headlines during fallout scares. Heat produced by the spontaneous decay of the radioactive material is converted directly into electricity by 60 sets of thermoelectric couples. Since there are no moving parts, nothing in the generator can wear out (see THESE GENERATORS HAVE NMP! in this issue). Its operating time is put at two years.

The South Pole generator is similar to but more powerful than one which, since last summer, has been powering a weather station located on a remote island above the Arctic Circle.

In the Antarctic project, the entire unmanned observatory will be buried in the snow. Steel and wooden outriggers will keep it from sinking too deeply, however.

If you should be walking your dog team in the neighborhood and stumble onto the station there wouldn't be much to look at. Only a whip antenna and some sensing elements will protrude above the surface. Its weather data will travel 400 miles to the McMurdo Sound base camp.

Photoelectric encoder (left) is part of nuclear weather station in Arctic; test gear is at right.



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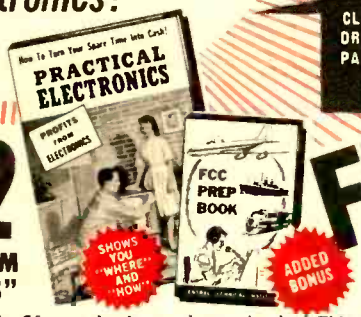

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Superintendent of Communications for the K. C. Southern Railway Company is Central graduate Lawrence D. Fry, with 15 years of railroad communications experience. "Central is a fine school," says Mr. Fry. "I've always recommended it, and have sent several students to Central."

Field Service Representatives for the Bendix Computer Division, L. A., California, are Central graduates E. John Kempf, left, and Robert Young. Mr. Kempf was employed as a maintenance man before he became interested in radio and TV. His first project was building test equipment at home. After enrolling with Central, he began to make extra money repairing radios, auto radios, etc. "The field of Computers is expanding, and there's a real need for trained technicians," he says. "I have found the work to be both profitable and interesting!"

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EI builds A COMPLETE HAM STATION

Hallicrafters amateur radio receiver and transmitter kits make a hot combo for both the Novice and the old-timer.

HALLICRAFTERS, an old and honored name in amateur radio, decided not long ago to try for a slice of the lucrative kit market, a new venture for them. A complete ham station comprising a 75-watt transmitter and matching receiver is their first build-it-yourself offering.

The equipment is designed to give high performance on all bands from 80 through 6 meters. The transmitter, model HT-40, is priced at $79.95; the receiver, costing $94.95, is designated the SX-140. Both products are kit versions of wired equipment introduced previously by Hallicrafters and still offered for $99.95 and $109.95, respectively.

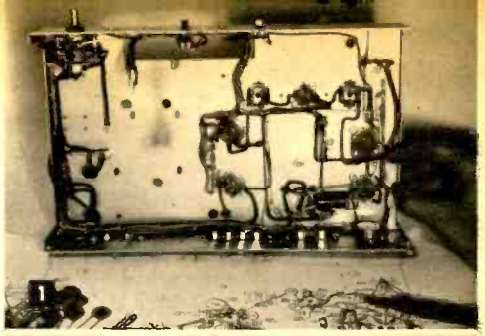
Kits obtained by EI for building and testing were some of the first off the assembly line. Although the equipment worked well after construction, the early instruction manuals were in some parts confusing and contained some errors. As a result, Hallicrafters took the drastic (and costly) step of redesigning the manuals from cover to cover. The new ones appear to be much improved and include elaborate detailed drawings of construction and chassis wiring.

If by some chance you purchase a kit with the older manuals be sure to obtain a set (two books per kit) of the new ones from Hallicrafters. All the latest manuals have the number 661 printed on the lower left of the rear cover.

Let's look at the SX-140 receiver first. Its five tubes (plus two silicon diodes) actually perform 11 tube functions and do the job

well. The circuit includes an RF amplifier stage and RF gain control, a controlled regenerative IF stage for added selectivity and CW pitch control, a built-in 3,500-kc crystal calibrator, an antenna trimmer, S-meter, noise limiter and earphone jack. Auxiliary terminals at the rear of the chassis control an external antenna relay and key the transmitter at the same time. Speaker terminals and an S-meter adjustment are also on the rear of the chassis.

The instruction booklet is well illustrated with clear, detailed drawings. The step-by-step instructions are clear and it is difficult to make an error as you read the instructions carefully. Two wiring harnesses supplied with the kit simplify wiring and lead dressing problems. The critical RF and oscillator coil assemblies are supplied wired, tested and prealigned. All hardware such as transformers, sockets, terminal strips and tie lugs are mounted first. Harnesses were next, followed by general wiring, tuning capacitor mounting, front panel, prewired bandswitch and finally the dial cord and the tubes. Assembly time was about 12 hours.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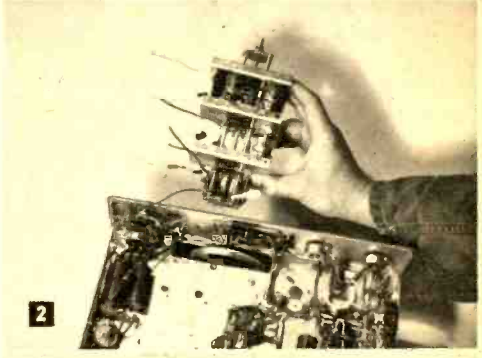
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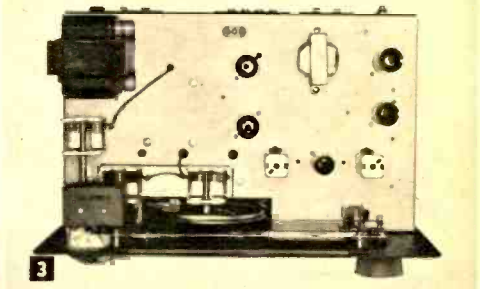
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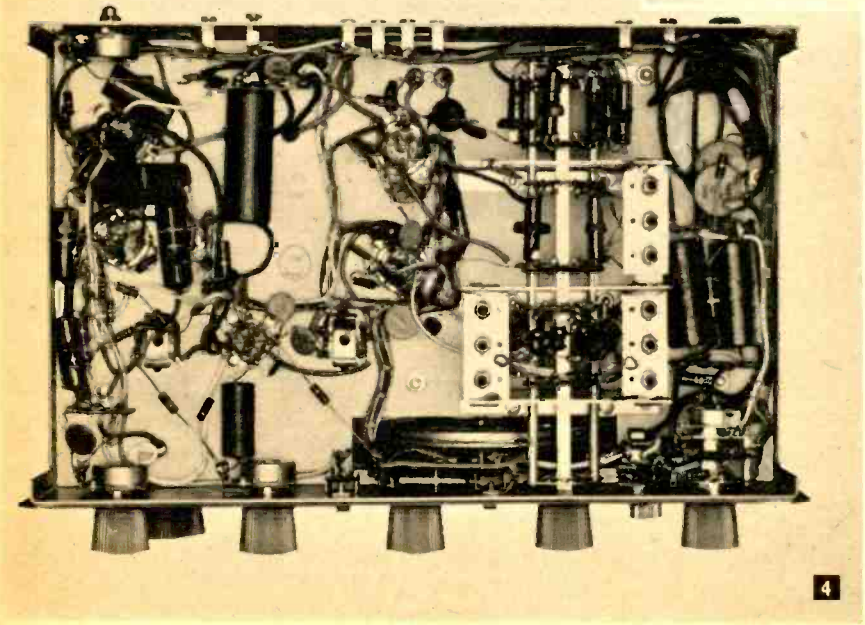
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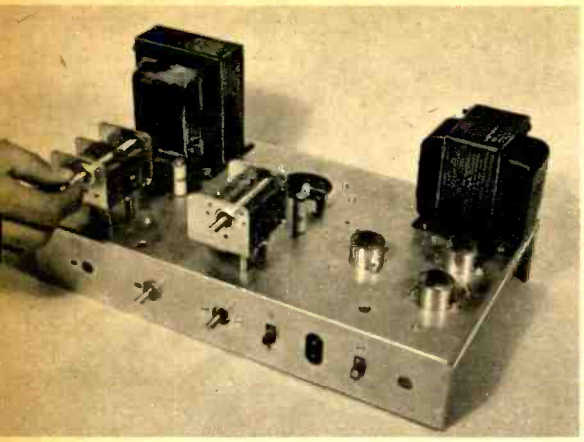
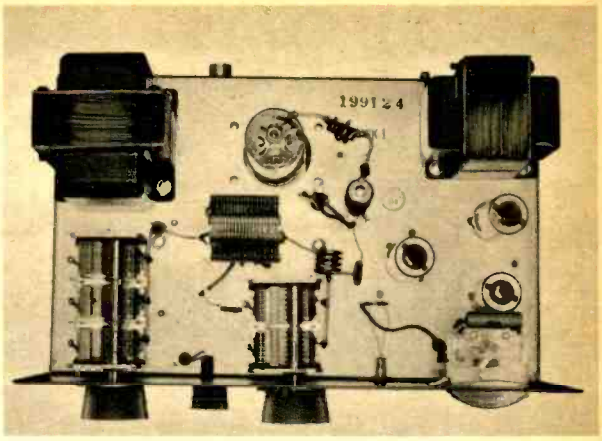
(1) Receiver underchassis view after pre-assembled wiring harness is installed. (2) Bandswitch subassembly which includes coils and switch. (3) Top and (4) bottom chassis view of completed receiver.



Above-chassis view of partially assembled transmitter. Open chassis layout eases assembly.



Completed transmitter. Edgewise meter on front panel of unit measures RF Output-Grid Current.

After rechecking the solder connections, etc., the SX-140 was turned on and the band edges were checked with the crystal calibrator. All bands could be reset without further adjustment of the front end. Signals came rolling in from all over the country on the 80, 40 and 20 meter bands, with *no* antenna connected. Slight adjustments were made for optimum reception on the 15, 10 and 6 meter bands. There was no difficulty receiving New Zealand on 15 phone from the New York City area, as well as W6's on the West Coast and other stations in Central America. Ten meters was not too active, but California came in loud and clear. Six meter reception was poor and the band was full of harmonics from local TV stations, calling services, towing trucks and other unidentified carriers.

A complete and attractive ham station can be formed with the SX-140 and the HT-40, not forgetting the addition of a loudspeaker, key or mike and an antenna change-over relay and antenna system. A simple dipole fed with 75-ohm coax will do a nice job.

The HT-40 transmitter is an attractive companion to the SX-140 receiver. It is designed for full bandswitch operation on the most popular bands. With the inclusion of the 6 meter band, all classes of license holders can use the rig. The maximum power input of 75 watts and crystal control makes it ideal for CW use by the Novice. An external VFO can be added when a General Class license is obtained.

The circuit uses a 6CX8 as a crystal oscillator and buffer feeding a 6DQ5 pentode tube that operates as a straight-through amplifier on 10 through 80 meters but doubles into the 6-meter band. The audio amplifier and modulator tubes are a 12AX7 and a 6DE7. One section of the 6DE7 acts as a cathode follower and its audio frequency component is applied to the screen of the 6DQ5 final (screen modulation). Silicon rectifiers and a power transformer serve in a voltage doubler power supply.

Wiring is greatly simplified by the use of two wiring harnesses furnished with the kit. All the parts are neatly packaged with a part number, description, quantity and a bag item number. It is quite easy to line up all the items in numerical order. Unfortunately, no mention is made in the step-by-step instruction of the number of the bag that holds the next part to use. This would have helped.

The installation instructions failed to mention anything about grounding the chassis of the transmitter. This is essential for safety, minimum TVI, etc.

Construction time was approximately 12 hours. Most of the time was con-

[*Continued on page* 108]

Computer On The Phone

Continued from page 40

have to settle for a fraction of that speed.

The computers we've been talking about are off-line machines. They switch to the phone lines only for data transmission. There also are on-line machines which keep track of some given quantity and stay hooked to the phone wires all the time to receive orders, bookkeeping figures, etc.

The airline reservations computers are examples of on-line equipment, as are the big bookkeeping brains located in the main offices of some banks. Deposits and withdrawals from all branch banks are figured up (and checks bounced) by the one giant machine.

What Is Impedance?

Continued from page 76

automatic volume control (AVC) maintains a constant volume level despite variations in signal strength.

The degree of control that an amplifier's negative feedback exercises over these variations in speaker impedance is termed the amplifier's *damping factor*. In general, inexpensive speakers perform much better when connected to an amplifier with a large amount of negative feedback (high damping factor) because feedback eliminates the effects of the speaker's relatively large changes in impedance, producing a smoother, less boomy sound. On the other hand, some high-priced speakers which have small impedance variation with frequency appear to lack bass response when connected to an amplifier with a high damping factor. This was the reason for the variable damping controls that appeared on amplifiers several years ago. However, most of these controls did more harm than good and they are seldom incorporated in modern amplifiers.

That's the basic impedance story. If you want to go into more detail you will be able to find several good volumes on the subject in any library.

Tech Editor's Test Bench

Continued from page 65

That would take care of the bass and mid-range; how about the highs? One might suppose that all you need to do is let the speakers go their own merry way assuming that unlike the five-inch replacement jobs, quality speakers had the potential to deliver highs. However, when highs are radiating from a number of independent sources interference patterns are set up. For an analogy, think of a bank of sixteen nozzles all squirting a fine stream of water under high pressure. As each stream gets farther and farther from its nozzle, it tends to spread and interfere with the adjacent streams. Eventually instead of a solid wall of water there would be a very uneven spray, splash and drip. The same sort of situation occurs when you have multiple sources radiating highs. You get cancellations and a very uneven dispersion. With high-frequency speakers, unlike woofers, it is certainly *not* a case of the more the better.

If you've received the impression that I believe the multiple speaker business is composed mostly of invalid theories backed up by tin ears—you're right!

Note that I'm not theorizing about these speaker systems off the top of my head. I have a 24 speaker monster sitting on the floor of my workshop right now that produces some of the lowest-fi you've ever heard. (I built it when I was young and innocent.)

If you're intent on building your own speaker system, I can recommend the projects in EI's November '60 special section on loudspeakers. Or if you can wait a couple of issues, we are going to run complete plans for a hot little two-speaker bookshelf system that produces great sound for its under-$20 cost.

For those not inclined to take hammer and saw in hand and do it themselves, there are several under-$20 systems in both kit and assembled form. As an example, the little Cabinart speaker system we listened to the other day won't rock the rafters, but it certainly will produce fine sound for its $15 price tag.

Postscript
TO EI's FM TUNER REPORTS

Continued from page 51

are in the order of 1% or less, the relative distortion figures are meaningless because of residual test equipment distortion.

As the IHFM amplifier standard states, residual test equipment distortion must be no higher than 1/5 of the test results obtained. Even so, the results obtained are then in error by ±1/5 of the actual distortion. By the same token, it is not possible to just arbitrarily subtract test equipment distortion (or partial test equipment distortion of the audio oscillator only) from the overall test result. As is well known, harmonic distortion consists of the harmonics of the fundamental frequency. The distortion of the test equipment can be subtracted from the total measured result *only* if the phase of each and every harmonic of the equipment under test is the same as the phase of each and every harmonic of the test equipment. This is almost impossible to establish. For these reasons, the published distortion figures are in serious error.

Similar arguments can be shown for the signal to noise ratio measurements since the rating of the generator is 60 db below 75 kc deviation.

One further note: The IHFM tuner standard states (in the section on normal control settings) that the AFC controls be turned off for testing purposes. Since DSR is a form of AFC (extending into the audio frequencies) the test results without DSR should be used.

I hope this illuminates some of the problems involved in testing tuners.

Daniel R. von Recklinghausen,
Chief Research Engineer

Some interesting points are raised in Mr. von Recklinghausen's letter and we will take them up in order.

First, it is true that the accuracy of sensitivity measurements made with the Measurements Corporation Model 210-A FM signal generator are guaranteed to only ±5%, although judging by our unit's performance, it seems to have a much tighter tolerance. However, even assuming a 5% error, 5% of 2 microvolts is only 0.1 microvolts. The difference between 2 microvolts and 2.1 or 1.9 microvolts, as we stated in the report, is insignificant in terms of tuner performance.

With reference to the distortion question, we agree that the inherent distortion should not be greater than 1/5 of the test results obtained. Although Measurements guarantees no more than 1% distortion, our 210-A actually checks out at .5% or better. This would mean that our distortion figures could be in error by ±.5% if the phase relationships among the signal generator, tuner, and distortion meter were exactly *in or out of phase. Such an occurrence is highly unlikely. It is more probable that some intermediate situation exists which results in measurement error somewhere between 0 and .5%.*

We've found that most manufacturers are measuring their tuners with the same test equipment lineup used by the Audio Workshop. They also ignore the effect of phase differences, probably for the same reasons we did. It is not surprising therefore that our distortion figures were, for the most part, close to what each manufacturer claimed for his unit.

With reference to the signal-to-noise ratio measurements, we again have to refer to the actual performance rather than specs of the generator we used. Checked against Dynaco's Marconi generator, we were able to match their 71.5 db noise figure. This would not have been possible if our generator had only the 60 db S/N figure guaranteed by Measurements Corporation.

CB Corner

Continued from page 55

20 years ago. Efficiency meant money!

Sideband gear is more complex and expensive than present CB equipment but the powerful signal it can deliver certainly would make it worth the money to many.

What does the FCC think of SSB on the band? The commission perceived the possibility of sideband CB long ago and has stated some opinions. First, it acknowledges that SSB is permissible under the present rules of Part 19. But then it begins thinking about interference. The problem is intensified in a mixed band where part of the units operate on SSB, the rest on regular AM. Current equipment would be at a disadvantage trying to compete with 40-watt signals.

The FCC sums it up in these words: "If undue destructive interference is caused to conventional units, the commission may consider initiating proposed rulemaking to prohibit the use of such emission by class D stations." This is clearly a restatement of the FCC's desire to keep CB radio a short-range service with interference held to a minimum.

But there is an advantage in SSB that no one seems to have mentioned. An SSB signal occupies much less room on the band than does conventional AM and two stations can transmit simultaneously on the same channel with little mutual interference. It's a case of selecting different sidebands. With so few frequencies available in the total radio spectrum, this can be important. SSB would double the number of CB channels from 23 to 46 without spilling out of present band limits.

We've seen the frequency problem threaten expansion in commercial two-way radio. In this case a system of narrow or split channels has evolved. Though not the same as SSB, it's a comparable answer to the problem of getting more stations into the limited space available.

SSB CB . . . It's shaping up as a hot issue. We'll keep you posted.

Bargains? . . . Looks like CB is coming of age. Early, outdated equipment is now being sold at fire-sale prices in the big discount stores. One New York chain advertises a "27 mc Radio-Phone by the most famous name in electronics" for only $39.88 per unit, about 60 per cent below list.

Actually, CBers who read the flyers from electronics distributors were exposed to these "bargains" many months ago. We have found no misrepresentation of the "famous name" but keep in mind why the units are being replaced by improved equipment. The disadvantage of older rigs is principally in receiver selectivity. The super-regenerative circuits just can't separate close-packed CB channels. Yet under the right conditions these marked-down transceivers are serviceable—on a farm, in a small town or other areas of sparse population and low interference.

Good Reading

Continued from page 77

the dedicated audiophile. And there are a few funny cartoons, too.

And make note of . . .

NEW SHORTCUTS TO TV SERVICING. By Leonard C. Lane. Gernsback. 160 pages. $3.20.

TRANSIENT CIRCUIT ANALYSIS. By Y.H. Ku. Van Nostrand. 441 pages. $13.

INDUSTRIAL TRANSISTOR AND SEMICONDUCTOR HANDBOOK. By Robert Tomer. Sams. 256 pages. $4.95.

ELECTRONIC EQUIPMENT DESIGN AND CONSTRUCTION. By Geoffrey W. A. Dummer, Cledo Brunetti and Low K. Lee. McGraw-Hill. 238 pages. $8.50.

THE RADIO HANDBOOK. Fifteenth Edition. Edited by William I. Orr. Editors and Engineers, Ltd., Summerland, Calif. 798 pages. $8.50. Current edition of a long-time favorite of hobbyists and engineers.

MOST-OFTEN-NEEDED 1962 TELEVISION SERVICING INFORMATION. By M. N. Beitman. Supreme. 192 pages. $3.

The Ham Shack

Continued from page 49

to the amplifier for reproduction. A simple RF filter in the grid circuit of the first AF tube cured the trouble.

—o—

Batten Down the Hatches . . . The hurricanes that swept along the East Coast late last summer taught several hams an expensive lesson: thin unbraced towers and floppy beams are poor investments.

Amateurs seem to regard antennas primarily as electrical structures—which of course they are—but if they are exposed they must be protected against big blows, too. Towers sometimes are advertised as self-supporting, but their life expectancy can be improved considerably if three or more guy wires are attached.

Military and commercial users of big dish antennas have licked the problem by enclosing them in radomes. It's only a matter of time before some ambitious ham adapts the idea to his own beam.

I often wonder why more hams who work on the high frequencies don't simply put beams for 6 and 2 meters and the other lower bands in their attics, eliminating all possibility of storm damage. The elements for a beam for the popular 144-mc band, for example, are only 19 inches long, so there is plenty of turning space in almost any attic. The usual roof of wood, building paper and shingles seems to have no effect on radiation.

—o—

Old Goat Speaks . . . Rube Riesland, W6HTN, who calls himself "The Old Goat of Del Mar" (California), has been in experimental radio for half a century, so he is entitled to voice a few ideas about the ham game. He says, "I would like to see a power limit of 100 watts, SSB on separate channels, more courtesy and less handling of useless traffic."

I've held a ham ticket 43 years, so I'll argue with him: 1) Power isn't the whole story in short-wave transmission. Often a station with only 50 watts sounds louder than one with a full gallon (1,000 watts). Let those who can afford it use the legal limit. It makes them feel important and is good for business. 2) Why on separate channels? If the phone bands are to be improved, the way to do it, in my opinion, is to eliminate conventional double sideband altogether and make SSB mandatory. This would double the usable width of our phone assignments. 3) How do you teach people courtesy? My treatment for bores: don't answer 'em. 4) "Useless" traffic handling is good practice for the real thing, such as a flood or tornado emergency.

These Generators Have NMP!

Continued from page 73

into electricity. In general, two hollow carbon electrodes are set in an electrolyte (potassium hydroxide). So far, the apparatus resembles an ordinary battery. But now hydrogen is introduced into one hollow electrode. In passing through the carbon to the electrolyte the hydrogen loses electrons—which flow into an outside circuit. What's left is hydrogen ions (hydroxyl) which move to the opposite electrode and combine with oxygen and the returning electrons to form water waste.

An amazing quality of fuel cells is their efficiency. The current goal is about 75% efficiency but a figure close to 100% is possible. In addition, a fuel cell theoretically would never wear out.

Large experimental cells to be used as auxiliary equipment in satellites are being built to produce 50 watts of power. On the other hand, another fuel cell designed for space use is only about as large as a wrist watch and turns out one watt. Units of various sizes have operated without incident for as much as two years.

If they're that great, why aren't they in everyday use? The answer lies in the ingredients, mainly the hydrogen and oxygen, which are expensive when compared to coal or oil. Many of the experiments now under way are testing new materials for fuel cells—porous nickel electrodes, plain air instead of oxygen,

Profiles in Electronic Engineering Technology

CREI

"a CREI home study program helped me become an electronics engineer"

—Robert T. Blanks

Engineer, Research & Study Division
Vitro Laboratories, Silver Spring, Md.
Division of Vitro Corporation of America

"THROUGH A CREI HOME STUDY PROGRAM I learned the practical theory and technology I needed to become a fully-qualified engineer—not a 'handbook' engineer, either—and I did it while I was on the job," says Robert T. Blanks. Today thousands of advanced electronics personnel—engineering technicians, engineers, administrators, executives — attribute their present high salaries and positions to their home study of CREI Programs in Electronic Engineering Technology.

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sodium amalgam, chlorine, bromine, etc.

The *MHD generator* (the letters stand for magnetohydrodynamics) probably represents the biggest threat to the conventional generator, being designed primarily for commercial electric power production.

The common generator consists of a conductor (wires) moving in a magnetic field. That induces a current in the conductor. The MHD generator is different only in that the conductor is a stream of gas that has been ionized (made conductive) by heat. (See THE MHD REVOLUTION, April '61 EI.) After the ionized gas picks up an electric charge by passing through a magnetic field, the charge is tapped off by electrodes. The result is direct-current power.

Theoretically, an MHD generator could be much more efficient than any turbo-generator. But, as usual, there is a flaw. The high temperatures involved would melt any ordinary material, so special compounds must be found. And these, naturally, are extremely expensive.

The Listener

Continued from page 34

border station time-buyer explained that the Mexican Government had done it as a "result of some very unwise and unethical attacks made by a radio preacher against other churches and ministers." There was little doubt about whom he meant.

In 1960 XERF got back on the air just before our presidential campaign and Gilbert became a busy distributor of anti-Catholic propaganda, along with two other XERF preachers, Eddie Oxendine (at one time heard on 150 U. S. and two European stations) and V. E. Howard, who now broadcasts on XEG (1050 kc) at Monterrey, Mexico.

In the Gilbert business XERF seems to be more than just a medium. The station actively promotes his religious "literature" and similar masterpieces of bigotry by its other preachers.

XERF's latest disappearance from the air ended in the middle of last fall. Returning with it was none other than Dan Gilbert, now conducting a program called Prisoner's Bible Hour. Will the station stay on the air? The answer to that question seems to be held by the Mexican Government, which apparently is keeping closer tabs now than in the days of XERA.

XERF is easy to pull in virtually anywhere in the U. S. after sunset, when American stations must clear the channel. Listeners near the Canadian border must wait until midnight when one of the "C" stations (CFOR, Orillia, Ont.; CFRY, Portage la Prairie, Manitoba; CHUB, Nanaimo, B. C.) signs off.

—o—

UN News . . . WRUL, only commercial international broadcaster operating from the U. S., provides complete coverage of United Nations debates. The broadcasts are beamed to Africa, Europe and Latin America but can be heard in many parts of the country at 1015 EST (11790, 15380 and 21460 kc), at 1500 (11790, 15385 and 17750 kc) and at 1715 (11855, 15390, 17750 and 17845 kc).

—o—

Katanga Again . . . Elizabethville in the Congo was broadcasting first-hand news in Belgian and English on 11875 kc during the UN military action in Katanga but got knocked off the air in the middle of the affair. While the station was on, signals came in fairly clear here, although they got pounded a bit now and then by Cuba's propaganda outlet.

—o—

Mum's the Word . . . Castro's newsmen have said nothing about consolidation of the island's radio facilities after the government took over all the more than 400 private stations. But consolidation there has been: Havana's CMCU on 660 kc (formerly Radio Garcia Serra) now is tied up with the CMQ net; CMCX at 1060, also Havana, is controlled by Radio Progreso Cadena Nacional but carries some programming from CMQ's key stations of CMBC (690) and COBC (9362). CMBS at 1090 (formerly Radio Capitol Artelejo) now serves merely as a relay for the big-brother twins, CMBC and COBC.

Happy listening!

Very Hot News . . . from **hallicrafters**

Two great new kits...a complete, high-performance AM/CW station, from the world's most experienced designers of short wave equipment

HT-40 TRANSMITTER, $79.95

A perfect match for the handsome SX-140, both in quality and appearance. Hallicrafters' transmitter leadership is evident in every precision-engineered feature of this crystal-controlled 75-watt beauty—features as important to old-timers as they are to novices.

- **FEATURES:** You get excellent CW performance as well as AM. Full band switching, 80 through 6 meters. Enjoy easy tune-up and crisp, clean styling that has efficient operation as well as appearance in mind. Unit is fully metered, TVI filtered.
- **SPECIFICATIONS:** Maximum D.C. power input: 75 watts. Power output in excess of 35 watts CW, 30 watts peak AM phone. (Slightly less on 6 meters.) Frequency bands: 80, 40, 20, 15, 10 and 6 meters.
- **TUBES AND FUNCTIONS:** 6DQ5 power output; 6CX8 crystal oscillator and driver; 12AX7 speech amplifier; 6DE7 modulator; silicon high voltage rectifiers.
- **FRONT PANEL:** Function (AC off, tune, standby, AM, CW); Band Selector (80, 40, 20, 15, 10, 6); Drive control; Plate tuning, plate loading, Crystal-V.F.O.; Grid Current; Meter; AC indicator light; RF output.
- **REAR CHASSIS:** Microphone gain; antenna co-ax connector; remote control terminals; AC power cord.

SX-140 RECEIVER, $94.95

Doesn't it make sense to team up your skill with the experience of a company who has designed and built more high-performance receivers than any other in the world? Especially when the result is the *lowest-priced amateur band receiver available?*

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- **CONTROLS:** Tuning; Antenna Trimmer; Cal. Reset; Function (AC off, standby, AM, CW-SSB); Band Selector; Cal. on/off; RF Gain; Auto. Noise Limiter on/off; Selectivity /BFO; Audio Gain; phone jack; S-meter Adj.
- **TUBES AND FUNCTIONS:** 6AZ8 tuned RF amplifier and crystal calibrator; 6U8 oscillator and mixer; 6BA6 1650 kc. IF amplifier and BFO; 6T8A 2nd detector, A.V.C., ANL and 1st audio; 6AW8A audio power amplifier and S-meter amplifier; (2) silicon high voltage rectifiers.

P.S. *Both units are available fully wired, and tested. SX-140, $109.95. HT-40, $99.95.*

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FEEDBACK

Continued from page 4

● ***Minority Report***

That stuff about working in California electronics (SHOULD YOU GO WEST?, November '61 EI) is a bunch of hooey. California just wants to lure you out here and then not pay you anything. They only want to build up the population. It's like the Gold Rush, only now you just find the state.

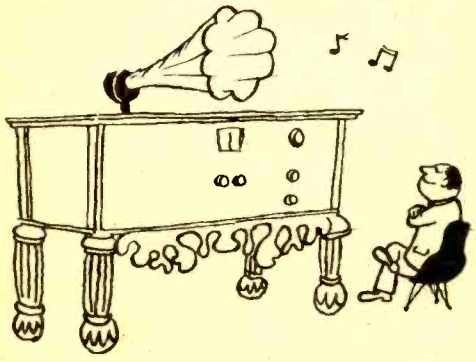
M. G.
Glendale, Calif.

● ***Fan Letter***

Since reading EI's articles on HOW TO REPAIR RADIOS by George Gordon I have successfully repaired six home radios for friends and myself, mostly just from the information given in Part IV. I think this type of article is a fine service to the public (May, '61 EI).

Anthony P. DaVinci
Chester, Pa.

● ***An Antique***



I wonder if any of your readers ever saw a Priess Straight Eight battery radio? I'd like to find out something about the date the sets were built because I have one in like-new condition.

The chassis is housed in a big chest with a piano-hinged top. There are eight tubes. Inside I found a letter dated Jan. 19, 1928, stating that the set had been repaired by a shop in New York.

Frank Selman
1401 North 8th St., Lebanon, Pa.

Can anyone help Mr. Selman out?

● ***Good old Days***

How reminiscent it was to read the letter by A. J. Cornelius in FEEDBACK regarding the Grebe radio.

The set was called the Grebe Syncrophase. First model was a breadboard and later ones were cabinet-enclosed. The TRF coils were twin-mounted.

The maker, A. H. Grebe, sponsored a program called Mr. Wu, a musical program saturated with Confucian philosophy. It was broadcast on his own station, WAHG, at Richmond Hill, N. Y. Then it became WABC, the Atlantic Broadcasting Co., and today it is known as WCBS, New York, the anchor station of the CBS network. Some growth!

I wonder what's happened to Grebe?

By the way, I was a tester for Grebe. The pay: 40¢ an hour.

H. E. Delheit
N. Plainfield, N. J.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946, AND JUNE 11, 1960 (74 STAT. 208), SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

ELECTRONICS ILLUSTRATED published bi-monthly at Greenwich, Conn., for October 1, 1961.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Fawcett Publications, Inc., Greenwich, Conn.; Editor, Bob Beason, Oradell, N. J.; Managing Editor, Larry Eisinger, Staten Island, N. Y.; Business Manager, Gordon Fawcett, Greenwich, Conn.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960, to be included in all statements regardless of frequency of issue.) 186,019.

GORDON FAWCETT,
Business Manager

Sworn to and subscribed before me this 30th day of September, 1961.

[Seal] LILLIAN M. KLEIN
(My commission expires April 1, 1963)

If you can't afford a Fisher tuner...

build one!

Introducing the newest Fisher StrataKit: the KM-60 FM-Stereo-Multiplex Wide-Band Tuner

Fisher FM tuners have always been reasonably priced considering their unsurpassed sensitivity and matchless overall design – but, even so, not everyone can afford them. If economics have thus far deterred you from buying the very finest, the new Fisher KM-60 StrataKit solves all your problems in exchange for a few evenings of entertaining and instructive work. It incorporates Fisher FM engineering at its most advanced, including built-in Multiplex and sophisticated wide-band circuitry–yet it costs almost one-third *less* than the nearest equivalent Fisher-built tuner.

This spectacular saving involves absolutely no risk, even if you are 'all thumbs.' The StrataKit method of kit construction has eliminated the difference between the expert technician ond a totally unskilled person as far as the *end result* is concerned. You assemble your StrataKit by easy, error-proof stages (strata), *each* stage corresponding to a *particular* page in the Instruction Manual and to a *separate* transparent packet of parts. Major components come already mounted on the chassis, and wires are pre-*cut* for every stage – which means every page! You can check your work stage-by-stage and page-by-page, before you proceed to the *next* stage. There can be no last-minute 'surprises' – success is automatic.

In the KM-60 StrataKit, the front-end and Multiplex circuits come pre-aligned. The other circuits are aligned by you after assembly. This is accomplished by means of the tuner's laboratory-type d'Arsonval signal-strength meter, which can be switched into each circuit *without soldering*.

The KM-60 is the world's most sensitive FM tuner kit, requiring only 0.6 microvolts for 20 db quieting! (IHFM-standard sensitivity is 1.8 microvolts.) Capture ratio is an unprecedented 2.5 db; signal-to-noise ratio 70 db. The famous Fisher 'Golden Cascode' RF stage, plus *four* IF stages and two limiters, must take most of the credit for this spectacular performance and far the superb rejection of all spurious signals. Distortion in the oudio circuits is virtually non-measurable.

An outstanding feature of the Multiplex section is the exclusive Stereo Beam, the Fisher invention that shows at a glance whether or not an FM station is broadcasting in stereo. It is in operation at all times and is completely independent of the tuning meter. Stereo reception can be improved under unfavorable conditians by means of the special, switchable subcarrier noise filter, which does not affect the audible frequency range.

Everything considered, the Fisher KM-60 StrataKit is very close to the finest FM tuner that money can buy and by far the finest you can build. Price $169.50.*

KX-200 80-watt stereo control amplifier StrataKit, $169.50.*

*Walnut or Mahogany cabinet, $24.95. Metal cabinet $15.95. Prices slightly higher in the Far West.

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Please send me without charge the complete Fisher StrataKit catalogue.

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EI313

Complete Ham Station

Continued from page 98

sumed in tracking down the parts. When it was finally turned on, it did work! The first contacts for the New York City area were to Tennessee and Florida, right through the heavy QRM of the 20-meter band. An excellent report was received from the Canal Zone on the 15-meter band. The antenna was a Mosley TA-33 Jr. beam. All audio quality reports were excellent, using a Geloso M-1110 Crystal microphone. Tune-up of the transmitter is easy. Only three controls must be adjusted for a maximum meter reading and you're on the air.—*Paul Hertzberg, K2DUX*

Hi-Fi Record Guide

Continued from page 62

More discs by this young pianist have been sold than by any other keyboard artist. Autumn Leaves was his first big hit and it heads this program of a dozen bits of tunefulness, schmaltz and rhythm.

Beethoven's Kreutzer Sonata inspired a sensational short novel by Tolstoy, and violinist Jascha Heifetz's performance indicates why. It is fiery and passionate, although Brooks Smith, the pianist who plays with him, is less a partner than an accompanist. More's the pity. A more assertive pianist could provide the balance to make this a great dual interpretation, as it should be. Coupled with the Kreutzer is Bach's Concerto for Two Violins, brilliantly played by Heifetz and his young protege, Erick Friedman, with the New Symphony Orchestra of London under Sir Malcolm Sargent.

More Beethoven, and probably his purest masterpiece, is performed by the Fine Arts Quartet. This is the String Quartet No. 14, in C Sharp Minor, Opus 131, an unparalleled creative distillation. The performance is refined and introspective, and admirably recorded.

Byron Janis has re-recorded Rachmaninoff's massive Third Piano Concerto, this time with the London Symphony Orchestra under Antal Dorati. This performance is more spontaneous than the one he recorded a few years ago with the Boston Symphony, and it is quite the best to be had in stereo. In mono, the Horowitz rendition remains supreme.

Riverside adds Kid Thomas and His Algiers Stompers to its New Orleans Living Legends. These jazz traditionalists who never left home play 11 numbers with fervor and Dixieland authenticity.

Records discussed in this column with monaural discs listed first and stereo versions just below:

Rimsky-Korsakov: Scheherazade	*Ansermet, Suisse Romande Orch.*	London	CM-9281 $4.98 CS-6212 5.98
Moussorgsky: Boris Godounoff Scenes	*London-Schippers*	Columbia	ML-5673 4.98 MS-6273 5.98
A Treasure Chest of American Folk Song	*Ed McCurdy*	Elektra	EKL-205 4.98 EKS-7205 5.95
Martha Schlamme at the Gate of Horn	*Martha Schlamme*	Vanguard	VRS-9091 4.98 (monaural only)
Brahms: Violin Concerto	*Milstein-Fistoulari*	Capitol	P-8560 4.98 SP-8560 5.98
A Chopin Collection	*Abram Chasins*	Kapp	KCL-9063 4.98 KC-9063-S 5.98
My Favorite Chopin	*Van Cliburn*	RCA Victor	LM-2576 4.98 LSC-2576 5.98
Greatest Hits	*Roger Williams*	Kapp	KL-1260 3.98 KS-3260 4.98
Beethoven: Kreutzer Sonata	*Heifetz-Smith*	RCA Victor	LM-2577 4.98 LSC-2577 5.98
Beethoven: Quartet No. 14, Op. 131	*Fine Arts Quartet*	Concert-Disc	CS-211 4.98 (stereo only)
Rachmaninoff: Piano Concerto No. 3	*Janis-Dorati*	Mercury	MG-50283 4.98 SR-90283 5.98
Kid Thomas and His Algiers Stompers	*Kid Thomas and Orch.*	Riverside	RLP-386 4.98 RLP-9386 5.98

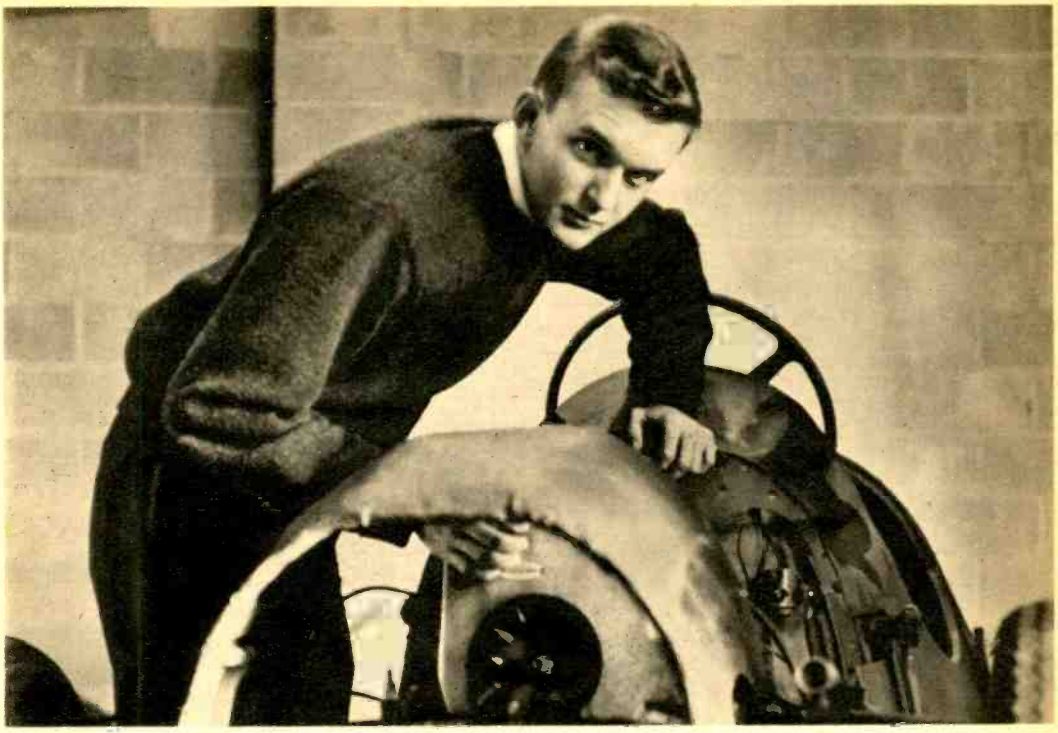
Antenna Duplexer

Continued from page 67

the PL-259 plug supplied with the M-52 antenna. Plug PL2 fits the antenna jack of your transceiver and PL1 plugs into the auto radio's antenna jack.

Each connecting cable from the Duplexer is made from RG-58A/U and should be about 24" long before trimming.

Choke L1 may not be available from all parts distributors. If necessary you can substitute the L1A/C1A combination for L1/C1 with equal results.



18-year-old Ronald Satterfield of Atlanta, Georgia, asked...

"Where should I build for the future?"

Ronald Satterfield answered this question last year by joining the Air Force. This year about 100,000 young men will also choose this highroad to the future.

Many will become expert technicians in such fields as airplane and missile maintenance, radar, communications. The future will find others in supervisory positions in important support specialties: administration, supply, air police work.

Numerous personal benefits go with service in the Air Force. Steady advancement, the opportunity for more education, medical and dental care, thirty days' vacation yearly. Most important, the Air Force can help a young man prepare himself for the age in which he will have to make his way—the Aerospace Age.

Could this be the place for you to build for the future? Use the coupon below. There's no obligation.

U.S. Air Force

Airman 2C Satterfield whose civilian hobby was building "hot rods," is presently enrolled in a 45-week electronic computer course at Keesler Air Force Base in Mississippi.

Career Information
Dept. ME32, Box 7608
Washington 4, D. C.

I am over 17 and a citizen (or resident) of the U.S.A. Please send me your illustrated booklet.

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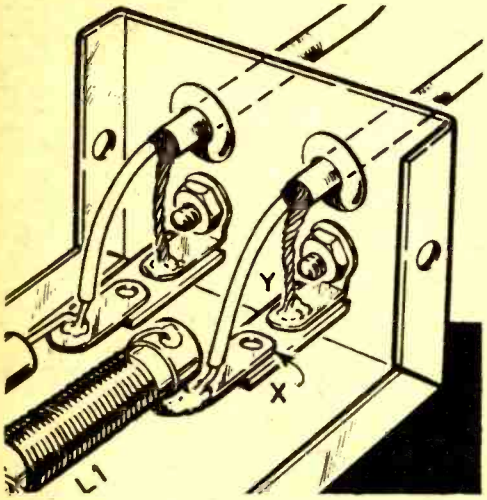
Address_____

City_____ **County**_____ **State**_____

Adjustment is made with an insulated alignment tool. Close C1 fully, and then back off the screw three-quarters of a turn. (C1's correct setting will occur at about one-half turn.) Temporarily connect the M-52 antenna *directly* to the transceiver and tune the transmitter for maximum power output.



Several methods may now be used to tune the Duplexer; if you have a grid dip oscillator, the Duplexer can be adjusted before it is installed. Using a *short* length of bare wire, short out jack J1 to the nearest ground point. Also solder a short jumper between points X and Y in the pictorial. With the GDO set to 27.1 mc adjust C1 for resonance; remove the shorting wires and install the Duplexer in the antenna feedline.

The preferred method of tuning uses a standing wave ratio meter which permits you to peak the Duplexer for use on your favorite channel. Install the SWR meter between the CB transceiver and the Duplexer. Adjust C1 for minimum SWR. The SWR meter technique will insure a negligible power loss in the Duplexer.

If no test equipment is available, install the Duplexer in the antenna feedline (do not plug in PL1) and adjust C1 for maximum field strength.

Regardless of which method of adjustment you use, retune the transmitter after adjusting C1. Transmitter tune-up and adjustment of C1 should be performed at least three times to insure maximum efficiency.

Finally, plug PL1 into the auto radio's antenna jack. In all probability, the BC radio signal will be low. Tune in a weak station at about 1400 kc and peak the radio's antenna trimmer (this is always an external adjustment, usually near the antenna jack) for maximum signal.

The Duplexer's Theory of operation is quite simple. The L1, C1 combination is series resonant at 27 mc and therefore presents a low-impedance path between antenna jack J1 and the CB transceiver via PL2. L2, on the other hand, appears as a high impedance to a 27 mc signal and prevents the signal from reaching the auto radio.

At broadcast frequencies, L2 appears as a low impedance and passes the BC signal into the radio. C1 appears as a high impedance to the BC signal, thereby preventing the transceiver input coil from short-circuiting the BC signal.

Filters and Cabinet

Continued from page 46

List and Fig. 4). Capacitors C13 and C14 remain unchanged. (5) Assemble the components (except C15, C16, C17, C18) on the two 5-lug filter strips as shown in Fig. 5. Note that the center lug of each strip is grounded. (6) Mount the two filter terminal strips with 6-32 hardware. One strip (we will call it A) is installed approximately under C19; the other is installed approximately where C17 is located (see pictorial, Jan. EI). (7) Now wire in the two strips as per Fig. 5. Connect the free end of C18 to the filter strip A located under C19. Connect C17 to the other strip. (8) Connect the previously installed red lead from one matrix strip to the A filter strip where C18 and R1A meet. At this same lug connect one lead of the new capacitor C16.

Connect the previously installed black lead from the other matrix strip to the junction of C1, R1 on the filter strip installed adjacent to C17. Connect C15 to the same lug. (9) The free ends of C15 and C16 are connected to Noise Filter switch S1 as shown in Fig. 5. S1's other two terminals connected to the nearest ground point.

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How We Talk To The Astronauts

Continued from page 54

be converted quickly to send Morse code, if needed.

Two radar systems are used, one a long-range tracking type and the other a medium-range precision set-up. The two frequencies are in the S band (29.1 mc) and the C band (5555 mc). Mounted in the capsule are two radar beacons or transponders. When radar tracking pulses reach the space vehicle the transponders fire off pulses of their own to reinforce the echoed signal, making a fatter and more recognizable blip on the operator's scope.

Finally, there are two Mercury rescue beacons. One is a "Sea Save" rig transmitting a continous-wave signal on 8.364 mc, and the second is a UHF device operating on 243 mc. Should these be knocked out, the regular UHF voice gear can be converted to an automatic beacon with the flip of a switch.

On the ground end of all these signals are 18 tracking stations (including four command stations) that make a 60,000-mile circle around the earth from Florida over the Atlantic to Africa and Australia and back across the Pacific. Linking the stations is a massive net of wireless and cable circuits for teletype, telephone and data transmission.

In a 50x60-foot room at Cape Canaveral is the control center for the operation, where the decisions are made. In it is a big map-like chart showing the position of the capsule and all sorts of instrument displays and status boards giving readings on some 100 quantities. Surprisingly, the control center is not hooked directly into the tracking network. Data from the trackers flow to a huge computer installation at Goddard Space Flight Center in Maryland, just outside Washington. The millions of figures are digested here by the electronic brains and the distillation is then funneled on to the control center.

An incredible amount of work has gone into the Mercury communications system. But the goal is a lofty one. For man, this is the Great Adventure of our time.

Marketplace

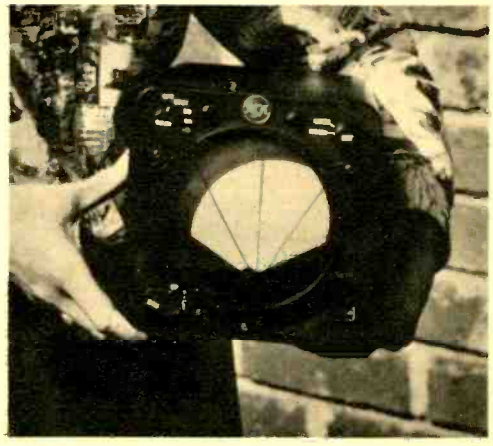
Continued from page 23

Pretty Familiar . . . is a tube tester that can't accommodate the great flood of new tubes with varying types of bases. Something new to solve the problem is Mercury's Model AD-4 tube tester

adaptor which will make most tube testers up to date and able to handle the new 12-pin, 10-pin, Nuvistor and Novar tubes. About $11. Mercury Electronics Corp., 111 Roosevelt Ave., Mineola, N.Y.

—o—

Reduced Radar . . . "Lightest airborne weather radar ever built" is what RCA engineers call their new Model AVQ-55 X-band system. It weighs only 40



pounds, has a range of 90 miles, and is a boon to small planes where space, weight and electric power are at a premium.

Marketplace

Low Cost Scope . . . Light and compact and using a three-inch cathode ray tube instead of a five-incher, the new Heath Model IO-21 is excellent for school labs, home workshop or ham shack. The unit

is especially useful as a modulation indicator among other abilities. It features a neck shield to ward off effects of stray magnetic fields. Kit is $50. Heath Company, Benton Harbor, Michigan.

—o—

Four-Band Receiver . . . The new Lafayette HE-40 communications receiver is a lot for $54.50. Here's what you get: four bands from AM broadcast through 30 megacycles, superhet circuit, noise limiter, electrical bandspread, S-meter,

built-in speaker and two antennas. The unit is fine equipment for beginner hams or short-wave listeners. Lafayette Radio, Syosset, New York. (PS—This set came out too late for inclusion in EI's SWL Equipment Roundup in our last issue.)

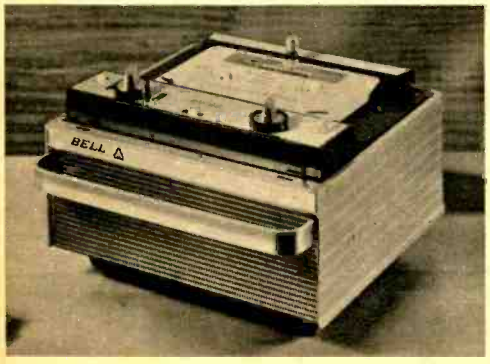
Marketplace

Everybody's Doing It . . . Tape cartridges, dozing peacefully for several months in the backwaters of the hi-fi market, have been given a big shot of vitamins in the form of new promotions by RCA and the Bell Sound division of Thompson Ramo Wooldridge, Inc.

RCA introduced three new recorders to play the magazine-loading cartridge that they have been making for several

years but which has never really caught on with hi-fi fans. The recorders range in price from $99.95 to a $169.95 stereo unit (the top photo shows the cheapest model).

Meanwhile, Bell Sound (Columbus, Ohio) also has brought out three new models of tape cartridge recorders to sell for $139.95 to just under $200 (for a stereo machine). All these units are de-

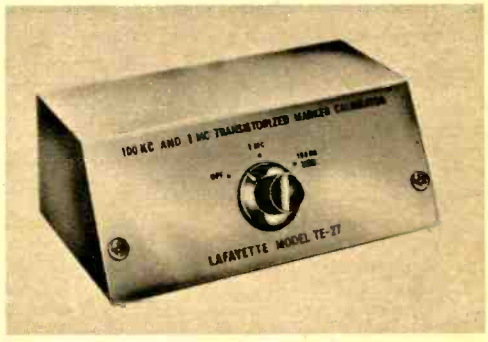


signed to handle the RCA cartridge. The lower photo shows the lowest-priced model.

A good many hi-fi addicts have been wondering whatever happened to a stereophonic tape cartridge announced with much fanfare back in 1960 by CBS Laboratories and the Minnesota Mining & Manufacturing Co. The CBS/3-M system featured small sealed cartridges, long playing time and could be changed automatically by the recorder. After a burst of publicity, however, the little fellows dropped out of sight. The 3-M people now say the revolutionary tape cartridges probably will hit the market in 1962 after solution of . . . ahem . . . some problems.

—o—

Beep, Beep . . . A two-in-one crystal calibrator introduced by Lafayette gives you your choice of marker signals every 1 mc or every 100 kc up to 54 mc.



The battery-powered instrument is handy when you're marking band edges or calibrating and aligning receivers. $18.95. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

—o—

Goodbye to Tubes . . . A 50-watt all-transistor stereo amplifier has been

added to Allied Radio's line of Knight-Kits, reflecting the big switch from tubes to transistors in the hi-fi field. The

Marketplace

Knight-Kit KX-60 has 20 transistors and four diodes, weighs just eight pounds and measures 2¾x11x9¼ inches. Among the claims for the KX-60 are minute hums, noise, microphonics and warm-up period. Harmonic distortion is put at 1.0% at full output. Kit is $79.95, plus $4.95 for a metal case, $12.45 for a wooden one. Allied Radio, Chicago 80, Ill.

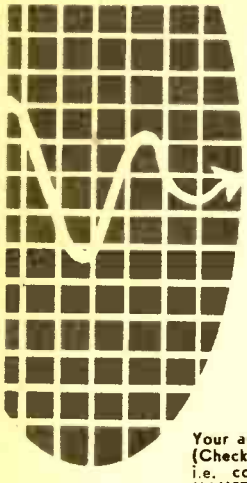
—o—

Be a Good Neighbor . . . Most TV and FM receivers also are transmitters (because of their local oscillator circuits) and if they aren't shielded and filtered they can raise the devil with nearby sets. The FCC recognized this problem and since 1957 has required labels on all sets stating that anti-radiation steps have been taken. Some manufacturers are dumping unprotected sets on the market, however, and in crowded areas, these are causing enough trouble to bring FCC engineers out to investigate. The owner of an unlabeled receiver not only stands the chance of being unpopular with his neighbors, but also invites legal action. Make sure the set you buy carries such a label.

—o—

More Transistors . . . The Cadre 500 is a transistorized Citizens Band transceiver intended primarily for mobile use. Squelch and an automatic noise limiter are features of the five-watter,

which measures 12x3x6 inches and weighs less than six pounds. It has five receiving and five transmitting channels and covers all 23 CB channels. $199.95. Cadre Industries, Endicott, N. Y.



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Your advertisement can reach this mail-buying audience for only 50¢ per word . . . payable in advance (Check or M.O. please) . . . minimum 10 words. Closing dates are the 20th of 4th preceding month i.e. copy for the July issue must be in our office by March 20th. Mail to ELECTRONICS ILLUSTRATED, 67 West 44th St., New York 36, N. Y. Word count: Zone number free. Figure one word: Name of state (New Jersey), name of city (New York); sets of characters as in key (14-D); also abbreviations as 35MM, 8x10, D.C., A.C.

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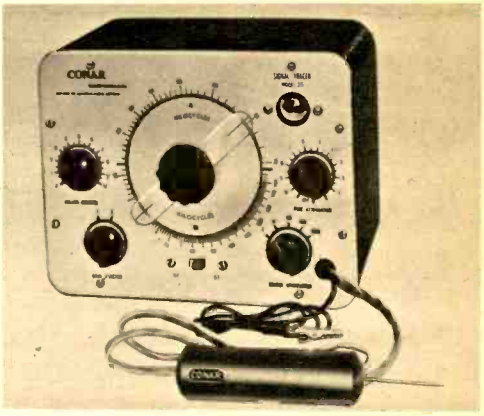
Marketplace

New Names . . . Two brand names have appeared in the electronic hobbyist kit field, Daystrom and Conar.

Daystrom—the name of the parent company which owns Heathkit—now is marketing a line of hi-fi kits out of St. Joseph, Mich., under the Daystrom

name. Included are stereo and mono amplifiers (we show a 20-watt stereo unit), AM-FM and FM tuners, a multiplex adaptor, a record changer and a speaker system.

Conar is the brand name given to a line of electronic kits being marketed nationally by the famed National Radio Institute, Washington 16, D. C. NRI



has been selling kits to its students and graduates since 1918 but it now has decided to sell to the public. First instruments out are a tuned signal tracer (shown), a TV kit and a VTVM. NRI is planning to add CB and ham kits.

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The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

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

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

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

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 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 complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are twenty 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 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for 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.

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

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

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

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

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

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

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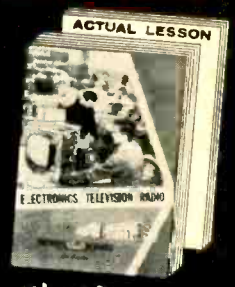

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