WHAT IS ELECTRICITY?

$100 CASH FOR THE BEST ANSWERS! See page 35

ELECTRONICS ILLUSTRATED

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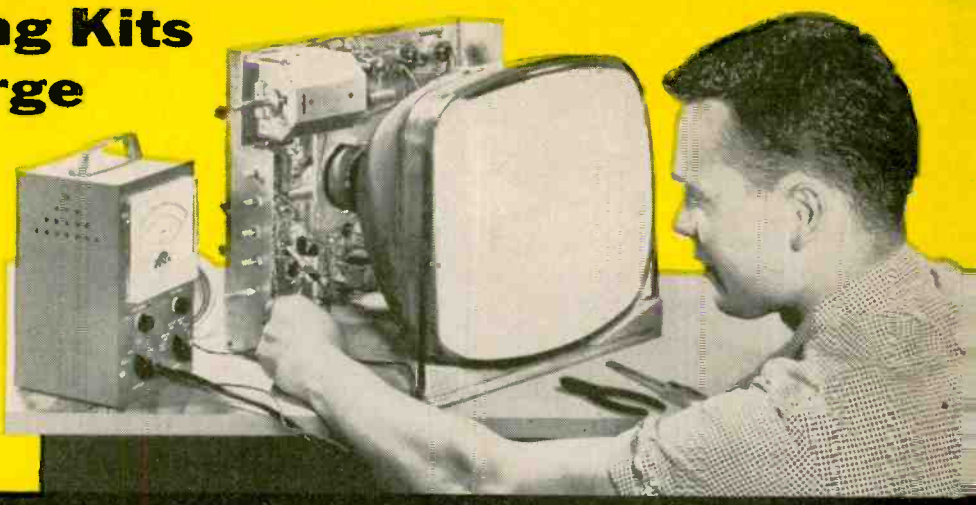

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ELECTRONICS ILLUSTRATED

July, 1961 Vol. 4, No. 6

A Fawcett Publication

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Has shop in basement—gets "more and more work all along"

"I HAD PRACTICALLY no knowledge of any kind of repair work. One day I saw the ad of NRI in a magazine and thought it would be a good way to make money in my spare time. Now I am busy almost all my spare time and my day off—and have more and more repair work coming in all along. I have my shop in the basement of my home."

—JOHN D. PETTIS,
172 N. Fulton, Bradley, Illinois

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CHECK the advantages of NRI training in Servicing Electrical Appliances

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- ☐ **NO ELABORATE EQUIPMENT NEEDED** — just simple hand tools, and Appliance Tester which we provide at no extra charge.
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- ☐ **NO NEED TO RISK YOUR SAVINGS.** Many businesses require a sizable investment. But here you can build up a following of customers *first*, then open a full-time shop if you wish to.
- ☐ **EARN $3 TO $5 PER HOUR.** Fixing appliances is a high-paying skill because the demand for trained men is so great.
- ☐ **ENJOY SEMI-RETIREMENT ON A GOOD INCOME.** When you're ready to retire, you can devote a few hours a day to this work. Live and work anywhere you please.
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IF YOU'RE like so many men today, you've been "hankering" to start "a little home business of your own." In spare time at first, then maybe full-time later on. Something you'd enjoy – and that pays well. Something that fills an existing need in your neighborhood or town – that "sells itself," without any high pressure arguments – that doesn't take a big investment or elaborate equipment.

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Your Skill Always in Demand —"Set Up Shop" Anywhere

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Your training costs less than 20¢ a day. And you need only the few basic tools you may already have – and an Appliance Tester which we provide at no extra charge. You can work anywhere–in a corner of your basement or garage, even on the kitchen table. If you like, you can open up your own shop, have others work for you. And you can save money by fixing your own appliances.

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FEEDBACK From Our Readers

● *Mystic Cult?*

Why does the electronics industry insist on holding to a mystic level? Why does it insist on using jargon that is beyond sensibility?

I believe electronics would be easier taught and understood if the mysteries were dropped and more accurate words were used. Blocking capacitor, filter condenser are confusing.

Let's name the parts for what they are and leave it like that.

Henry Boyce
San Leandro, Calif.

You've got a good idea, Hank. A simpler language of electronics would be a blessing. Unfortunately, electronics has become an extremely complicated subject and the language merely reflects this fact. Simplifying that language is going to be a little difficult. Any volunteers?

● *Hot Plans?*

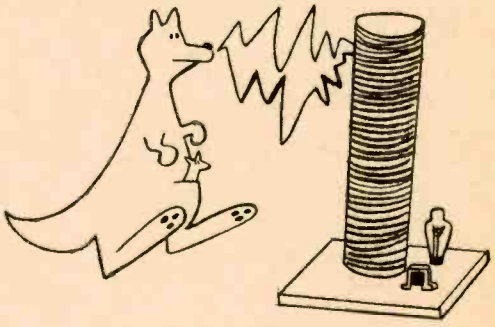
In reference to your article in the January EI about a plasma torch, I would appreciate any information on construction that you can supply. I would like to use the plasma torch in a high school science fair.

Could this equipment cause a complaint from the FCC?

D.B.
Memphis, Tenn.

The FCC might not complain, but the fire department probably wouldn't be too happy. Plasma torches involve temperatures a little higher than those generated by Bunsen burners (like several thousand degrees). They're just not for amateurs. An A-bomb might be safer.

● *Electrifying Development*



I have become interested in the work of Nikola Tesla ever since reading an article on his high-voltage coil in your fine publication (October '59 EI).

Since then I have constructed three progressively larger coils, the last having six-foot windings and nearly 5,000 turns. It discharges a beautiful 22-inch spark.

One receives the most unpleasant feeling when moving about as everything in the room throws a lusty spark when approached. A fluorescent tube held in the hand lights up at 30 feet.

W. R. Harris
Christchurch,
New Zealand

● *Osteopathic Objection*

Members of the American Osteopathic Association have asked us to write you regarding a reference in the

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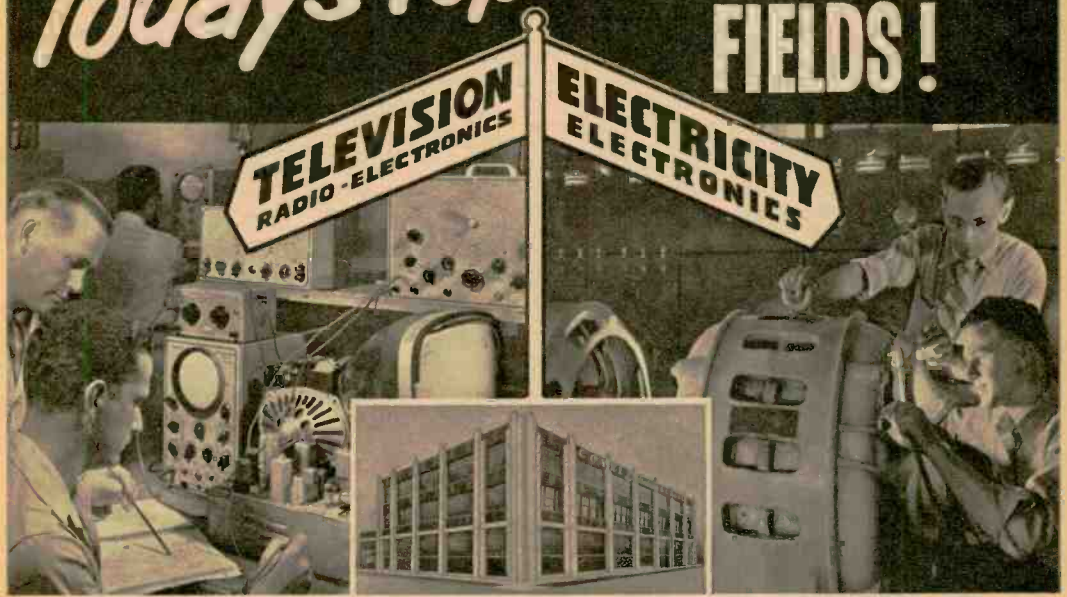

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FEEDBACK

September '60 EI to "100 assorted chiropractors, osteopaths, naturopaths and auto mechanics."

This type of reference is not only derogatory and harmful to the osteopathic profession but also conveys the author's ignorance of the professional status and training of osteopathic physicians and surgeons. You . . . may not be fully aware of the complete service which osteopathic physicians and surgeons are rendering to 11 million patients in America.

L. E. Heffel
American Osteopathic Association
Chicago, Ill.

Our apologies to the osteopathic physicians and surgeons, and also to the chiropractors, naturopaths and auto mechanics. We seem to have assembled the wrong crowd.

● *Crystal Clear*

As a subscriber to EI I am very pleased because in the January issue I found the answer to my prayers, plans for a Theremin. I built this item and to my amazement nothing happened. The article states that those who build them usually can't play them and vice versa, so it's pretty obvious that I'm musically inclined. Here is what I did that the author didn't:

I used a Halldorsen coil in place of the Miller coil. Article also said that the crystal may be surplus so I omitted it.

B.D.
Springville, Utah

The word you're thinking of in connection with that crystal must be superfluous, *which is exactly what the crystal is not. By* surplus, *we meant it may be obtained on the surplus market. Without it, the Theremin operates like a boat without a bottom. Also, this circuit is designed to use the Miller coil. If you want to use the Halldorsen, you'll have to redesign the whole thing.*

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- ☐ Business Management
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- ☐ Purchasing Agent
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FEEDBACK

● *Useful Experiment*

We are interested in the experimental program performed by your magazine on playback life of stereo records (November '59 EI) . . .

We have been planning a continuation of this study and your work will be a useful guide to us.

M. M. Lemcoe
Southwest Research Institute
San Antonio, Tex.

● *VOM Facts*

Some place I read that a VOM should be 20,000 ohms per volt. What does this mean? Does it make for easier reading on the dial, or what? So many VOM's are 5,000 or 10,000 ohms/volt. Then another costs the same as the 20,000 ohms/volt instrument but does not say anything about this. What is the answer?

Gerald Leonardy
Pascagoula, Miss.

A detailed answer to that one, Jerry, could fill up several pages. Suffice it to say that a 20,000 ohms/volt instrument is more sensitive and doesn't load down the circuit under test. It is therefore usually more accurate than VOM's rated at 1000 ohms/volt. And the rating should be listed on the instrument.

● *Rx for EI*

Continued articles inevitably end on opposite sides of the same page . . . and wonderful graphs and charts are presented back-to-back. Concluding articles separately might initially increase publication costs but (would lead to) greater circulation.

It would be a boon to subscribe to a periodical that broke a new issue at mid-month. Traditionally, we are all overwhelmed with new literature at the first of the month—and parched for three weeks thereafter.

Julius M. Tesi, M.D.
Yorkville, Ohio

Thanks for your comments. EI always attempts to end its construction articles

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35 DU 767. *Only $5 Down.* NET **$74.50**

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FEEDBACK

in the front of the magazine so the written instructions are as close as possible to the schematics, pictorial drawings and Parts Lists. This is not always possible, of course. As for our publication date, it is in mid-month. EI is that little oasis in the middle of a big desert.

● *Lost Art?*

What has happened to radios? Years ago a fair set could reach out and bring in stations all over the country. Now you are lucky if you can pick up a station in the next county.

A short time after radio came out in 1920 I purchased a set by the name of Grebe that at the time was very good. With this set I could pick up Havana and California from this city nearly all the time. What is wrong with radios today?

A. J. Cornelius
Pittsburgh, Pa.

Some pretty wonderful things have happened to radio in the last four decades, Mr. Cornelius. And broadcast-band DXing can be more exciting than ever before. In the old days the average station's power was 500 watts. Today it is close to 50,000 watts. Along with the increased power has come an incredible increase in the number of stations. All this has led to problems. Strong signals are in the air, to be sure, but to receive them you need a good outside antenna and a selective receiver hooked to it. With so many stations crowding the band your set must have selectivity to separate one signal from the others.

● *All a Matter of al*

I read your article in the March '61 issue titled UNDERGROUND RADIO IS NEWS AGAIN! Your reference to Development Engineering Corp. as a contributor to sub-surface communications experiments appears in error. This work is being conducted by Developmental Engineering Corp.

Charles E. Weller
Developmental Engineering Corp.
Washington, D. C.

Sorry, Charlie. It was an accidental.

● *Bright Point*

I have discovered something that may be of assistance to someone else. In tuning up my transmitter with a dummy load lamp (see A SHIELDED DUMMY LOAD, March '61 EI), I found that I couldn't be exactly sure of the best setting since the lamp glows brightly over a wide setting of the tank-coil. So I began using a photographic light meter, setting it on the most sensitive scale and placing it at a distance from the lamp that gives about half-scale readings. It works very well because reading the meter's dial is easier than trying to judge the brilliance of the lamp with the naked eye.

Frank Gilman, 1W6473
Mars Hill, Me.

Thanks for the tip.

● *Oooops!*

In your article TUNE YOUR ANTENNA (February '61 EI) you say that if coaxial cable is chosen for the input line, the connector J1 may be omitted. Since J1 *is* the coax connector wouldn't TP1 be omitted instead?

The parts list calls for a Minibox CU-3008A, which is 7x5x3 inches. The coil, Illumitronic 1610T is ten inches long, however. How can a ten-inch coil fit in a seven-inch box? I think the correct box number is CU-3011. This box is 12x7x4.

Jeremy Clark, KN1QHA
Pomfret, Conn.

You're right. Thanks for writing.

IMPORTANT NOTICE TO SUBSCRIBERS

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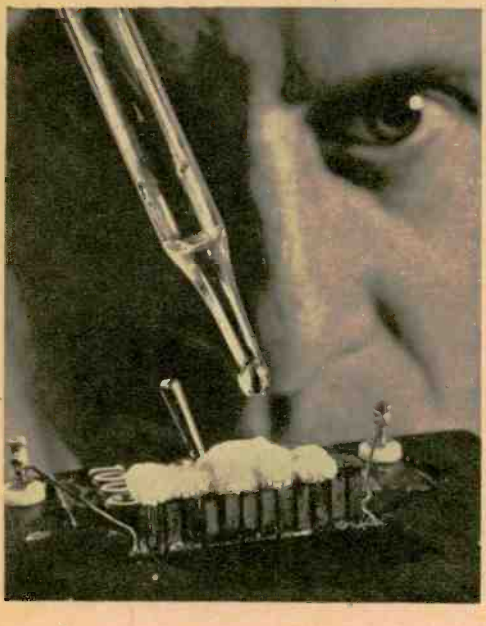
...electronics in the news



Cold Spot . . . A low-drain thermoelectric device which can freeze or boil a drop of water on the power of two flashlight batteries has been developed by Hughes Aircraft Co. The photo shows a scientist dropping water on the apparatus, about the size of a paper clip. It either heats or cools, depending on which way current is passed through it.

The principles of thermoelectricity have been around for more than 100 years but until now large amounts of current were required. The Hughes device reduces those requirements by 90 per cent. Chief of the Hughes contributions was a new technique for fabricating the two required semi-conductor materials.

The device could lead to a refrigerator with no moving parts but its real use probably will come later in temperature control inside spaceships.

—o—

Maser Milestones . . . Two developments in the light maser (or laser) are depicted in the photos below (see LIGHT-AMPLIFIER BREAKTHROUGH, January '61 EI). At right a scientist holds a continuously-operating optical gas maser announced by Bell Laboratories and at left is an operating light-beam radar employing a solid-state laser.

The Bell device, which operates on less power than a light bulb, is a tube containing neon and helium gases. The gases, highly excited, work together to produce a thin beam of coherent infrared light, capable of carrying a staggering number of telephone calls and television programs.

The Hughes Colidar (for Coherent Light Detection and Ranging) also emits a thin beam of light (the laser is in the circular transmitter at the top). The beam's

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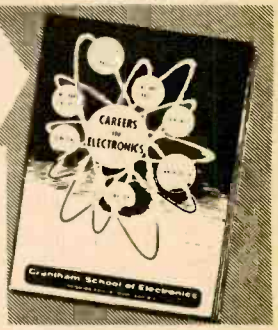

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reflection or echo from a distant object is then collected by the telescope, which appears as the large round circle at the bottom of the photo, and is fed to detection equipment. The operator is given a distance reading and other data. The beam of light—wavelength is 6,943 angstoms—intersects only about half a degree as it comes from the laser. When fed through a lens system, the beamwidth is reduced to .0189 degree. Radio-frequency radar covers 2 degrees.

—o—

Talking Gun . . . An infrared beam, invisible to the naked eye, is the ammunition shot out of a strange new gun produced by Minneapolis-Honeywell (see photo). The gun is capable of transmitting a modulated infrared beam for full-voice communication. A similar gun aimed at the transmitting unit detects the beam, recovers the modulation and converts it back to sound, making possible two-way communications which are extremely hard to detect or jam.

The shape of these infrared transceivers was dictated by the need for extremely accurate aiming by the users. The guns are designed for use by police, firemen, in industrial security work and in some military applications where maximum secrecy is necessary. Hand-held guns have a range of about three miles and larger units 20 miles.

The M-H devices mark the beginning of commercial infrared communications. Most previous IR devices of this type have been purely experimental or toys.

Signals From Space

THE IONOSPHERE, which is so important to long-range radio communications, is in for a fairly thorough examination by the Ionosphere Beacon Satellite S-45, built for launching by the National Aeronautics and Space Administration.

Besides its scientific goals, the S-45 has a special interest for short-wave listeners since it transmits low-power signals on six frequencies (see our story on DXing satellites in this issue). One S-45 was launched some time ago and apparently went into orbit. However, its transmitting equipment did not operate. NASA has indicated it will keep trying until it has a successful one in orbit.

Little actually is known about the ionosphere, the ionized layer at the top of the earth's atmosphere, from 50 to several hundred miles up. The S-45 will enable scientists to study its hills and valleys, orbiting from 240 miles (perigee) to 1,600 miles (apogee) above the earth.

The 74-pound satellite looks something like two salad bowls cemented together rim-to-rim. Standing out from its circumference is a six-foot loop antenna. Only one transmitter, containing a crystal with a basic frequency of 1.00025 mc, is in the S-45. Its six transmitted frequencies will be harmonics. The frequencies are 20.005 mc, 40.01 mc, 41.01025 mc, 108.027 mc, 360.09 mc and 960.240 mc. Radiated power will range from 10 milliwatts at the highest frequency to 106 mw at 20.005 mc.

The launching vehicle is a Juno II rocket, a three-stage monster weighing in at 60 tons. Cape Canaveral is the launching site.

Several universities and other groups in the United States and New Zealand will monitor the signals and analyze them by various methods, such as change in polarization and Doppler shift. However, it has been made clear that the S-45's signals also are for the intended use of anyone in the world who has an interest in the ionosphere.

When in orbit, the satellite will be given an Explorer name.

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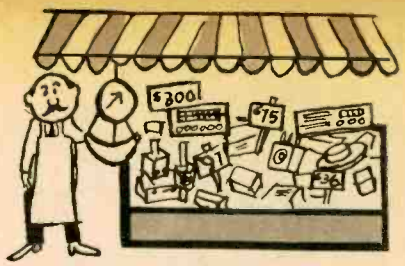

Electronic Marketplace

LOW-PRICE OSCILLOSCOPE . . . About the size of a telephone directory and priced around $70, the new Waterman Primer-Scope Mark 1 is a buy for student-experimenters, hams, electronics servicemen and light industrial users. It is designed specifically for beginners, as well as for professional workers who don't require the advanced type of scope.

The Primer-Scope weighs less than six pounds, is 7¼ inches high, 3½ inches wide and 11¼ inches long. It has a three-inch tube with an integral magnetic shield. Accompanying the instrument is a 75-page instruction book on basic scope technique.

Waterman Products Co., Inc., Philadelphia 25, Pa.

—o—

CB Antenna . . . A new beam antenna for Citizens Band service has been put on the market by the Cubex Co. Cubex claims the Cubical Quad beam offers high performance for both transmitting and receiving, gain up to 10 db, high front-to-back ratio, light weight and

Accredited by the National Home Study Council

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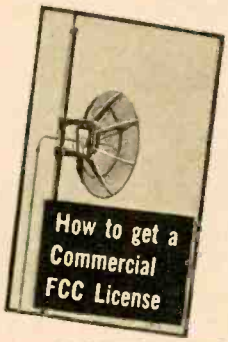

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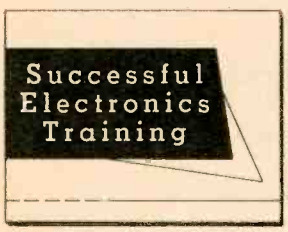

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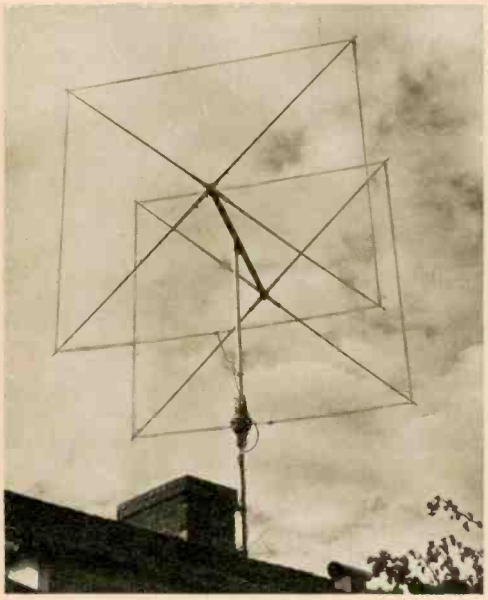
EI-33

Marketplace

small size. The standard CBQ with bamboo radial arms lists for $39.50 and a



deluxe model with fiberglass arms is priced at $64.50.

Cubex is at 3322 Tonia Ave., Altadena, Calif.

—o—

Meter Magic . . . As you turn the range switch of a new VOM called V O Matic 360, the correct scale clicks into view on the face. All 18 scales are direct-reading and do not require multiplica-

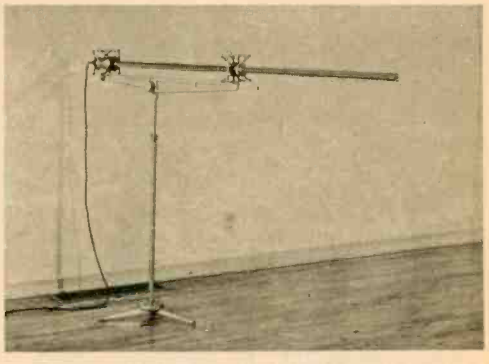
Marketplace

tion or other interpretation. A knife-edge pointer against a mirrored background makes possible precise readings on current, voltage and resistance. The meter movement is protected against burnout and has a rating of 20,000 ohms per volt DC and 5,000 ohms/volt on AC. The ohms-adjust control includes a switch that automatically short-circuits the test leads for zero adjustment. Another built-in convenience is a polarity reversing switch. Price is about $60.

B&K Manufacturing Co., 1801 W. Belle Plain Ave., Chicago 13, Ill.

—o—

What Is It? . . . That's the first question people ask when they catch a glimpse of a new Electro-Voice microphone. Some guess it's an air-cooled gun. The mike is listed as the Model 644 Sound Spot, its chief characteristic being extremely sharp directivity. It has to be aimed pretty much like a gun at the sound to be picked up.

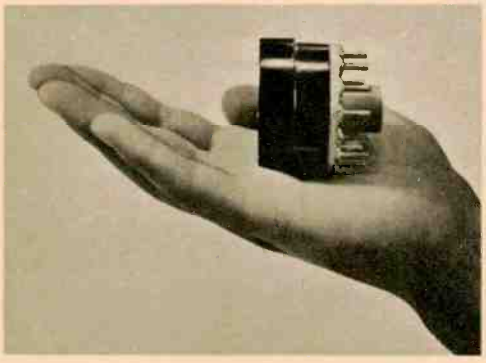


The Sound Spot permits great latitude in loudspeaker placement in public address systems, where feedback from loudspeakers often limits the usefulness of an installation. It solves some specialized recording problems, and professional eavesdroppers also may find it of interest since they have used shotgun mikes for years (although the trend now is toward small pickups placed close to the subject). Price of the Sound Spot is about $110.

Electro-Voice, Inc., Buchanan, Mich.

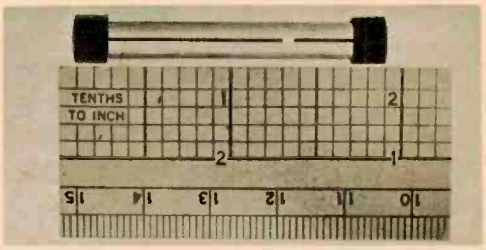
Marketplace

Little Booster . . . A pre-amplifier that fits inside the standard 14-pin base of an image orthicon TV tube has been developed by the Dage Division of Thompson Ramo Woolridge, Inc., Michigan City, Ind. Because the connecting leads



to the tube are less than an inch long, stray pick-up of unwanted video signals is greatly reduced. The transistorized amplifier is potted into the tube base.

Electro-Chemical Meter . . . A unique direct-reading ampere-hour meter, operating on electro-chemical rather than conventional electro-mechanical principles, has been developed by Curtis Instruments, Inc., Mount Kisco, N. Y. The meter is a glass tube two inches long



and a quarter of an inch in diameter. At first glance it looks like a burned-out fuse. When subjected to direct current, it undergoes chemical changes that cause the gap between the end caps to shift position. It is a simple matter to calibrate the device on the basis of current flow vs. elapsed time. The operation is reversible according to polarity,

Marketplace

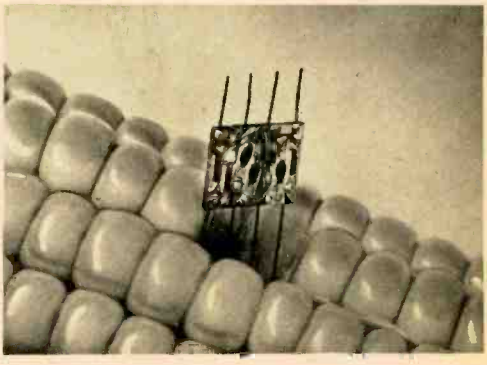
giving a convenient reset feature.

The meter works on any DC voltage and requires only a series resistor to adjust the operating current to the desired time range. For normal applications the current is less than 100 microamperes and, therefore, imposes no appreciable drain on the power supply. The instrument is ideal as a battery life indicator or warning signal for such portable instruments as radios, tape recorders, hearing aids, medical devices and radiation detectors.

—o—

Kernel Comparison . . . American electronics manufacturers are showing the Japanese that they, too, can make sub-sub-miniature equipment. A new development in this direction is Micram, defined as "microminiature individual components reliable assembled modules" (the Japanese might be able to beat that, English-wise).

The photo shows a sample flip-flop



oscillator stuck into an ear of corn for size comparison.

Micram is a joint effort of seven companies: Cleveland Metal Specialties, Wilrite Products, Aerovox, Formica, Pacific Semi-Conductors, Raytheon and Sylvania.

The makers stress that these assemblies offer high reliability under adverse conditions, such as those encountered by space vehicles.

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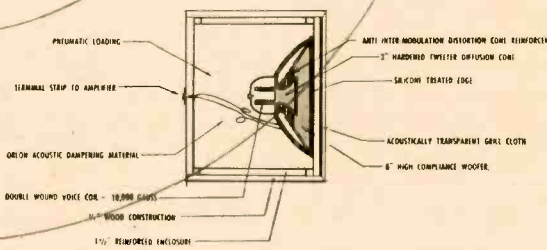

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Marketplace

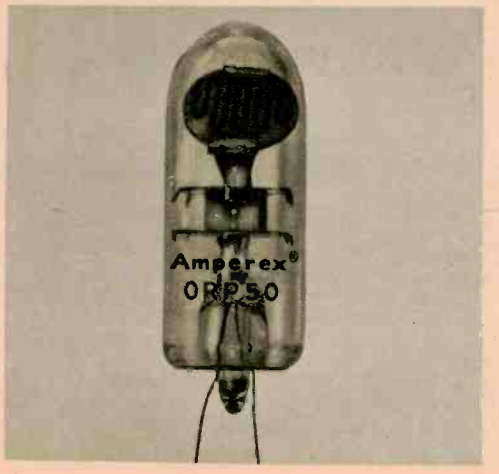
Tools for Beginners . . . Planning to give an electronic kit to a youngster just getting interested in radio, hi-fi and model control? A smart idea is to include a kit of basic tools, such as the Paco TK-6. This includes long-nose and

side-cutter pliers, wire stripper, two screwdrivers and soldering iron in a see-through case. Price is about $10.

Paco Electronics Co., Inc., Glendale 27, N. Y.

—o—

Alarming Development . . . A thumb-size light-sensitive cadmium sulphide cell that is sensitive both on the top and sides is announced by the Amperex Electronic Corp., Hicksville, N. Y. Called the ORP50, it is hermetically sealed and of strong construction. It can be used for such purposes as flame and fire warning, on-off switching by interrupted light beams, automatic counting and density control.



The ORP50 is about ⅝-inch in diameter and 1½ inches long.

—o—

TV-FM-System Kit . . . A do-it-yourself home TV-FM system kit that can feed as many as four TV or FM receivers has been brought out by Blonder-Tongue Laboratories, Inc., Newark, N. J. The kit has a new type of indoor antenna. The antenna elements are imbedded in the cardboard con-

tainer of the kit. When the container is unfolded, it forms a flat sheet six feet long and 18 inches wide, which can be tacked down on the attic floor or put into a closet or crawl space or behind a sofa. The kit includes a four-set coupler, a roll of twin-lead and installation hardware. List price is about $10.

—o—

Room Divider Furniture . . . A variety of combinations is possible with the Knight room-divider stereo system furniture offered by Allied Radio Corp., Chicago. The stereo furniture consists of supporting poles with pre-drilled holes, plus divider shelves and matching cabinets.

Matching accessories include a cabinet that can be used for record storage or for tuner, amplifier and record changer, and a speaker enclosure which is fastened to the supporting poles.

The units have an oiled walnut finish and the poles a satin brass finish. The

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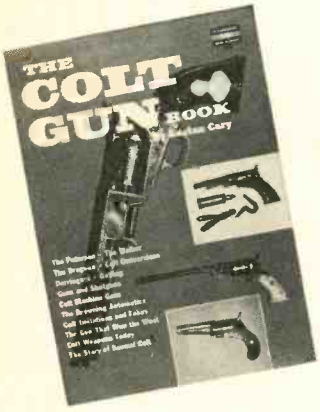

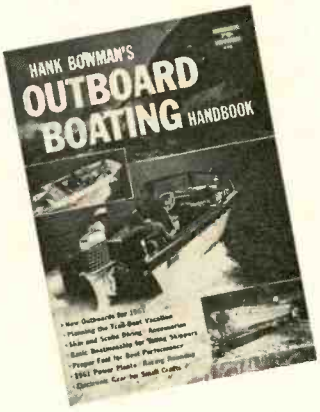

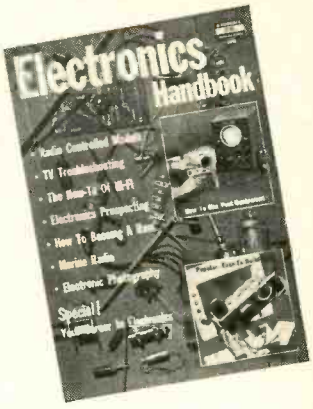

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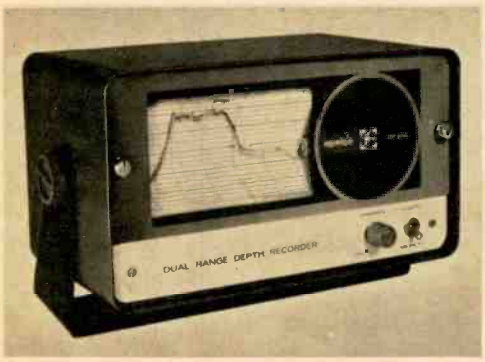
Marketplace

poles are hollow, allowing concealment of connecting cables. A purchaser can obtain the furniture in modules to fit the space available, or buy a piece at a time as finances permit.

—o—

New Depth Recorder . . . Introduced by Apelco of San Francisco is priced in the small-boat range with a tag of $285. Called the MR-200, the unit can sound down to 240 feet in two ranges and provides a permanent trace on moving graph paper. Besides depth, the instrument indicates bottom conditions and locates underwater objects and schools of fish. The MR-200 comes with a transducer designed for through-hull mounting. It measures 6½ inches high, 12½ inches wide and 7¼ inches deep. It operates only on 12 volts DC and draws two amperes.



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Kit $38.95 Wired $47.95

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ELECTRONICS ILLUSTRATED
JULY 1961

for your car:

An FM Tuner

Hi-fi on the highway can be yours at low cost.

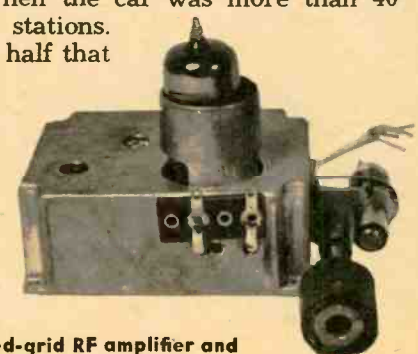
Tuner features a prealigned front-end and AFC.

By Len Buckwalter

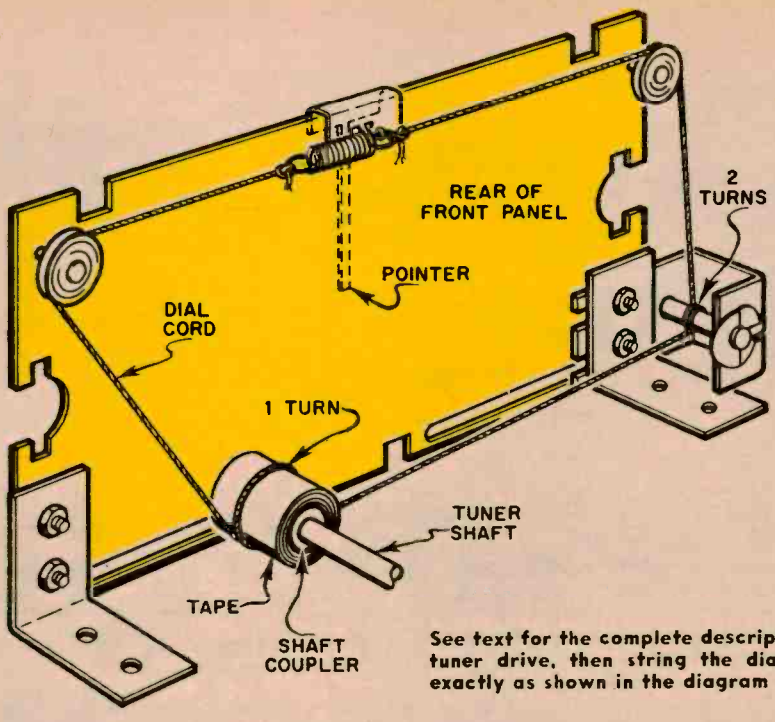
COMPARED to the number of home-brew AM sets built by the hobbyist, FM sets run a poor second . . . and with good reason. FM tuners usually require skill and special equipment for good performance. But the unit described here enables the builder to neatly detour the problem with a packaged "front end"—a small subassembly that completely eliminates the headaches of critical wiring and alignment. The remainder of the tuner is relatively simple.

Tested under rigorous conditions by tuning in FM stations while driving along, this tuner proved capable of excellent performance. An AFC circuit kept the station zeroed in despite the voltage fluctuations from the car's generator. During the checkout, reception faltered only when the car was more than 40 miles from metropolitan FM stations.

The cost of parts is less than half that of a typical commercial unit selling for around $80. Savings are realized by using the existing audio amplifier and speaker in the car's AM radio. In 6-volt cars, the AM radio can also furnish the necessary voltages; with 12-

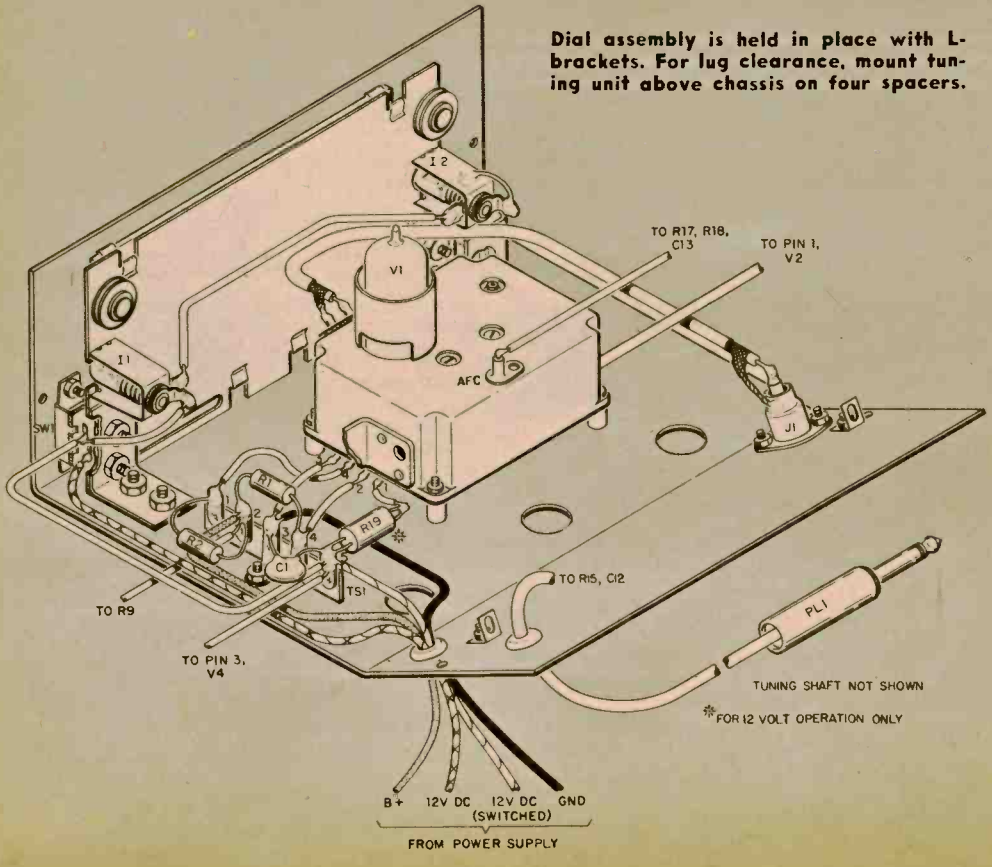


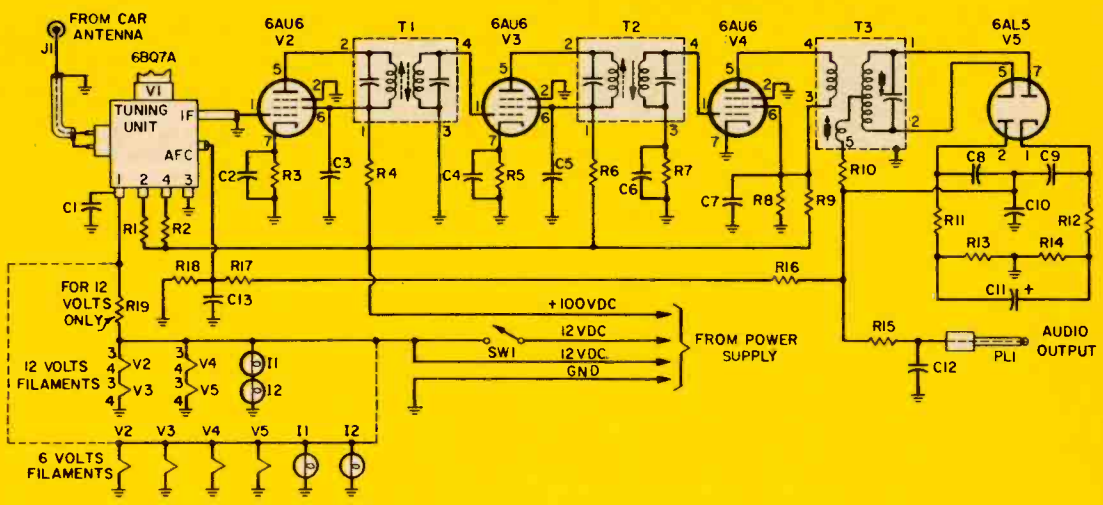
Front-end uses dual triode as grounded-grid RF amplifier and autodyne converter. Text has details of tape-wound pulley.



See text for the complete description of tuner drive, then string the dial cord exactly as shown in the diagram above.

Dial assembly is held in place with L-brackets. For lug clearance, mount tuning unit above chassis on four spacers.





Schematic of tuner. Three IF stages are followed by ratio detector. Note filament hookup option.

PARTS LIST

Resistors: ½-watt unless otherwise indicated
R1—1000 ohms, 1 watt
R2—10,000 ohms, 1 watt
R3—68 ohms
R4,R6,R12—1000 ohms
R5,R10—47 ohms
R7,R15—68,000 ohms
R8—15,000 ohms
R9—10,000 ohms
R11—1,500 ohms
R13,R14—6,800 ohms
R16—470,000 ohms
R17,R18—100,000 ohms
R19—15 ohms; 5 watts (for 12-volt car radios only)
Capacitors: 600 or 1000-volt, ceramic disc unless otherwise indicated
C1—.01 mf
C2,C3,C4,C5,C7—.0047 mf
C6—47 mmf
C8,C9,C10—330 mmf
C11—10 mf, 25-volt electrolytic
C12—.001 mf
C13—.05 mf, 600-volt paper tubular
V1—6BQ7 tube
V2,V3,V4—6AU6 tube
V5—6AL5 tube
T1,T2—10.7 mc interstage transformer (Miller 1463)
T3—10.7 mc ratio detector transformer (Miller 1465)
1—FM tuning unit—Waller UT-345-AFC (Available for $7.29 from Newark Electronics Corp., 223 W. Madison Street, Chicago 6, Ill. Page 389, catalog No. 71. Also available from Allied Radio Corp.)
J1—Antenna jack (Motorola Type or H. H. Smith No. 1207)
PL1—Standard phone plug
SW1—SPST toggle switch (reqd. for 12v operation only)
I1,I2—6-volt pilot lamps (#40) and matching sockets
Misc.—Four 7-pin tube sockets with center shield (Amphenol 147-905 or equiv.) one 5-lug terminal strip with center lug grounded; perforated Bakelite board, Minibox, 8"x6"x3½" (Bud CU-2109A); FM Tuning dial assembly (Croname CRIC, available from Allied Radio); knob, phono cable; small L-brackets; ¼" shaft coupler, closed-circuit jack, etc.

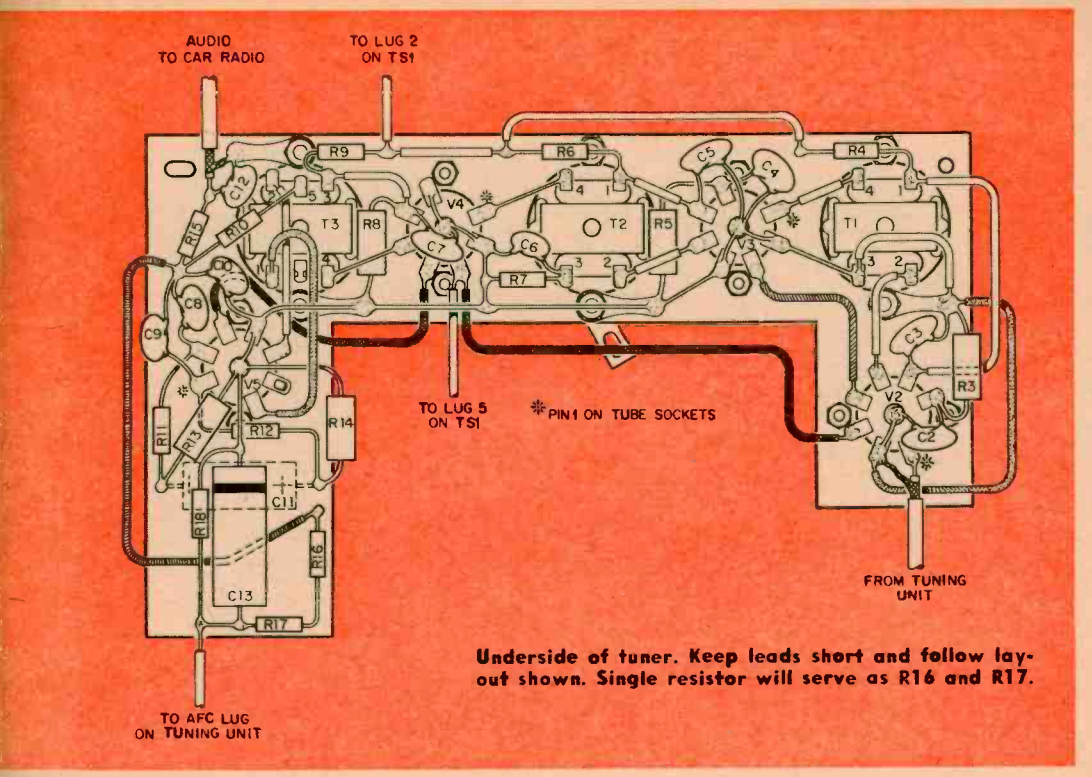
12-Volt Power Supply

C14—10 mf, 25-volt electrolytic capacitor
C15—40 mf, 150-volt electrolytic capacitor
R20—50 ohm, 5-watt resistor
R21—680 ohm, 1-watt resistor
D1-D4—Silicon Diode rectifier (Sarkes-Tarzian M-500 or the equiv.)
Q1,Q2—2N307 transistor
T1—Transistor power transformer, Triad TY-685
Misc.—Two insulated binding posts; aluminum case, 2⅛"x5¼"x3"; one 5-lug terminal strip, center lug rounded; two power transistor sockets; two diode holders (Littlefuse 099065)

volt car radios (which rarely use a high-voltage B-plus supply) a simple transistor supply is necessary.

Construction

The dial assembly is the first component to be mounted. Use the templates and hardware supplied with the dial to mount it in the position shown. The bottom edge of this assembly should be firmly seated against the bottom of the tuner cabinet and held by L-brackets at both ends. Install the tuning knob bracket at the lower left edge.

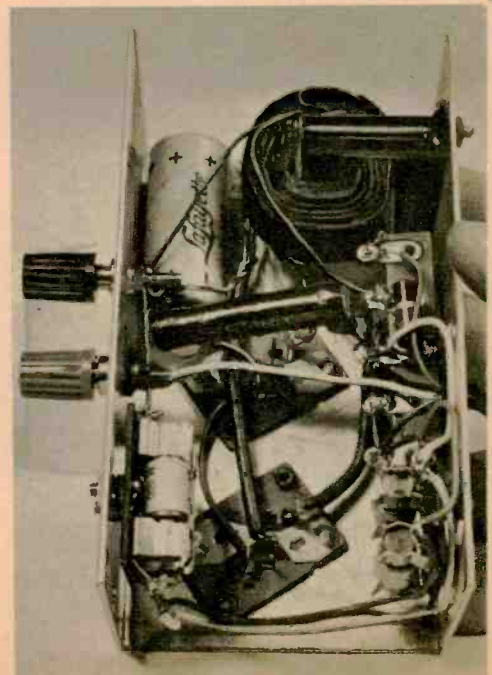


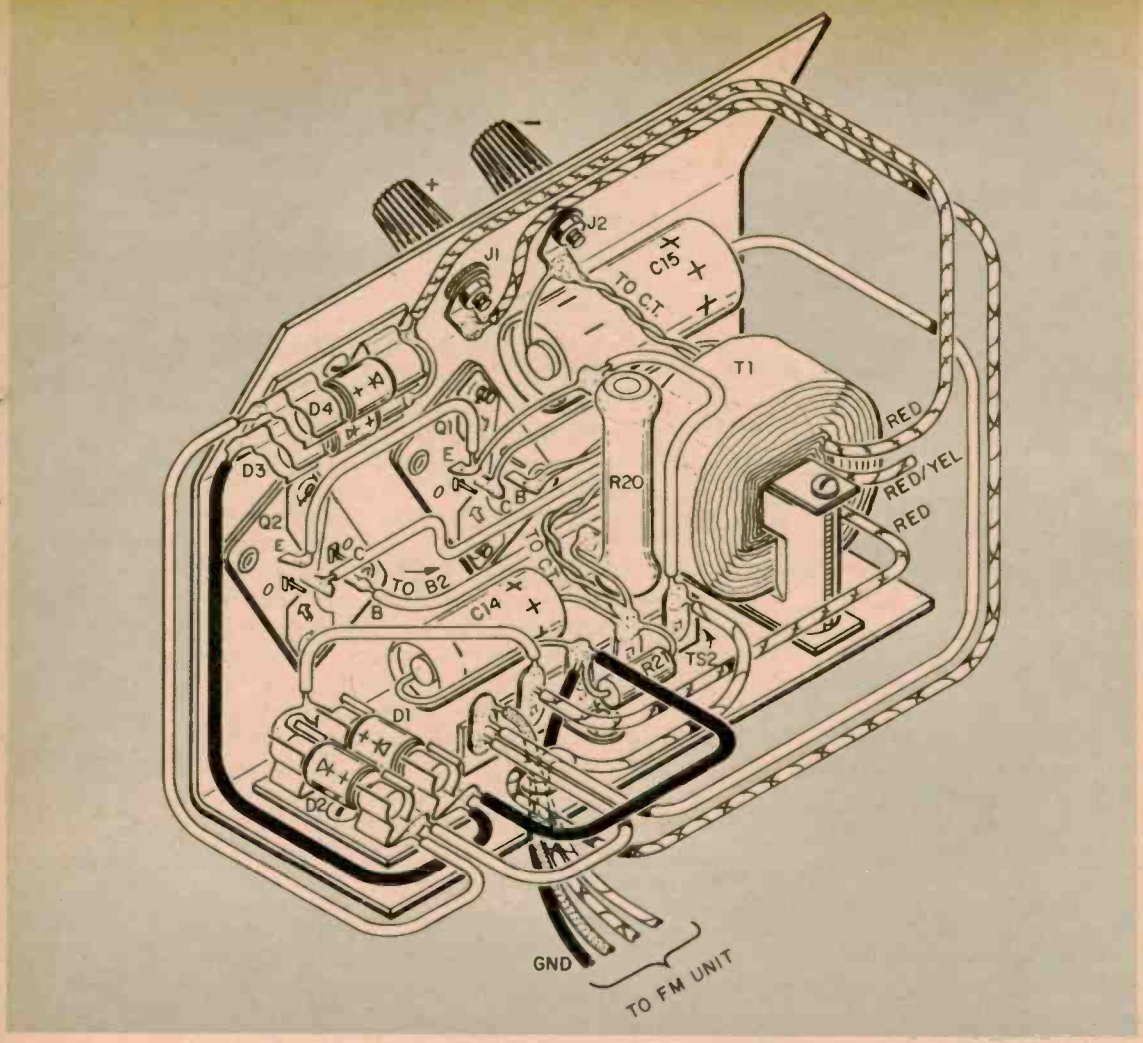
Underside of tuner. Keep leads short and follow layout shown. Single resistor will serve as R16 and R17.

The factory-wired and aligned front end is mounted next but before it is secured in place, a slight modification will have to be made to match its tuning to the frequency indicated by the pointer on the dial. Instead of the large tuning drum supplied with the dial assembly, a ¼″ shaft coupler is fastened to the tuner shaft. Note its position in the illustrations—the coupler is slipped halfway onto the shaft so one of its set screws can be tightened. This permits the tuning unit to be mounted the correct distance from the rear of the dial plate. The coupler is then wrapped with approximately 21″ of friction tape to bring its overall diameter to ¾″. Several dry runs should be made to see if the dial pointer is driven from one end of its travel to the other—while the tuning units' shaft rotates between its two stops. This can be done with the tuning unit outside the cabinet with the aid of the long dial cord supplied.

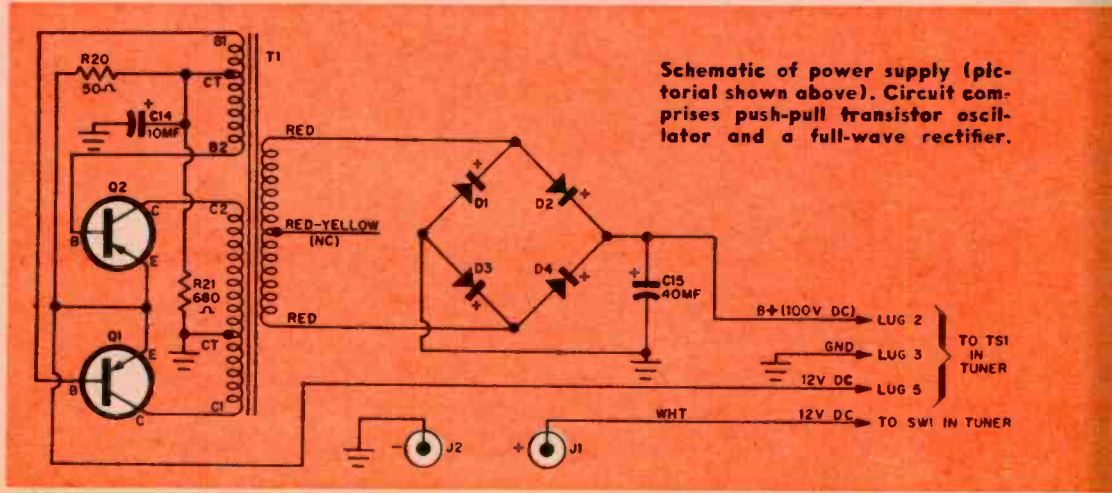
After this "gear" ratio is correct, solder four 3½″ insulated wires to the tuning unit's lugs (marked 3,4,2,1).

Transistor power supply for 12-volt cars. Be sure the cases (C) of both transistors (not visible) are insulated from chassis.

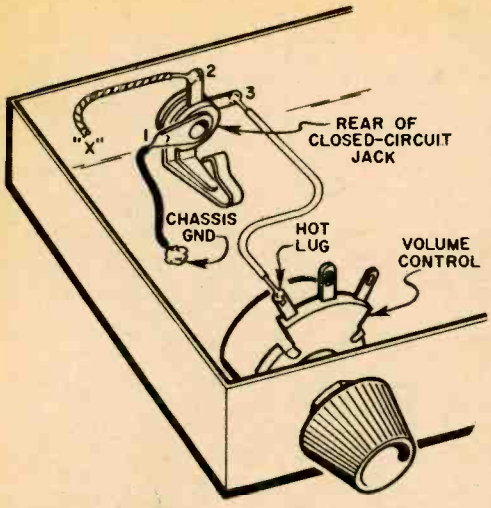




Power supply for 12-volt cars. Diode holders will short to case if attached flush. Space by threading nuts on mounting screws before installing.



Schematic of power supply (pictorial shown above). Circuit comprises push-pull transistor oscillator and a full-wave rectifier.



Audio jack added to car radio. Lead marked X originally went to the hot lug of control.

These will be connected later. Note that the bottom of the tuning unit must not touch the metal cabinet or its lugs will be shorted. Mount it in the following manner; drill four holes, insert long 4-40 screws from the outside of the metal cabinet and secure them in place with nuts. Thread another nut on each screw for several turns and place the tuning unit on them. These will be adjustment nuts for spacing the unit above the chassis. Check for lug clearance between the bottom of the tuning unit and the cabinet, then lock in place with four more nuts threaded onto the end of each 4-40 screw. The dial cord may now be strung.

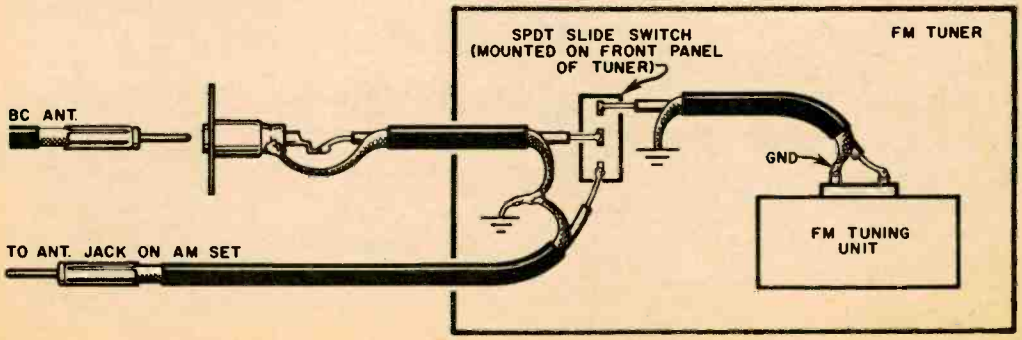
The IF strip is wired on a piece of perforated board *before* installation. Start by cutting the board to 6¾" x 4". Then, hold this piece in its mounting location and mark off a cutout which will permit its installation around the tuning unit, as shown.

After wiring, the finished board is mounted with three small angle brackets (Walsco #7570F). Note that brackets support the board at its two rear corners, while a third (flattened out) is held under one of T2's mounting screws and the screw on the tuning unit holding the "AFC" terminal. When the board is in place, the tops of the three IF transformers must not protrude over the top edge of the metal cabinet. *It is essential that the white shielded IF cable emerging from the tuning unit not be cut short* since its capacitance forms part of a tuned circuit. Three ½" holes are drilled or punched in the bottom of the cabinet directly under each of the tuning holes of the three IF transformers for alignment accessibility. Five more holes are cut in the top cover to provide access to the top slugs of the IFs and for ventilation.

Power Supplies

In some 12-volt hybrid car radios, the use of transistor stages and tubes which do not require more than 12 volts B-plus means that an external power supply must be used to energize the tuner. The cases of power transistors Q1, Q2 *must* be insulated from the metal case using a mounting kit or insulating washers and should be checked for shorts with an ohmmeter [*Continued on page* 100]

Optional switch could be combined with SW1 so power turn-on would effect antenna change.



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It has been said that everyone knows what electricity does, but no one knows what it is. The dictionary calls it "one of the fundamental quantities of nature . . ." The encyclopedia speaks of a flow of electrons through a wire. There is no one comprehensive theory that is universally accepted.

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.

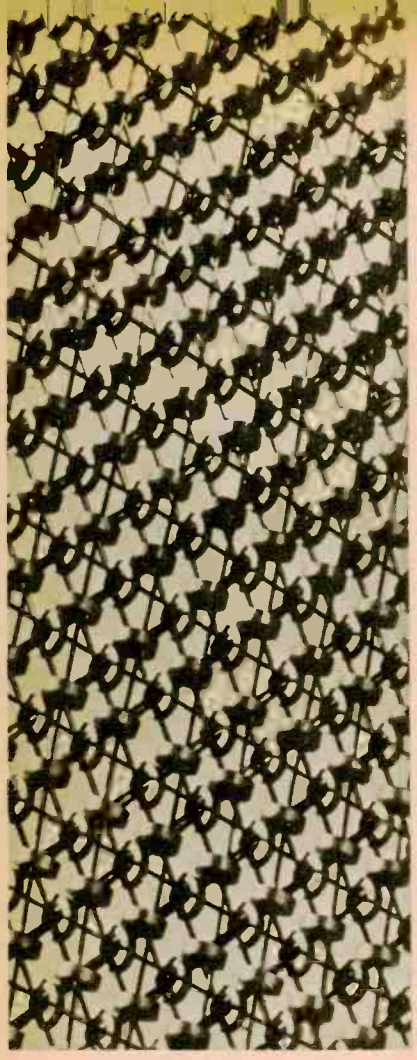
Mail entries to: EI Electricity Contest, 67 W. 44th St., New York 36, N. Y.

FERRITES...
Mighty Midgets of Electronics

Computers, tiny radios, big-screen TV and other marvels owe everything to odd-acting crystals.

By Ken Gilmore

Reddish dust at left is the basic raw material for ferrites. Traces of metals are added to the dust. Photo above shows ferrite memory cores in computer; the four-wire hookup to cores makes it possible to interrogate the units individually.



FOUR years ago the antenna in your bedside radio was a flat coil an eighth of an inch thick and as big as a sheet of writing paper. Today it is the size of a pencil or smaller and it does an even better job.

Not long ago it was said that TV tubes larger than 17 inches would never be practical. Today 27-inchers are not uncommon.

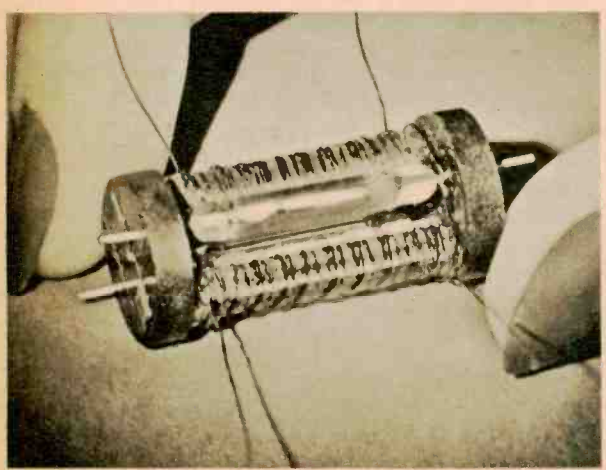
Scientists a decade ago had the major problems of computer circuitry worked out but the giant brains were not built because there were no practical memory units of reasonable size. Today has become the age of the computer because we are able to pack millions of memory cells into a few cubic feet.

All these remarkable advances, and hundreds of others ranging from day-after-tomorrow radar to improved motor car ignition systems, were made possible by the electronic wonder material of our time: ferrites.

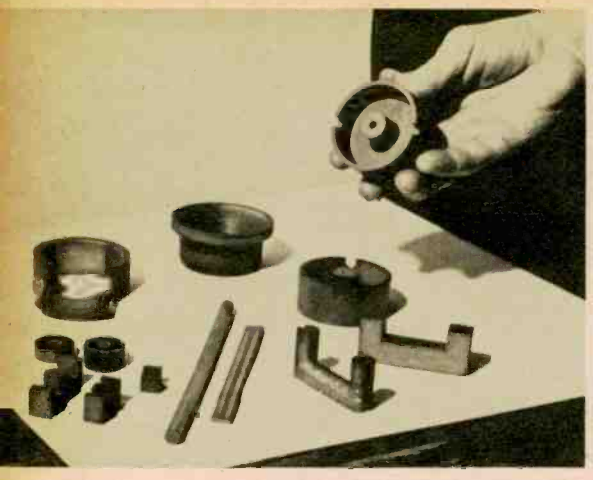
Ferrites are nothing more than iron oxide—rust—with traces of such additives as zinc, nickel, manganese, magnesium and other substances. The word ferrite sometimes appears as an adjective (ferrite loopstick, ferrite stampings, etc.) but the plural form becomes a noun . . . ferrites. Though the terminology is a bit confusing, a ferrite is a tiny crystalline structure made up of the substances listed above.

To become useful, millions of ferrite crystals, which look like nothing more than reddish dust, are mixed into a special dough and stamped into intricate shapes by giant machines which exert tons of pressure and look like cookie cutters. After that the stampings are baked in kilns at high temperatures for a day or more. Out of the kiln come blackish bars, rods, rings, blocks and cylinders. The raw material looks pretty nondescript and so do the stampings, but their appearance

Bell Labs ferreed is a ferrite-bar switch that is 1,000 times faster than models now used.



Each of these ferrite doughnuts represents a single memory core for a modern computer.



Sample ferrite stampings include TV yokes at upper left; C cores for flyback transformers at right; rod, strip are for radio antennas.

Tiny computer memory cores are counted with a paddle containing 400 holes. Worker scoops up cores, makes certain every hole is filled.

is deceiving. These electronic cookies are able to do a great many jobs that were simply impossible before they came along.

Ferrites perform their tricks because they combine two properties seldom found in one material. First, they are magnetic and can be magnetized and demagnetized like iron. And second, they are insulators. Unlike iron, they will not conduct electricity.

Why is this combination so important? Take the output transformer in your hi-fi amplifier. It, like many other electronic devices, works because it has the electrical property of inductance. Its inductance, and hence its efficiency, can be increased hundreds or thousands of times if it is wound on a core of magnetic material, usually iron. But the core creates its own problems.

The inductance, which does the transformer's useful work, unfortunately induces an eddy current in the iron core. This eddy absorbs power, cutting down efficiency and thus partially defeating the purpose of the core. At low frequencies the loss is small. But the higher the frequency, the higher the eddy current loss. Finally, the loss becomes so great that the transformer is useless.

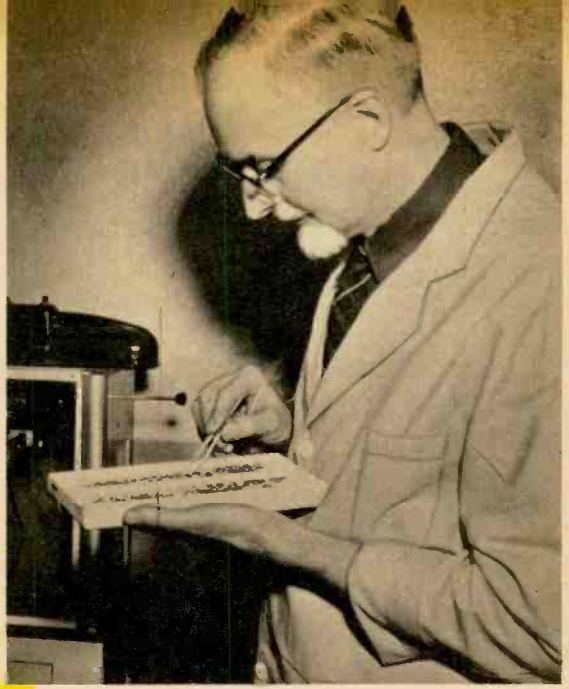
To combat this problem, transformer designers split iron cores into thin, insulated sheets. This breaks up the conducting path through which the eddy current can flow and raises the useful frequency limit of the transformer. But this is only a partial remedy. As the frequency rises, eddy currents begin to flow in the individual sheets.

But ferrites are magnetic materials which also are insulators. Consequently, they can serve as cores but no eddy currents can flow. Thus hundreds or thousands of new or improved electronic devices become possible.

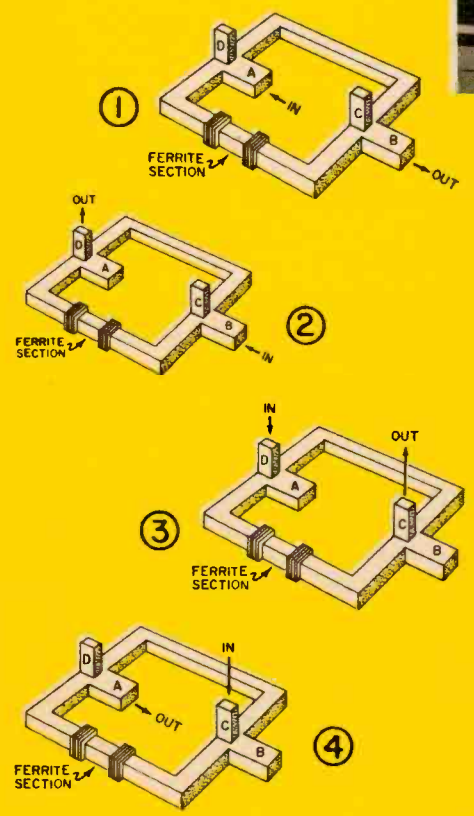
The first child of the ferrites to gain wide acceptance came after World War II. Researchers had been intrigued with ferrites but they remained laboratory curiosities. Then along came television. Manufacturers shopped for a magnetic material to increase efficiency of the flyback transformer—the component which provides the high voltage for your TV picture tube. The flyback had to handle a lot of power and at the same time work efficiently at high frequency. A ferrite core did the trick.

About this time General Ceramics Corporation, which for almost 150 years had been making ceramic products from ash trays to bathroom fixtures, was looking for new fields to conquer. The choice was ferrites because ferrites and ceramics are first cousins—both are metallic oxides fired in a kiln.

Dr. Ernst Albers-Schoenberg, a lead-



Dr. Ernst Albers-Schoenberg, a leading authority on ferrites, developed memory cores for computers and played a major role in search for other uses for the material. He is holding tray of cores.

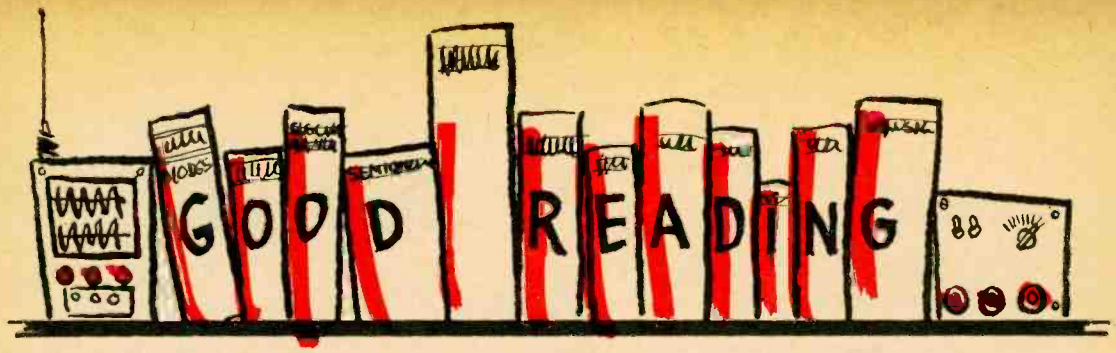


Ingenious ferrite circulator develops some strange phase relationships. Signal that goes in A comes out of B, but signal in B comes out of D rather than A. The diagrams show other possibilities. In radar work, transmitter is hooked to A, antenna to B, receiver to D. Transmitter pulses then cannot damage receiver but radar echoes are channeled to receiver, as they must be.

ing ferrite expert, was made GC's research director. He developed several types of ferrite material, but they caused no great excitement and went mostly to researchers. Then TV came on the scene and the staid old ceramics firm suddenly had back orders amounting to $3,000,000. The biggest part of GC's facilities were turned into ferrite production. Other companies are now in the business but GC is the biggest.

By 1950 television was a fixture but the 17-inch tube seemed the practical limit. Even though the flyback was efficient, the coils into which its power was poured to do the beam sweeping just couldn't develop enough magnetic force to deflect the beam over a larger tube face. Again, ferrites to the rescue. An engineer at General Electric built a ferrite collar—or yoke, as it is now known—to fit over the deflection coils around the tube's neck, thus giving the system more magnetic strength. The result was the 21, 24 and 27-inch picture tube.

In 1953 MIT's Lincoln Laboratory designed a computer using electron tube memory cells which showed promise. But there were problems. The most difficult one was that tubes are subject to failure at a predictable rate. If you put 10,000 or so of them together you're likely to average a breakdown a day. Computers, to [*Continued on page* 97]



HOW TO READ SCHEMATIC DIAGRAMS. *By David Mark. John F. Rider, New York. 147 pages. $3.50.*

While this book is not intended as a substitute for years of study and practical experience with electronic circuitry, it's a worthwhile acquisition for anyone who is beginning to feel his way in electronics. And there's more in it than the title implies. In addition to an explanation of symbols (including their variations from manufacturer to manufacturer) and their application in schematics, it provides short but accurate explanations of many kinds of circuits. Its only real shortcoming is the scanty coverage of transistor circuitry.

BASIC ELECTRONIC TEST PROCEDURES. *By Rufus P. Turner. Rinehart & Co., New York. 316 pages. $4.95.*

Here is a straightforward, step-by-step guide to electronic testing. The overall approach is distinctly in the textbook category, with summaries after each chapter and comprehensive review questions, but the style is clear and easily readable. Beginning with a section on the correct use of meters, the book proceeds in stages to explore measurement techniques for increasingly complex circuitry and finally outlines the applications and importance of test procedures in industrial and design processes.

BASIC MATHEMATICS. *Volume 1. By Norman H. Crowhurst. John F. Rider, New York. 143 pages. $3.90.*

If you've been promising yourself that you're going to review all that math that you glossed over or never understood, here is your chance, and you should make the most of it. Mr. Crowhurst asserts, with considerable justification, that most of those who find mathematics a problem were simply never taught the right way to approach it. He is an outspoken opponent of rote learning, and considers memory no substitute for understanding. He feels instead that all math, from basic arithmetic on up, should mean something to the user. And, in line with his conviction that finger-counting is more helpful than mere memorizing, he begins the book by presenting various methods of counting. This, of course, is the new approach to math instruction, but Mr. Crowhurst doesn't indulge in unnecessary philosophizing. He is practical and the emphasis is on everyday matters that you can put your finger on. Four volumes are projected for this series, and if the next three are up to the standard of the first offering, chances are they will make calculus as easy as multiplication for the average reader . . . and perhaps as much fun as finger-counting.

THE STORY OF STEREO: 1881 -. *By John Sunier. The Gernsback Library, New York. 160 pages. $2.95.*

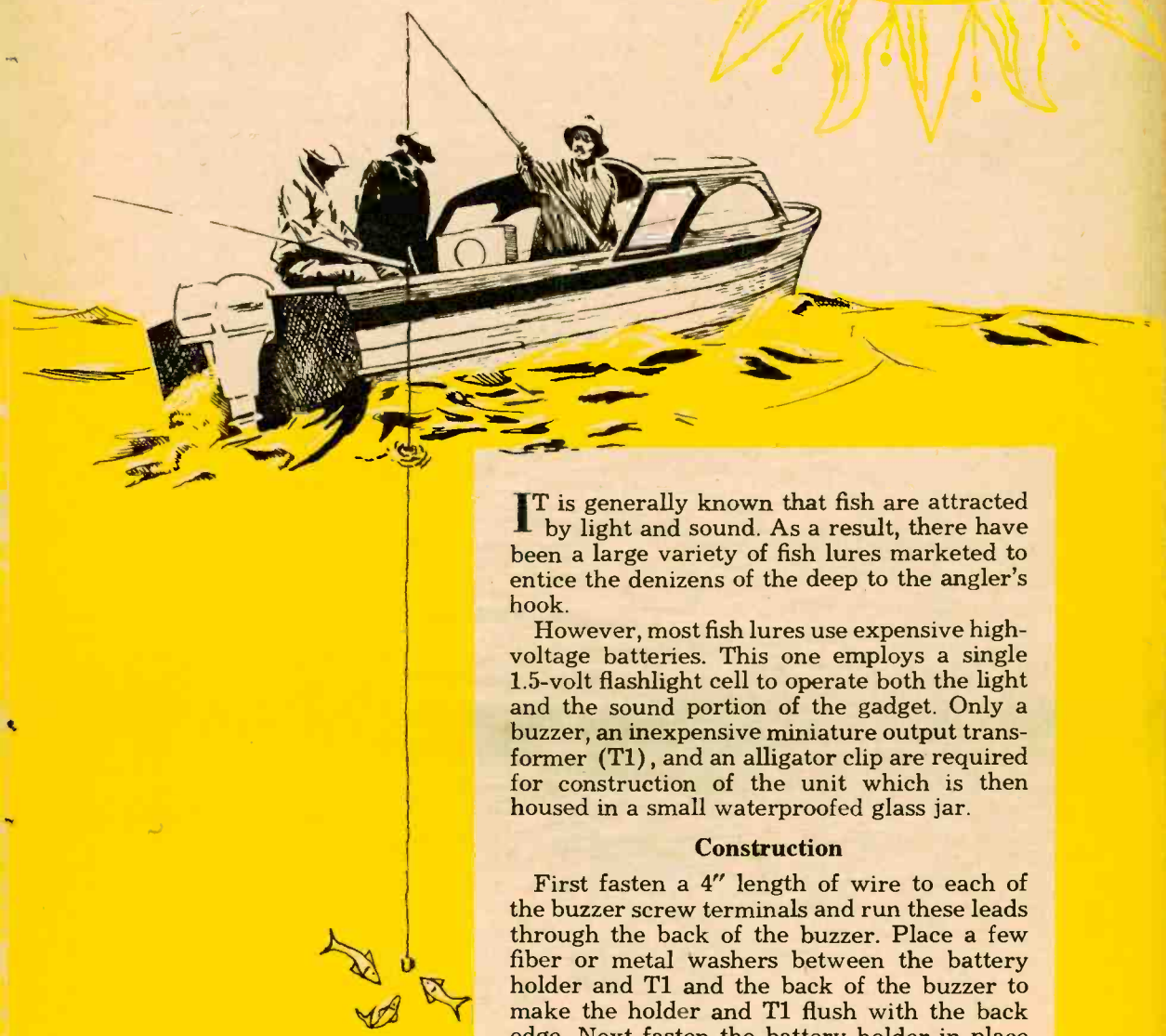
For hi-fi buffs, here is a comprehensive summary of the principles of stereo and their applications. As the title suggests, the approach is historical, tracing the phenomenon back to its first test at the Paris Exhibition of 1881. But despite the emphasis on stereo's history, this book makes for anything but dry reading. It's well written, and just about every aspect of stereo reproduction comes in for intelligent discussion. In addition to useful suggestions for achieving good stereo in the home, you'll find interesting and thorough coverage of its applications in films and broadcasting. All in all, it's a fine book for the audio novice or the veteran hi-fi addict.

Electronic Fish Lure

A fisherman's dream come true. Have fun, Sons of Izaak Walton.

By Forrest H. Frantz, Sr.

Special Section: **24 Pages of SUMMER PROJECTS**

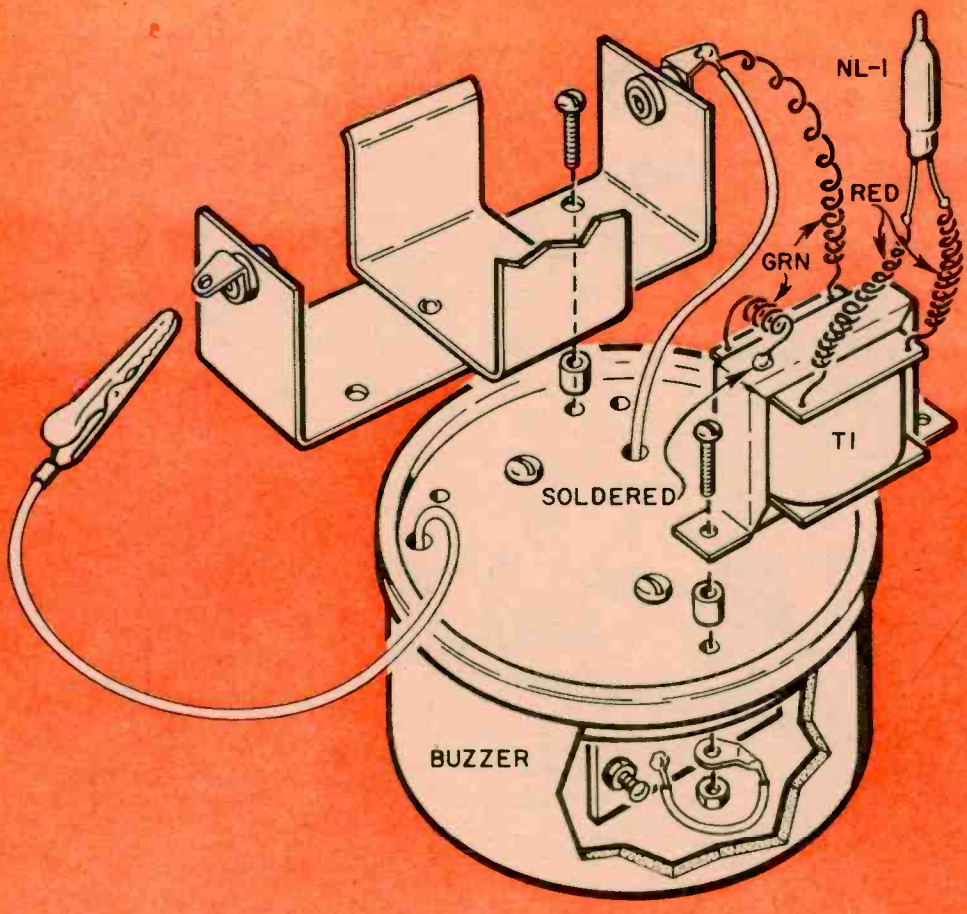


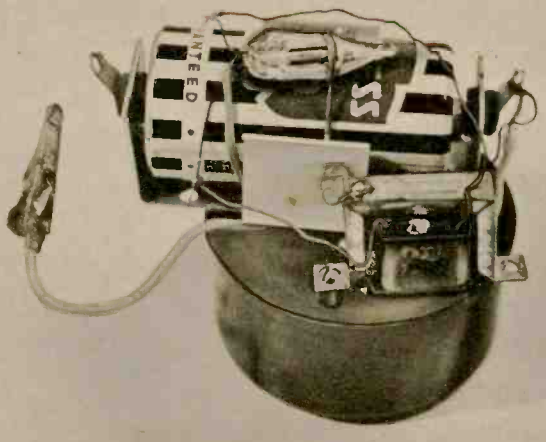
IT is generally known that fish are attracted by light and sound. As a result, there have been a large variety of fish lures marketed to entice the denizens of the deep to the angler's hook.

However, most fish lures use expensive high-voltage batteries. This one employs a single 1.5-volt flashlight cell to operate both the light and the sound portion of the gadget. Only a buzzer, an inexpensive miniature output transformer (T1), and an alligator clip are required for construction of the unit which is then housed in a small waterproofed glass jar.

Construction

First fasten a 4" length of wire to each of the buzzer screw terminals and run these leads through the back of the buzzer. Place a few fiber or metal washers between the battery holder and T1 and the back of the buzzer to make the holder and T1 flush with the back edge. Next fasten the battery holder in place over the buzzer mounting hole. Solder a lead from the frame to the screw and solder one





Place washers under transformer and battery holder for flush mount against edge of buzzer. Alligator clip connected to lug on battery holder starts unit.

of T1's green secondary leads to its frame. Solder the other green secondary lead and the lead from the buzzer coil terminal to the positive battery holder terminal. Solder the clip to the other buzzer lead which should be long enough to permit clipping to the negative battery terminal. Connect the red primary leads of T1 to the neon lamp. Fasten the neon lamp to the battery with a rubber band and place the battery in the holder.

If the buzzer sounds too loudly, you can weaken its signal by inserting a small value resistor at the point marked "X" in the schematic.

Operation

To operate the lure, all you need do is connect the clip to the negative battery terminal and adjust the buzzer contact screw for a clear *high frequency* note. This adjustment may be somewhat critical and you may have to repeat it several times. Install the buzzer in the jar, fasten the lid, and lower the lure into the water on a line. If necessary, add weight to the jar, and use cellophane tape to hold the components and the weights in place.

A hook made of No. 14 copper wire may be soldered to the jar lid for attaching the line. Since a glass jar is used, it's a good idea to provide a similar hook on the inside of the jar lid to permit tying a string to the battery holder. Then, if the jar is broken by accident when the lure is submerged, the contents will not be lost. If through some accident the jar does break, the electronic components should be dried by placing in the sun or an oven. If immersed in salt water, rinse in fresh water before drying.

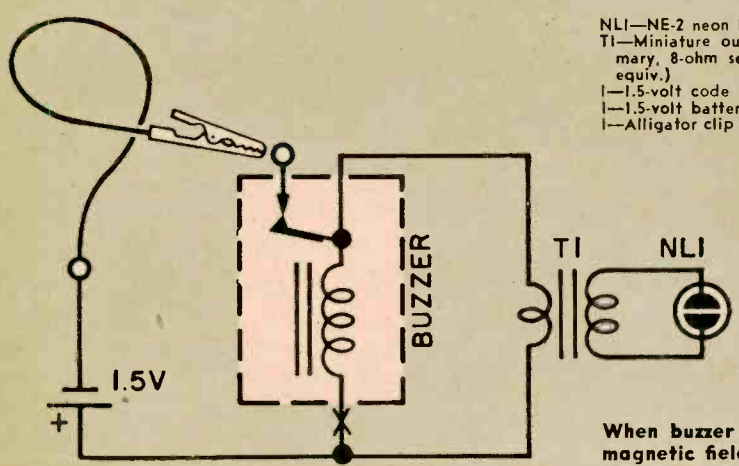
This lure provides continuous sound and light. Those anglers who prefer periodic or intermittent sound and light can add an external remote on-off switch for operation from the boat. Leads will have to be added and brought out through waterproofed insulated terminals in the lid and given several coats of spar varnish. You could also install a mercury switch between the clip and buzzer and position it so the lure is normally on. Attach a string to the jar to tilt the unit to switch it off.

How It Operates

The pulsating direct current that appears across the buzzer terminals is stepped up by the primary of T1. The high AC voltage across the secondary of T1 energizes the neon lamp. T1 connected in reverse steps up the voltage to almost 100 volts, sufficient to light the neon bulb.

PARTS LIST

NL1—NE-2 neon lamp
T1—Miniature output transformer; 2,000 ohm primary, 8-ohm secondary (Lafayette TR-93 or equiv.)
1—1.5-volt code practice buzzer
1—1.5-volt battery and matching holder
1—Alligator clip



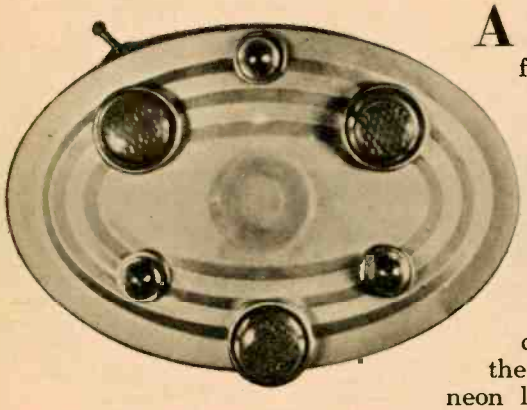
When buzzer contacts open, collapsing magnetic field in primary of T1 induces high voltage in secondary to light NL1. Add a resistor at X to weaken buzzer.

SUMMER PROJECT

build a

Flashing Electronic Taillight

By Jack Allison

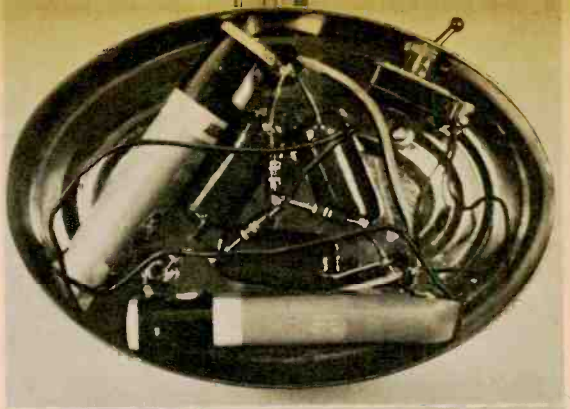


A sure-fire conversation starter and traffic stopper, this unusual gadget for your bike will add safety to your night trips and fun to any indoor gathering. The circuit is simple and easily constructed. The "chassis" can used by the author leaves plenty of room to work, but there's nothing to prevent you from building a smaller unit.

Construction is easy. Draw a circle on the can and drill holes on the circle for the reflectors and the neon lamps. Enlarge the holes with a reamer if necessary. You can use practically any neon lamp provided it does not have a built-in resistor. The larger the lamp, the greater the battery drain. The bulbs chosen are pushed through rubber grommets. (It will help if you moisten the bulbs first.) Pick the grommet that fits the bulb type you are using.

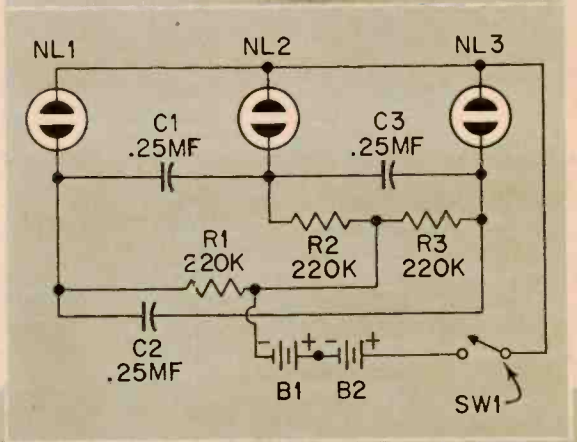
The pictorial shows the placement of parts. Make sure all connections are soldered well and that there are no shorts. Place tape over the battery terminals. As protection against moisture and vibration, drive small nails around the edge of the can into the wood back, then place a strip of tape around the edge of can. To prevent theft, attach taillight so you can remove it easily.

Components are soldered directly to the neon lamp bases. Spaghetti insulation should be used to avoid possible shorts.

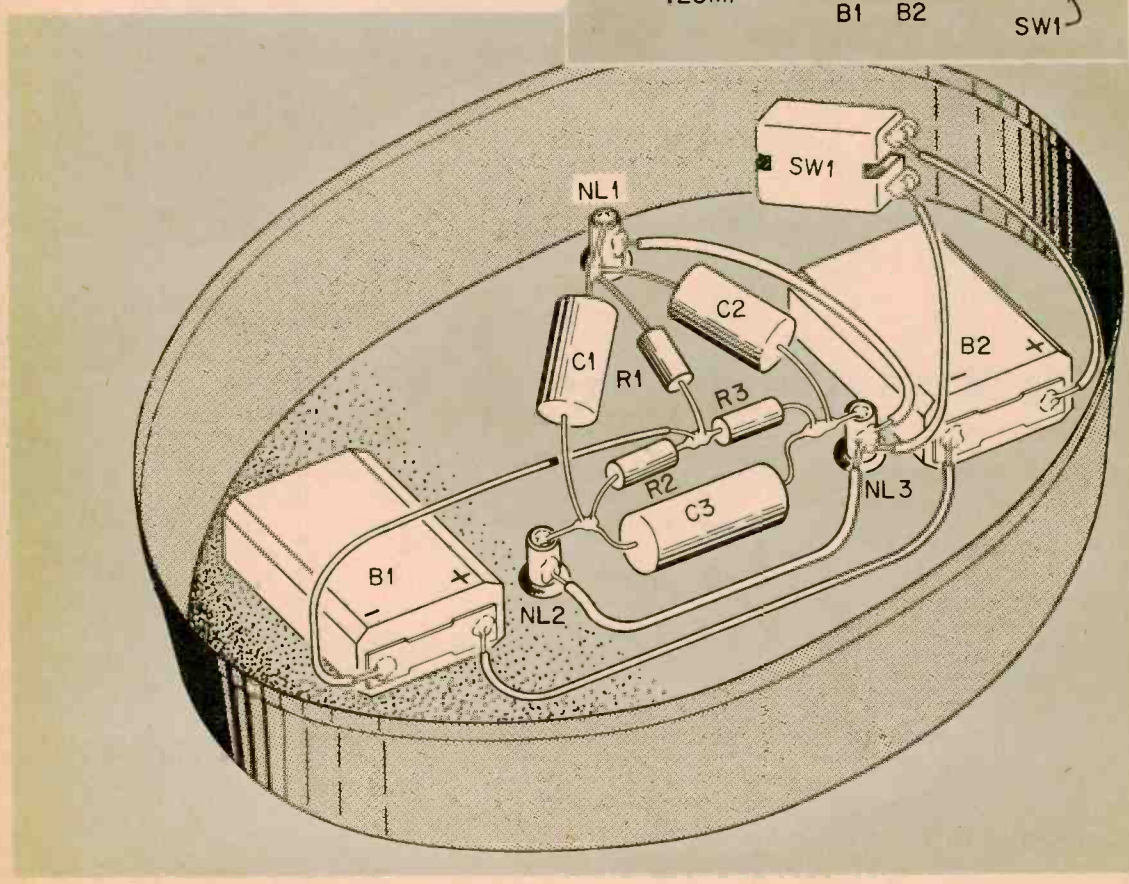


PARTS LIST

C1,C2,C3—.25 mf, 200 volts (or higher) capacitors
R1,R2,R3—220,000 ohms, ½ watt, 5% resistors
NL1,NL2,NL3—NE-51 or NE-51H neon lamps (see text)
SW1—SPST toggle switch
B1,B2—45-volt batteries (four-22.5 volt batteries may be substituted)
3—Red reflectors
3—Rubber grommets to fit lamps
1—Tin can and fitted wood back
Misc.—battery connectors, wire, etc.



It may be necessary to turn SW1 on and off a few times to start flasher. Neons are fragile and should be moistened so they can be fitted through grommets.



SUMMER PROJECT

build a transistorized

Camper Power Pack

Provides 117-volts, 60-cycle AC from a 12-volt car battery to power a TV set or a tape recorder.

By Donald L. Stoner, W6TNS

FRIDAY evening rolls around and mom, dad, and the kids hop in the pickup truck with the camper attachment and join hundreds of other similarly equipped trucks on the crowded highways. It's a typical scene, and the fad of "heading for the hills" is catching on all over the country. The portable home on wheels has everything, *including* the kitchen sink.

About the only thing you miss, miles from civilization, is that handy AC power outlet found in each room of your home. If you need power at some remote vacation spot you usually lug along a bulky engine-generator combination. For low power applications, such as electric razors, radios, lights,

or portable television receivers, the EI Camper Power Pack does a lot better job with much less weight and expense. The unit costs less than $20 to build, too! To use the supply, all you need is 12-volt ignition system with a *negative* ground in your car or truck.

Construction

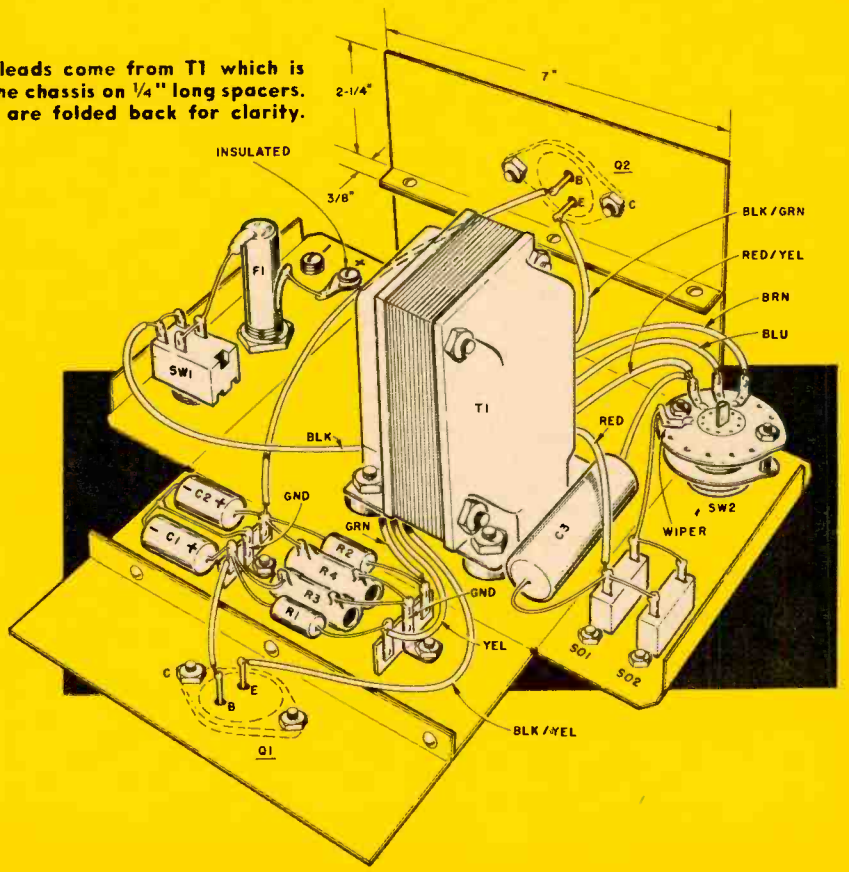
The Pack is built on a 5″ x 9″ x 2″ aluminum chassis with the components mounted inside. The transformer, positioned in the center of the chassis, "sits" on ¼″ thick spacers to prevent pinching the leads between its case and the chassis.

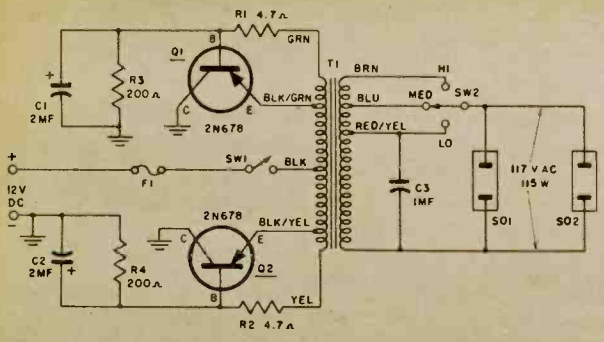
Note that transistors Q1 and Q2 are mounted on 2¼″ x 7″ pieces of aluminum. These cooling fins are necessary since the transistors handle large amounts of current and consequently get quite warm. The exact location of the transistor on the fin is unimportant, but they should be located near the center for best cooling.

Start the construction by mounting the battery terminals (the negative terminal is bolted to the chassis and one positive terminal is insulated from the chassis), fuse holder F1, SW1, and the terminal strips. Set the transformer in the center of the chassis so you can mark and drill the mounting holes. Make sure the transformer clears the back of the fuse holder. Next, drill the holes and mount the outlets (SO1, SO2) and SW2. Finish the drilling by constructing the fins and installing the transistors. Since the collectors are grounded, Q1 and Q2 can be bolted to the fins directly without insulators.

Start wiring the power pack by installing the resistors and capacitors on the side apron then wire the positive battery lead to F1, and the other fuse terminal to SW1. The two sections of SW1 are wired in parallel so it can handle the heavy current drawn from the battery. At least #14 wire should be used in this area.

All color-coded leads come from T1 which is mounted above the chassis on ¼" long spacers. Sides of chassis are folded back for clarity.





PARTS LIST

C1,C2—2 mf, 150-volt electrolytic capacitor
C3—1 mf, 200-volt paper tubular capacitor
F1—15-ampere fuse, and matching holder
R1,R2—4.7-ohm, 2-watt carbon resistor
R3,R4—200-watt wirewound resistor
SW1—DPST toggle switch
SW2—Single-pole, three-position rotary switch (Centralab 1401 or equiv.)
T1—power converter transformer, 12.6 volts to 117 v. AC (Triad TY-75A)
Q1,Q2—2N678 transistors (Bendix)
SO1,SO2—117-volt AC., receptacles
Misc.—5"x9"x2", aluminum chassis, 2¼"x9" aluminum fins (see text) two 3-lug terminal strips, four ¼" long spacers, transistor sockets, hdwe.

Be sure input polarity is correct. SW2 adjusts the square-wave output voltage.

Next install T1 and connect the wires to the components already installed. Finally complete the unit by attaching the fins to the chassis with 3 sheet metal screws and wire Q1 and Q2.

Testing The Power Pack

Make a dummy load by wiring a 100 watt lamp to an AC plug, and insert it in SO1 or SO2. Connect the supply to the car battery with heavy wire (#12, or better yet—#10). Make sure the negative terminal is connected to the car body and the positive lead is hooked to the "hot" lead of the battery. WARNING: *If you get these connections reversed you will immediately destroy the transistors, even before the fuse has a chance to blow!* Beware of incorrect connections, a new set of transistors will cost over six dollars! When you switch the pack on, it should make a growling noise and the bulb should light. If it doesn't, remove the power *immediately* and check the wiring.

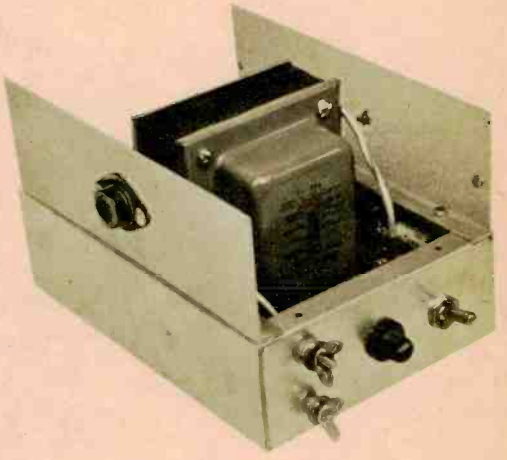
Using the Supply

The power pack will deliver an absolute maximum of 115 watts, or 1 ampere at 115 volts. At full load the battery consumption is about 12 amperes. Fortunately the power supply has built-in protection. If you overload it heavily the circuit will "stall." When this occurs, the transistors will not be damaged, but will merely draw a small bias current (2 amperes, or so). It is the slight overload that you must be careful of. It will not be enough to stall the supply, but will cause overheating of the transistors and might even destroy them.

When you use the supply, always make sure you know how much power the load consumes. For example, you can illuminate four 25-watt bulbs, a radio (35 watts or so) or a portable television receiver (approximately 85-100 watts).

In addition to observing your battery polarity and total power consumption, there is one other important caution. Never operate the power converter without a load of some sort. If the power is not absorbed in the secondary circuit (output), it *could* kick back and damage the transistors.

[*Continued on page* 101]

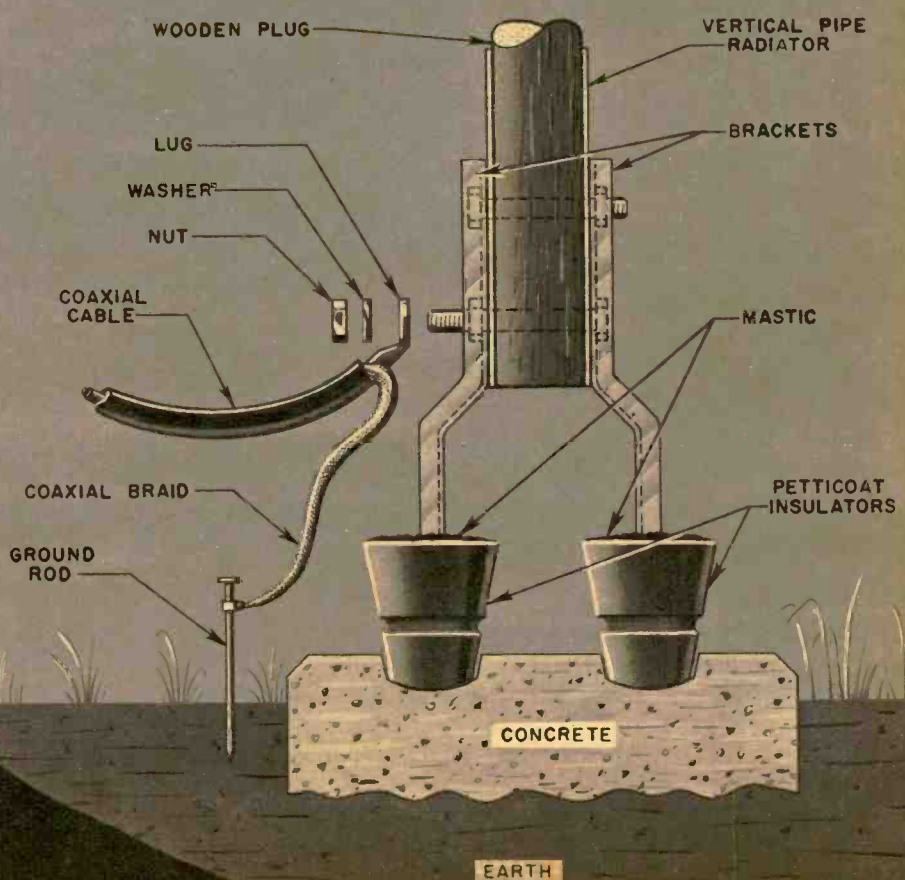


Unit is built in an inverted chassis. Added side wings act as heat sinks for transistors.

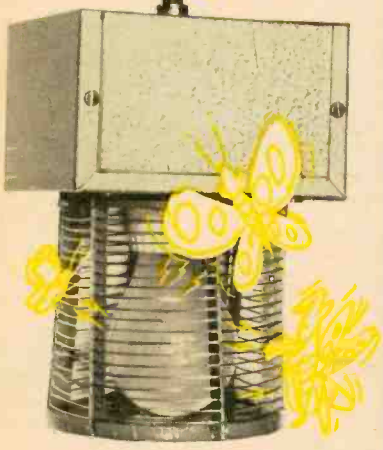
SUMMER PROJECT

Low-Cost Base Insulator

WHEN a ham decides to build himself an insulated-base vertical antenna of water pipe or conduit or irrigation piping he is often puzzled about what to use for a low-cost insulator. The best answer is petticoat insulators of the type used by telephone and power companies. They are made of bottle glass or brown porcelain and can support a sizable load if it is evenly distributed. Electrically, they will hold many times the legal output of a ham rig. Your local phone or power company can tell you how to get a couple of petticoats. While you're at it, pick up two offset mounting brackets. Bolt the bracket and insulator assembly to the base of your mast as shown in the drawing (a wooden plug keeps the mast from being crushed). The lower bolt serves as an RF connection. Best base size is about 12x14 inches and 6 inches thick.—*Howard Pyle, W70E*



SUMMER PROJECT



stop those patio parasites with El's

Electronic Insect Killer

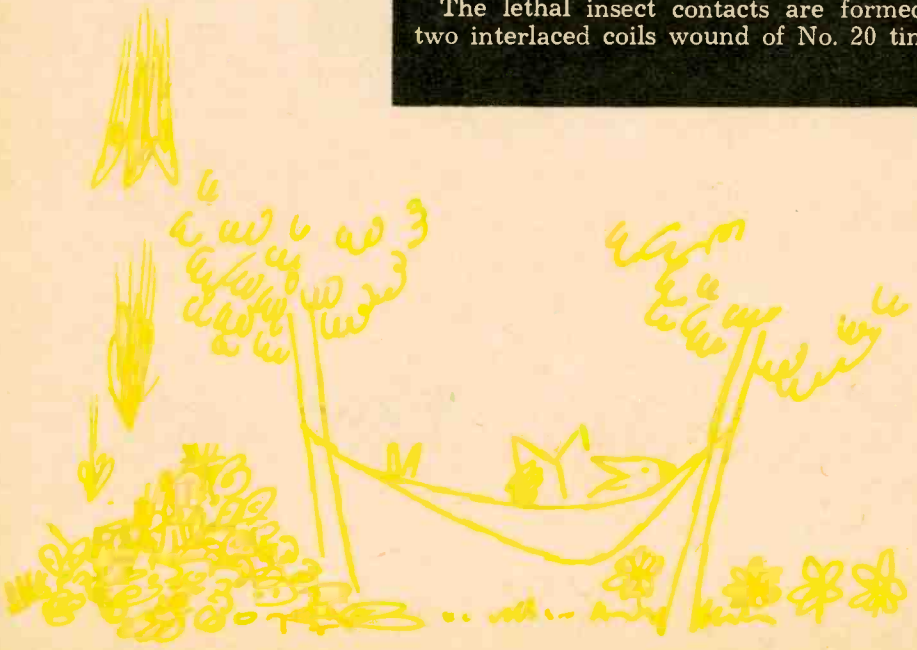
By Harvey Pollack

OPEN terraces, patios, and porches—today's standards of relaxed suburban living—make ideal places to retire with one's guests after dinner—provided you don't mind sitting in the dark. Turn on the lights, and the flying insect invasion gets under way. Although the best remedy is full insect screening, you can relieve the situation substantially by using an electronic bug-killer lamp on your terrace.

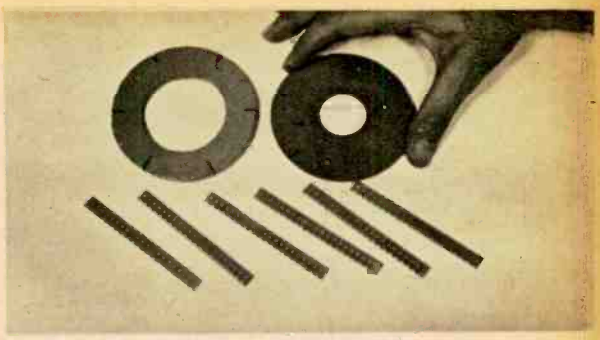
The idea is to attract the bugs to the light and then flash them into the next world with a bolt of insect lightning! Of course a bug electrocutor must also be harmless to humans, big or small; hence, a rather tricky circuit is used. If the trap is touched with the fingers while the current is on, you feel the merest "pinprick" of electrical energy from a small charged capacitor.

The Coil Trap

The lethal insect contacts are formed by two interlaced coils wound of No. 20 tinned,



bare copper wire. The coil form is made with two 4" dia. Masonite, plywood, or Bakelite discs notched about ⅜" in from the circumference at six evenly spaced (60° apart) spots. Cut a 2½" diameter hole in one disc to allow easy lamp replacement and prepare the second disc with a center hole large enough to pass a standard electric-fixture receptacle. The receptacle should be of the porcelain or bakelite variety that unscrews in two parts. Using tin shears, cut six 4" x ⅜" lengths of perforated bakelite right down the line of holes. By cutting through the hole centers, you will have a natural serrated-edge wire guide for coil winding. Next assemble the coil form by gluing the bakelite strips into the ⅜" notches in



Discs form ends of coil in which ribs are glued. Larger hole must exceed bulb diameter.

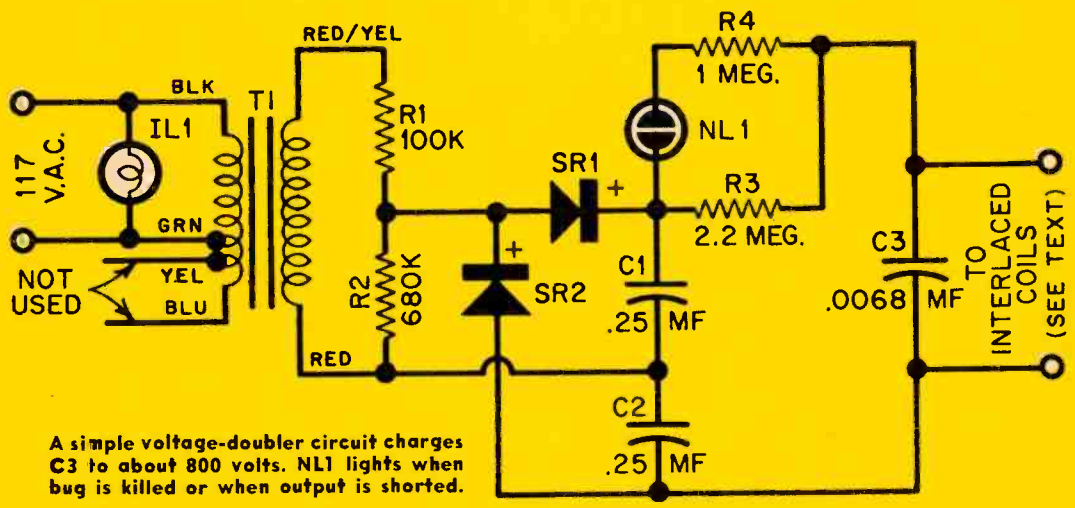
the discs and allow the glue to dry thoroughly. Starting with the serration nearest to the disc that will hold the electric receptacle, wind one coil as tightly as possible without distorting the ribs, omitting *every other* serration as you proceed. After the ends of this coil are secured to prevent unravelling, wind the second coil in the previously omitted serrations, thus forming a pair of interlaced, disconnected coils. Some polystyrene coil dope or acetate household cement applied in small blobs on the serrations will help to hold the wire firmly in place. Now go on to the "shock-box."

PARTS LIST

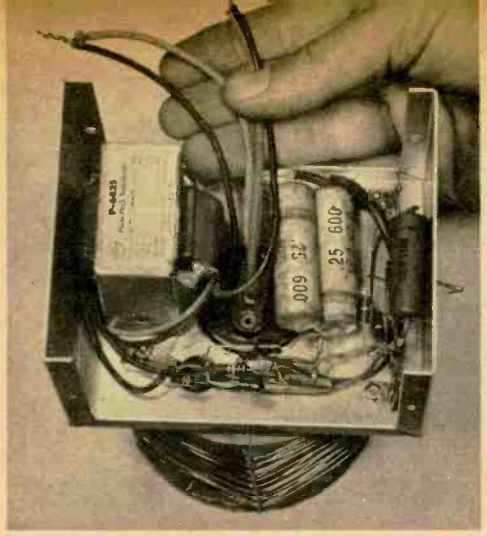
Resistors: ½-watt, 10%
R1—100,000 ohms
R2—680,000 ohms
R3—2.2 megohms
R4—1 megohm
C1,C2—.25 mf, 600-volt paper tubular capacitor
C3—.0068 mf, 1200-volt molded paper capacitor
IL1—60-watt lamp and porcelain socket
NL1—NE-2 neon lamp
SR1,SR2—silicon diodes 750 ma, 600 peak inverse voltage (PIV) Texas instrument IN2071 or equiv.
T1—105/115/125-volt primary; 400-volt secondary photoflash transformer. Stancor P-6425
Misc.—30' No. 20 bare tinned copper wire, piece of perforated Bakelite board, 4" dia. Masonite or plywood disc, 3"x4"x5" metal box (Bud CU-2105), grommets, terminal strips, hdwe. Length of line cord or piece of threaded brass electrical fixture tubing

The Power Supply

The 400-volt secondary of a small in-



A simple voltage-doubler circuit charges C3 to about 800 volts. NL1 lights when bug is killed or when output is shorted.



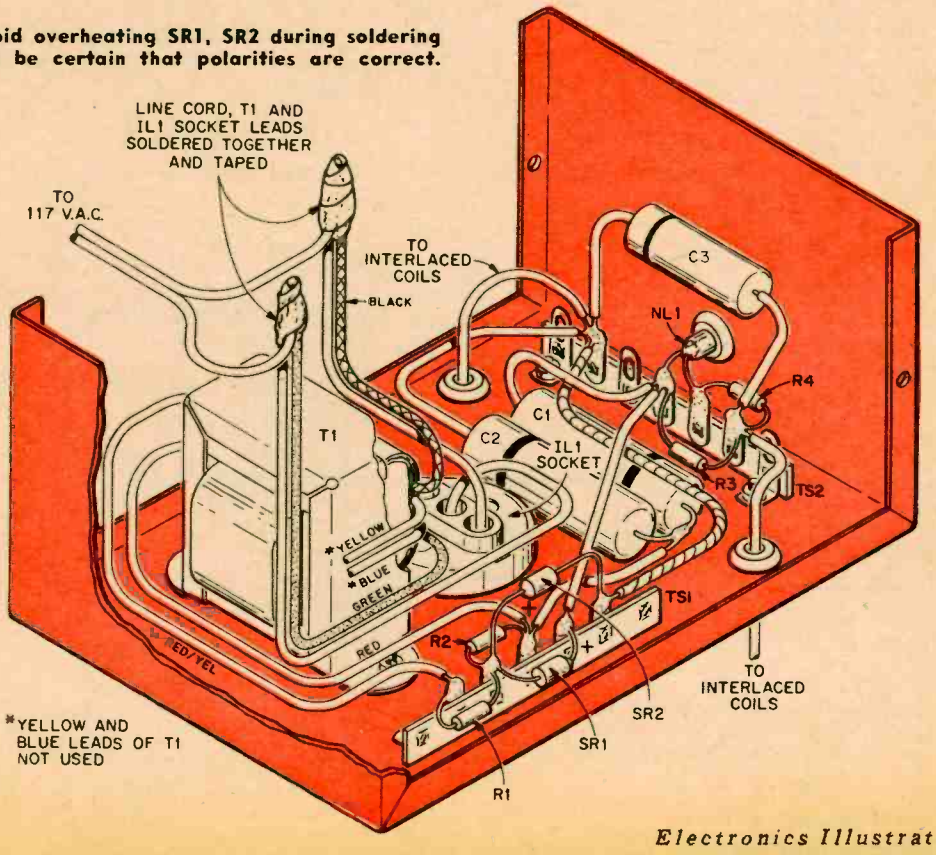
Cramped quarters require construction care. Due to high voltage, parts should be isolated.

expensive photo-flash transformer is connected, through a voltage divider comprising R1 and R2, to two silicon diodes (SR1 and SR2) arranged as a voltage doubler. (R1 and R2 prevent the peak secondary voltage from exceeding the peak inverse voltage rating of SR1 and SR2.)

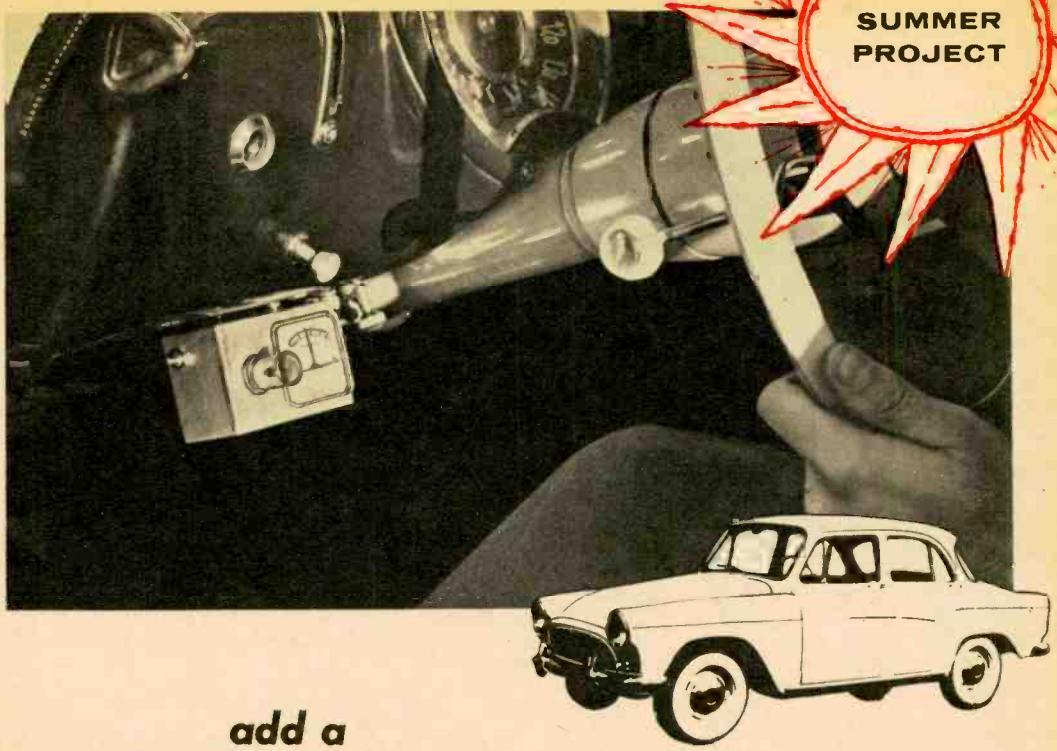
SR1 and SR2 charge capacitors C1 and C2 and since C1 and C2 are in series, their combined voltage, applied to C3 through R2, is near 800 volts. This voltage is applied to the interlaced coils and has a lethal effect on insects. C3 is so small, however, that the energy content is too low to harm a human; also, note that the coils are isolated from the voltage doubler by a 2.2-megohm resistor (R3).

Neon lamp NL1 and R4 add an interesting feature. When an insect gets across adjacent trap wires, the current flowing through him develops sufficient voltage drop across R3 to light the neon lamp. One insect—one quick red flash! The reason for adding the neon indicator was not merely one of effect, however. Occasionally a bug sticks to the wires after being killed; should this happen the indicator will remain on. When the insect is removed with a soft brush, the [*Continued on page* 104]

Avoid overheating SR1, SR2 during soldering and be certain that polarities are correct.



SUMMER PROJECT



add a

Temperature Gauge to Your Car

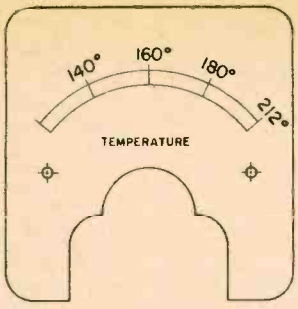
Early warning from direct reading unit will prevent costly engine repairs due to overheating.

By Harry Kolbe

THERE I was merrily cruising along the New Jersey turnpike, when suddenly my engine began missing badly and I started to lose speed and coasted to a stop. On opening the hood, I was greeted by a blast of heat, smoke, and smoldering gaskets. Later, at the garage I was told that the engine was suffering from a ruined water pump, a burned-out piston and head gasket, a badly warped cylinder head, etc., etc. All due to overheating. Yet when I bought the car I was told that it would *never* overheat. In fact, the manufacturer hadn't even bothered to include a temperature gauge.

It's true the car won't overheat if the cooling system *is functioning properly*. In my case, however the water pump gasket had ruptured and the water had drained out of the cooling system. A temperature gauge would have indicated that the engine was beginning to overheat and I would have been able to shut the engine off before any major damage was done.

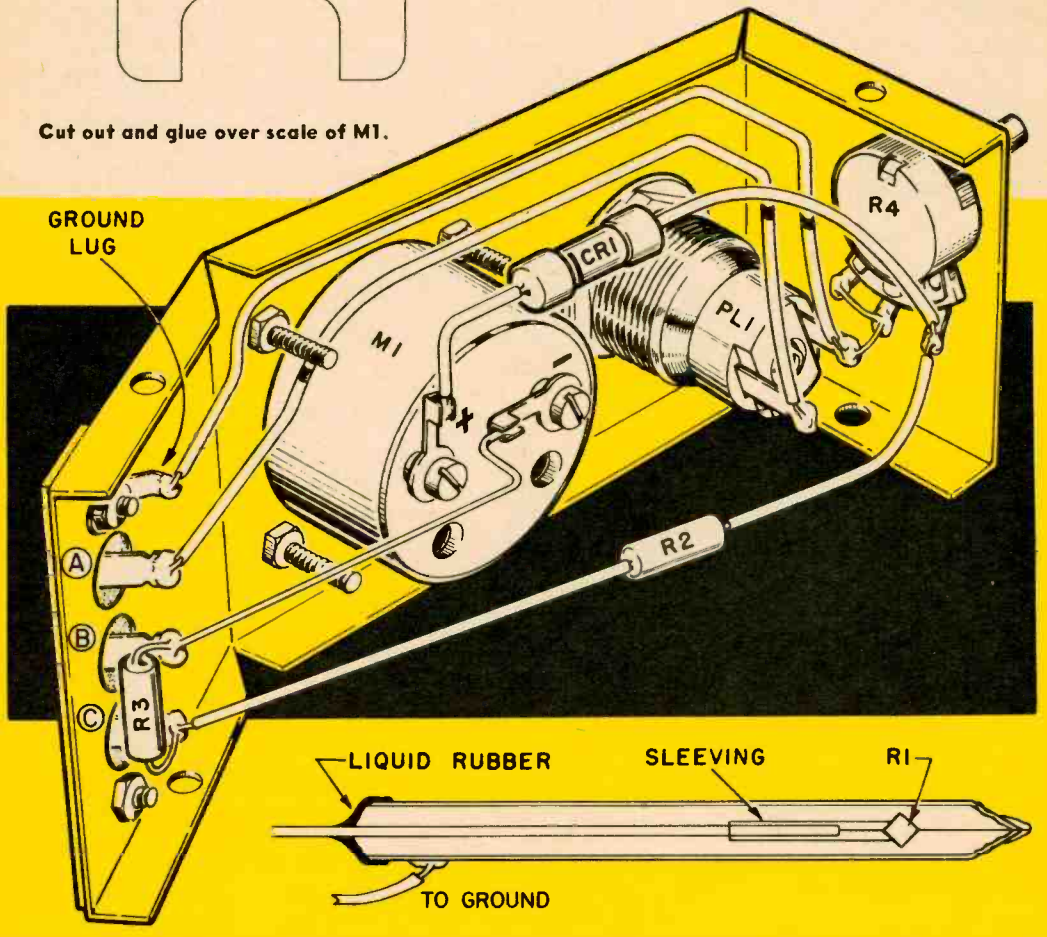
For those who own cars that either have *no* temperature gauge or only a temperature warning light (warning lights can become loose in their sockets, or defective, and you would never know it), here are details on a



Cut out and glue over scale of M1.

PARTS LIST

R1—1000-ohm thermistor (Glennite 31TD2)
R2,R3—4,700 ohms, ½-watt resistor
R4—5,000 ohm miniature potentiometer
CR1—1N34 diode
M1—0-1 ma miniature meter
PI1—panel light (Dialco 4-1840 or equiv.)
1—3¼"x2⅛"x1⅝" Minibox
1—piece of copper tubing ¼" O.D. x approx. 12" long



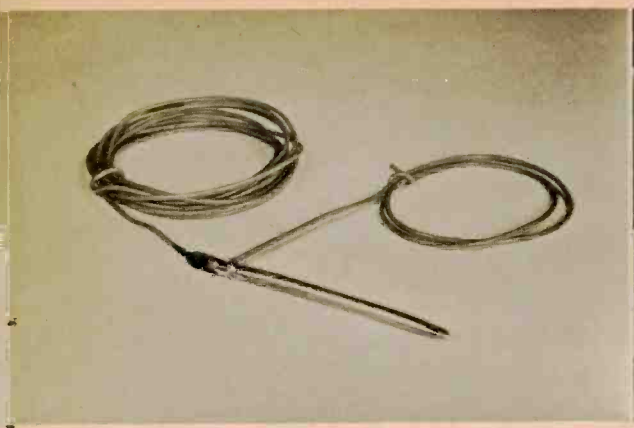
One thermistor (R1) lead goes to gauge, other into probe tip which is crimped and soldered.

highly accurate temperature gauge that can be built for under five dollars.

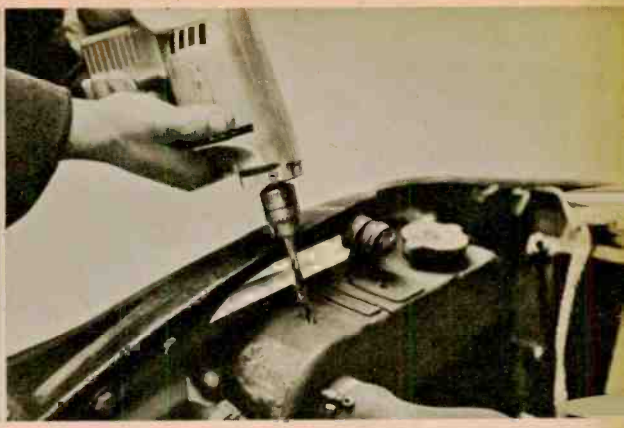
Construction

The gauge consists of two separate assemblies: the probe, which is installed in the engine radiator, and the meter which is mounted on or under the dashboard.

In making the probe, one must first determine its length, which will vary depending on the car. Insert a ruler into the radiator and measure the distance between the top of the radiator element and the radiator housing. This measurement, plus 1½", will be the probe length. Now cut a section of ⅜" outside-diameter copper tubing to the previously determined probe length. Cut



Probe ready for installation. Short coil of wire is for ground connection at chassis bolt.



Mount probe over water return inlet. Be sure hole is well sealed and wire is away from fan.

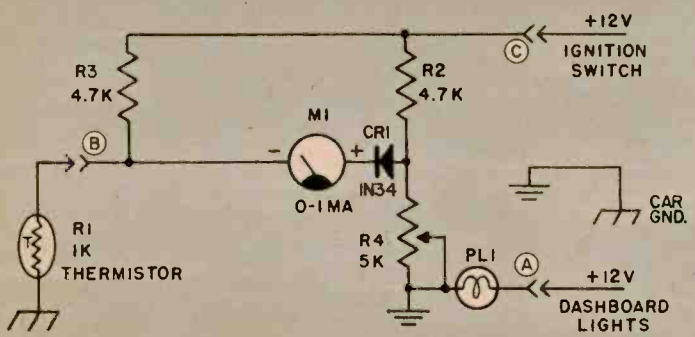
one lead of thermistor (R1) to ½". Solder this lead to a piece of rubber-insulated wire long enough to reach from the radiator to the dashboard. Slip a 2" length of sleeving over the wire so as to completely insulate the connection between the wire and the thermistor. Do not cut the other lead, but bend it forward so when the thermistor is inserted, the free end goes in first. Slide the thermistor down the tube until about 1" from the end. The free lead of the thermistor will extend about 1¼" beyond the end of the tube. Crimp the tube end with a pair of pliers, completely seal it with solder, and clip off the protruding thermistor lead. Solder a ground lead about ¼" down from the other end of the tube, and then seal the tube with liquid rubber.

The meter and associated circuitry are mounted in a 3¼" x 2⅛" x 1⅝" Minibox. In addition, a hooded panel light is installed to provide meter illumination for night driving.

Calibration

Remove the plastic case from the meter, unscrew the two tiny bolts which hold the face plate, and slip out the face plate, *being careful not to damage the meter needle*. Cut out the new meter scale and cement it to the plate with rubber cement. Replace the new scale and plastic case front.

To calibrate the meter, connect it to the probe and a 12-VDC source. Immerse the thermistor end of the probe in boiling water and adjust the calibration pot (R4) so that the meter reads 212° (full scale). [*Continued on page* 101]



R4 of bridge circuit is adjusted so M1 deflects full scale when R1, in probe, is at exactly 212°.

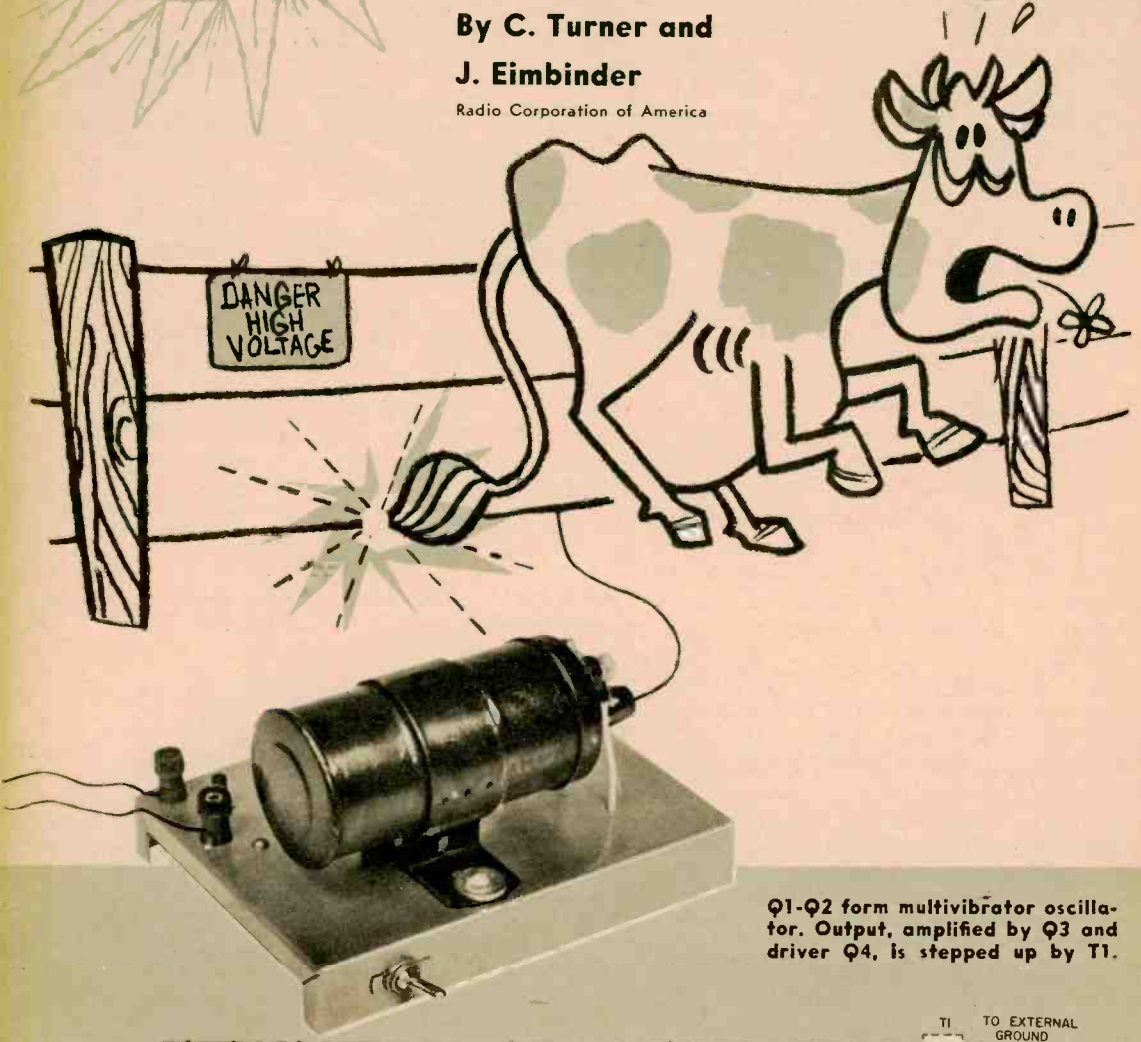
SUMMER PROJECT

build a transistorized

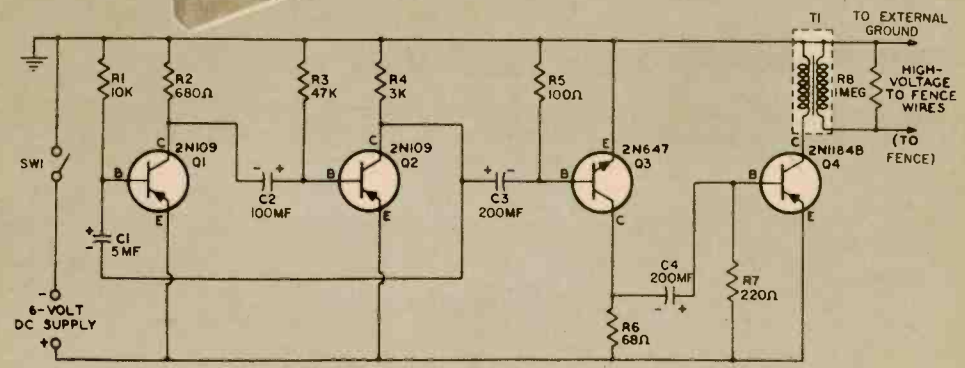
Fence Charger

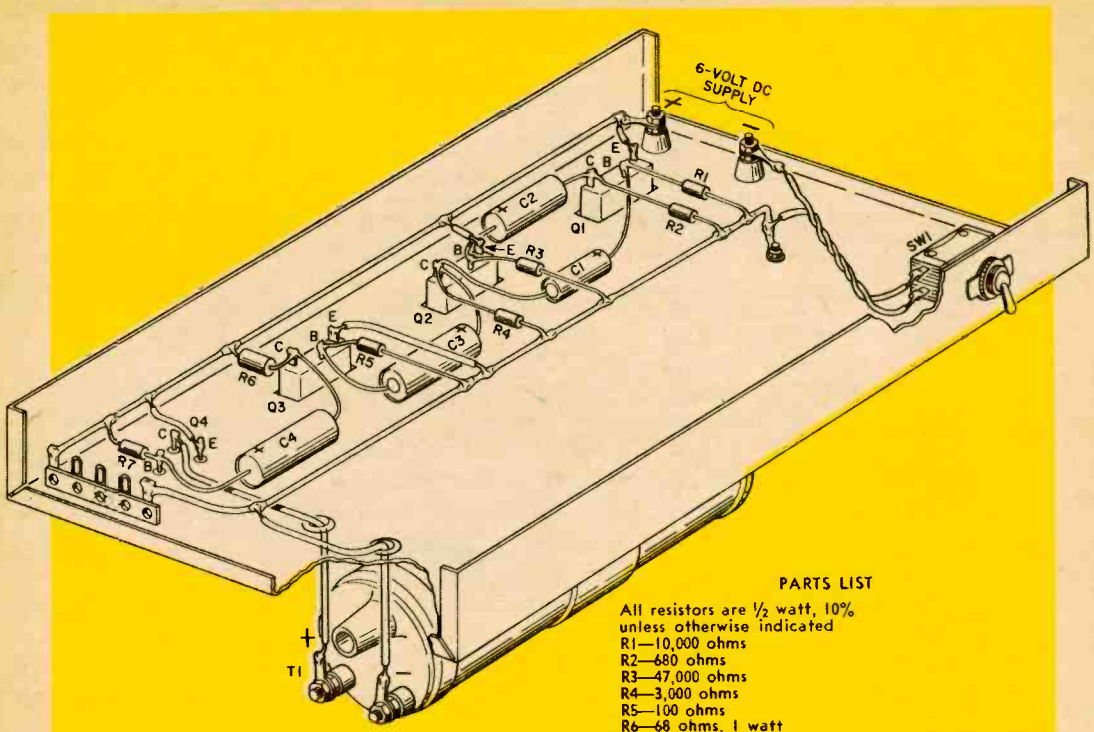
By C. Turner and J. Eimbinder

Radio Corporation of America



Q1-Q2 form multivibrator oscillator. Output, amplified by Q3 and driver Q4, is stepped up by T1.





Connect length of well-insulated wire from T1's high-voltage jack to fence. Observe T1's polarity markings. Chassis is grounded.

PARTS LIST

All resistors are ½ watt, 10% unless otherwise indicated
R1—10,000 ohms
R2—680 ohms
R3—47,000 ohms
R4—3,000 ohms
R5—100 ohms
R6—68 ohms, 1 watt
R7—220 ohms
R8—1 megohm
C1—5 mf, 6-volt electrolytic capacitor
C2—100 mf, 6-volt electrolytic capacitor
C3,C4—200 mf, 6-volt electrolytic capacitor
SW1—SPST switch
T1—6-volt automobile ignition coil
Q1,Q2—2N109 transistor
Q3—2N647 transistor
Q4—2N1184B transistor
Misc.—6-volt storage or "hot-shot" battery. 7"x6"x1" chassis, insulated binding posts, transistor sockets, buss wire, hdwe.

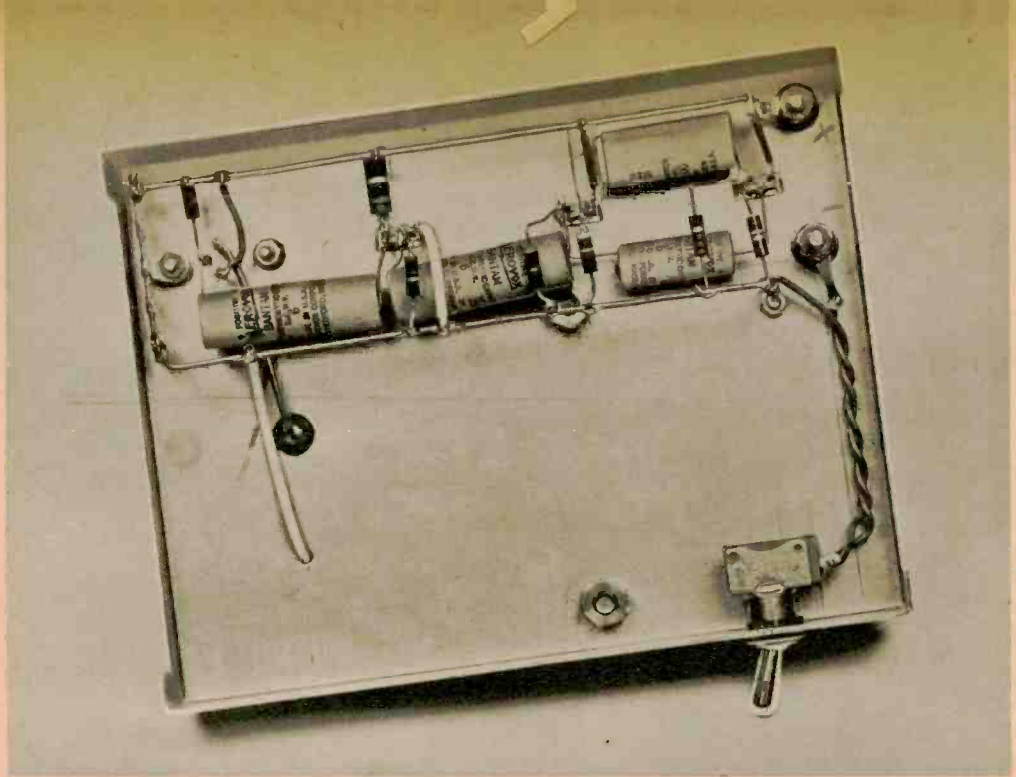
Guaranteed to keep those gate crashers down on the farm.

ARE you one of EI's farmer-type readers, whose livestock believes that the grass is greener in the other fellow's field—and is willing to go right *through* the fence to get to it? If so, you've doubtlessly investigated the possibilities of the electrified fence. Its intention is not just to make the Jerseys bounce, but to save your fences and finances by training the animals to the idea that the fence area is *verboten*.

EI's fence charger is guaranteed not to sour the milk of the most sensitive bovine, since the high-voltage, low-current pulses it generates are harmless to man and beast. And if you already own a fence charger you'll appreciate the absence of trouble-prone mechanical moving parts in EI's all-transistor unit. Hooked up to a standard 6-volt storage battery, this highly efficient device requires nothing more than a fence (properly insulated) to get to work.

For the homeowner, this unit may prove the solution to dog vs. garbage can problems. Although the electric shock is not harmful, it acts as a deterrent to further contact.

Because humans as well as animals may come in contact with the fence,



Both binding posts in upper right corner are insulated from chassis. Lower buss is common ground.

the average current for the electric-fence control circuit described in this article is at a relatively low 8 ma. In any case, the fence should be posted to warn of its shock hazard.

The transistorized circuit delivers a 500-microsecond-duration pulse of approximately 5000 volts every 1.25 seconds. Elimination of resistor R8 will increase the output voltage to 6000 volts; reduction of R8 to 100,000 ohms or 60,000 ohms will decrease the output voltage to 2,200 or 1,500 volts respectively.

Circuit Description

Transistors Q1 and Q2 are connected in a multivibrator circuit which oscillates because of the feedback from the collector of Q2 to the base of Q1 via C1. The pulsed output of the multivibrator is fed to the NPN transistor (Q3) coupled to power output transistor Q4. The power pulses at the collector of Q4 are boosted by ignition coil transformer T1 to provide the high voltage.

Installation

The charger and the storage or hot-shot battery should be mounted in a waterproof box on or very near a fence post. The high voltage ground connection can be made by driving a 2'-3' length of bare pipe in the ground. The entire length of fence wire to which the charger is connected should be about ⅔ of the average height of the livestock and insulated from the fence posts.

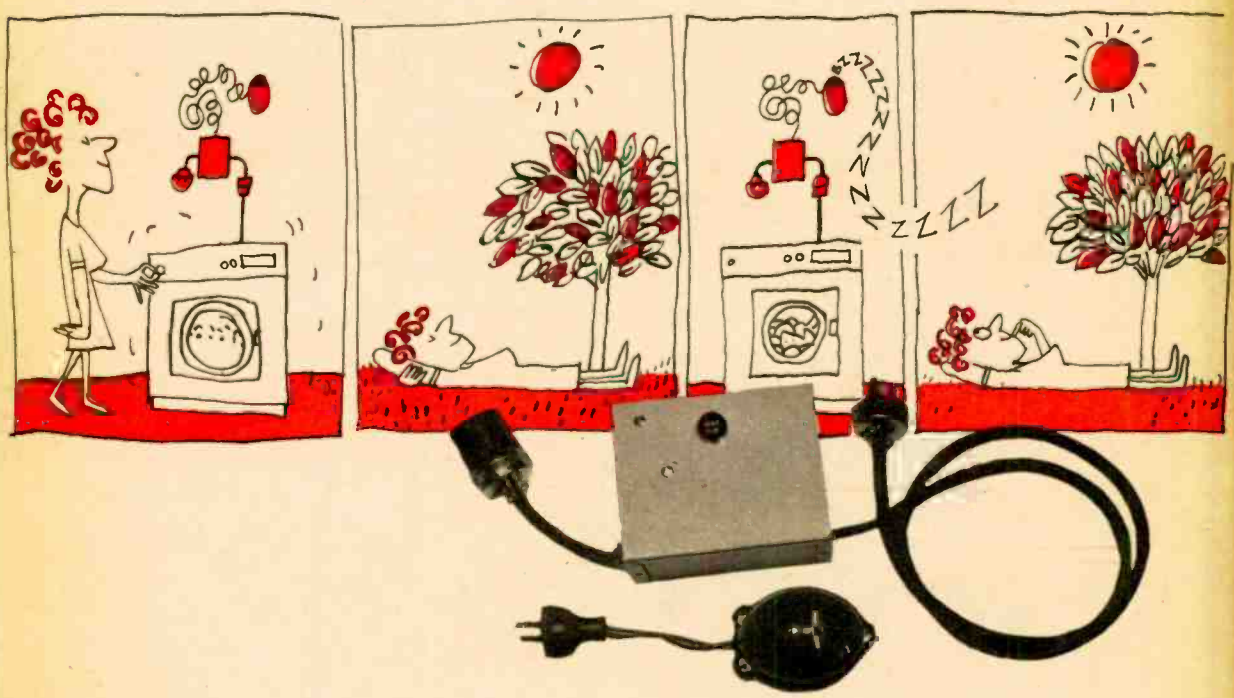
Q4, at far left, is supplied with mounting instructions and uses the chassis as heat sink.

SUMMER PROJECT

Step-Saver Appliance Alarm

Plug in this gadget and your washing machine will call you when its job is done.

By Paul Harvey



HERE'S a signal device that obviates the need of running down to the basement to hear if the washing machine is still running. Its outstanding feature is that you need not tamper with the appliance wiring in any way. Merely plug the alarm into the AC receptacle and transfer the plug of the washer to the alarm. The alarm works equally well with a clothes dryer, dish washer, broiler, or any other heavy-current AC device that has a timed operation cycle.

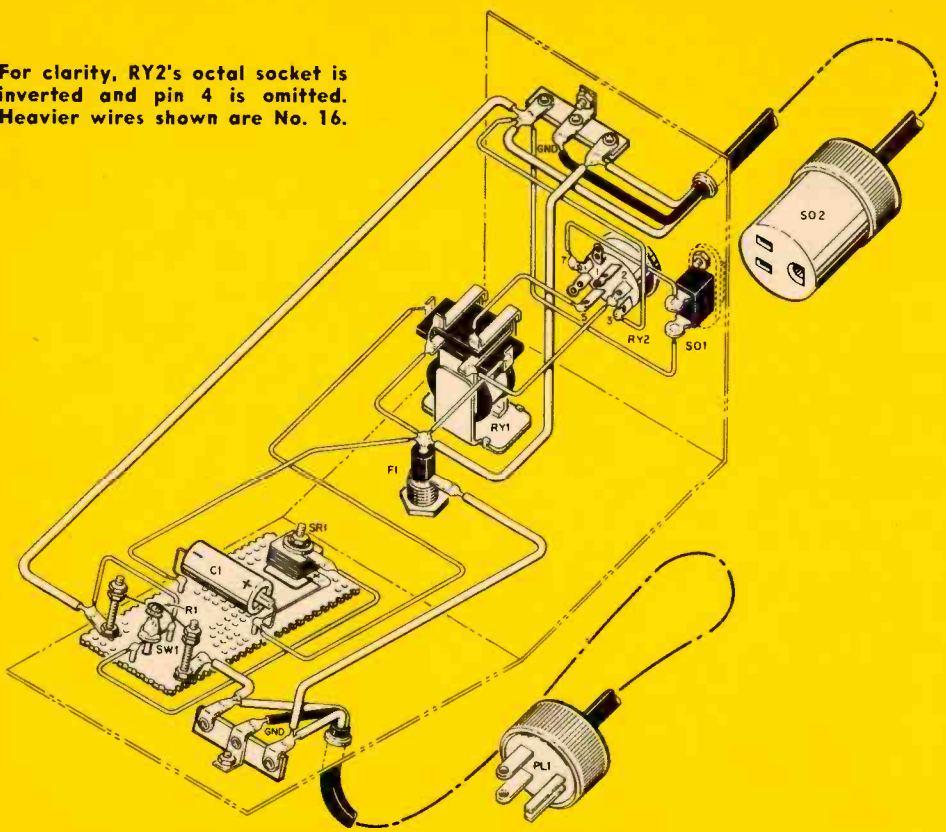
When the cycle is complete, the alarm sets off a buzzer which sounds loudly for about 5 seconds and then shuts off, ready for the next cycle. You know, therefore, when the appliance is through with its job and is ready for the next one.

Construction

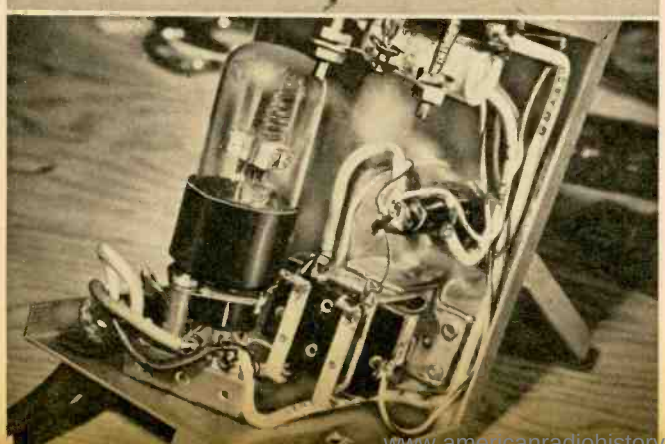
Check the plug on your washer. Since 1957, most have been equipped with three-prong plugs for safety grounding. If this is the case, PL1 and SO2 must be three-contact connectors of the *same* type as on the appliance. If your appliance is older, it probably has a standard 2-prong AC plug. In that case, you must be sure the appliance is grounded to a cold water pipe or its equivalent by using a three-wire cable to PL1. Ground the third wire to the outlet box.

The alarm circuit uses thermal-current sensing. A 4" length of nichrome wire from an old heating coil or a re-

For clarity, RY2's octal socket is inverted and pin 4 is omitted. Heavier wires shown are No. 16.



Thermal current-sensing element. Wire R1 gets hot and should be supported well above Bakelite base board. Center SW1 in R1.



Note how RY1's socket is mounted on spacers above metal cabinets. Vent holes should be drilled in the cover for cooling of R1.

placement element is used to make heater resistor R1. Double the wire back on itself and twist tightly to form a 2" length of twisted lead. Form the twisted lead into a two-turn loop by wrapping it around a ¼" drill. Now mount the coil on two 1¼" machine screws to hold it well away from the perforated base board.

Thermal switching action is accomplished by the bi-metallic strip taken from a fluorescent starter. Remove the starter from the metal case as shown and carefully break the glass from around the bi-metal starter element.

Using standard flea clips, mount the element in the center of the loop formed by R1.

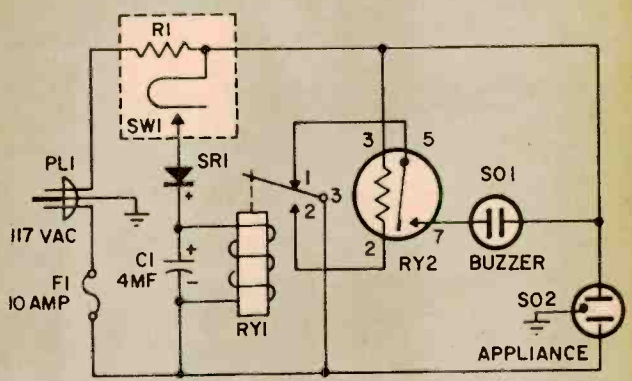
DC relay RY1, selenium rectifier SR1, and capacitor C1 keep the make-break current of the fluorescent starter contacts low. Thermal time-delay relay RY2 has a closing time of 15 seconds and a re-cycling time of about 5 seconds. The re-cycling time controls the "on" period of the buzzer as follows: when the appliance is turned on, the 117-volt buzzer, which is plugged into SO1, does not sound because the contacts of RY2 are open. As the washing machine starts, its current flows through R1 which heats and causes bi-metallic strip SW1 to close. This in turn, energizes RY1. RY2 now heats, and its contacts close 15 seconds later. The buzzer remains off, however, because contact 1 on RY1 is now open. When the appliance goes off SW1 opens de-energizing RY1 whose contacts transfer and apply power to the buzzer through the closed contacts of RY2. RY2 cools and its contacts open five seconds later restoring the system to its ready-off condition.

Starter used for SW1 is separated from base, soldered to flea clips, and centered in R1.

PARTS LIST

R1—Twisted heater-coil wire (see text)
C1—4 mf, 150-volt electrolytic capacitor
F1—10-amp, type 3AG slow-blow fuse and holder
PL—3-wire *heavy-duty* AC plug
RY1—Double-make, double-break relay. (Available for 95¢ plus postage from Edlie Electronics, Inc., 154 Greenwich St., New York 6, N. Y. Catalog No. BX1197)
RY2—Thermal-delay relay (Amperite No. 115NO15)
SC1—Chassis-mount AC receptacle
SC2—3-wire *heavy-duty* AC receptacle
SR1—65-ma selenium rectifier
SW1—Bi-metal fluorescent starter (see text)
1—5"x4"x3" Minibox
1—Octal socket
2—1" long spacers
1—⅜" long spacer
Misc.—Two 3-lug terminal strips, 2½"x2" perforated Bakelite board, 117-volt AC buzzer (Lafayette EL-86 or equiv.), Length of No. 16 3-conductor rubber-covered wire, etc.

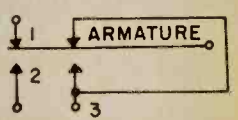
F1 should be large enough to carry current of the appliance. If RY1 is an AC relay, SR1 and C1 can be eliminated.



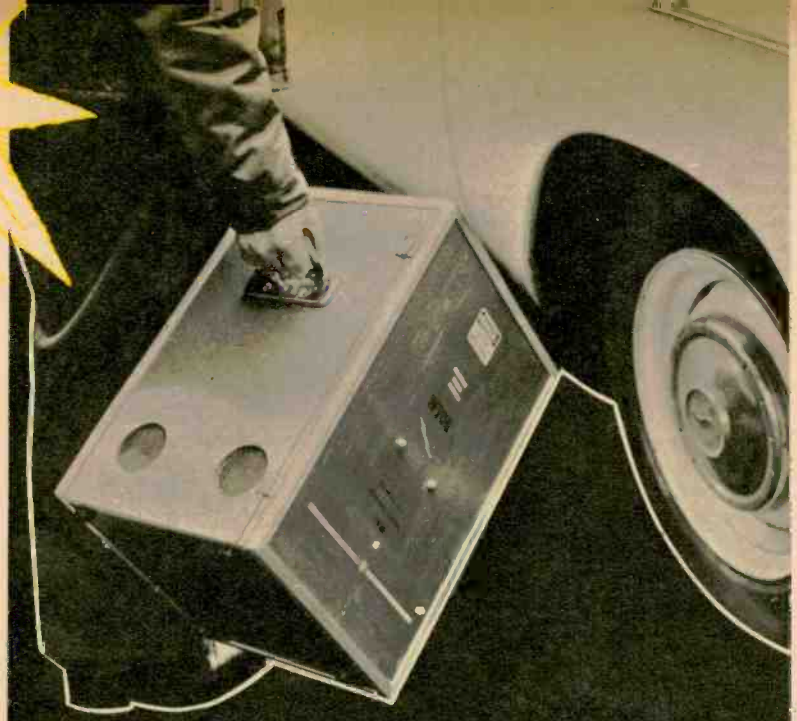
R1, SW1 HEATER-STARTER ASSY (SEE TEXT)

RY1, RY2, SW1 SHOWN IN DEENERGIZED (COLD) POSITION

WIRING FOR DOUBLE-MAKE DOUBLE-BREAK RELAY



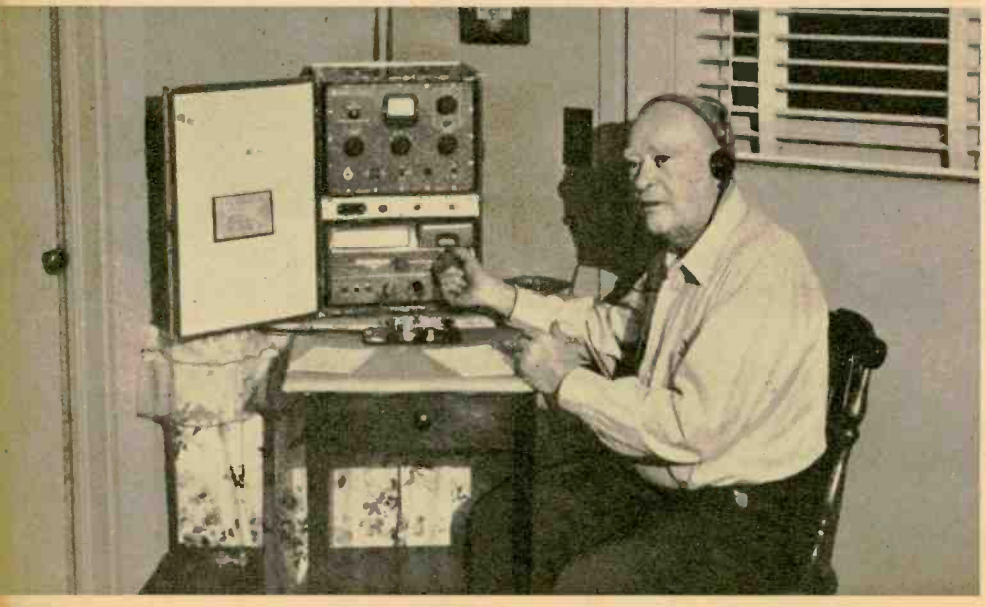
SUMMER PROJECT



Tag-Along Ham Rig

And don't forget to take the ham rig! Your whole station can tag along on a business or pleasure trip, putting you on the air from a hotel or motel room. You don't have to leave the air every time you leave your home!

The author has his CW gear set up and is ready to go on the air. Having equipment in the case makes for a fast start next morning.



You get extra pleasure out of those vacation and business trips if you take your ham station along!

By Howard S. Pyle, W7OE

WHEN you hit the road this summer on vacation, or if you are required to travel often in your business, why don't you take along your ham station?

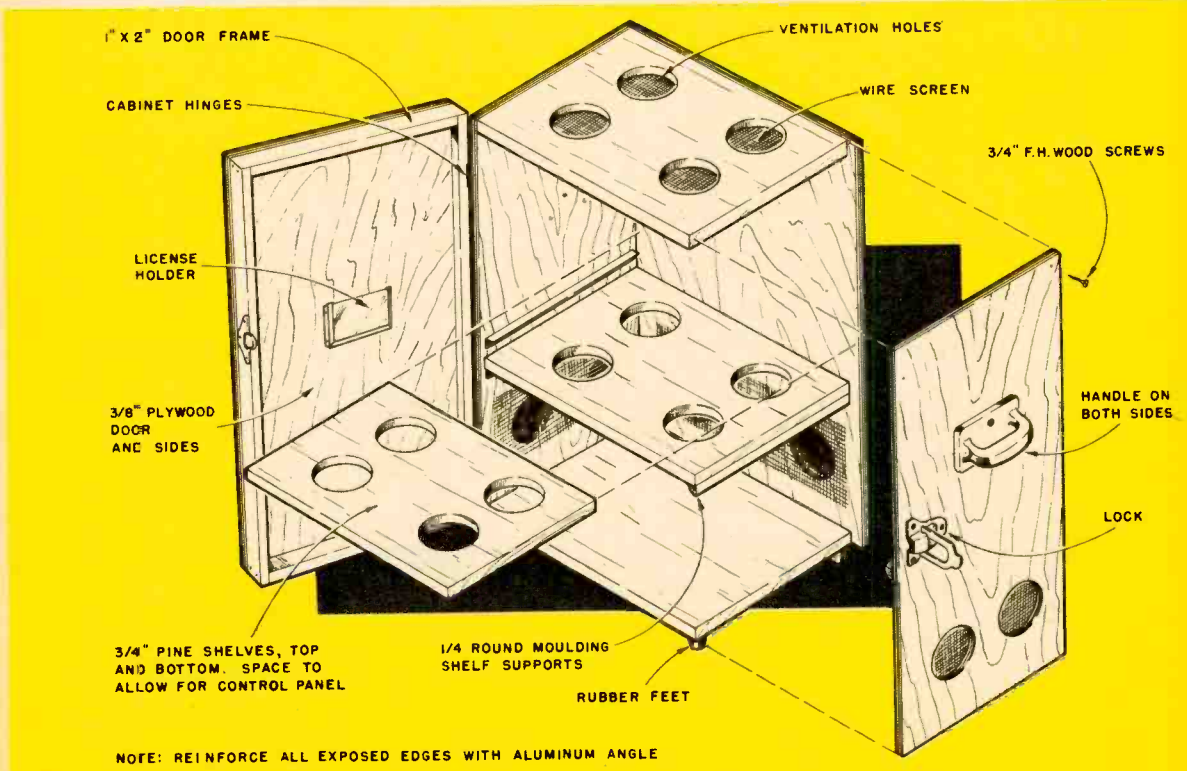
The idea may strike you as a little far out but I can tell you that it isn't. I've been taking my rig along for years!

A completely portable station fills a definite void for anyone on the road. Many hams simply leave the air when they leave home. Others have mobile gear in their cars, which is all right as long as you're in the car. But when you stop off at a motel or hotel you won't find much pleasure during the long evening if you sit huddled over the dash while your car is parked in a garage or out in front of your motel unit (with the engine idling on the high side to provide the needed juice). Misery soon triumphs and in you go.

You can invest in one of the auto-home units but they are pretty expensive. A less expensive way to stay on the air away from home is to build yourself a carrying case for your home station and take it with you (if your equipment is anything like carrying size). With station in hand, you can simply plug into the nearest 117-volt outlet, drop into an easy chair and you're in business!

I first devised a carrying case for my ham gear during my many years of government service, when the XYL and I traveled practically all the time through 11 western states. We often wanted to check into our home area traffic net because that gave us a contact with our

Diagram gives general instructions for case but you determine dimensions to fit your own rig.



Control panel fits into space between Knight-Kit 50-watt CW transmitter and the National SW-54 receiver on the bottom. Note key and phones.

daughter and her family. At other times, I just wanted to be on the air on the popular amateur bands (the bug had bitten me hard).

At first, we attempted to carry loose pieces of gear around, but that didn't work because of the packing and handling problem. In the town where we happened to be at the time, I went out and had a carpenter make up a case for my transmitter, receiver and related gear. It was a little expensive, but worth it. Since then, I've made up several cases to fit other gear that I've owned.

The instructions in this article for building a carrying case are necessarily pretty general. The case pictured was built for a 50-watt Knight-Kit CW transmitter and a National SW-54 receiver. But your equipment may differ, therefore, we aren't giving you dimensions. You'll have to figure those out yourself to fit your own components.

Only the most basic carpentry tools—a hand saw, square, hole saw or expansion bit, etc.—are needed for the job.

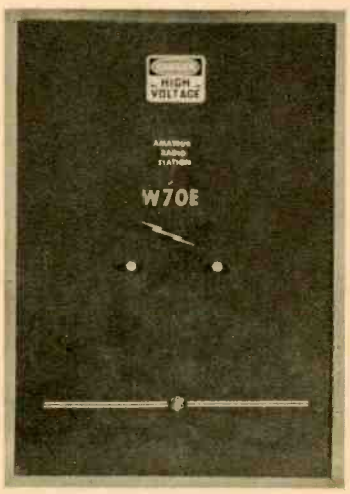
The best stock for the door, back and sides of the box, I have found, is ⅜" plywood. This is light to carry but still strong and rigid. The shelving and top and bottom are ¾" pine. I used ¾" countersunk flathead wood screws for the major assembly, and put quarter-rounds under the shelves to support them.

If you follow the general instructions shown in the drawing you shouldn't have any trouble.

At one time I was taking along both key and microphone, plus VFO and modulator. But I found those extra pieces just too much. Now I stick with crystals and straight CW, and I've found it strangely rewarding to be left without a mike. You keep up your speed if forced to use nothing but CW (and avoid perjuring yourself when you swear that you can do 13 wpm on your next FCC license application).

The control panel on my tag-along case is simplicity itself. I use a telephone-type lever antenna switch but a double-pole ceramic rotary will do as well. Other items on the panel are a jack-type fuse holder, a pilot jewel (for on-off power indication) and a power switch. The panel can be of Masonite, Bakelite or similar material.

On the back of my [*Continued on page* 104]



W7OE's case has his call letters and some other adornments on it. Make yours to fit your own taste.

Take Care of Your Tape!

By Norman Eisenberg

THE SUCCESSFUL and enjoyable use of tape recorders depends in large part on skillful handling of the tape. Even the best recorder is useless if it is given tape that has been mishandled by the owner.

Fortunately for the hobbyist, many accessories now on the market can help him care for his tapes and thus make recording and playback problems easier. Correctly used, these items make possible results that only a professional could have boasted a few years ago.

The first requirement of tape is that it be clean physically and electrically (magnetically). The former consideration involves dust, bits of tape coating, grease and the like picked up by the tape when used or handled. Obviously, the cleaner the recorder, the cleaner the tape run on it. So

Handy tape accessories shown here include white plastic leader tape at the top which can carry an identifying note, special cloth for cleaning tape at upper left, and stick-on label, at right, for the identification of tape reel.

Degaussers are designed to clean a tape electrically through the use of a strong magnetic field. Reel is put on spindle and rotated in case of the degaussers below, sold by (l. to r.) Olson, Microtran, Robins, Lafayette. Magneraser at left is unique in that it is simply held in the hand and moved over reel of tape.

the equipment—heads, capstans, pressure pads, rollers—must be kept clean. The tape itself can be cleaned with a special cloth, such as the Jockey Cloth marketed by Robins Industries. This cloth is wiped across the tape as it unreels from the tape deck.

An electrically clean tape is one that has no audible signal, as from previous recordings. The erase head on a good machine can remove most of this sound, but there are exceptions. Even top-quality heads have trouble with tape that has been too heavily recorded—overloaded with signal—or tape that has been stored too long. Fresh tape may have a residual noise level which shows up on your recordings as vague, annoying background noise.

Thorough magnetic cleansing can be done with a tape degausser, or bulk eraser. Such a device is simply a large electromagnet which sets up a strong field. A reel of tape, placed in the field, can be quickly restored to a neutral state. A reduction of as much as 6 db in residual noise has been claimed for degaussers, which in looks resemble small boxes with two holes on the top for different size reels. To use a degausser, you place the spindle in the proper hole, put on the reel, press the *on* button and rotate the reel a few times by hand.

Typical degaussers range in price from the $12.50 Olson T-272 to the powerful, professional model 710 by Aerovox, listing at $49.95. Audiotex and Robins offer $33 models. The Microtran HD-11 sells for $27.50. Lafayette's powerful and rugged ML-120

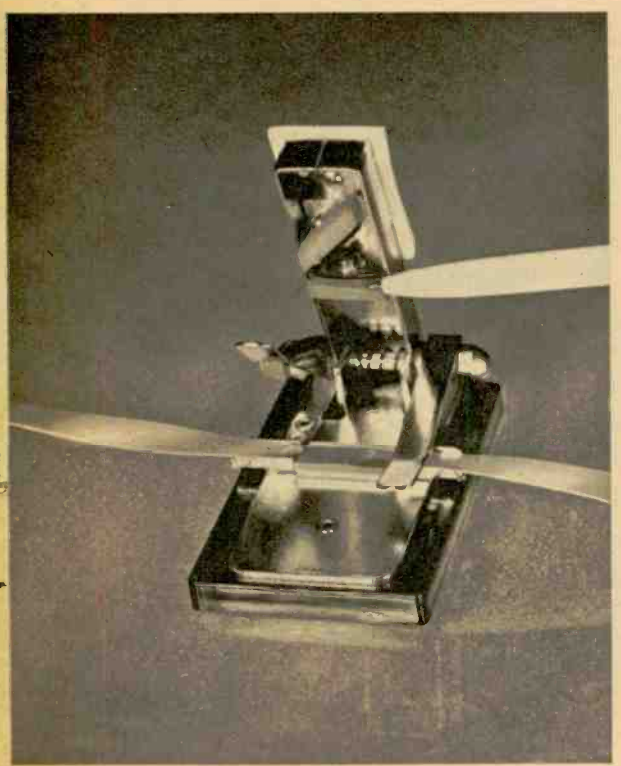
Special mailing boxes are handy for the tape correspondence fan, come in variety of sizes.

sells for $18.95. The Magneraser by the Amplifier Corp. ($18) is unique in that it is held in the hand and moved over the reel of tape.

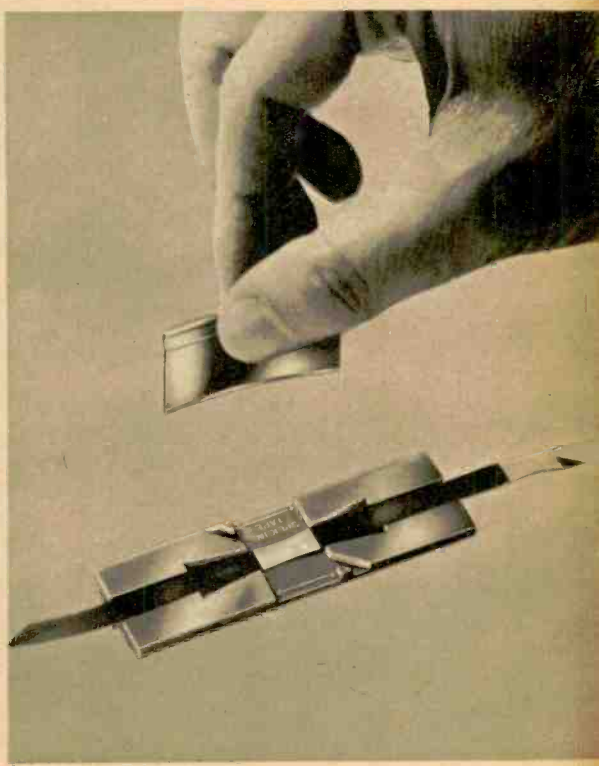
Tape breakage once was a common problem. But stronger, more tensile tapes and improved braking and handling by recorders have helped a great deal, although it still can happen. When tape does snap, it must be spliced. Splicing, of course, is also a major part of editing tapes, in which sections are removed or re-arranged or new material is added. Indeed, ease of editing has helped make tape the master recording medium for professionals, as well as a source of fun for amateurs.

Tape can be spliced with a pair of scissors or a razor blade, but devices made expressly for this purpose do a neater, faster job, and do it easier. A good splice must be secure, the ends of the joined sections fitting together snugly without overlap or exposed areas. And the splicing tape that joins the two sections must not project beyond the edges of the recording tape. In other words, a spliced tape should present to the recorder heads a surface almost as smooth as that of an unspliced tape. To accomplish this, it's an excellent idea to get some kind of tape splicer.

Many types of splicers are available but basically each has a means for holding the tape ends in place and a guide for cutting (and sometimes trimming) the splice. The most elaborate splicer is the Skila Model K-1 by the F. Reiter Co. Priced at $69.75, it is a precise, automatic machine intended for professionals. Most hobbyists find lower-priced models suit their needs. Robins offers a choice of splicers from an industrial model at $55 to a hobbyist model at $1.75. [*Continued on page* 99]



Hobbyist's tape splicer, the Rystl Sr., boasts three blades to perform miter and trim cuts. Pencil points to trim blade. Price is $3.49.

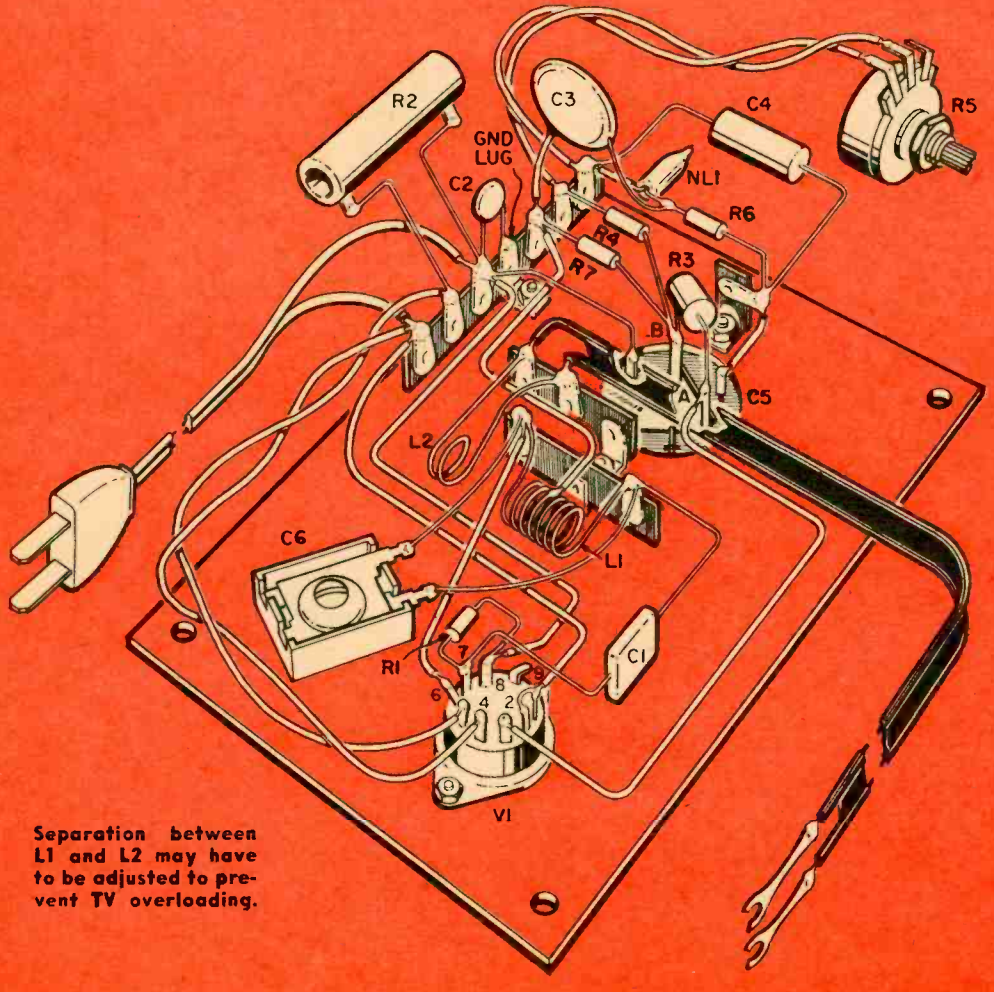


Most basic of all the tape splicers are the blade-and-block affairs. This Robins model has a curved cutting blade, sells for $1.75.

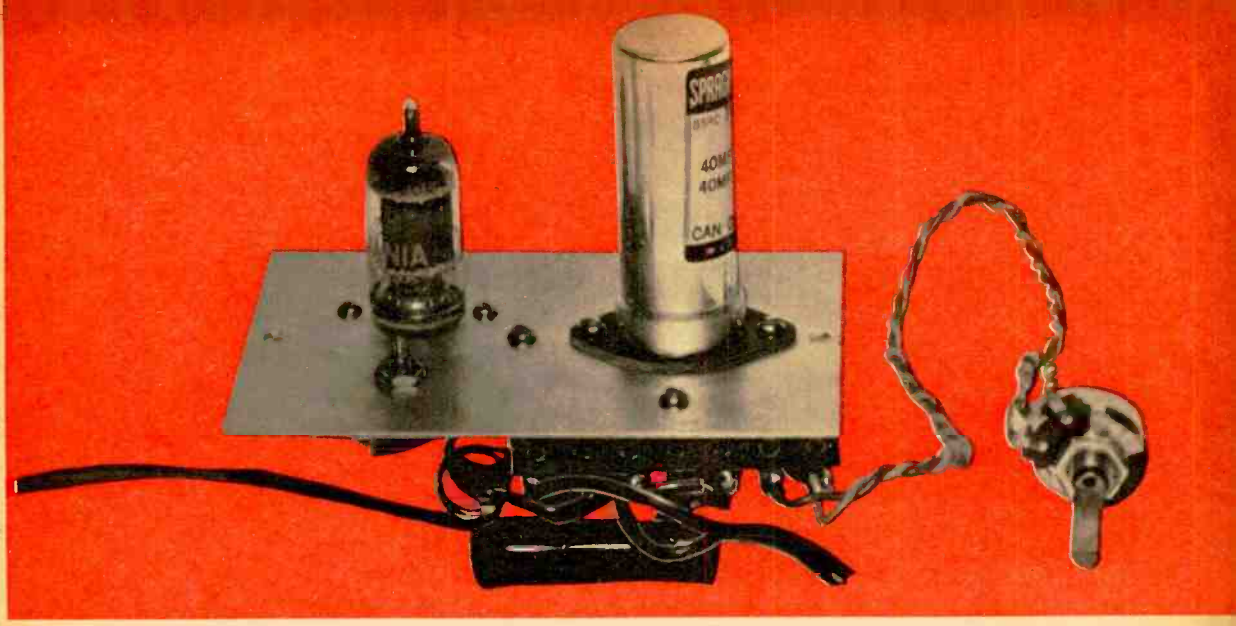
TV Patterner

One-tube unit generates test pattern for perfect height and linearity adjustments.

By John Potter Shields



Separation between L1 and L2 may have to be adjusted to prevent TV overloading.



Can of C5 is connected directly to AC line and is "hot." A fiber mounting wafer isolates chassis.

TURN on your TV set and take a good look at the picture. Do the people on the screen suffer from over-long legs and squashed heads? And are the wheels on the old covered wagon a bit egg-shaped? If these troubles plague your TV, then you should build the TV Patterner.

The Patterner will provide an adjustable number of stationary horizontal lines on the face of your TV picture tube which enable you to accurately adjust your set for the best picture size and linearity. All you have to do is to connect the twin-lead from the Patterner to the antenna terminals of your set and adjust the vertical size and linearity controls until the picture fills the screen completely and the horizontal lines are evenly spaced as shown. The gadget also provides a variable frequency audio signal which can be used to adjust the sound section of the TV receiver. The Patterner is easy to build and even if all new parts are used, its price will be less than a ten-dollar bill.

Construction

The author's Patterner is constructed on a piece of 4" x 6" sheet aluminum. No housing was used as the author's model was to be mounted with several other pieces of test gear in a larger cabinet. It would be best to mount the chassis shown in some sort of insulated cabinet. Coils L1 and L2 are ½" in diameter and are wound from #18 tinned copper wire. Both coils are supported by their leads from tie lug strips as shown.

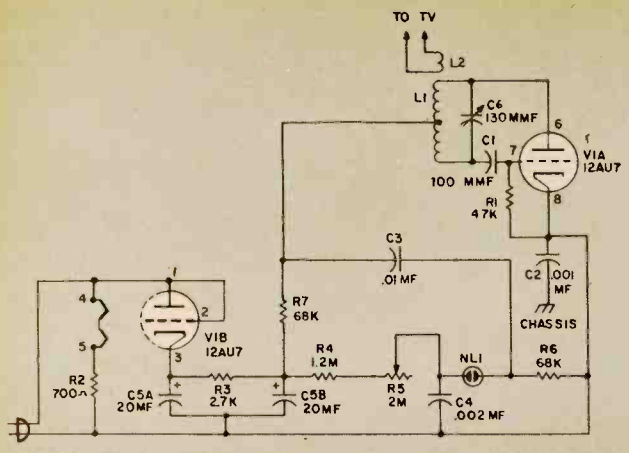
Adjustment

To use the Patterner, connect its twin-lead output cable to the antenna terminals of your TV receiver and switch the receiver's channel selector switch to any vacant channel between 1 and 7. Next, adjust C6 until the Patterner's signal appears as a number of horizontal lines on the face of the picture tube. Adjust R5 for the desired number of horizontal lines. It may be necessary to vary the spacing between L2 and L1, so as not to feed too strong a signal to the receiver which might cause overloading.

You will find that R5 will vary both the number of lines and the pitch of the audio signal. If more horizontal lines are desired, it is only necessary to decrease the value of capacitor C4. This will decrease the R-C time constant of the relaxation oscillator and raise its operating frequency.

Circuit Operation

V1A is connected as a series-fed Hartley oscillator producing an RF signal whose frequency is set by C7 within



PARTS LIST

R1—47,000 ohms, ½ watt
R2—700 ohms, 20-watt wirewound
R3—2,700 ohms, 2-watt
R4—2.2 megohms, ½ watt
R5—5 megohm linear-taper potentiometer
R6—100,000 ohms, ½ watt
C1—100 mmf, 400-volt mica or disc
C2—.001 mf, 400-volt mica or disc
C3—.01 mf, 400-volt mica or disc
C4—.002 mf, 400-volt mica or disc
C5AB—Dual 20 mf @ 150-volt electrolytic (can type with insulating plate and sleeve)
C6—Trimmer capacitor, 15-130 mmf (value not critical)
L1—7 turns No. 18 tinned copper wire; ½" diameter
L2—2 turns No. 18 tinned copper wire; ½" diameter spaced approximately ½" from L1
V1A/B—12AU7 tube
NL1—NE-2 neon lamp
Misc.—9-pin tube socket, hdwe., 4"x6" piece of sheet aluminum, length of TV twin-lead, terminal strips

RF signal generated by V1A is pulse modulated by modified relaxation oscillator that includes NL1.

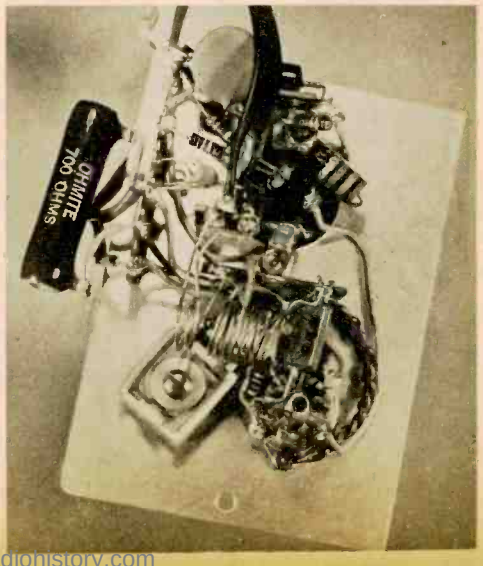
the range of lower TV channels. L2 is a pickup coil which couples the RF signal from L1, via the twin-lead, to the antenna terminals of the TV receiver.

The RF signal is pulse modulated by a modified relaxation oscillator consisting of R4, R5, R6, C4 and neon bulb NL1. When C4 charges to the firing voltage of NL1, NL1 "fires" and discharges C4 through series resistor R6 producing a sharp pulse across R6. This pulse is coupled by C3 to the oscillator side of R7, where it plate-modulates the oscillator. The modulating pulse frequency is varied by R5 to produce a frequency which is a multiple of 60 cycles. If this frequency is twice 60 cycles (120 cycles) two horizontal lines will appear on the picture tube face. If the frequency is three times 60 cycles (180 cycles) three lines will appear, etc. With the values given in the schematic, up to twelve lines can be produced. This number can be increased by changing C4 as was explained earlier.

This type of modulation also produces considerable frequency modulation of the carrier so that the signal can also be received by the sound section of the TV receiver. Varying R5 will vary the frequency of the audio output signal. By the way, the RF oscillator's harmonics can be received on an FM receiver which makes this a handy gadget for occasionally troubleshooting an FM set.

The power supply is conventional, consisting of the second half of the 12AU7 (V1B), connected as a half-wave rectifier. The two heater sections of V1 are connected in series and supplied directly from the line through series dropping resistor R2. Since B-minus, common to one side of the AC line is not connected to the chassis, C2 is used to ground the chassis and RF signals to B-minus. However, the can of C5A/E is connected to one side of the line and will be hot. Cover it with an insulating sleeve or tape to prevent shocks.

Underside view. If the patterner is built in metal box, drill ventilation holes around R2.



CB To Ham

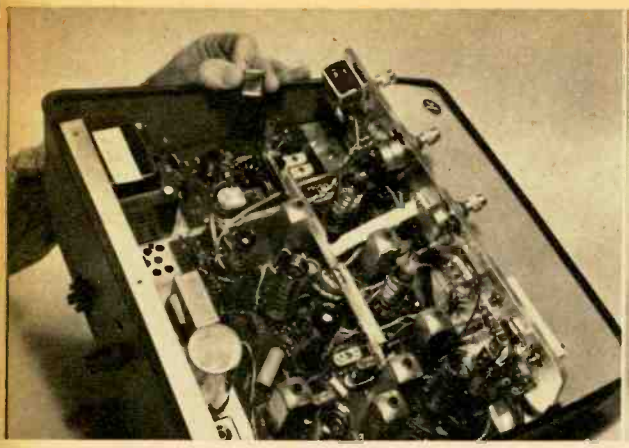
Converting yourself and your equipment from the Citizens Band to the Amateur Service can be easy!

By Robert Hertzberg, W2DJJ

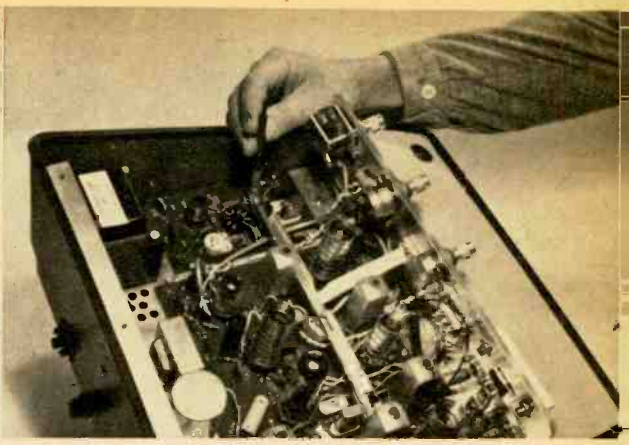
THERE are several reasons why a Citizens Band licensee might want to convert himself and his equipment to amateur radio operation.

If your true interest lies in the field of electronics or radio experimenting, the reason for the conversion is obvious. Any experimenting done on the CB bands is severely limited. Your frequencies are restricted, you cannot use more than five watts, you may not make adjustments in the transmitter itself and the FCC requires you to limit your communications to local stations. If you want to experiment you *must* become a ham. As a ham, you have an open choice of more than a dozen frequency bands, you can use any power up to 1,000 watts, you can build and experiment with equipment to your heart's content and you are free to talk with other hams anywhere in the world.

CB radio certainly has its attractions and it is a vital new link for necessary communications. But few would deny that a ham license gives you more prestige and makes you feel that you have accomplished more than does a CB ticket. Converting from CB to



Knight-Kit C-27 CB transceiver is a good unit to convert to ham use. Transmitter section requires new crystals, which merely plug in.



Tuning coil slugs are shown being adjusted for maximum output on ham band. The receiver section also must be trimmed for 10-meter use.

ham radio, then, can be a matter of self-improvement.

Or perhaps after getting into CB radio you have made a belated discovery that what you really wanted all along was ham radio.

Whatever your reasons, the switch from one service to the other need not be difficult for you. The ham license tests really are quite easy. Soon after learning this, you'll be busy practicing code (as the two youngsters are doing on the opening page of this article) and reading up on the FCC regulations.

But what about your CB equipment? If you decide not to continue with CB radio, can you salvage your rig for use on the ham bands? This article will attempt to give a general answer to that question. Let's see where you stand.

Transmitters-Receivers. Virtually all CB units are transceivers. That is, many of their circuit elements are used for both transmitting and receiving. The lower-price sets, the ones that are sold in the greatest number, employ receiving circuits of the super-regenerative type. While these are quite sensitive, they are also notoriously noisy and broad in tuning.

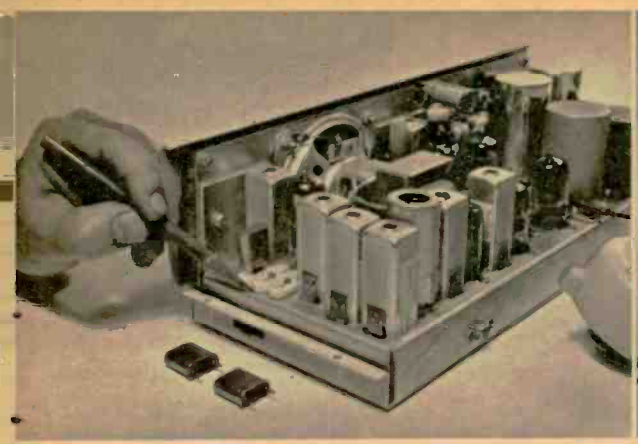
It is a sheer waste of time, energy and money to attempt to rework super-regens for ham purposes. If you have one in good condition, why not simply hold onto it? You might want to use it again for Citizens Band operation. Of course, you may hold CB and ham licenses at the same time. The two activities have little to do with each other.

Far superior are the CB transceivers using super-heterodyne circuits in the receiving section. These are sensitive and, more importantly, much more selective than super-regens. You can make these sets operate in either the 6- or 10-meter amateur band by changing a few small components. This is an interesting, instructive and relatively simple undertaking if you have any background in electronics, which you must have acquired by now through your CB experience.

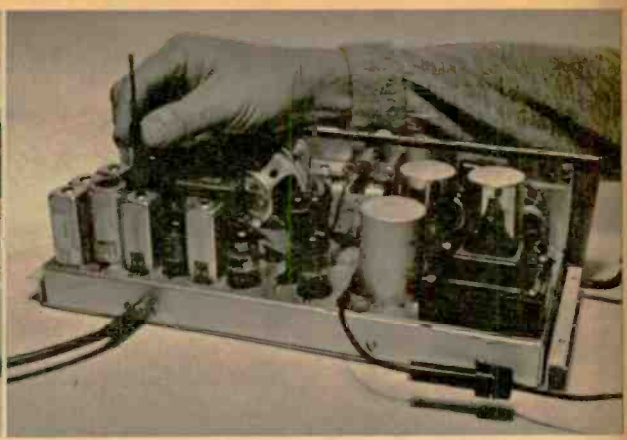
If you obtain the usual general-class ham license, probably the best idea is to revamp your CB set for the 10-meter band, which is effective for both local and DX communication. In most cases you will have to buy only one or two new quartz crystals (available by the bushel at low prices) and re-adjust a couple of minor controls.

As alternatives you can, of course, retain the CB equipment unchanged, sell it for cash or apply it against the purchase of ham gear. Super-het type transceivers have good turn-in value, and horse-trading is the usual order of the day in stores that handle both ham and CB merchandise.

Antennas. You're in luck here be-



A Heathkit CW-10 does well on 10-meter band. Pencil points to three crystal sockets which can give you three transmitting frequencies.



The tuning coils are inside shield cans in the Heath equipment. They can be reached easily with alignment tool for trimming to 10 meters.

cause the standard CB whip antenna needs only to be shortened a couple of inches to make it perk beautifully on the 10-meter band. To do this job properly you need a grid-dip meter, but you'll buy this anyway for many applications in your ham shack.

Perhaps you were an ambitious CBer and invested in a beam antenna and a rotator to move it around. You'll have to shorten the elements a bit and experiment with their spacing but this, too, is easy. You'll find a beam of enormous advantage in ham communications. For transmitting, it provides a large increase in effective power by concentrating the radiated energy like a searchlight. For receiving, it works in reverse by gathering signals from one direction while attenuating those from other directions.

Microphones, Power Supplies, etc. All just as good for ham as for CB purposes!

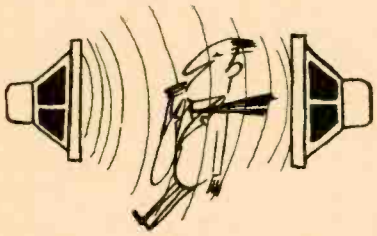
At any event, a revamped CB set is only intermediate or stop-gap equipment in your ham program. You'll learn quickly that [*Continued on page* 108]

After you pursue ham radio a while you may have a beautiful shack full of equipment like W9IOP, who is Lawrence LeKashman, South Bend. He has two receivers and four transmitters.

EI's Hi-Fi Doctor . . . .

Second Thoughts on Stereo—Part Three

LAST month I plugged for "bounced-off-the-wall stereo" as a solution—at least for the time being—to the problem of stereo speaker placement. I'd like to start off this time with a few more words on how to get the most out of your stereo speakers.



If you've ever complained that your stereo seems to have a "hole in the middle," chances are you've put the blame on something beyond your control—like your wife, who insists on putting one speaker in the living room and the other in the back yard. But unless your stereo speakers *are* that far apart, I'd be tempted to bet the slim contents of my wallet that the real reason for that "hole" is that your speakers are out of phase. The thin-sounding stereo that issues from out-of-phase speakers *is* easy to confuse with the hole-in-the-middle effect, especially since the latter is now an honored part of stereo folklore. But it's better and easier to put the blame where it belongs, and take time to phase your speakers, than to shell out hard-earned cash for *extra* speakers to fill a nonexistent hole.

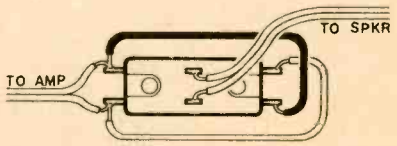
Getting your speakers in phase is actually a double-barreled job. First there's the simple but important matter of *acoustical* phasing. All this means is that you should take the time to locate both stereo speaker systems about the same distance from your usual listening spot, so that you get the sound from both at the same time. The further away you sit from your speakers, the less you have to worry about their being *exactly* the same distance from your listening position. And as long as you don't change your listening set-up, you have to worry only *once* about acoustical phasing.

Unfortunately, *electrical* phasing is something that stereo won't allow you to "set and forget." You have to *put* your speakers electrically in phase to start with, and then you have to *keep* them in phase.

The best way to phase your speakers initially is by listening to a *mono* record with your speakers close together. After a few minutes worth of listening, reverse the leads to *one* speaker and take another earful. The right connection will give both maximum bass and maximum volume. In fact, in-phase mono (with the speakers well spaced) sounds very much like stereo.

I suggest a *mono* record to phase your speakers for the same reason that I say you have to pay attention to *keeping* your speakers in phase. After three years of stereo disc production, *some* records still reach your dealer's shelf with their two stereo channels out of phase. It's an understandable matter, since there are plenty of chances for the channels to wander out of phase during the long process that starts with the setting up of the recording mikes.

If your stereo amplifier doesn't have a switch for phase-reversal, it's easy to install a DPDT switch in *one* speaker line to do the trick. Whenever things don't sound "right," phase-reversal is worth a try. Use the hookup below.



Next month I'll suggest a short-cut to good stereo.

and Clinic

Hi-fi questions are all answered by mail.* If of general interest they will appear in this column.

Hi-Fi Fusing

My amplifier does not have a fuse built-in. Could you tell me the easiest way to install one?

B. Newman
Little Rock, Kansas

The simplest way to fuse your preamp is to change your line cord plug to a type that holds two fuses. There are several on the market which use a cartridge fuse in each side of the line.

Consult the manufacturer's specifications for the power consumption of your unit in order to determine the correct fuse size. As a rule of thumb, for each 25 watts of AC power *consumed* .25 amperes of current will flow. For example. If your amplifier consumes 75 watts of power you should use a ¾ amp fuse.

Adding Speakers

To improve the sound from our radio, we added two additional speakers. We have been told that using a crossover or an L-pad would improve their sound. Can you tell us which to use?

Alfred Nadeau
Sanford, Maine

Neither is necessarily of any value in your case. A crossover is a frequency selective device. When used with a speaker system, its function is to send the correct range of frequencies to the appropriate speaker; the high frequencies to the tweeter, the lows to the woofer. The L-pad is used as a speaker volume control and it would only be of help to you if one speaker is louder than the other.

How Much Power?

How many speakers will my 15-watt amplifier drive?

Arthur Horn
Keene, N. H.

There are a number of factors that must be known before this question can be answered. First, how efficient are the speakers? Second, how much clean bass do you want? If the speakers are of average efficiency and not too much bass is demanded a fifteen-watt amplifier could easily drive up to a dozen speakers. Driving a couple of efficient horn speakers, 15 watts could fill Carnegie Hall with sound. On the other hand, most 15-watt amplifiers would be at a loss to produce any deep bass from acoustic suspension type speakers such as the KLH or AR.

Amplifier Buzz

After about ten minutes of operation I notice a buzzing from my amplifier that I don't hear in my speaker system. What can I do to cure this?

L. Herman
Santa Clara, Calif.

This is a common problem that does not harm the amplifier and is not difficult to correct. What has happened is the laminations in your power transformer have loosened up and the sound you hear is the loose plates vibrating. While the transformer is still warm, tighten the long bolts through the laminations and tighten the nuts that hold the transformer to the chassis.

Four-Track Stereo

My stereo tape player is equipped with a two-track in-line playback head. Is there any way I can use this to play the new four-track stereo tapes?

W. Martin
New York, N. Y.

A two-track stereo head will reproduce all four tracks of the new stereo tapes at once, giving you a jumble of confused sounds. To play four-track tapes, you'll have to replace your playback head with a four-track type.

***Address inquiries to Hi-Fi Clinic, c/o Electronics Illustrated, 67 West 44th St., New York 36, N. Y. Please enclose a stamped self-addressed envelope for a prompt reply.**

Our Amazing New Robots

Talented mechanical men are being built for voyages where humans are yet afraid to go.

By Lloyd Mallan

WHEN the first man steps out of a spaceship on the moon or Mars or Venus he is likely to be greeted by another earthling who can tell him about conditions of soil and water and oxygen in his new surroundings. The creature at the foot of the ramp will be a robot, who no doubt will already be known as our electronic man on the moon.

Man is just now breaking free of his earthly bonds but he will not for a decade or more be ready for a journey even to the moon, our closest neighbor in space. Before he can go safely to another heavenly body we must learn much more about conditions existing at his destination and the requirements for survival there.

To obtain this information, we earthlings will land sensing devices on the surface. At first, these pieces of equipment probably will sit in one place and radio back data on temperature, radiation, gravity and perhaps chemical composition of the surface layer. Later and more sophisticated models will send back television images and will be capable of interrogation from the earth, and after that will come machines which will move about and carry out jobs at the command of men.

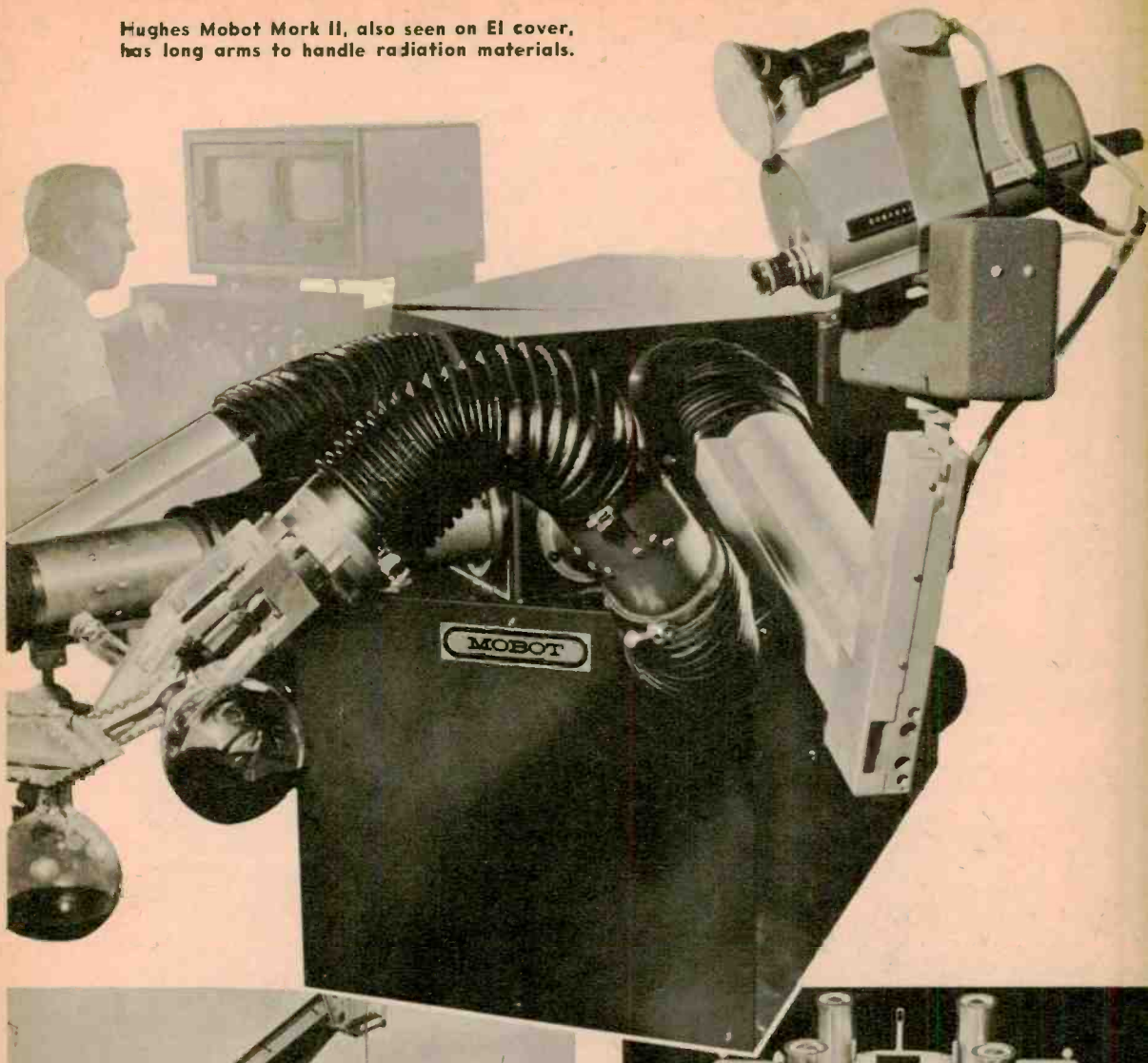
These mobile machines will be robots, designed for the specific job of exploring where man is yet afraid to tread.

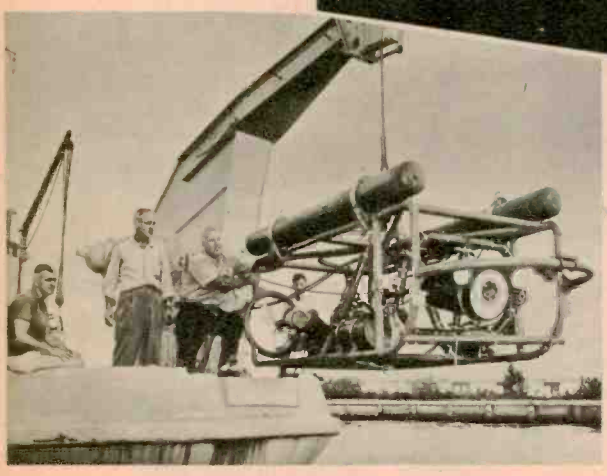
As a matter of fact, all the sensing devices we send to other spatial bodies could be called robots because by definition the term applies to any machine which does

Trekking out of the Pacific after a scouting mission is the Navy's undersea robot, RUM.

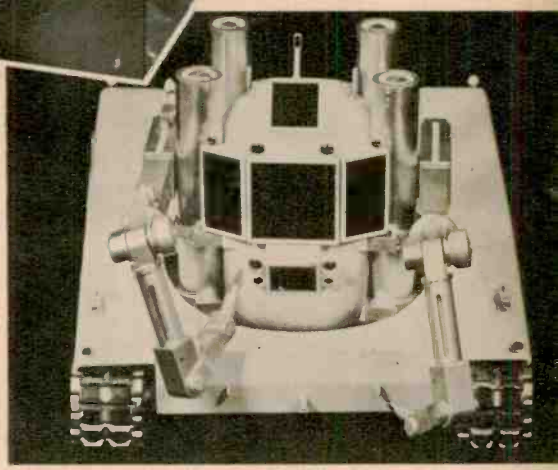
RUM'S keeper is an engineer who views images from robot's TV eye and controls its hand.

Hughes Mobot Mork II, also seen on EI cover, has long arms to handle radiation materials.



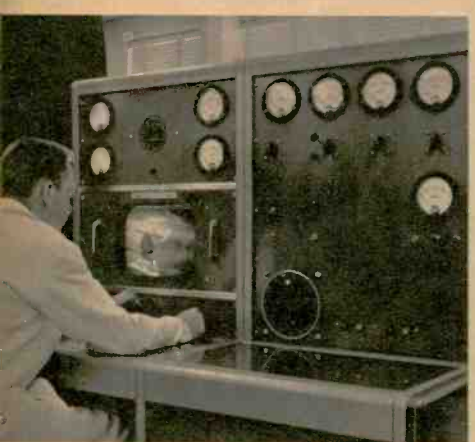


Mermut is mobile underwater, takes movie, still and TV photos, can have working arms.



GE tractor robot assembles nuclear reactors, is run by well-protected man sitting inside.

Mechanical men out of fiction and the amateur workshops tend to look and act a little like the real thing, although human form and actions are illogical for machines. This is MM7, built by a Viennese engineer. It can pour a drink into a fragile glass without breaking it, also startles guests by polishing floors (left). Elaborate control panel runs the 6-foot robot.

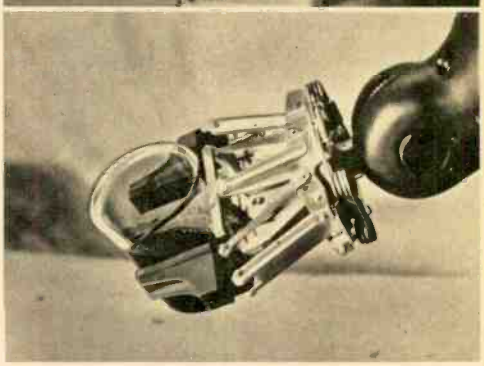


Huge claw of Solaris, a one-eyed robot built by Vitro Laboratories, can clamp onto an object on the ocean floor and then lift as much as 7,500 lbs. to the surface. It is controlled from aboard ship by the operator above. Unit includes TV camera and lights at rear, two props for maneuvering, mechanical power unit in sphere. It operates at end of two cables, can go to 2,000 ft.

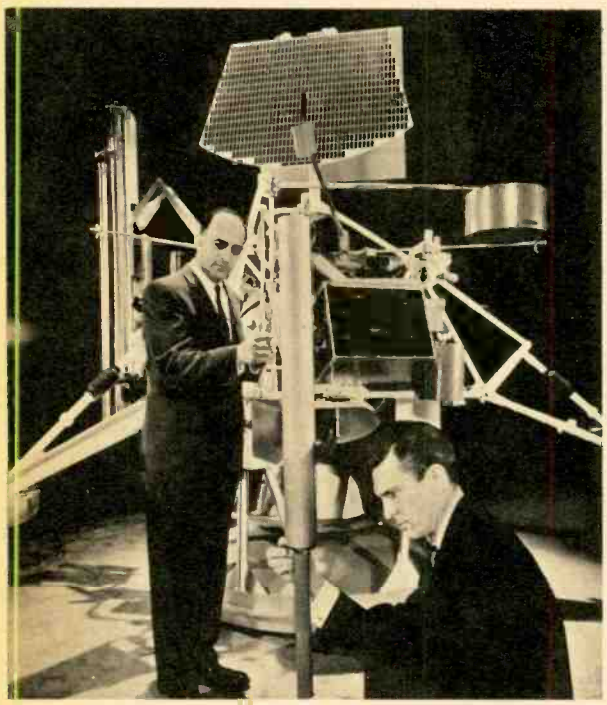
a man's work. Certainly, these pieces of equipment will be doing that. In fiction and the minds of boys a robot is a machine that looks and acts like a man, but in actual fact the amazing new robots now being designed and built bear little resemblance to their makers. In their specialized jobs, however, they are incredibly talented.

At least a dozen major companies are quietly researching, designing and building robots. Some of their progeny are operational, others are in prototype form and still more are in the planning stage. Robots now in existence could map the surface of the moon's hidden side, examine its crust, make geological probes below its surface and explore its mountain chains. We lack only the means of landing them there safely.

Scientists now foresee electronically controlled robots which will be able to build and operate satellite stations in outer space and then gather data and correlate the material for easy analysis by humans. After exploring the moon and nearby planets, these mechanical men could be instructed to locate mineral deposits, mine them and refine the ore for the use of real men who arrive later.



Hand of Master-Slave Manipulator, used in radioactive rooms, is flexible, sensitive. It follows commands from human hand above.

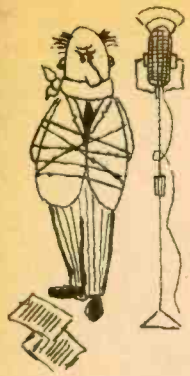


NASA Surveyor is to land on moon, send back its findings. It has solar panel (top), TV cameras, probe, drill and special antenna.

Only a few years ago the robot was plodding along in its dreary work of handling radioactive substances in research laboratories. It was a job man could not perform, but the future was murky. Then opportunity beckoned.

"Now the big need is in outer space," says Ralph Mosher, equipment development engineer at General Electric, who built a robot called Handyman. "Handyman was designed for work in the hot shops but now we are working on new and different applications." Plainly, outer space has a job for Handyman.

Handyman was quite an advance in robotry when it became operational. Its arms and claws, controlled by a slave-unit, can be [*Continued on page* 110]



Commercial Killer

The luxury of sponsor-free radio can be yours for less than three bucks. Could be used for TV too!

By Virgil L. Parker

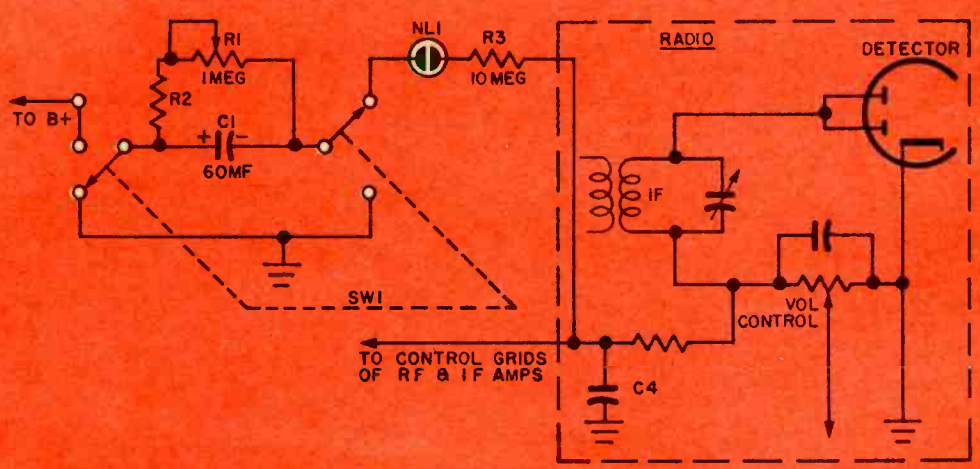
HERE'S good news for people who are plagued by radio commercials. This novel commercial killer was designed primarily for the car radio (though it can be used with any receiver) to eliminate frantic grabs at the volume or tuning knob when an advertiser gets overbearing.

By the push of a button the radio is silenced for a fixed length of time, at the end of which it comes back on automatically. A minimum of parts are required as use is made of the radio's AVC (automatic volume control) circuit as the suppresion point.

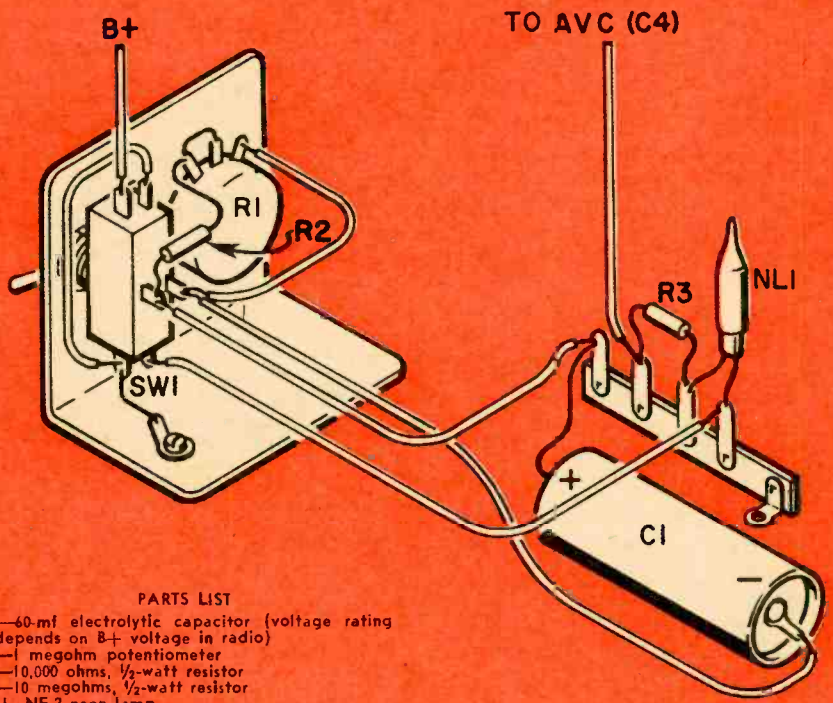
Theory

All radios have an AVC circuit which controls the negative bias on the RF and IF amplifiers. If this bias is made sufficiently

Killer output goes to the AVC line in radio. Refer to the volume control to locate C4. It's at other side of a 2 or 3 megohm resistor and is about .05 mf.



Parts arrangement for car-radio installation. For TV, the output could bias the audio stages.



PARTS LIST

C1—60-mf electrolytic capacitor (voltage rating depends on B+ voltage in radio)
R1—1 megohm potentiometer
R2—10,000 ohms, ½-watt resistor
R3—10 megohms, ½-watt resistor
NL1—NE-2 neon lamp
SW1—DPDT momentary push-button switch or spring-return toggle switch
Misc.—Solder lug terminal strip, knob mounting plate, hdwe., etc.

large, the tubes will be driven to cutoff and the receiver will be silenced. When SW1 (DPDT spring-return pushbutton switch) is depressed, C1 is charged to B+ potential. When SW1 is released, the positive terminal of C1 is grounded and the negative terminal is connected to the AVC line. Thus the application of a high negative voltage to the AVC line silences the radio.

The parts listed worked well with a 200-volt B+ supply and permitted adjustment of the dead time from a few seconds to one minute. If longer time is desired, or if the Commercial Killer is to be used with AC-DC receivers with lower B+ voltage, R1 or R2 should be made larger to lengthen the discharge time of C1. R2, a current limiting resistor, prevents damage to R1 when R1 is adjusted to minimum resistance. Neon bulb NL1 acts as a switch to open the circuit abruptly when the voltage drops below its ionizing potential. This removes the high negative bias from the AVC line instantly and prevents distortion which would occur if the tubes were biased near cut-off. There are several points in the AVC circuit that the commercial killer could be tied to, however the high side of C4 (in a typical radio) was found to operate best. This capacitor is usually a .05 mf and can be located easily. For testing, SW1 should be held for five seconds to insure that C1 is fully charged.

Construction

Construction is simple. The terminal strip supporting [*Continued on page* 104]

Electronic Brain

Have you any question on electronics? Send it in and the Electronic Brain will provide the answer.*

Determining Fuse Rating

In the December 1959 Electronic Brain you mention that a fuse may be installed in any equipment to protect its components. How does one determine what amperage this fuse should be able to carry?

Stanley Horn
Miami Beach, Fla.

The very best way to determine required fuse size is to measure the current flowing in the AC input circuit by inserting an AC ammeter of 0-15 ampere range in series with one leg of the AC line. The fuse rating should then be 50% greater than the normal current. For example, if the current is found to be 3 amperes, the fuse should be $3 + \frac{1}{2}(3) = 4.5$ amperes. A 5 ampere fuse is the closest commercially available value and would be quite satisfactory. If a wattmeter is available, the current requirements of the equipment may be obtained by dividing the wattage reading by the line voltage. Although this assumes unity power factor, the reading will still be approximately correct for all practical purposes.

Since manufacturers almost invariably state the input power requirements of their apparatus in their instruction booklets, you can use this literature to determine the fuse size from the rated power by the method given above. Finally, as a last resort, install the fuse holder and starting with a 1 ampere fuse (which may burn out), determine the *smallest* fuse size that remains operative over extended periods of use of the equipment. This means that you may waste one or two fuses, but it is a safe procedure.

Filament Transformer Substitute

Can a universal output transformer be used as a filament transformer? I applied 117 volts AC to the primary of one of these transformers and measured about 15 volts at the secondary.

James Wallace
Appalachia, Va.

The voltage measured across the unloaded secondary may not be the same when the secondary is loaded. Since universal output transformers are seldom designed to provide more than 3 or 4 watts of audio, the secondary winding will not carry much more than 0.5 amperes. Loading the secondary will reduce the output voltage and may cause the transformer to overheat. The easiest way to determine if an output transformer will work as a filament transformer is to try it. If the voltage is within 5% of the tube rating, the transformer may be used provided that it does not overheat.

Ham Antenna

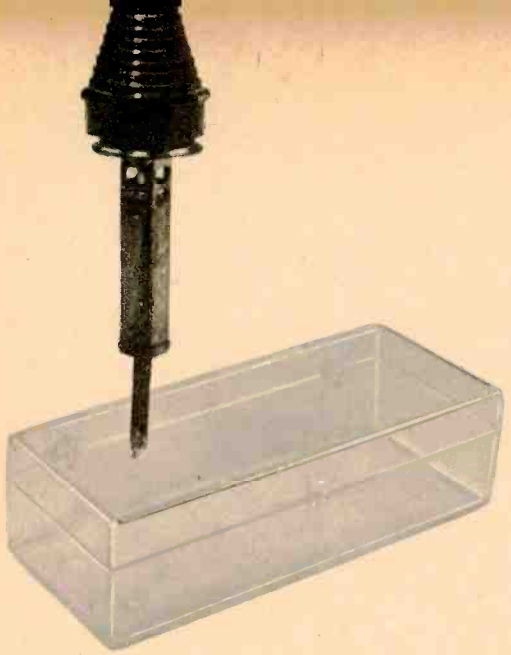
I would like to become a ham but have been told that I would need a 50-foot long antenna. Since I am not permitted to use the roof, can I erect an antenna on a terrace nine stories up?

E. Berman
Jackson Heights, N. Y.

You would need a 50-foot antenna only if you decided to operate on one of the lower frequency amateur bands. A 50-foot antenna folded to fit on a 12-foot terrace would be unsatisfactory. You should consider operating on the higher frequency bands where you will be able to use an antenna suited to your terrace.

For complete information on all aspects of amateur radio and license requirements, obtain a copy of the most recent edition of the ARRL handbook.

***Write to Electronic Brain, Electronics Illustrated, 67 West 44th Street, New York 36, New York. Enclose a stamped, self-addressed envelope for a prompt reply.**



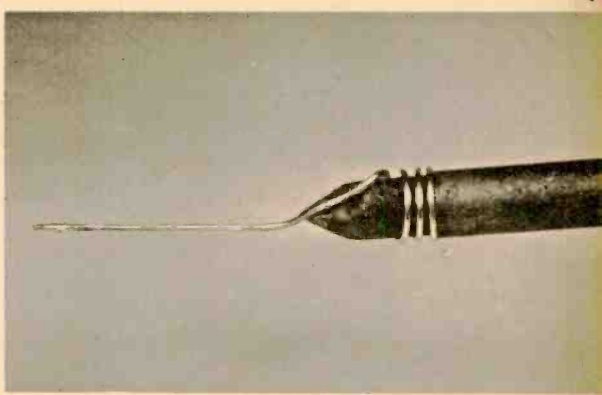
El's Hot Tips

Plastic Drilling

When a hole must be drilled into plastic, an indentation made with the tip of a hot iron at the spot will help start the drill. Holes in Bakelite can be drilled easily this way.

Stopping Tip Corrosion

You can slow down or stop the corrosion of your iron or gun tip by coating it with aluminum solder. Its higher melting point keeps the tip brighter longer by reducing oxidation.

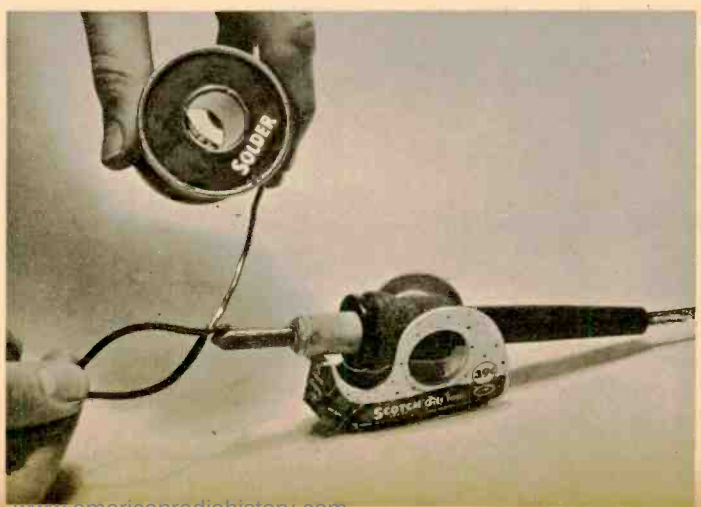


Soldering in Cramped Quarters

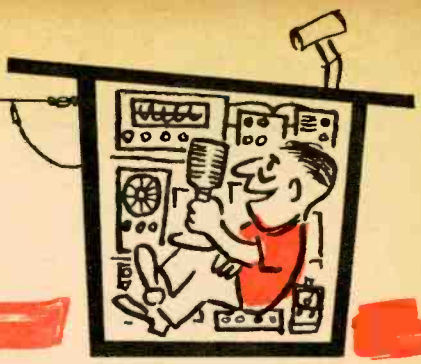
Wrap about four turns of No. 14 tinned copper wire around the iron tip. Have the extension make good contact along the iron and flow solder in space between wire and the iron tip.

Third Hand

Do you have a three-handed soldering job and no way to hold the work, iron, and solder at the same time? A vise might crack the iron. A good way is to use an empty metal tape dispenser.



The Ham Shack



By Robert Hertzberg, W2DJJ

FIFTH COLUMN . . . From time to time we hear that the possession of a short-wave receiver by a Russian is frowned upon, to say the least. The Soviets obviously don't want their people listening to the rest of the world for fear they might learn what is happening outside the Iron Curtain. However, Soviet propagandists seemingly acknowledge the presence of many such receivers by jamming most international broadcasting frequencies (if there were no receivers jamming naturally would not be necessary).

It is, therefore, a surprise to hear Russian hams engaged in communication with other hams in many parts of the world, including the U. S. They talk excellent English, as well as several other languages, and in general are top operators. In fact, they are too good. And that's significant.

In view of the nature of the Soviet state, it seems a certainty that these hams are government agents of one kind or another. The equipment situation alone makes this evident. If basic short-wave receivers are contraband, what chance does an ordinary citizen have of obtaining a communications receiver, much less a powerful transmitter?

Maybe the Soviets have rediscovered a long-standing axiom in the military radio intelligence business: you can learn more from the enemy by letting his radio stations work in the clear than by jamming them. Just what they expect to get out of American hams is a question. They do well if they can even figure out what is said in a typical report:

"Say, you're sure pinning the S meter here in little old Squeedunk. S for sarsparilla, Q for quack, double E for easy does it, D for doughnuts, U for useless, N for nuts, K for kookie. Handle here is Mac, as in MacPherson. The QRMary is building up, and your QSB is bad, but I'm pulling you in fine business."

Ivan's boys no doubt get medals for decoding chatter like that . . . and they probably deserve them.

—o—

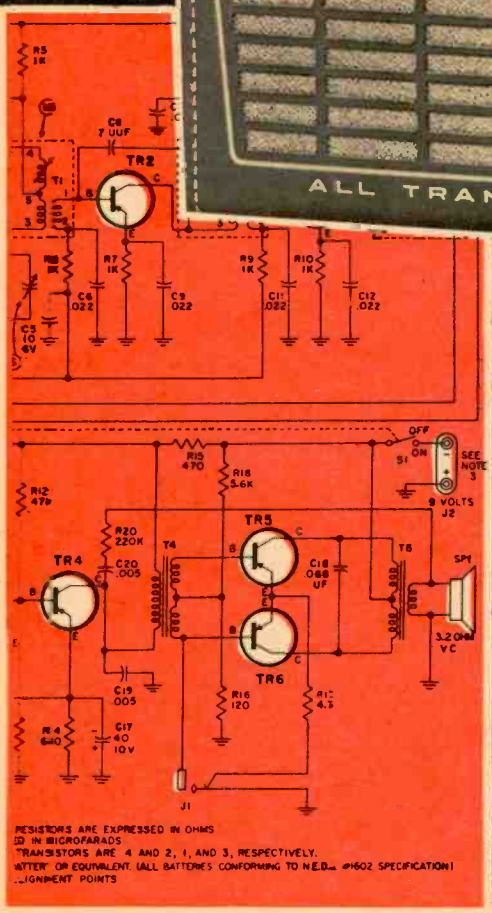
These call letters belong to Ralph Thomas of Hawaii, winner of an Edison Award this year.

Status Symbol, Cont'd. In the previous Ham Shack I described the frustrations of new hams who try to obtain special call letters to match their initials. It can't be done. But there's an interesting reverse switch that's worth mentioning (see photo).

When the FCC gives you your call letters, check with the motor vehicle bureau of your state and determine whether it issues special plates bearing the call letters [*Continued on page* 108]

EI builds a

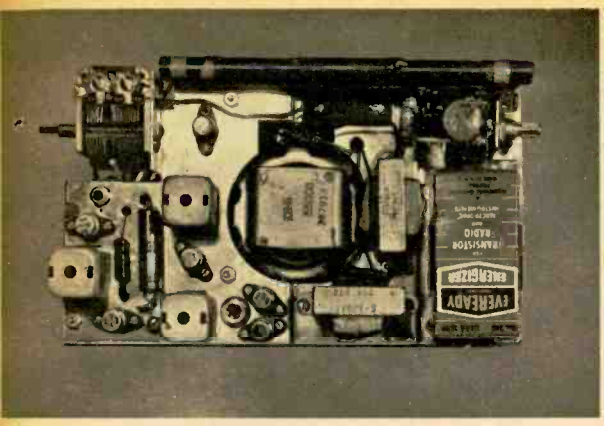
Transistor Radio



WHETHER you're an old hand who simply enjoys putting together electronic equipment or a novice assembling your first kit, perhaps as a preliminary to building your own hi-fi, the EICO Model RA-6 portable radio has much to offer.

Among its features, this six-transistor superhet boasts a 4" x 6" speaker, a 250-milliwatt push-pull output stage, planetary-vernier fine tuning, that makes catching those elusive marginal stations a cinch, a ferrite-antenna and a jack that eliminates output-stage current drain when an earphone is used.

We were very impressed with the performance of the completed kit, and found, for example, it brought in New York stations in Boston, Mass. The relatively large speaker provided



Rear view of chassis. Note large ferrite-rod antenna and the socket-mounted transistors.

good volume without excessive distortion, a problem many other portables have not licked.

Construction will not be too difficult for a novice. The instructions include exact descriptions, and in many cases pictures of all hardware. All electronic components are identified by number and color code. For those not familiar with electronic parts, in some instances a picture or drawing would make positive identification simpler, but careful attention to the descriptions will see you through.

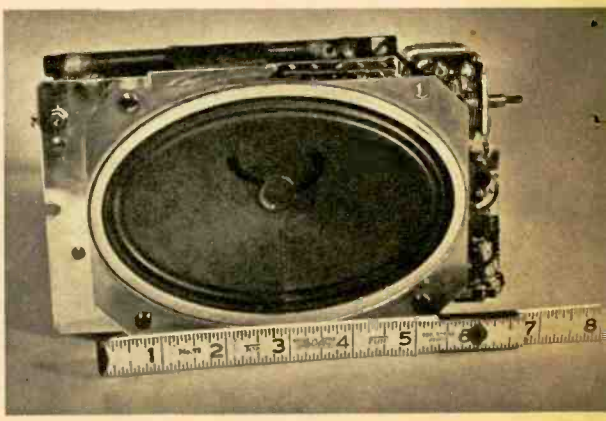
This is not to say that there were no rough spots. In most cases these took the form of too many operations in the same step, confusing to the inexperienced, but not insurmountable. And at one point we were earnestly told to hold a lead wire with a pair of pliers while soldering it. Not aware of the approved techniques for this sort of thing we first tried, with pliers in one hand and soldering iron in the other, to hold the solder in our teeth. This method will prove effective only if you are bent on melting your fillings. We finally wrapped some solder around the forefinger of the hand holding the pliers, leaving several inches sticking out, and this worked fine.

After all the components were soldered in place, we were informed that, when installing the speaker, "If any component touches the frame of the speaker, dress the component closer to the chassis and away from the speaker frame." Not forewarned of this possibility quite a few components touched the speaker frame, an occurrence apparently anticipated, for the instructions continued, "When pushing the components down away from the speaker frame . . ."

The only other area found troublesome was alignment. The IF transformers are prealigned at the factory. However, the oscillator and RF section are aligned by turning screws on the tuning capacitor. The instructions were inadequate for this phase. While warned that this adjustment was "critical" and that another screw adjustment ("for volume") was not, the directions left out a rather vital piece of information. The two screws must be jockeyed back and forth in conjunction with one another. That is, after locating a high-frequency station for the critical adjustment, the volume screw must be adjusted at several points to "follow" this station to its proper dial position.

In summing up, the EICO portable performed well, can be assembled with no special knowledge or training and compares well with any similar product in its price range. It is rugged, too. While pulling off a tuning knob in the latter stages of construction the chassis skidded off the work area and fell over three feet to the floor. We're happy to report that the radio continued to function perfectly! —*Bruce Knowles*

Sizable speaker provides excellent volume and tone. Case dimensions are 8½" x 4½" x 2¼".



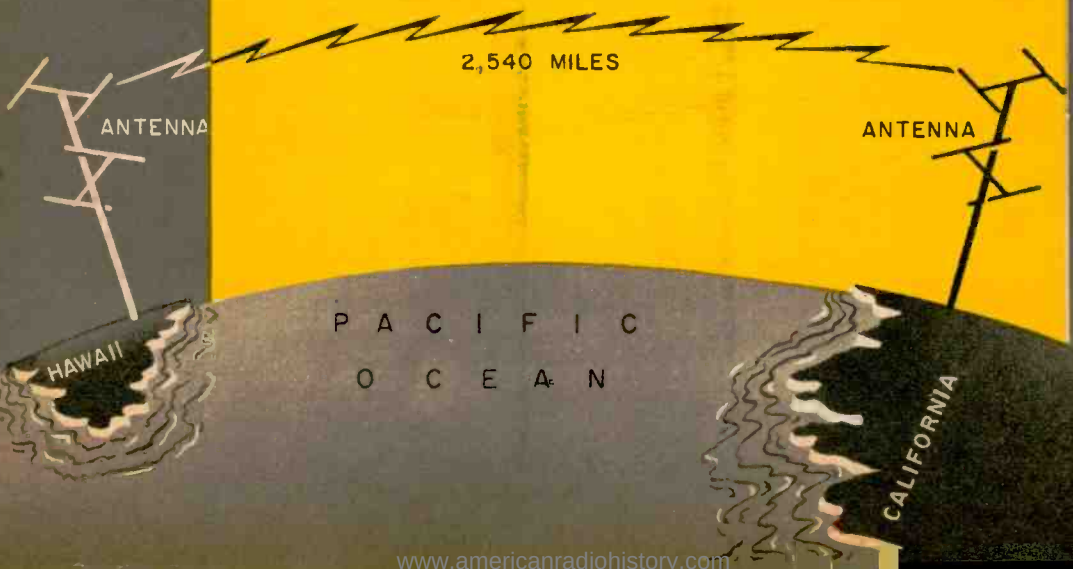
They Said It COULD Be Done!

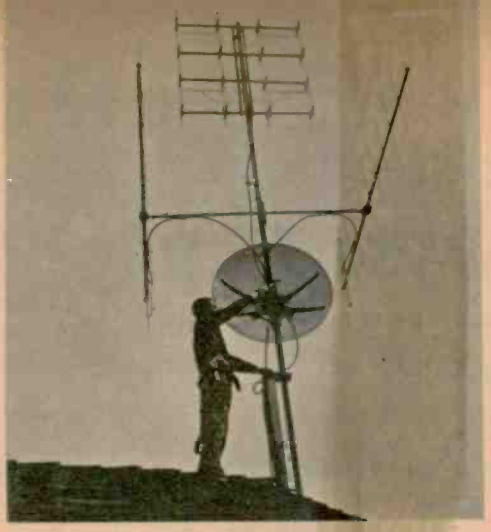
Two award-winning hams prove that long-distance communications are possible on high frequencies.

NOT LONG AGO practically anyone knowledgeable in radio would have told you that the VHF and UHF frequencies were fine for short-range communications but just couldn't be used over long distances. In fact, those high frequencies already had been assigned line-of-sight limitations.

But two veteran hams couldn't believe that, and they set out to prove the theory wrong. The results of these experiments by Ralph E. Thomas, KH6UK, of Kahuku on the island of Oahu, Hawaii, and John T. Chambers, W6NLZ, Palos Verdes Estates, Calif., can be judged by the fact that the two men are co-winners

Hawaiian ham shack of Ralph E. Thomas, KH6UK, sports a wealth of surplus and home-brew equipment. High-frequency antenna sits amid palms outside.





On Stateside end of the VHF-UHF link was John Chambers, W6NLZ, Palos Verdes Estates, Calif., shown here in his shack and adjusting his rooftop antenna, which includes experimental dish.

of the Edison Radio Amateur Award for the year.

The work involved, of course, was not quite as simple as it sounds. Thomas and Chambers experimented for four years before they achieved success. Included in the four years was one nine-month period of daily transmissions.

"It just took time and patience," says Thomas. "I guess you've got to be a nut to keep at something like that."

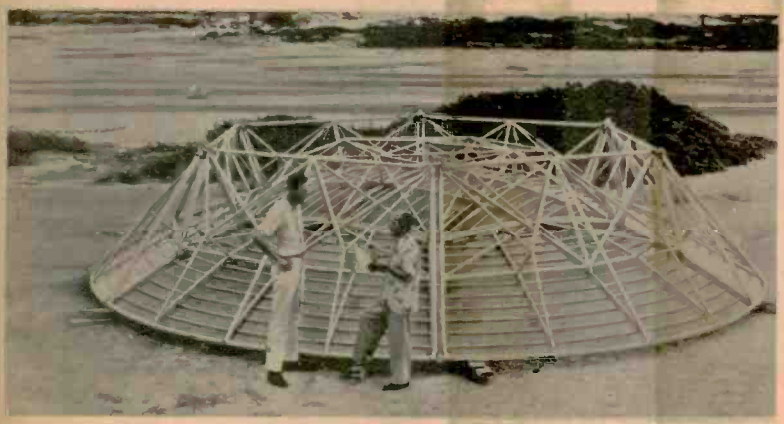
In presenting the Edison awards at a dinner in Washington, Federal Communications Commissioner Frederick W. Ford called the men "pioneers in the wilderness of radio wave propagation."

Using low-power equipment, mostly of military surplus and home-brew origin, the Thomas-Chambers team first set a long-distance record on 144 megacycles, in the VHF range, over the 2,540-mile path between their homes. They later moved up to 220 mc, also a VHF frequency, and then jumped into the wilds of UHF at 432 mc. On July 20, 1960, the two made the historic first link at 432 mc. A faulty tube in the RF amplifier used by Thomas on the Hawaiian end prevented him from hearing Chambers, but his signals were received by Chambers in California.

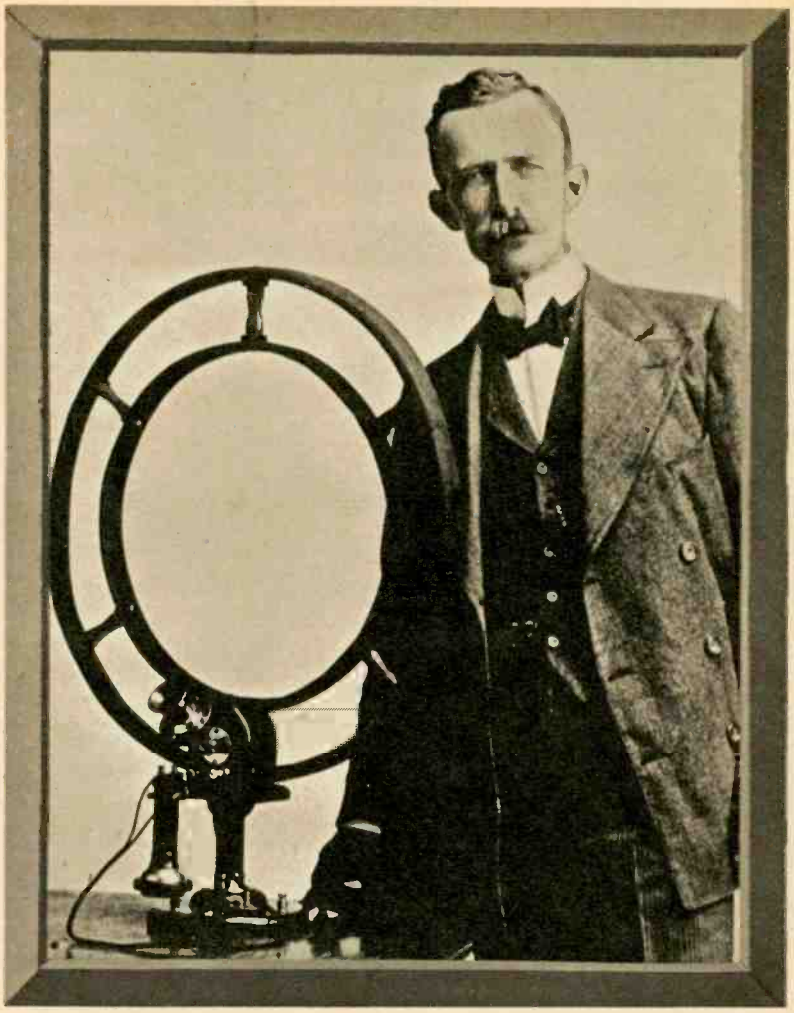
The long-distance links on high frequencies were possible because of a phenomenon known as tropospheric ducting, which occurs mainly during the summer inversion season. The inversion of hot, dry air over damp air close to the ground changes the refractive index of the atmosphere at the point where the two air masses meet and makes UHF DXing possible.

During the experiments Chambers kept a weather eye on Los Angeles smog. When it clung thickly to the ground, he knew conditions were right for a DX attempt. In Hawaii, Thomas watched the evening sky for low clouds with flat tops as his signal for another attempt.

[*Continued on page* 111]



The shape of things to come is this giant parabolic antenna designed and built by Ralph Thomas for experiments at 1296 mc.



Inventor Nathan B. Stubblefield and his invention, now believed by many to be first radio. Photo was taken around the turn of the century. The large loop above modified telephone is thought to be the rig's antenna.

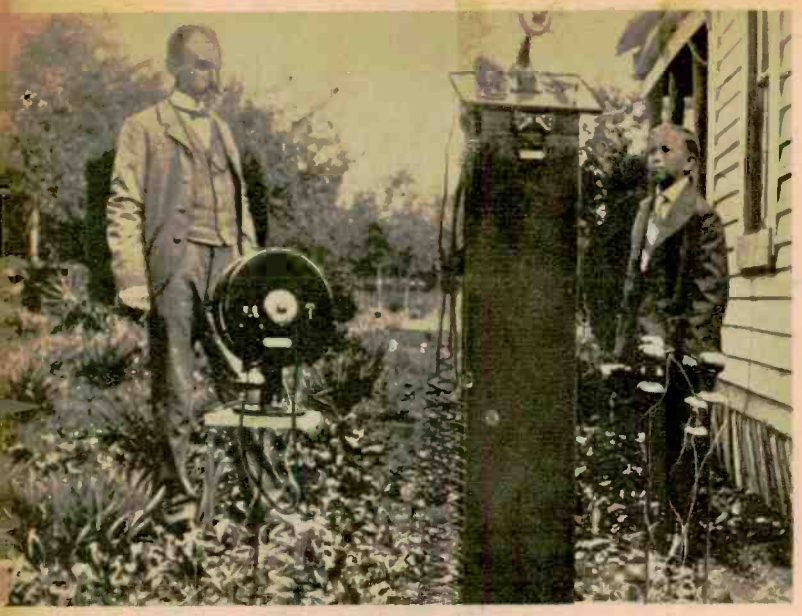
America's Own Marconi

Many now believe it was an obscure Kentuckian who achieved the first wireless transmission of voice.

By Martha K. Gunter, W9HIX

WHO INVENTED radio? The answer for most people is Guglielmo Marconi, the Italian engineer who died in 1937. But there is a growing group of dissenters, and in one town in Kentucky virtually everybody from the dog catcher to the bank president will tell you the true father of radio was Nathan B. Stubblefield.

The town is Murray (pop. about 10,000), which calls itself the Birthplace of Radio because Stubblefield lived there until his death in 1928. To feed and clothe his family, Nathan Stubblefield raised and sold vegetables but most of his time was given over to experiments involving the telephone, and more particularly a telephone which



Stubblefield and his son Bernard with two pieces of his equipment. Note the rods driven into the ground in front of Bernard. The inventor never divulged the exact components of any of his equipment. Photograph probably dates from 1905.

operated without the benefit of wires.

Stubblefield lived on the edge of town in a little shack surrounded by an untrimmed hedge. Like a lot of inventors, he drew an elaborate curtain of secrecy over his experiments and automatically suspected that everyone wanted to steal his inventions. He kept a gun handy to discourage prowlers. Under such conditions it is not surprising that other Murray residents came to think of him as slightly mad. Children pointed at him when he appeared on the street and dogs barked at his heels.

According to all evidence at hand, Stubblefield did make some discoveries and inventions which would have been of value in their time. But because of his passion for secrecy and his failure to put his inventions to the use of others, his contribution to the world of science is virtually nil.

Stubblefield seems to have been experimenting with wireless transmissions before Marconi and some of his earlier probings in the field may have been contemporary with Bell's telephone experiments (Bell received his patent in 1876) and even the mathematical formulations pertaining to radio waves which were published in 1865 and 1873 by James Clerk Maxwell.

It is known that Stubblefield did achieve wireless transmission of the human voice in 1885. Marconi received his patent for a radio-telegraph device on June 2, 1896. It was not until 1888 that Heinrich Hertz demonstrated the existence of electromagnetic waves.

The only person Stubblefield allowed to be near [*Continued on page* 112]

Stubblefield on bonk of the Potomac in 1902 receiving wireless telephone message from the central office some three-fourths mile away.

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How to DX Satellites

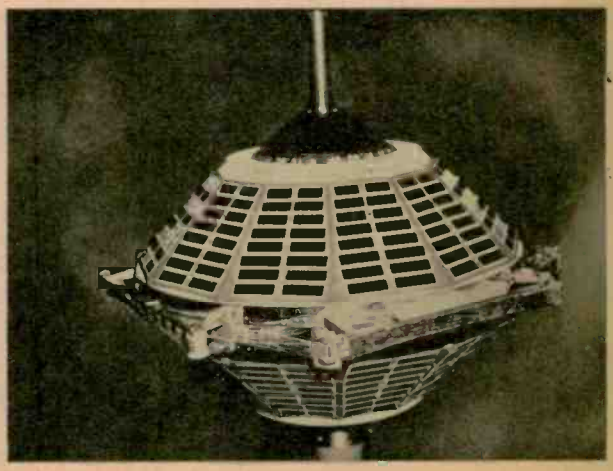
Biggest of all challenges for the SWLer is bringing in space signals, but it can be done!

By C. M. Stanbury II

ARE YOU, as a short-wave listener, beginning to look around for something more challenging than bringing in London or Moscow or Hong Kong? If you're seeking more worlds to conquer, let me tell you about a real hair-curling DX challenge that is literally out of this world. I'm talking about signals from artificial earth satellites, sun satellites, moon probes, Venus shots and other assorted spaceships.

The mention of satellite DXing is enough to stop many people cold. Impossible, they say. But it *can* be done. I have

Experimenter's satellite is S-45 Ionosphere Beacon (related to Explorers), built by the U. S. to transmit on six frequencies for the benefit of anyone anywhere interested in or studying phenomenon of ionospheric signals.



done it and I can tell you that the resulting QSL cards are worth the time and effort required.

DX catches usually are judged by four criteria: distance, power, accessibility of channel and ease of verification. Most bands qualify on at least one point. International broadcasters, for instance, have plenty of kilowatts and QSL faithfully. Even aeradios are often blessed with clear channels.

Earth satellites and the others, unfortunately, don't qualify consistently on any of the criteria. Your target is likely to be a great distance away (100,000 miles, for instance), power may amount to only a watt, the channels are offbeat and getting a QSL is like taking a five-spot away from Jack Benny. But satellites and spaceships truly represent the ultimate DX.

Let's take a look at the equipment required. Fortunately, many satellite radios operate on short-wave, between 19990 and 20005 kc. Sputnik I (20005) was heard by SWLers around the world with only one watt of power, and America's Explorer VIII put out a good signal on 19991.5 kc. Equipment is no problem so far as these satellites are concerned.

Amongst the VHF frequencies used for outer space work, 108 mc is the most popular. That is right atop the FM broadcast band but in order to use an FM tuner you'll have to adapt it for AM reception, possibly using it as a converter in front of your short-wave receiver. In general the signal is tapped off just in front of the tuner's detector stage and fed to the short-wave set's antenna post. The SW receiver is then set to 10.7 mc, the standard FM Inter-

[*Continued on page* 103]

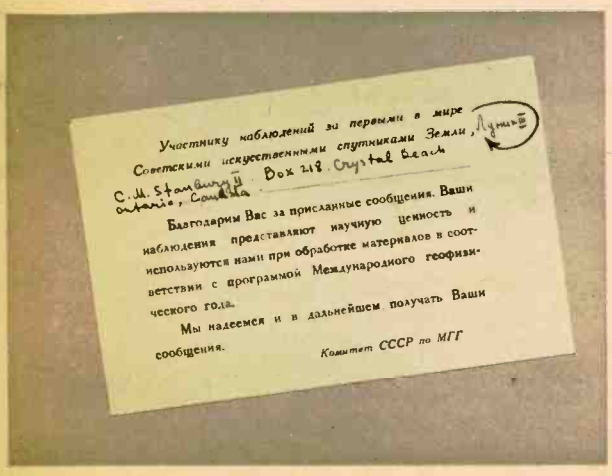
DX GUIDE TO SATELLITES

Frequencies (mc)	Used by
19.99-20.01	U.S.-U.S.S.R.
39.98-40.01	U.S.S.R.
54	U.S.
108-108.06	U.S.
162	U.S.
183.6	U.S.S.R.
216	U.S.
324	U.S.
922.8	U.S.S.R.
960.05	U.S.

SHORT-WAVE CHART

Frequency (kc)	Space Vehicle
19991.5	Explorer VII, VIII
19993	Lunik I, II, III
19995	Lunik I; U.S.S.R. Spaceships I, II, III, IV
19997	Lunik I, II
20003	Lunik II
20005	Sputnik I, II, III; Explorer VI

Two of author's coveted Russian QSL cards verify reception of signals from space vehicles. Card at right is standard Red QSL form. "Lunik III" note penned on other card (see circle) is a bit of irony. Russians kept Lunik III frequencies "secret" but faithfully QSLed, anyway.



EE Topics

New developments in electrical engineering.

ELECTRICAL engineers are expecting new secrets of matter to be revealed when Russia puts its 70 billion electron volt atom smasher into operation. An even bigger atom smasher is reported under construction in the U. S. Largest one now in use is rated at 30 BEV. The last sizable increase in power made possible the creation of anti-protons.

The first all-aluminum power transmission towers are now in use on a 218-mile line in Pennsylvania. The towers do not require paint and are said to be economically competitive with steel. So electric power transmission becomes another battleground in the steel-aluminum war.

Mixing and blending such substances as cement and fertilizer may be taken over soon by a team of modern electronic marvels hooked together as a team—the digital control computer and the X-ray analyzer. The computer controls the mixing and the X-ray equipment tells the computer whether it is right. The job now is an art performed largely by human specialists.

A new thyratron tube which is self-testing may be the bearer of good news for hams and CBers, or even television watchers. When the thyratron nears the end of its life, xenon and neon gases inside it produce a bright red light to tell maintenance men it's time for a change. If the development reaches consumer-type tubes it could eliminate a lot of pencil-tapping by home repairmen.

A General Electric engineer warned the Winter Meeting of the American Institute of Electrical Engineers of the danger of having Russian technical papers translated by people who know Russian but have no engineering background. The choice of one wrong word may make a translation meaningless or misleading.

AIEE's Edison Medal has been awarded to Dr. Harold S. Osborne, retired chief engineer of AT&T, for a long list of contributions to the art. Dr. Osborne has predicted that in the future everyone will be given a telephone number at birth and a little later will receive a gadget about the size of a pocket watch. This will be his telephone, which will have 3-D television to go with the voice. You will be able to call anyone on earth and see him while you're talking to him. Presumably a miniature curtain will cover the video lens when you step into the shower or leave the office early.

Telemetering equipment will be used more and more in the pipe line industry, engineers predict. Telemetering makes quantity and flow control, formerly done manually by men who communicated via telephone, just a matter of pushing buttons or turning a dial.

Electronics, which has solved a great many problems for man, now may be called on to do a job that would dwarf most past accomplishments. The new assignment is to save the nation's railroads from rack and ruin, and even to put them in the black. A Westinghouse expert says sound financial health may be possible with a four-part electronics package: a better communications system, automation in the business office, centralized traffic control and conversion of diesel-electric locomotives to straight electrics. Big-city railroad commuters might dream of a fare reduction, but even electronics has its limitations.

Ferrites—Mighty Midgets

Continued from page 39

be really useful, must have hundreds of thousands of memory cells. That would mean tubes popping like firecrackers, faster than they could be replaced.

The answer to the problem was simply not to use tubes. Instead, Dr. Albers-Schoenberg developed a ferrite material which could be moulded into a doughnut a fraction of an inch in diameter. This tiny structure was able to serve as a computer memory cell because it could be magnetized in one direction or the other (yes or no) and then could produce this information a minute or a year later. Dr. Albers-Schoenberg and Lincoln Lab got together and history was made.

For a test, the lab built two computers, one using tubes, the other—the famous Whirlwind I—using ferrite memory cores. The giant brains, containing about 140,000 memory cells each, went into operation in August 1954. Six months later, Whirlwind had made two errors in millions of calculations. Its vacuum tube cousin had been down for repair over a third of the time. In addition, the ferrite memory proved to be faster and able to handle more work.

IBM, giant of the computer field, studied the results and switched to ferrite core memories. Today, although magnetic tapes and drums, photographic images, and other devices are being used in specialized applications, all large-scale, random-access computer memories use ferrite doughnuts. Some employ millions of cores.

There are other exciting gadgets made of this processed rust. Do you have a super-sonic remote control unit for your TV? When you press a button, this little wizard tells your TV set what to do with a series of sounds too high for you to hear. The TV set must not only pick up these sounds, but must discriminate between signals of several different frequencies. For this job, it uses five to ten ferrite filters which can tell a high squeak from a low one and thus know whether to change the channel or turn up the volume.

Within a few years you may have an automobile radio mounted in your car's trunk, thanks to ferrites. The radio now competes for space under the dash because you must turn the dial manually—and the capacitor or inductive tuner behind it—to change stations. But certain ferrite materials change their permeability, or magnetic properties, under the influence of electrical signals. This means that the tuning section of your receiver could be varied electrically rather than mechanically. Your radio could thus be anywhere in the car with no difficulty.

Ferrites are helping make things smaller too. Some shirt-pocket transistor radios owe their small size in part to ferrite-core IF transformers the size of a sugar cube. Portable and bedside radio antennas are getting so small that a Dick Tracy wrist radio now seems a possibility.

Within a year or so you'll probably be able to do away with unsightly TV rabbit ears with the use of a new ferrite antenna which will be enclosed in the set and will do a better job. Several companies are reported near commercial production.

Electronic equipment of all kinds, from voltage converters for Citizens Band transceivers to recording heads on tape recorders, is being improved with ferrites. Scientists at Bell Labs recently dreamed up a gadget they call the ferreed. Basically, it is a tiny switch which operates a thousand times more rapidly than any present model. It may be routing your telephone calls before long. The ultra-high-speed switching is done, needless to say, by a versatile ferrite material.

Ferrite devices of another kind may help speed along your telephone calls. Engineers have found new ways to send hundreds or perhaps thousands of conversations over one microwave link or coax cable simultaneously. The only trick is to separate the signals at the other end. This electronic routing is a job for filters, and a newly developed ferrite "cup-core" may just fill the bill.

Ferrite microwave switches are doing away with many complex mechanical devices. For instance, a piece of ferrite material is put inside a waveguide—a pipe through which high-frequency signals flow. Normally, the waves go through the material just as though it were not there. But apply an electric current and it stops them cold.

Research in ferrites goes on, both to develop better basic materials and to find new ways to use them. Some of the developments promised by ferrite research include:

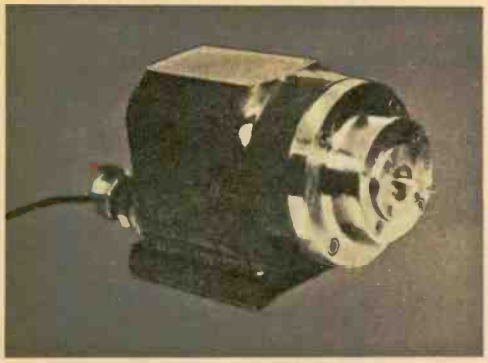
A better, non-flickering fluorescent light.

Power tools (electric drills and the like) which will weigh one-third as much as present models.

More efficient automotive and boat ignition and electrical systems which will be smaller, lighter, cheaper and more reliable.

Clearly, ferrites are destined to play a major role in our lives from here on.

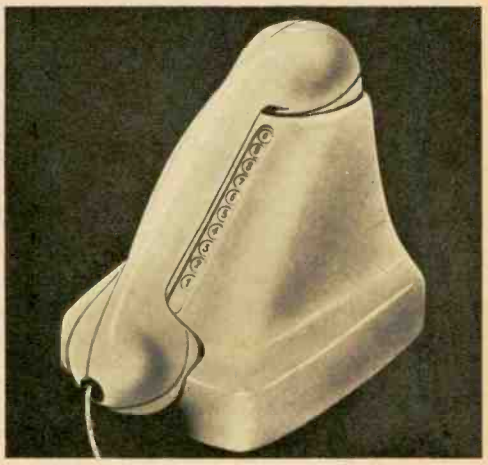
150,000 RPM



A NEW three-phase induction motor (above) built by Toshiba of Japan is capable of doing 150,000 rpm, a record in its class. The water-cooled unit operates on 300-380 volts at 2,500 cycles, requiring a special static inverter which has a silicon-controlled rectifier. It has a rating of about 270 hp. The motor will be used to turn high-speed lathes and grinders.

Vertical Dial

A GERMAN inventor has patented a vertical-dial telephone which, among other things, stops the instrument's annoying habit of slipping sidewise when you dial with one hand. The vertical dial (you pull down) is a plastic tape which turns selector wheels inside.



Electricity From Salt

WHAT does salt have to do with electricity? That was what scientists at the Honeywell Research Center got to wondering one day, and they didn't know the answer. Neither did anyone else. No one had ever done thorough research on the special characteristics of salt. So the wondering men at Honeywell launched a research program on common table salt (sodium chloride). They first took a fine-mesh platinum screen (see photo) and filled it full of salt. Then they heated the crystals until they melted. After that, they studied the infrared absorption qualities of salt (which gave them clues as to its structure). In answer to the question of what salt has to do with electricity, they found that man's most popular seasoning actually can be made to generate electric power. Even more interesting, solid-state salt is an insulator but when molten, the researchers found, it becomes a conductor, its resistance decreasing by as much as seven orders of magnitude. Thus salt may one day have a role in switching.

Take Care Of Your Tape

Continued from page 67

All feature the Gibson Girl cut, so named because of the curves they make in the edge of the tape at the point of splice. Audiotex offers two models, one listing for $9.95 that features the rounded cut, the other, priced at $2.75, being a simple metal block-and-razor blade unit. Somewhat similar to the latter is the $3.95 Bib offered by Ercona. Both have metal clamps that hold the tape in place during splicing. The Bib also has a vertical cutting groove as well as the usual miter groove. The vertical cut is useful for close, precise editing. Cousino's $1.50 splicer resembles these two but has no holding clamps for the tape ends.

Other models include the $8.92 Editall, the $1.50 Rason Jiffy-Splice, the $2.98 Rystl Tape Splicer Jr., the $8.95 ORR Irish model SP-3 and splicers by Brand Products and the Olson Radio Corp., $1.98 and $1.49 respectively. Any of these splicers will do the job. The extra money you spend for the more expensive ones buys convenience and speed.

To join sections of recording tape securely, splicing tape should be used. This pressure-sensitive material is thin and strong and its adhesive material will not bleed beyond its edges and gum up the recorder. Splicing tape rolls are offered by Audiotex, Minnesota Mining & Manufacturing (Scotch), ORR (Irish), Reeves Soundcraft and Robins. You get several inches per penny.

Tape involves a lot of tape. From recording and splicing tape we move on to leader or timing tape, which is neither adhesive nor magnetic. It is a tough, flexible ribbon which may be spliced to the beginning and end of a recording tape, as well as at intervals in between. It serves as a convenient leader, making for easier threading and permitting you to use all the recording tape. Spliced between sections of tape, it serves as an interval marker for timing purposes or provides periods of silence. Some leader tapes have markings to permit a visual estimate of time or recorder speed. As an added convenience, you can write identifying data on leader tape to tell what is recorded on the reel.

Other identifying aids—for reels as well as sections—are labels that may be pressed on a tape reel and tabs for affixing to the tape itself at desired spots. Low-cost packets of these items are available from Audio Devices, Audiotex, Brady, Dactron, Reeves and Robins. Audio Devices also offers colored recording tapes which, when spliced in standard tape, provide quick identification.

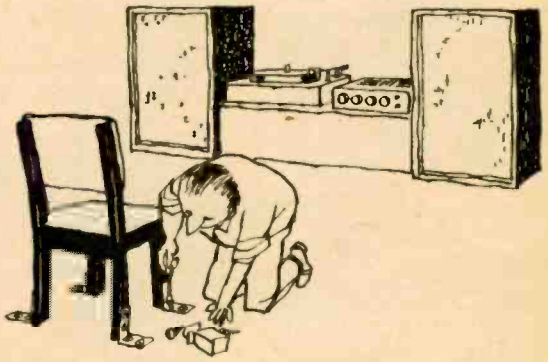
Little plastic clips that slip over the edge of a reel and hold the loose end of the tape in place are an aid in handling and storage. These are offered by Audiotex and Robins.

For the best storage of tapes, the serious hobbyist can buy metal cans, racks or drawer-tray units sold by Olson, Reeves, Robins and Sonoramic. These provide the proper environment for long storage and also catalog and identify a large collection.

Some tape recorders have an automatic electronic stop feature which shuts off the motor at the end of a reel or at any point desired. To trip this mechanism, the tape is fitted with stop tabs. Some machines also are designed to use foil stop tabs—little pieces of foil which can be stuck on the tape.

People who correspond by tape find mailing cartons offered by Audio Devices, MMM, ORR and Reeves especially useful The cartons come in various sizes and cost a few cents each.

The newest tape accessory, yet one which serves a long-felt need, is the tape threader, which makes threading a tape from reel to reel easy and swift. The Robins Tape Threader, listing for $1, is a metal grip with a tiny handle. It slips over the loose end of the tape and helps wind it on the take-up reel. The Tape Threading Leader by Audiotex ($1.40) is a 24-inch strip of leader tape with a small foam rubber pill attached to one end. The leader is spliced to the recording tape and the pill slips into the slot on the take-up reel. The pill is strong enough to start the tape moving, yet pliable enough to slip out when the tape is rewound.



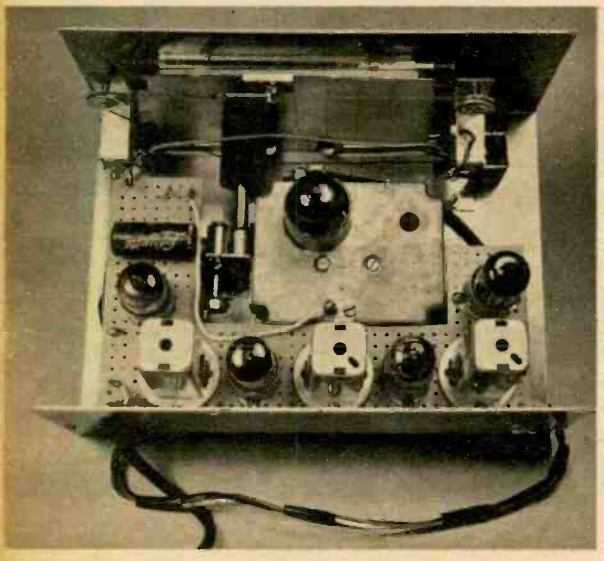
Continued from page 34

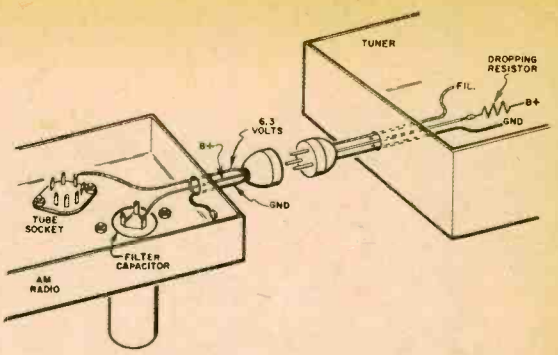
before being wired. Also, the two diode holders will short out if they are mounted flush against the case. Space them by threading nuts onto their mounting screws before pushing the holders onto these screws. For good heat dissipation of the completed power supply, the metal case should be mounted on a metal surface under the dashboard.

If the tuner is to be used in a 6-volt system, the power may be "stolen" from the AM radio. The difference in wiring the tuner for 6 volts is primarily in the filament circuit. This is illustrated in the schematic —one side of each filament goes to ground, rather than in series with the filament of another tube. The same is true for pilot lamps I1 and I2. Note that R19 (filament dropping resistor for V1) is not required for 6-volt operation; simply run a wire from lug 1 on the tuning unit to the 6-volt source.

The power pickup from the 6-volt supply in the AM radio is shown in a pictorial. However, since the high B-plus voltage from the car radio is usually 250 volts, a dropping resistor must be used to bring the voltage down to the 100 volts required by the tuner. The tuner draws about 35 ma, therefore the resistor needed to drop the extra 150 volts would be 4000 ohms at 10 watts. For other voltages: resistance equals the voltage to be dropped, divided by the current (35 ma).

Top view of finished tuner shows IF strip held by bracket under screw on tuning unit.





Connections for obtaining power from 6-volt car radio. 6 volts is taken from filament pin and B+ from lug with highest voltage. Dropping resistor should be 10-watt wirewound.

Audio and Antenna Connections

The audio output of the tuner feeds into the high side of the volume control of the car radio. A closed-circuit jack, added to the car radio, is wired so that unplugging PL1 automatically restores AM operation. To find the correct lug of the volume control, remove the radio from its mount, take off its cover and apply power. (This can be done on the test bench if the builder has a 6 or 12 volt battery eliminator.) With the volume turned full up, touch each of the control's outside terminals. (Be careful not to touch any other exposed parts to avoid shock.) The lug which causes a loud hum in the speaker is the correct one.

The standard car radio antenna serves as an excellent FM antenna. Pull its plug from the jack on the AM radio and plug it into the FM tuner at J1. To change from FM to AM reception, the audio plug is removed from the AM set and the antenna re-inserted into the AM jack. If desired a switching system, as shown, may be added.

Alignment

The FM tuning unit is pre-aligned at the factory and does not have to be touched. The rest of the tuner can be aligned by ear or with a VTVM. Since the IF transformers are also pre-set, only a slight "touch up" is necessary. Tune in a station and adjust the top and bottom slugs of T1, T2 and the bottom slug only of T3. At this time, adjust for maximum volume, not clarity. Next, set the top slug of T3 for least sound distortion. There is a possibility that the IF stages will go into oscillation and impart a

"mushy" quality to the sound. If so, detune T1 or T2 *slightly* until the sound is clear.

For VTVM alignment, tune in a station, set the meter range to 15-volts DC, and set the function to −DC. Ground one test lead and touch the ungrounded lead to the negative terminal of C11. Adjust the IF transformers, *except* for the top slug of T3, for maximum voltage. A typical reading on a moderately strong station will be about −5 to −8 volts. If the VTVM needle suddenly jumps to a high value, back off on the slug to kill the oscillation. The last step is to adjust the VTVM to its zero-center position on the lowest DC range and touch the ungrounded probe to the center lead of the audio cable (the junction of R15 and C12). Rotate the top slug of T3 for a zero voltage reading and alignment is complete.

One of the major limiting factors to the quality of the sound produced by the FM tuner is the speaker in the AM set. A remarkable improvement is possible with the installation of a rear-seat speaker. The type which includes a small tweeter is especially recommended—it will help to reproduce the wider audio range of FM.

Temperature Gauge

Continued from page 55

Installation

Drill a hole, large enough to accommodate the probe, over the water return inlet in the radiator. Insert the probe in the hole until it reaches the top of the radiator element then cement the probe in place with liquid or plastic steel. Be sure that the hole is completely sealed. Connect the probe's ground lead to the car chassis by placing it under a nearby chassis bolt. Run the center-probe wire back through the fire wall to the dashboard, keeping clear of the engine, fan, and ignition wiring. Mount the meter box on or under the dashboard with self-tapping screws. Use lock washers to ensure a good electrical connection between the box and the dashboard as the car body is the negative side of the 12-volt system. Connect the wire from the probe to the appropriate terminal on the meter box. Run wires from the ignition switch and the dashboard lights to the box.

Camper Power Pack

Continued from page 48

Circuit Operation

Power from the battery (12 volts DC) is fed to the transformer center tap through F1 and SW1. When SW1 is closed, current starts to flow through both Q1 and Q2, but since they're not precisely alike, one transistor, let's say Q1, conducts more heavily than Q2. The current flows from the battery through the upper half of the primary of T1 and Q1 to ground causing a voltage drop across the primary. The polarity of this voltage is such that the base of Q1 is negative with respect to the emitter causing Q1 to conduct heavily. The voltage induced in the bottom half of the primary causes the base of Q2 to be driven positive and Q2 is therefore cut off. This process continues until the core of T1 saturates. At that time the induced primary voltage then falls to zero and the reverse voltage developed from the collapse of the magnetic field starts Q2 conducting.

The induced voltage in the top half of T1 now cuts off Q1 and Q2 conducts heavily until T1 saturates—and the process repeats. In effect the two transistors switch back and forth in 1/60th of a second providing a 60 cps alternation.

What does all this accomplish? Well, if you followed the explanation closely, you noticed current flows alternately in each half of the primary, just the same as alternating current. Thus the transformer can step these alternations up to 117 volts for powering appliances. If the transistors did not "chop up" the battery DC, the steady current would soon blow the fuse. Taps are provided on the secondary of the transformer to adjust the output voltage to 117-volts AC

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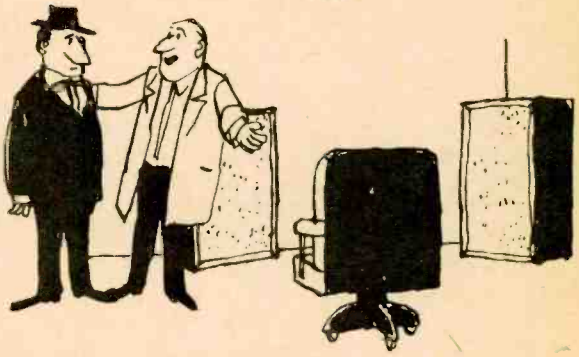
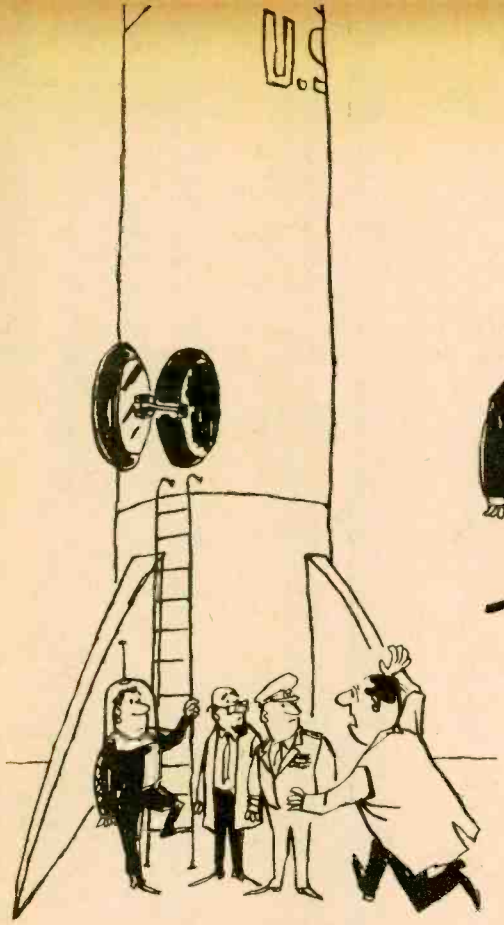
SHORT CIRCUITS

BY

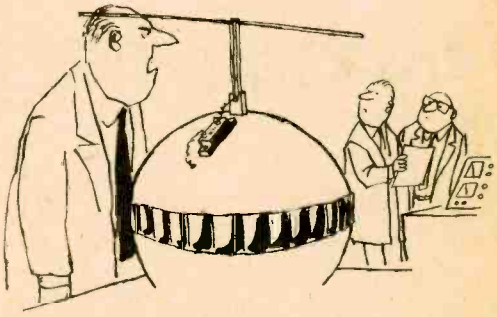
Rodrigues



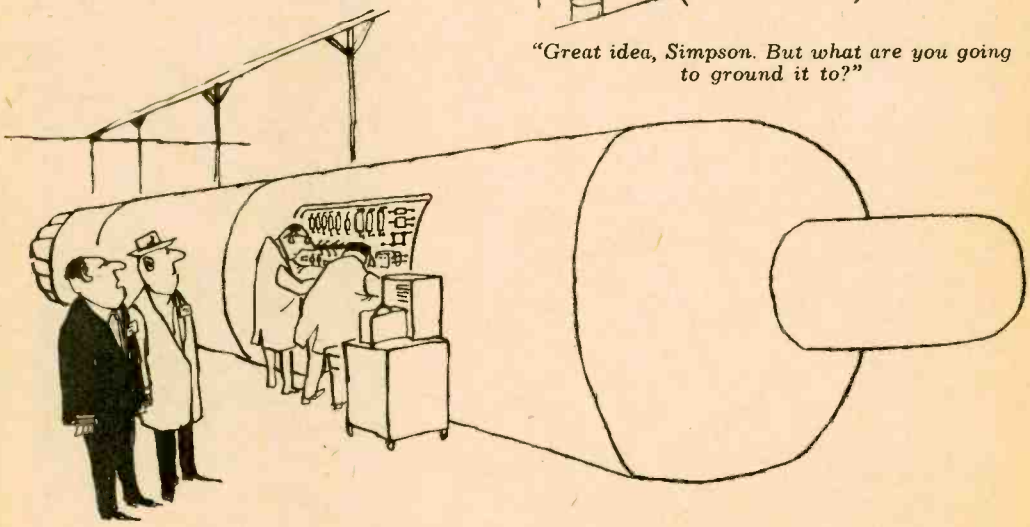
"Like I say, Congressman, it's an amazing satellite. Ever heard of stereo beeps?"



"Hold it! He flunked the code test!"



"Great idea, Simpson. But what are you going to ground it to?"



"Saved a lot of money here, Senator. Bought it in kit form, you know."

How To DX Satellites

Continued from page 95

mediate Frequency (IF). Other types of converters are possible, of course.

A less active VHF band, but one easier to pull in, is 54 mc, on the upper edge of the 6-meter amateur band. Many receivers tune this band, and converters are available. The Transit (navigational) satellites use 54 mc.

The top band now used for space work is 900 mc, in the UHF range. Industrial communications equipment might be adapted for reception here but, frankly, these loggings would be beyond the capabilities of most such gear.

On whatever frequencies (below 300 mc) you work, it is advisable to use a crystal calibrator fitted with a 1-mc crystal. This accessory ranges in price between $20 and $30 but is well worth the price since exact tuning is a prime requisite for successful space monitoring.

The best short-wave receiver for space DXing is, of course, the communications type which is not only sensitive but selective. If your set lacks selectivity, a Q-multiplier would be a worthwhile investment. Your best bet for an antenna is a single wire, as long as possible so it will receive well in all directions. A directional array would provide more gain but it would be difficult to know which way to point it. Long wires have been used for DX reception beyond 150,000 miles (Lunik I).

How do you spot a signal from outer space? One clue is duration. Whether heard directly (line-of-sight) or via short-wave skip, reception from a fast-moving satellite should not last more than a few minutes. If it lasts even that long, turn on your BFO (beat frequency oscillator) and you'll hear a distinct frequency shift (Doppler effect) as the vehicle approaches, then recedes. In many instances reception lasts only a few seconds.

Satellites transmit no call letters and the simple beep pattern of Sputnik I has been replaced by more complicated and less distinctive signals.

The Soviets have put up many satellites transmitting in the short-wave ranges, so let's examine some Red signals. Three simple sound classifications are possible: (1) An irregular beep pattern with A1 modulation, requiring a BFO for reception (otherwise the signals produce a clicking sound). Be careful not to confuse this signal with radioteletype, which is sent more regularly during marker periods and at higher speed during the handling of messages. (2) A high-speed pulse modulation producing a hiss. (3) An A2 modulation composed of two musical notes which sound simultaneously. This is Russia's most advanced signal and was used by the animal-bearing spaceship dubbed Arknik II.

To pick up a Red spaceship signal proceed this way: after a launching is announced, listen to Radio Moscow until frequencies are given. Then tune to one of them and wait (there is a lot of waiting in space DX). If your equipment is well warmed up and reasonably stable, monitoring on short-wave will require only patience and good ears. If it's unstable you'll have to tune periodically.

Send your signal reports, containing complete details, to: Secretary, Institute of Radiotechnics and Electronics, Academy of Sciences of Soviet Socialist Republics, Moscow—or to Mrs. Eugenia Stepanova, North American Service, Radio Moscow. In approximately two months you should receive a QSL card and/or a letter. While the card is highly decorative, it is of little value without the accompanying letter. The letter refers to your report as informative (rough translation) and thus at least implies confirmation.

The easiest American satellites to DX are the Explorers because they are at the low end of the outer-space short-wave band. They operate on 19991.5, down near the frequencies used so often by the Russians, and not far from a WWV frequency. The Explorer signals sound much like the Soviet signals just described, so care must be taken not to confuse them.

In the UHF ranges, 108 mc is used by so many spacecraft that identification becomes difficult and so does confirmation. Advanced communications systems can detect several different American space sounds, but most amateur rigs bring in only the satellite's carrier by using a beat frequency oscillator.

This signal also is like the Russian signal (1) we described earlier. At lower frequencies, these space signals tend to sound similar to radioteletype, as we have noted, and on UHF, the resemblance becomes even stronger. Certainly, there is a difference between satellite signals and RTT but you will have to hear both to know what it is. There is one shortcut to identification of U.S. satellites. Watch your local paper for times at which a given satellite is visible in your area and listen at those specific hours. Once you hear a U.S. space vehicle and tentatively identify it you're ready to go QSL hunting. Confirmations are harder

to get out of Washington than from Moscow, but they will be worded better. Reports should state which satellite you believe you heard, frequency, date, exact time and a description of the sound. Make the latter as detailed as possible. Then you can request verification in the form of a letter, or you may enclose a self-prepared QSL to be signed and mailed back to you.

Reports on Navy satellites go to the U.S. Naval Research Laboratories, Washington, D. C. Air Force space vehicles may be reported to U.S. Air Force Headquarters, Washington 25, D. C., but to receive a reply you'll definitely have to enclose a prepared card. Other reports may be sent to Director of Communications, Project . . . (name of satellite series, e.g., Project Tiros), c/o Office of Public Information, NASA, Room A-106, 1512 H Street N.W., Washington 25, D.C.

No one can promise you satellite QSL's. Each attempt is a hit-or-miss proposition. But outer-space QSL's are worth the time and effort required, and tomorrow they will be collector's items.

Electronic Insect Killer

Continued from page 52

neon indicator lamp (NL1) will then go off.

There is nothing fussy about the construction of the shock-box. Be sure to observe rectifier polarity carefully; don't use the metal case as a common connection; be sure that AC wires don't touch the case anywhere; use rubber grommets when passing the wires from the coils to their respective terminals; and don't use parts with too low a voltage rating. The neon lamp is friction-fitted in a ¼" i.d. rubber grommet fitted in a ⅜" dia. hole.

To install the bug killer in an overhead ceiling receptacle use a length of threaded brass tubing of the kind used in making table lamps. At one end of the tubing connect a commercial screw plug to replace the regular incandescent lamp in the ceiling fixture. The other end of the tubing is held to the case by a pair of large, flat nuts also available from the electrical fixture store. This way the trap hangs below the shock-box.

You may prefer to set the trap on a patio table. If so, the coils are uppermost and the "shock-box" case acts as a lamp base. Here, an ordinary 6-foot length of AC line cord is used to bring power to the equipment. Be sure to use grommets in all holes through which the AC-line cord passes.

Commercial Killer

Continued from page 81

the electrolytic capacitor, resistor and neon bulb can be mounted on the outside of a car radio. The time control potentiometer and switch can be installed on a mounting plate under the dash. In any other receiver the parts should be mounted in vacant space inside the cabinet.

The parts listed are those used by the author, however most values are not critical and can be found in the standard junk box.

Tag-Along Ham Rig

Continued from page 64

cabinet I have installed both a feed-through insulator and a coax connector, along with a ground bolt, which is simply a stove bolt with the head inside and two nuts on the outside. The top nut, of course, is used to hold on my ground wire lug.

Some time after completing the last case, I added a pair of phone jacks at the back, one for the key and the other for headphones. With these in place, I simply unplug the key and phones, stick them in a suitcase and away I go.

What about an antenna? I mounted a whip on the back of my case. It can be removed easily by turning one wing nut.

If you choose not to use a whip, there are many alternatives. Anything metallic will radiate! When I first started this operation from hotels and motels I used nearly anything in sight. Once I worked more than 1,300 miles on 33 watts, using a rusty barbed wire fence for an antenna. Other possible radiators include a wire thrown over a tree branch, the insulated guy wire on a utility pole, a metal rain gutter or fire escape ladders. In a hotel you can just drop a little wire out the window. Finding a suitable antenna is part of the pleasure!

At one time I used an eight-foot telescoping military whip, obtained on the surplus market for less than a dollar. I simply stood it in a corner (at an angle if the ceiling was low) and could usually do 800 to 1,000 miles. If it didn't load sufficiently to suit me, I simply hung an aluminum stew pan on the top and had a top-hat loader.

As you may have gathered by now, I've had a lot of fun taking my ham station along on trips. I think you will, too.

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Ham Shack

Continued from page 84

of hams who can show FCC tickets. At last count, more than 40 of the 50 states allowed hams this privilege, sometimes for an extra charge for making the plates (the labor costs usually are pretty low at those little stone-walled factories just up the river). You can be certain of one thing: nobody, but nobody, can use your call except you. So your tabs are quite distinctive.

—o—

Queer Signals. Puzzled by queer, wobbling signals that sound like CW but just don't quite come out in the form of dots and dashes? Rest easy. They're not from Mars or Venus but in all likelihood from hams who use radioteletype in preference to phone or radiotelegraph. The boys who play with RTT are almost a breed apart. They consider phone, even single sideband, too easy. They enjoy the challenging complexities of RTT, which has both electronic and mechanical problems.

—o—

Monitor Your Keying. After obtaining CW operating experience with straight keys many hams graduate to keys of the semi-automatic type . . . the bug or sideswiper. What too many of them neglect to acquire at the same time is a monitor of some kind that enables them to hear their own sending. The result is often such sloppy transmission that the advantages of the bug are lost. Hold the dot side closed just a trifle too long, and what you intended as I comes out S. The same negligence with H produces the number 5, which certainly can leave the guy on the other end a little confused.

—o—

All Clear? If you listen in on CW nets comprised of several stations on the same frequency, you may occasionally hear a terse signal that sounds like "IE." This is usually answered by "K" (for "go ahead") or "AS" (for "wait").

Actually, the signal is not IE but the letter C sent in American Morse, the former land-line telegraph code. While not official in any way, its recognized meaning among older operators is, "All clear? May I transmit?" It's a useful shortcut and makes for snappy operating.

Mike Madness. What is there about a microphone that turns otherwise sane and sensible citizens into chattering magpies? Maybe ham phone operation provides a much-needed outlet for henpecked husbands, or maybe many guys are just plain lonely. Given half a chance, some hams start reciting life histories before you can give them a signal report. Recently I clocked one chap who talked for seven solid minutes apparently without even catching his breath. And he was still going strong when I turned to another frequency.

It might be a good idea for all ham mikes to be adorned with a plain but legible sign reading, "Who cares?"

—o—

Shocking Business. A farmer-ham I know has lots of space, so he decided to string a 133-foot antenna for 80-meter operation. He secured one end well up in a tree and started reeling out the wire toward his house. Suddenly he found himself flat on the ground, dazed but conscious. At first he thought he'd been struck by a stray shot from the woods but when he recovered his senses he realized he'd been hit by something potentially much more dangerous: a static charge picked up by the antenna. Unwittingly, he had repeated Ben Franklin's famous experiment.

What misled him at first was the fact that the day was clear and bright. Heavy static usually precedes a storm and can be heard on radio receivers long before it builds up and becomes nature's most terrifying and violent manifestation, lightning. Obvious caution: when handling long, open antennas, keep them well grounded.

CB To Ham

Continued from page 73

the basic building block of a ham station is a high-grade communications receiver. To this can be added converters for bands outside its normal frequency range. In most shacks the transmitter is entirely separate from the receiver. More likely, there are transmitters of several types.

Ham equipment costs more than CB gear. It should, because it is far more elaborate and does much more. Fortunately, it has long life and it pays for itself many times over in the enjoyment it furnishes its knob-happy owner.

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Our Amazing New Robots

Continued from page 79

manipulated through ten essential motions. The bend of a wrist or elbow or the crook of a thumb can be simulated with almost human flexibility. Handyman is operated by a man who inserts his hands and arms into electronic controls that cause the fingers and arms of the robot to perform in identical manner.

Other robots may differ from Handyman to some extent but the basic concept remains the same. The vital ingredient is a man who issues instructions, either directly or through recorded data. The instructions are transmitted via cable or radio (or may be stored in the robot itself). At the receiving end is a machine supplied with power from another cable or from a self-contained source which could be nuclear. There is also a possibility of wireless transmission of the required power.

The robot, supplied with power and instructions, may contain some sort of sensing device, which could be a TV camera, a radiation counter or a magnetometer. Through these sensors, the robot gathers information and sends it back to the human operator.

Or, the robot may have grasping devices resembling human hands and arms. Following instructions, the robot can pick up and move objects just as a man might do. Some kind of feedback circuit usually is required to tell the operator how hard the claws or hands are gripping, or other information. Some robots are so sensitive that they can handle delicate glassware without breakage.

Whatever a robot's abilities, simple or complex, it must be able to perform tasks that a man cannot do for reasons of ability or environment. Otherwise, the mechanical man has no useful purpose.

Other advanced robots now amongst us or due for arrival soon include these:

Unimate, developed by the Consolidated Controls Corp. of Danbury, Conn. Unimate is a wireless robot which is given instructions before being sent off on an assignment.

"You just teach Unimate and send it off where you want it to go," says Consolidated's Charles Colt. "If you teach it right, it will go and perform the right job. It can be used to explore a planet or a mountain top. It can double as a stock clerk, machinist, miner or astronaut. You just take it by the hand and teach it the things you want it to do, then press a button and the things stay in Unimate's brain of magnetic memory drums."

Unimate is a flexible machine with a longer reach than any human. It can sense its position magnetically and has a digital control system and digital memory. It can be taught work programs requiring 150 sequential commands. It can carry 25 pounds and has extra sets of specialized hands which it can change by itself.

Mobot Mark II, created by the Hughes Aircraft Co., probably is the best known of the new robots because of a barrage of publicity released by the company. Mobot (see EI's cover) is a remote-control handling machine with six-foot arms containing shoulders, elbows and wrists. Two television cameras mounted on rising, jointed tentacles serve as eyes. Microphones on the wrists serve as feedback mechanisms, allowing the operator to hear the hands at work. Except for the arms, Mobot looks like a big filing cabinet mounted on wheels. The cables connecting Mobot with its master carry more than 100 command channels and two TV channels. Although designed for work in radiation rooms, Mobot may be adapted to undersea or outer space tasks.

Surveyor, designed by Hughes for the National Aeronautics and Space Administration, is a probe vehicle to be soft-landed on the moon. It is equipped with a big retro-rocket and three vernier rockets to make the landing possible. Surveyor has a solar battery panel for power, a directional antenna, four TV cameras, a drill to dig into the moon's surface and instruments to analyze the resulting samples, a seismometer to record moon quakes and meteoritic impacts, a magnetometer to determine magnetic field, gravity instruments and radiation counters.

RUM (for Remote Underwater Manipulator), designed for the Navy by Scripps Institution, is a tractor-type vehicle which crawls into the ocean from the beach and can go down to 20,000 feet and as much as five miles from its control panel on shore. RUM has both TV and sonar equipment, mercury vapor lights and a working arm. Receiving instructions and power via cable from shore, it can observe the sea floor, collect samples and assemble and install deep-water oceanographic instruments at the bottom of the sea.

Mermut, designed by Vare Industries, Roselle, N. J., to explore the ocean depths. Many of the new robots are undersea machines built for exploration or to accomplish special underwater tasks. There also seem to be other long-range possibilities. The surface of Venus, for instance, is

largely covered by water. Mermut was built for the Navy. Project engineer Charles Krause says: "The Navy needed a device that could do things a diver couldn't, something that could submerge more deeply, see more clearly, have better endurance than a man and be able to tie a line around an object in deep water so it could be hauled to the surface."

Mermut sees via television, can operate motion picture and still cameras and descends to 20,000 feet. One version can splice an undersea telephone cable.

Solaris, developed by Vitro Laboratories, Silver Spring, Md. It also is an undersea robot which can descend or surface, move forward or backward, or hover. Its working hand is a giant claw.

Beetle, developed by General Electric. It has 15-foot arms and crawls on tractor-like treads. It will be used to inspect and overhaul "hot" equipment at atomic test sites. But it could also be used on the moon, which scientists believe is covered by thick layers of dust.

Thus the robots go, more talented and useful than ever before. And the future holds a still more important job for them. Says Dr. Fred Whipple, director of the Smithsonian Astrophysical Observatory:

"They can do the job at far less expense, weight and emotional concern than any man."

They Said It Could Be Done

Continued from page 88

Both men have solid technical backgrounds and work at electronics professionally, yet continue to enjoy ham experimentation after long devotion to the hobby. Thomas, 57, is engineer-in-charge at RCA's Kahuku Point operation. He has been a ham 45 years. Chambers, 40, is a satellite communications project leader with Hughes Aircraft Co. He got his ticket in 1936.

The Edison Award was established by General Electric in 1952 in memory of Thomas A. Edison, probably the greatest experimenter of all time.

Thomas and Chambers don't intend to rest on their laurels. Even now they are planning a DX assault on 1296 mc, the next higher ham band, which at present is a no-man's land. Thomas, who won an American Radio Relay League award in 1955 for his work with meteor scatter, already has designed and built a 28-foot parabolic antenna for the new experiments.

—Robert Hertzberg, W2DJJ

America's Own Marconi

Continued from page 90

him when he was experimenting was a son, Bernard, who was born around 1890. Sometimes, however, he did allow chosen individuals to view demonstrations of his apparatus and later even gave public exhibitions. After his 1885 experiment he one day ran into Duncan Holt, a Murray contractor who was as near a friend as he had, and exclaimed, "Duncan, I've done it. I've been able to talk without wires . . . all of 200 yards . . . and it'll work anywhere!" He still did not let Holt see the equipment, however. That honor was withheld until 1892, when Stubblefield allowed Dr. Rainey T. Wells, an attorney and prominent educator, to view his tangle of wires and telephones.

Dr. Wells later wrote:

"One day Stubblefield invited me to his farm for a demonstration of some kind of wireless outfit. Mind you, this was in the days when even telephones were rare. He had a shack about four feet square near his house, from which he took an ordinary telephone receiver such as we have today, but entirely without wires. Handing me this, he asked me to walk some distance away and listen. I had hardly reached my post which happened to be in an apple orchard, when I heard, 'Hello, Rainey,' come booming out of the receiver. I jumped a foot and said to myself: 'This fellow is fooling me. He has wires someplace.' I moved to the side about 20 feet but all the while he kept talking to me. I talked back and he answered me as a human voice sounds over a telephone today. But there were no wires."

Also in 1892 Stubblefield gave his first public demonstration on the town square in Murray. Hundreds of people watched as he set up one piece of equipment beside the courthouse and then another about 250 feet away. Those present noticed there were no connecting wires. Stubblefield spoke in low tones into one piece of equipment and his words came out of the other piece, distinct and clear. The crowd was astounded.

Few if anyone, realized what they had just seen and heard, however. In fact, the demonstration, plus such things as eerie wireless lights sometimes glimpsed in the trees outside Stubblefield's shack and weird voices that seemed to come from the air, only strengthened the suspicion of neighbors that they had a genuine nut in their midst.

Today, several sources credit Stubblefield as the inventor of radio telephone. The World Almanac says he made the first radio broadcast in 1902. World History at a Glance by Joseph Reither of New York University declares him the inventor of the wireless telephone. Joseph Nathan Kane in his book, Famous First Facts, attributes two firsts to Stubblefield: the first radio broadcast and the first marine demonstration of wireless telephony.

The marine demonstration took place March 20, 1902, on the steam launch Bartholdi on the Potomac River near Washington. Stubblefield was able to transmit his voice from the launch to scientists on the bank as the craft chugged up the river.

Stubblefield said in an interview published March 21, 1902, in the Washington Post:

"My invention . . . is capable of sending simultaneous messages from a central distribution station over a very wide territory. For instance, anyone having a receiving instrument, which would consist merely of a telephone receiver and a few feet of wire, and a signaling gong could, upon being signaled by a transmitting station . . . be informed of weather news. My apparatus is capable of sending out a gong signal as well as voice messages. Eventually it will be used for the general transmission of news of every description.

"I have as yet devised no method whereby it can be used with privacy. Wherever there is a receiving station the signal and the message may be heard simultaneously. Eventually I, or someone, will discover a method of tuning the transmitting and receiving instruments so that each will answer only its mate.

"The system can be developed until messages by voice can be sent and heard all over the country, to Europe, all over the world."

What equipment did Stubblefield use? Probably no one will ever know exactly because the inventor never divulged his secrets. The New York Sun in 1930 described the gear of the then dead inventor in this manner:

"His transmitting apparatus was placed in a box four feet high and six inches in width. A coil of heavy wire was at one end and led to the ground. He [Stubblefield] made the startling statement that the earth's electrical waves furnished the power by which an ordinary telephone transmitter was operated. About a quarter of a mile away another box was fastened to a stump. There were wires leading to the ground and a pair of telephone receivers on top.

"Examination showed that the wires terminated in each case at steel rods topped with a ball of iron which was nickel-plated.

"Stubblefield claimed that the earth and all about it is charged with electrical power, part of which he was harnessing—and that in time spoken messages could be sent without wires thousands of miles.

"He admitted that he had developed radio-frequency current through a battery of his own arrangement, an earth battery, following which he devised a system of modulation and an adjustment for tuning. The detector was a receiving coil, tapped for adjusting inductance."

A modern assessment of Stubblefield's equipment doesn't divulge much more. He probably used a standard telephone receiver fitted for wireless reception. His transmitter, of his own design, probably contained, among other things, a ground battery cell system, an amplifier of some sort and some tuning coils. His use of rods driven into the ground suggests he may have stumbled onto underground radio (see UNDERGROUND RADIO IS NEWS AGAIN!, March '61 EI), although the iron balls atop his ground rods could have served as antennas.

Stubblefield made the 1902 trip to Washington in an attempt to obtain patents and he did receive one radiotelephone patent, No. 887357, on May 12, 1908.

Why didn't Stubblefield become known as the inventor of radio? No one can give an answer. Stubblefield was on the edge of fame after his demonstrations in 1902, but then he faded. His refusal to allow anyone to buy into his invention, giving him working capital, probably was a reason.

Some believe his invention was stolen while visiting Washington in 1912, since Stubblefield took it with him in a trunk when he left and no one saw him return with it. Whatever happened, Stubblefield returned home a disappointed and embittered man. Soon after, his house mysteriously burned and his family left him. He then moved into a crude, drafty hut lined with corn husks. Forgotten by the world, Stubblefield worked on in the hut until March 28, 1928, when he died of starvation and neglect.

Nathan B. Stubblefield's home town continues to back him as the inventor of radio and the local station honors him by having his initials in its call letters, WNBS. There is a monument to him on the Murray State College campus. But his ironic fate probably was spelled out at the time of his death. His passing was not even mentioned in news reports on the radio.

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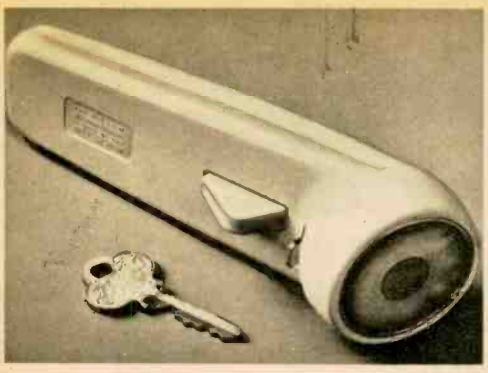

New Electronic Larynx

A NEW electronic larynx is being introduced on a non-profit basis by the Bell Telephone System to aid those whose larynx has been removed or paralyzed. The electronic larynx provides a substitute for the sound of the vocal chords.

Looking much like a modern electric razor, the unit is held against the throat. It transmits sound waves into the throat-cavity, replacing those normally emanating from the vocal chords. Speech is produced by forming words with the teeth, tongue and lips, just as in normal talking.

Some persons who have lost their voices are able to talk by esophageal speech, that is, by modulating air which is first swallowed and then released from the esophagus in a controlled manner.

However, many cannot master this type of speech and those who do master it lose the ability from time to time. These are the persons who may be helped most by the electronic larynx.

The larynx is produced in two models. One is high-pitched to simulate the female voice; the other, for men, has a lower pitch. Both models, contoured to fit the hand, have a finger control so the user may vary the pitch of his voice over a half-octave range, giving his speech natural inflections and emphasis of words and phrases. With practice, naturalness is possible.

The larynx is manufactured by Western Electric and sold at cost—$45.

Full information about the unit may be obtained from local Bell offices.

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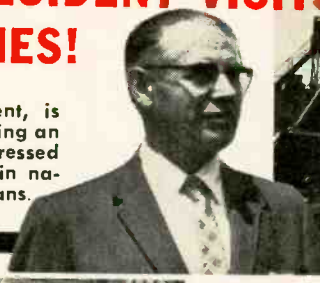
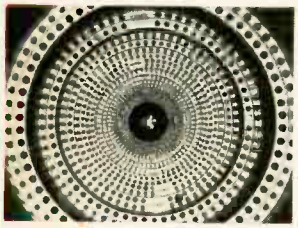
Not only the basic applications of electronics like Radio and TV, but also the satellites, space ships, guided missiles, all depend on Electronics Technicians who install, adjust, maintain and repair the equipment needed. What other job can be so exciting, profitable and promising? Yet many men, 17-55, can now train in the DeVry way at home for such jobs—without previous technical experience or advanced education.

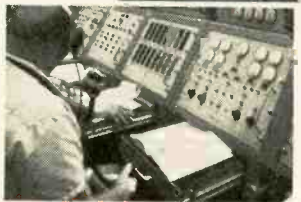
DeVRY TECH PRESIDENT VISITS MISSILE FACILITIES!



Mr. T. J. Lafeber, DeVry's President, is shown here at missile test stand. During an inspection tour, he was deeply impressed with the role that is being played in national defense by electronic technicians.



A RARE VIEW! This inside view of a ballistic missile is seldom seen by a civilian. It's a sight that greatly impressed Mr. Lafeber.



THE COUNT DOWN! Here is a control panel for missile tests. Missile check-out and adjustment are largely the work of the Electronics Technician.

WHAT SOME DeVRY TECH GRADUATES ARE DOING!

Edward Hahn, Illinois, was a laborer. Now he is an Electronic Project Engineer with the Martin Company, a large producer of missiles.

Dale L. Gawthorpe, Illinois, left a clerk's job to take the DeVry program. He is now enjoying his work with automatic pilot equipment at Sperry Phoenix Company.

Charles Morishita, Oregon, worked as a farmer before taking DeVry's training. Now he builds and tests equipment at Lockheed's Space and Missile Division.

George D. Crouch, California, was a retail store clerk. He took the DeVry training program and today he is doing very well with his own business in the servicing field.

THE HEART OF THE MISSILE! Missile wiring soon becomes clear to a DeVry Tech man because he learns basic circuits by use of the "Electro-Lab," a training device that helps speed up learning.

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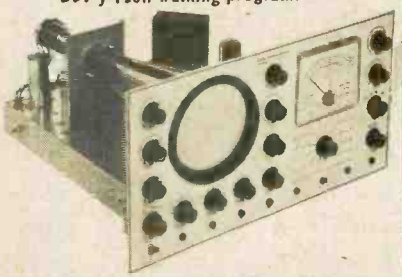

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