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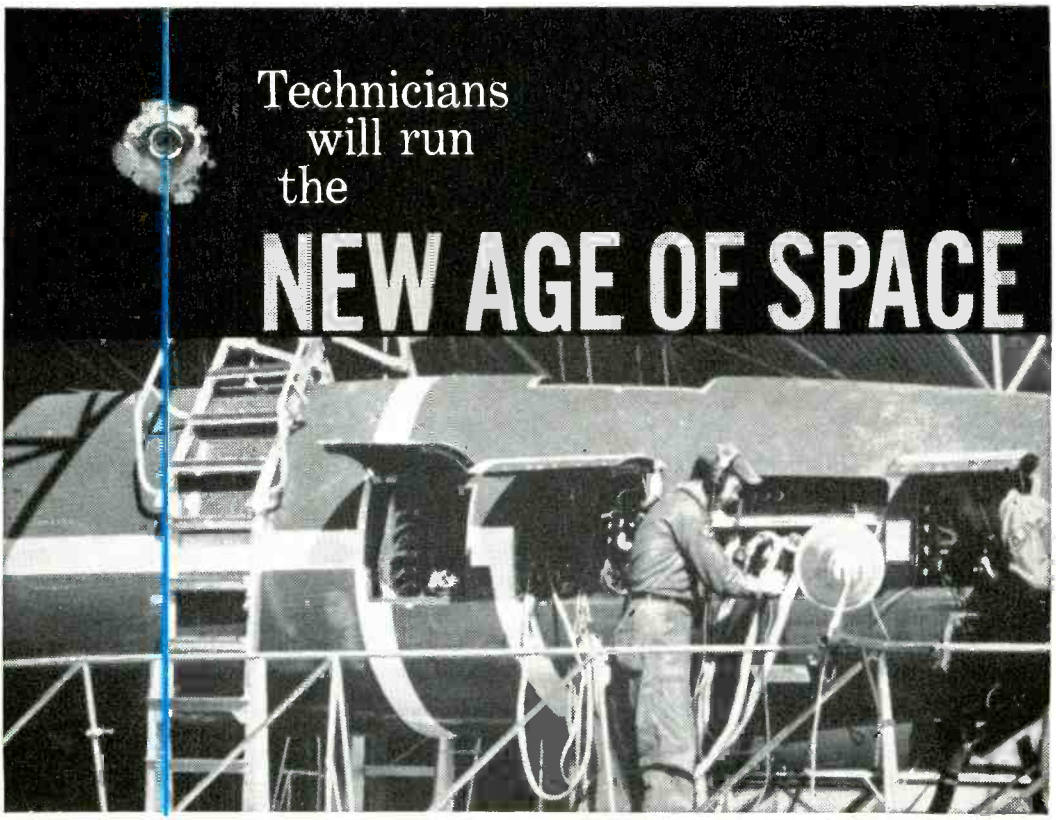

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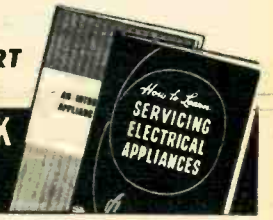

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ELECTRONICS ILLUSTRATED

Sept. 1958

A Fawcett Publication

Vol. 1 No. 3

Contents

ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Place, Greenwich, Conn. W. H. Fawcett, Jr., President; Gordon Fawcett, Secretary and Treasurer; Roger Fawcett, General Manager; Roscoe K. Fawcett, Circulation Director. Editorial and Advertising offices: 67 West 44th Street, New York 36, N. Y. Application for second class mail privileges pending at Greenwich, Conn., additional entry Louisville, Ky. Price 25c a copy. Subscription price, 12 issues for $3.00 in U. S. and Possessions and Canada.

A Message From the Editor

You've made us a success! ELECTRONICS ILLUSTRATED is going monthly with the next issue, the October one. The newsstand sale of the first and second issues was beyond all expectations and the response to our editorial approach from you our readers, has been gratifying and encouraging. We've been flooded with requests for the plans of the SAFE model rocket described in our July issue. We expected letters, but we were not prepared for the tremendous number we received and we are still receiving.

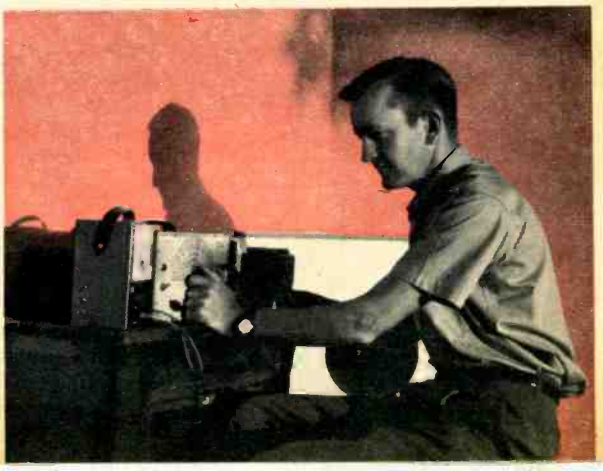
We had reason to suspect that electronics as an industry has fared better throughout the current recession than most others. In particular, we believed that there were fewer layoffs of skilled electronics technicians and engineers than was the case with similar occupations in other fields. Was this true? Well, we had Harry Kursh look into this for us and the article on page 34 gives the answers.

Harry, who lives and writes in the seclusion of Hollowbrook Lake near Peekskill, N. Y., has had considerable experience in studying and reporting on business and economic problems. After serving his "apprenticeship" as a newspaper reporter for several New England daily papers, he became a war correspondent and then press advisor to the Foreign Minister of Hyderabad, India. Back in this country, he worked as an editor for a business publication. He has studied contemporary British economic problems on a scholarship from the Institute of International Education and has written many magazine articles about the manpower problem. A great deal of the material he has accumulated appears in a new book, "Apprenticeships In America," published by W. W. Norton & Co., N. Y., N. Y., presenting the where, the what and the how of obtaining apprentice training for needed skills in electronics and other fields.

Summertime is outdoor time and this issue brings to you some interesting build-them-yourself ideas to use around your home, on your picnics, or in your country place. Every home owner who is tired of standing on his front lawn after dinner every evening with a hose in his hand, will thank us for developing the Electronically-Controlled Lawn Sprinkler on page 66. Any lawn sprinkler can be modified in a short time and for a few dollars, so that it will sprinkle your lawn when it is dry, when you are busy, away on vacation or just lazy.

HARRY KURSH

DAVE WEEMS



Our hi-fi section this issue features a corner loudspeaker enclosure that can be quickly put together for just over $8.00 and is ideal for a summer home, playroom, or living room, depending on how you finish it. The article is on page 38. The author, Dave Weems, is a Missourian who needs to be shown, and to that end, tests every enclosure he designs. He's shown here checking the original model of the corner enclosure in our article. He has, by his own admission, built and discarded just about every type of speaker enclosure and amplifier design known, and is now "teaching general science at Neosho, Missouri, to a captive audience of high school students, one of whom won a local science fair recently with an original amplifier design." David is now at work remodeling an old farmhouse "which, of course, will be wired for sound."

I would like to introduce some more of our authors to you but this will have to wait till next month, because now I want to tell you about some of the features coming in the next issue.

We've just interviewed an electronics engineer who has spent some time in Russia studying their electronics industry. His impressions are startling. "Inside Russian Electronics" is an article you will want to read and reread. Hi-fi fans who have wondered about how good the new stereo records are will have a chance to try them out with a minimum of expense if they follow our special stereo setup described in the October issue. For about $7.00 you will be able to build a stereo record player complete, that will really work! Also in next month's issue is the first article on a new, completely transistorized mobile ham rig that is so different you will want to build it just for the fun of it. It won't cost much either. And of course there will be much more.

Be with us again next month, and once again, thank you for your support.

Charles Tippin

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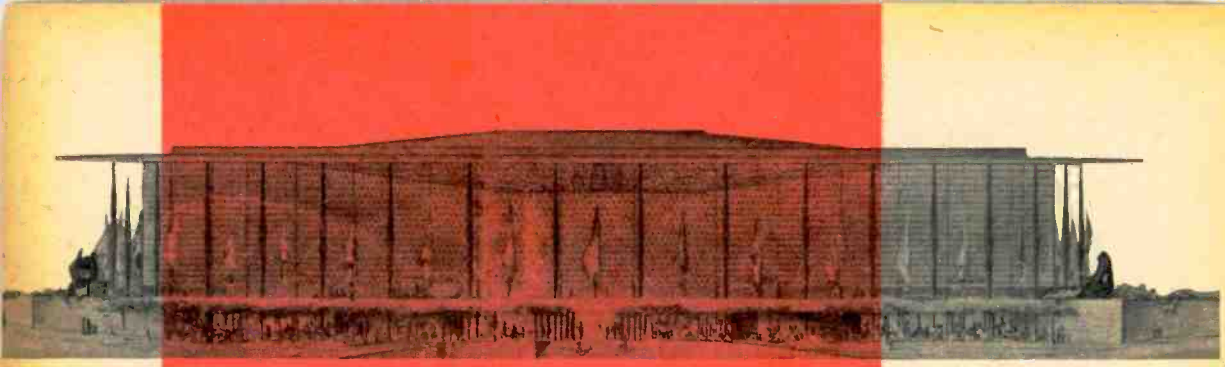
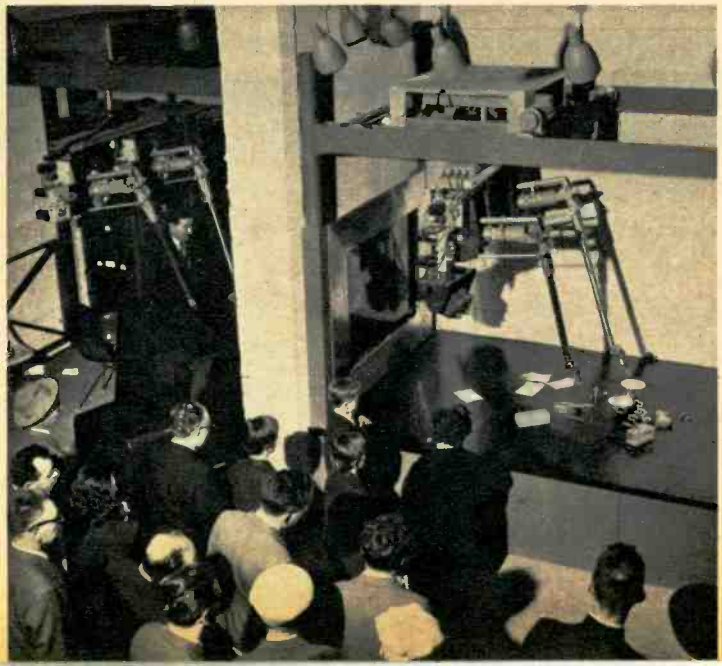


Electronics in the News

An impressive array of electronics exhibits are displayed in the striking U. S. pavilion at the Brussels World's Fair. Fascinated crowds see closed circuit telecasts on color receivers from RCA's model TV studio, become even more intrigued by suddenly seeing themselves on the screen as cameras are turned onto the watchers. Above right, an old mathematician meets a new one. Dr. Paul Pruyck, 69-year-old Belgian professor is introduced to IBM's RAMAC Computer.

Photos by F. Gerritssen from PIP



Also at the Fair, the U.S. is displaying an electronic method of safely handling radioactive materials. The materials are kept in a lead shielded room and a visitor on the outside controls the servo-mechanized arms. Every motion he makes is electronically duplicated by the arms inside the room. This technique makes it possible to measure and mix safely radioactive materials for experimental purposes.

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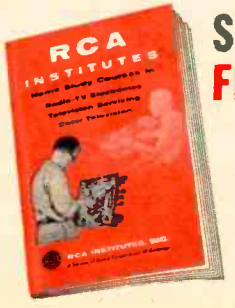

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Here's a new 3-in-1 integrated FM tuner-preamplifier-amplifier from Harmon-Kardon, Inc. It's the Sonata, Model FA-10. Features include broad-band Foster-Seely discriminator and limiter, AFC and flywheel tuning for the tuner; preamplifier equalized for magnetic cartridges and tape head; loudness contour control and separate base and treble controls. Complete with black enclosure and copper-finished front panel, the Sonata sells for $114.95 in the East and Midwest, slightly higher west of the Rocky Mountains.

—o—

RCA recently announced the manufacture of its two-billionth electronic tube, a traveling-wave tube for use in radar and missile control systems. In their twenty-eight years of tube making they have produced enough receiving tubes to equip 17½ million TV sets and 300 million radios. The rest of the number is comprised of various industrial tubes, power tubes and tubes for television cameras, oscilloscopes and microwave equipment.

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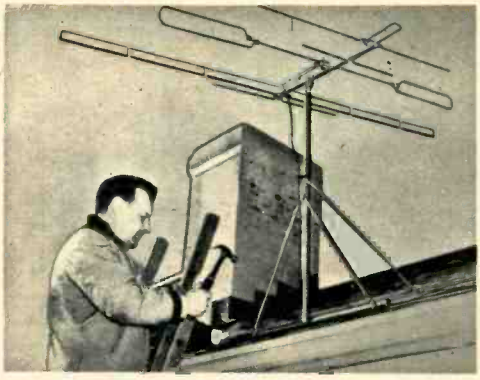

A complete outdoor antenna system that can be installed by anyone, in less than 10 minutes, is now available from the Technical Appliance Corporation. The TACO "Quikie" includes an assembled antenna, mast, mast mount, all necessary hardware and the transmission line to connect to the TV receiver. The transmission line is factory-connected to the antenna and terminates in a special clip that snaps onto the receiver connections. Antenna and mount are made of aluminum, anodized in gold, and special aluminum nails seal out water. The system can be installed without actually climbing onto the roof and no technical knowledge is required to do the job. It is recommended for all installations up to 40 miles from TV stations. The company claims it can be used for UHF as well as VHF.

—o—

A dramatic step has been taken toward averting the terrible disasters caused by floods, with a flood forecasting radio communications system, operated in Pennsylvania by Motorola who supplied the setup. Over 40 observers form a network from various water level and weather reporting stations throughout the state. They report by voice either directly to the central office in Harrisburg, or to district offices which in turn relay messages and warnings by voice or radio teletypewriter. There are also seven unattended automatic water level gauges reporting river level by radio when activated by the radio transmission of a tone code from the central office control console.

—o—

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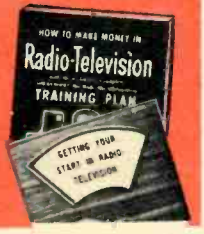

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For existing PA systems, Allied has just made available a booster unit which will provide 60 watts of added power output with only 0.4 volt input. This Knight Power Booster is $69.50.

—o—

With the new Regency FM TeleVerter any TV set can become an FM receiver at the flip of a switch, without interfering with normal TV reception. Only 6 inches long, and completely transistorized, the TeleVerter can be installed by anyone; the only necessary connections are to the TV antenna terminals. Cost is $19.95.

—o—

An electromagnetic stereo cartridge for $45 has been introduced by Shure Brothers. Completely compatible, it will play monaural records monaurally and stereophonic records both monaurally and stereophonically. Called the Stereo Dynetic, it claims to have high vertical and lateral compliance.

Despite the rush by all hi-fi component manufacturers to introduce stereo units, Shure has taken this opportunity to market a new monaural pickup using the moving magnet principle. These "Dynetic" cartridges feature low record wear.

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

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

FROM OUR MAIL BAG

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

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

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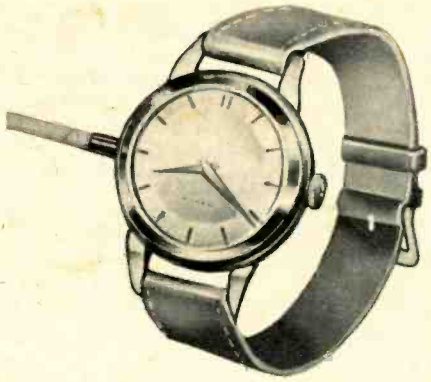

It looks like a wrist watch, but it's actually a crystal microphone. Ideal for investigative work or for candid recording, this highly sensitive microphone is connected to a thin, flexible, 6½ foot cable which may be run up the coat sleeve to a concealed pocket-type portable tape recorder. The mike-watch may be connected to any high impedance tape recorder or preamplifier. Called the PA-47 "Wrist-Watch" Crystal Microphone, the ½ pound unit is available from Lafayette Radio, for $5.95.

Heath has just announced shipment of its new amateur radio receiver kit, the model RX-1, called the Mohawk. It features wide-band slide rule type vernier tuning and a double conversion circuit to cover the amateur band from 160 to 10 meters. It is specially designed for single-sideband reception with crystal controlled oscillators for upper and lower side-band selection. A completely preassembled, wired and aligned front end is furnished. Other features are a bridged T-notch filter, a built-in 100 kc. crystal calibrator, and accommodations for converters to cover 6 and 2 meters.

The kit, priced at $274.95, features 10db signal-to-noise ratio at less than 1 microvolt input.

—o—

Here's a truly portable tape recorder, the Geloso Hi-Tone, weighing 7½ lbs. and smaller than a clock radio. This two-speed machine delivers up to 2 hours of recording on a 3¼" reel when operated at 1⅞" per second. Its other speed is 3¾" per second. Reproduction is good for its size and can be improved by connecting it to an external amplifier and speaker. The $179.95 list price includes a reel of long-playing tape, rewind reel, a sensitive crystal microphone and a cordovan-finish carrying case.

—o—

The use of transistors in TV studio cameras has resulted in improved home reception. A new specially designed black-and-white TV studio camera recently developed by General Electric uses transistors instead of vacuum tubes. The latter are often subject to vibration when the cameras are moved about and this vibration results in microphonics, a type of tube-generated noise that leads to wavy lines on the home TV screen. This condition is particularly noticeable during high-pitched sound portions of a program. No more tubes, no microphonics.

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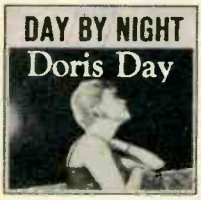

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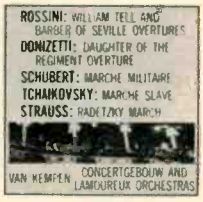

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19 Almost one hour of dance music

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21 Four melodic works for strings

22 Tony with a wonderful beat

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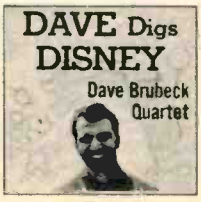

24 Dave works over six Disney tunes

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11. Norman Luboff Choir—Just A Song
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L-20

A single five-component automotive systems analyzer available now, is designed to facilitate complete engine tune-ups. A unique feature of this unit, designed by Alland-Amann Corp., is that tachometer, dwell and vacuum readings can be taken simultaneously on this unit while the car being tested and tuned is in the shop or on the road. Weighing less than 8 pounds and using only two leads, the ASA-120 can be carried inside the car to check the vehicle while it is in motion. The price of this analyzer is $128.50 list.

—o—

A test for the tester has been developed by DuMont. Junction boxes, used by the Armed Forces in test equipment for radar systems, are themselves checked by a multiple function automatic tester, which makes 30 individual wiring checks per minute. The device can select 5 points simultaneously for a given test. Each of these 5 may be routed to any one of 22 separate points. Tests are to discover broken wires, to determine whether the right wires are connected to the right points, to verify the condition of wire insulation and to check resistance. The multiple purpose automatic tester has an average speed of one test every 2 seconds and a capacity of 900 input points, consisting of 30 connectors of 30 terminals each.

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A pair of great products . . . great because they reflect 35 years of skill and the standards of leadership. No gadgets . . . no compromises . . . only the time-proven features which guarantee continuing, undeviating excellence.

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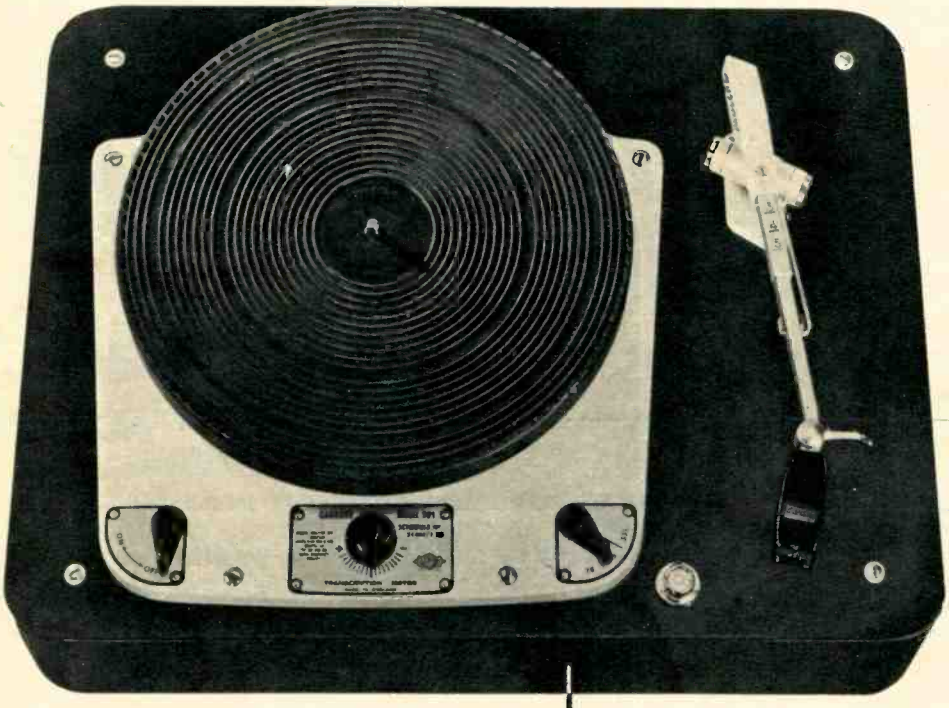

Model 301
PROFESSIONAL
TRANSCRIPTION TURNTABLE

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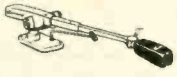

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- Built to insure professional quality performance, with traversing and vertical friction reduced to absolute minimum by special cone-type ball-bearing pivots, as in the finest chronometers
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the international race for

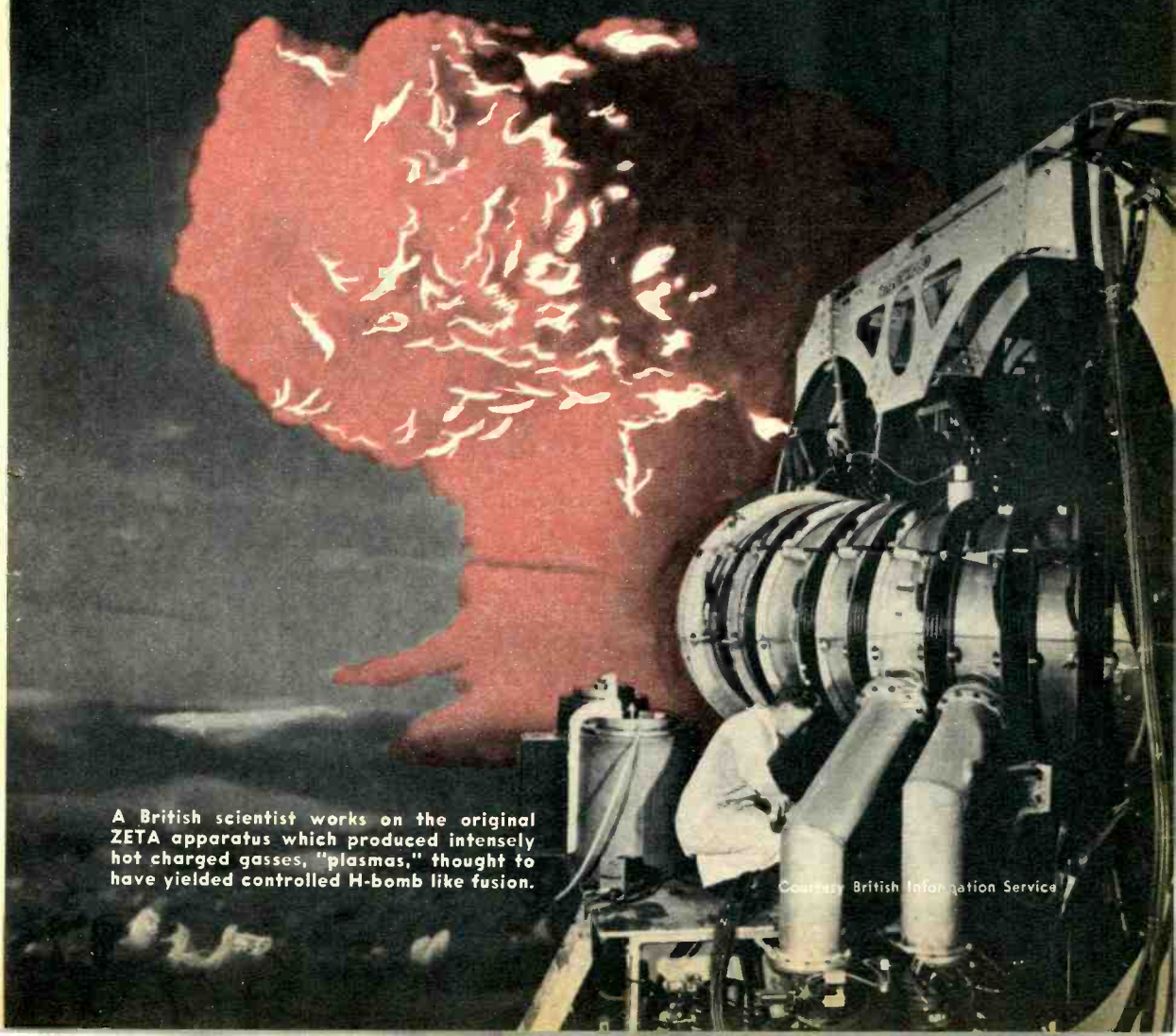
Thermonuclear Power

By Paul Beame

Electric power from controlled H-bomb fusion is the goal; the source for this power is—water!

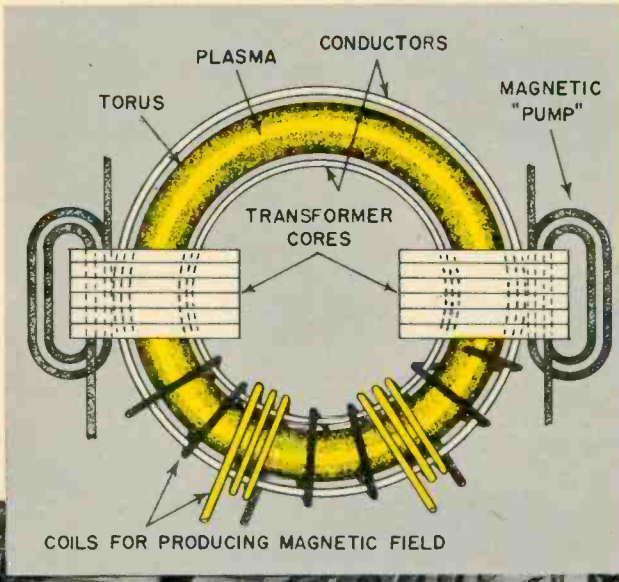
IF SCIENCE has its way, we may wake one bright day in the not too distant future to find the Mississippi—and all the other rivers of the world, and the oceans too, changed to rolling reservoirs of power. Power so limitless that it would last billions and billions of years—longer even than the earth has existed in the cosmos.

What kind of power can we get directly from water? Fusion

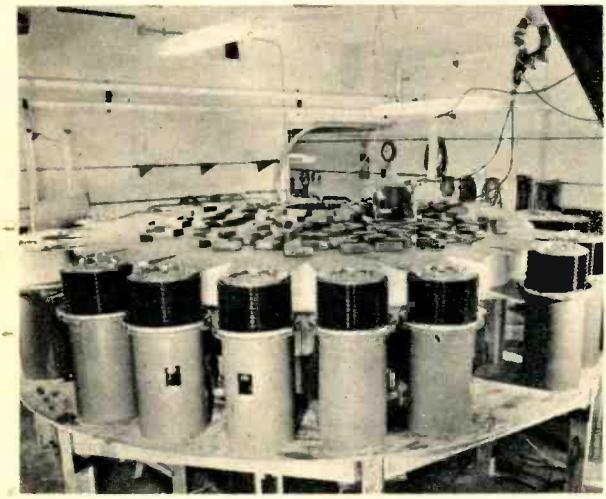


A British scientist works on the original ZETA apparatus which produced intensely hot charged gasses, "plasmas," thought to have yielded controlled H-bomb like fusion.

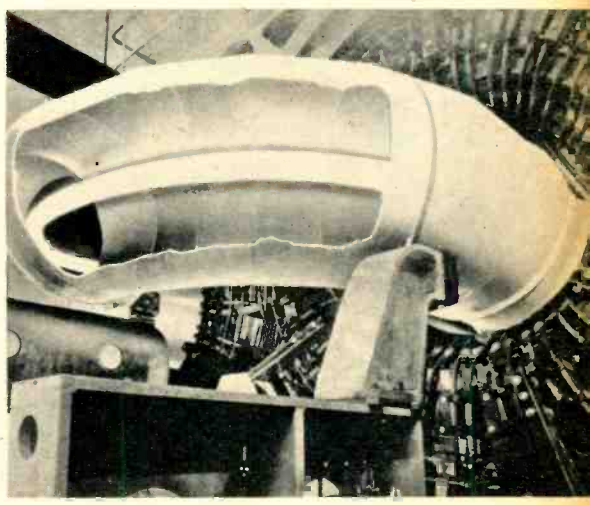
Courtesy British Information Service



Most of the experiments to harness fusion occur in torus tubes like one at left and in new ZETA below. Hydrogen gas in the tube is charged and heated to high temperature by a large current discharge through the tube. This current is produced by making the tube the secondary of a huge transformer with the primary around it. The charged gas, called plasma, is "pinched" into a thin stream by surrounding magnetic fields so as not to touch sides of torus.



These large capacitors store the current which is shot through the gas raising its temperature.



The hot gas pinched by the current through it becomes a plasma through center of the torus.

power! The power which today can be unleashed in one fearful blast by the hydrogen bomb to sear a city into lifelessness in a fraction of a second.

If scientists in the United States, England, the Soviet Union, France and Japan make the big breakthrough, man will be able to harness the tremendous energy in the heart of the hydrogen atom. Science has already taken the first faltering steps, and it may not be many years before the first fusion power plant is opened to provide electricity at a fraction of today's cost.

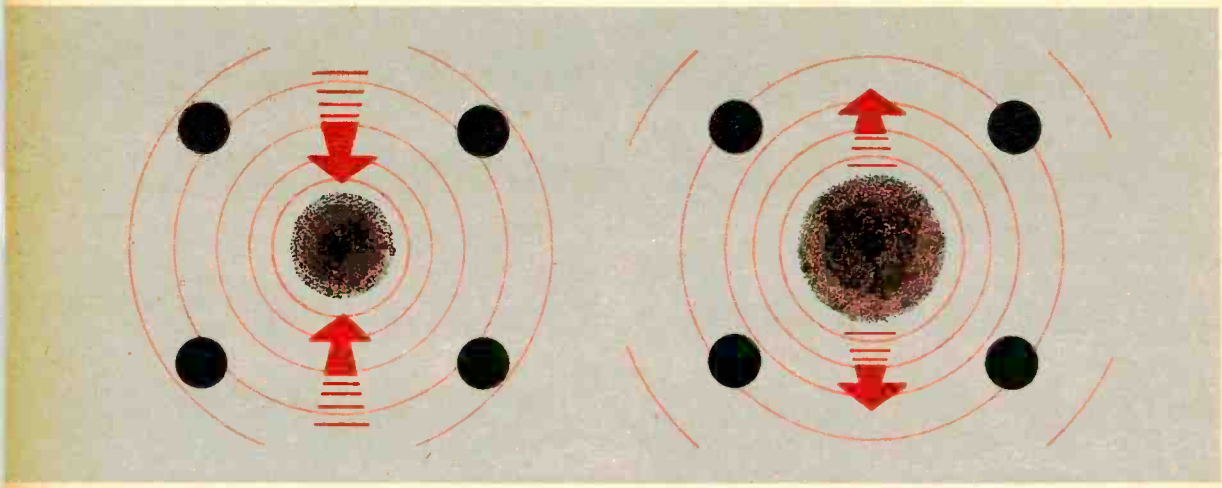
In understanding fusion we have to grasp one distinction. Fusion is not fission. We already have fission power, obtained by the splitting of the uranium atom. Fusion is somewhat the reverse process. It is the bringing together, or *fusing*, of the nucleus of the heavy hydrogen atom, deuterium, and thereby releasing energy.

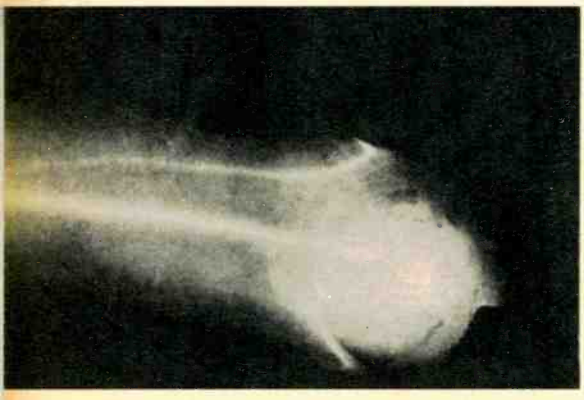
There are two very good reasons why we would prize fusion power over that of fission, such as we obtain from the new plant at Shippingport, Pa., and in the reactors of the atomic powered submarines, Nautilus, Seawolf and Skate. First, and perhaps foremost, fission produces radioactive wastes, which remain potent and dangerous to man for thousands of years. Already these wastes are proving a difficult disposal problem. Some scientists have even proposed shooting them into space to get rid of them. Fusion produces no such dangerous residue.

Secondly, in fission we must obtain power through heat exchangers—a system which heats a liquid flowing through the atomic reactor, which in turn heats water, which turns to steam, drives a turbine and in turn, generates electricity. Fusion would eliminate this cumbersome process. It is believed we could obtain electrical power *directly* from the fusion process, a tremendous saving of time, materials and labor, all of which amounts to money in the final analysis.

A somewhat less pressing reason for preferring fusion power is that, while there seems to be a plentiful supply of fission fuel on this earth, it would not last forever, while there is enough deuterium in a bucket of water to provide the energy we get from two tons of coal. In all the oceans there is enough deuterium to equal the power we could get from 5×10^{23} tons of coal (500,000,000,000,000,000,000,000 tons), which would last 100 million million (10^{14}) years. In short, enough to eliminate the fuel problem forever

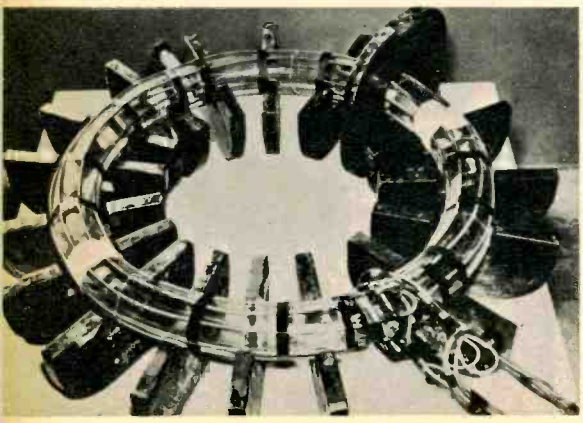
The theory behind the fusion of hydrogen isotope gas is rather complex, but it can be stated as follows:





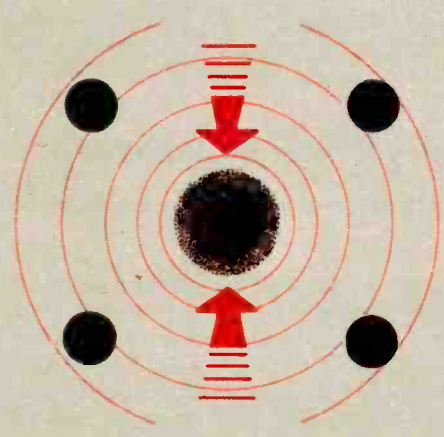
Actual photo of high-energy pinched gas (central track) rounding a curve in Perhapsatron.

Perhapsatron tube used by AEC for early fusion attempts rests on field-producing magnets.



At extremely high temperatures, matter enters a fourth state called "plasma." (The other states are solid, liquid and gas). In plasma, electrons no longer orbit about the nuclei of atoms, but instead fly about wildly. Under such conditions, the nucleus of deuterium, a hydrogen isotope called "heavy hydrogen," composed of a proton and a neutron, may collide and fuse with another similar nucleus. This may produce either a helium^3 nucleus (two protons and a neutron) plus a neutron, or a triton (nucleus of tritrium, or extra-heavy hydrogen, made up of two neutrons and a proton) plus a proton. In either case, this fusion also results in the release of extra energy, on the order of 3.3 million electron volts for the former and 4 million electron volts for the latter. It is this extra energy which science is trying to convert to usable power. Already the United States and England have reached the stage where they believe they have created controlled fusion. The Soviet Union may have also done so. Japan and France are also in the running.

Basically, the technique used involves introducing deuterium gas into a closed toroid, or doughnut-shaped container. A tremendously high current, in the order of hundreds of thousands of amperes, is passed through it, heating it to millions of degrees. This serves to "pinch" the gas into a narrow beam of plasma, in which there is a chance for fusion, and the release of energy. The



The great promise of controlled fusion is that we may be able to obtain electric power from the plasma directly rather than by using a heat exchanger, as in fission. The way this works is shown at left. First, as the plasma is pinched by the current it carries and the magnetic field around it, its own magnetic field contracts, cutting and inducing a current in the conductors through the torus. Next, the high energy deutrons (nuclei of heavy hydrogen) in the plasma collide and fuse, pushing out the plasma and its magnetic lines of force. The latter cut the conductors again, inducing a current. Lastly, plasma is pinched, wires cut.

difficult problem is in reaching a temperature high enough to cause fusion, such as occurs in the interior of the stars.

A typical torus is ZETA, at England's atomic energy research installation, Harwell. The tube itself, shaped somewhat like an auto tire, is a little over 13 feet across, with double walls of aluminum. Two quartz windows allow obervers to watch the discharges. In order to provide the "pinch" effect, magnetic fields of force must be wrapped around the torus. This is done by building a transformer around the tube with the tube itself acting as the secondary. Just like a common power transformer, this giant is built up of laminated steel, with a tunnel cut into it to hold the torus. Wrapped around the outside is a layer of heavy electrical conductors, which form, in effect, the primary of the transformer.

If a voltage is induced in the primary, it in turn induces a voltage in the torus. If large enough currents are passed through the primary, they could generate a charge in the tube and keep it going. However, since a generator would be unable to supply sufficient power for this, another arrangement is used. A huge bank of capacitors, some 20 yards away, are charged by a generator, and these are discharged in an instant through the primary. It takes about 10 seconds to fill them to capacity, at which time they store half a million joules of energy. These can be discharged through the transformer in four thousandths of a second—in other words, at the rate of 10,000 kilowatts. This discharge through the deuterium in the torus builds up the circular magnetic field which serves to constrict or "pinch" the discharge. However, in order to supply the "backbone" and prevent the discharge from wriggling, and touching the walls, another field must be applied. This is done by wrapping a series of coils around the tube itself and feeding them separately. Compared to the discharge current, extremely weak forces are needed for this effect.

It is believed a temperature in the order of 100 million degrees centigrade is needed to sustain controlled fusion. The Russians, we know, achieved nearly 1 million degrees some years ago. The British have recorded a temperature somewhere between 1 million and 5 million degrees in ZETA (zero energy thermonuclear assembly). In another torus, Sceptre III, they hope to get 30 to 40 million degrees by the end of this year.

In our own Project Sherwood, the S3 assembly is said to have reached a temperature of about 6 million degrees.

In all of these cases, the extra energy which is a result of fusion is said to have been detected. While it is possible the released neutrons could have been due to contact of the plasma with the glass walls of the toroids, where neu-

[*Continued on page* 109]

The Picnic Music Maker

By Lou Garner

This 3-speed record player runs off flashlight batteries and takes only a few hours to build.

IF you own a portable radio receiver, you can, if you wish, take music with you wherever you go. But the music you can receive may not always be the music *you want*. Too often, a radio station's programming will not coincide with your mood at the moment and music at a picnic will lose its relaxing quality when interrupted with a "message from Jack Shark, your *friendly* Loan Company."

But you can take the kind of music you want with you

Photo by Mike Bonvino

An easily available portable phono case houses the music maker that requires no winding, plugging into power lines, or auto cigarette lighter attachment. The volume control is in front of tone arm.

wherever you go . . . without the annoyance of commercial messages . . . *if* you have a portable phonograph and a collection of records—a portable, that is, that works completely from batteries.

The phonograph described here is no larger than a small overnight bag and light enough for a child to carry. It can be used anywhere and requires no "winding" and no "plug-in" for operation, yet will handle standard 45, 33⅓ and the newer 16⅔ rpm records. Easily assembled from readily available components, this phonograph operates on four standard flashlight batteries. It provides adequate volume and tone quality for dancing and "mood" music, but is not a high fidelity instrument.

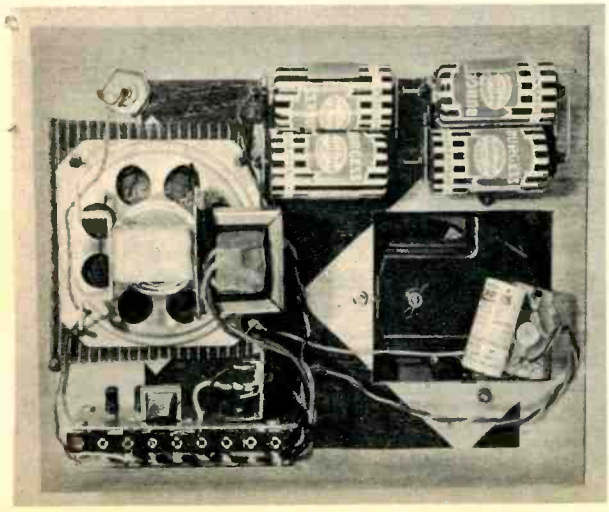
A standard portable phonograph case is used to house the completed instrument, which consists of five major parts mounted on a plywood board . . . the amplifier chassis, loudspeaker, power supply, turntable, and pick-up arm. Make sure you have all the parts you need on hand *before* you start assembly.

Two metal chassis are used for the amplifier. One is a small sub-chassis which serves as a "heat sink" for the 2N255 power transistor. It is attached to the main chassis with standard machine screws and nuts, with fiber washers used to provide electrical insulation between the two chassis. As with most power transistors, the 2N255's collector electrode is connected electrically directly to its outer metal shell.

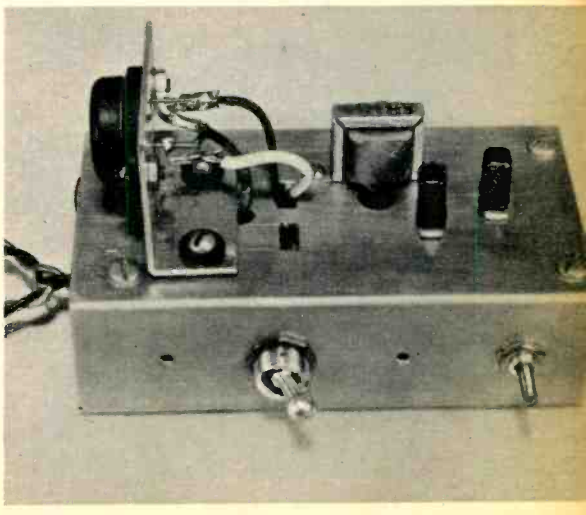
Small spring clips are used for mounting the two sub-miniature sockets needed for the CK722 transistors. A ground lug, held in place by one of the 2N255's mounting screws, serves as a connection terminal for the transistor's collector electrode. Connections to the power transistor's base and emitter electrode pins may be made with small clips . . . you'll find that pin terminals salvaged from a discarded 7-pin miniature tube socket make excellent connection clips for these terminals.

The output transformer (T2), loudspeaker, battery power supply (B1), and motor filter capacitor (C6) are *not* part of the amplifier chassis. When you've completed wiring the amplifier chassis, recheck all connections, paying particular attention to electrolytic capacitor polarities and to the color-

Bottom view of the mounting board shows amplifier chassis lower left, motor at right.

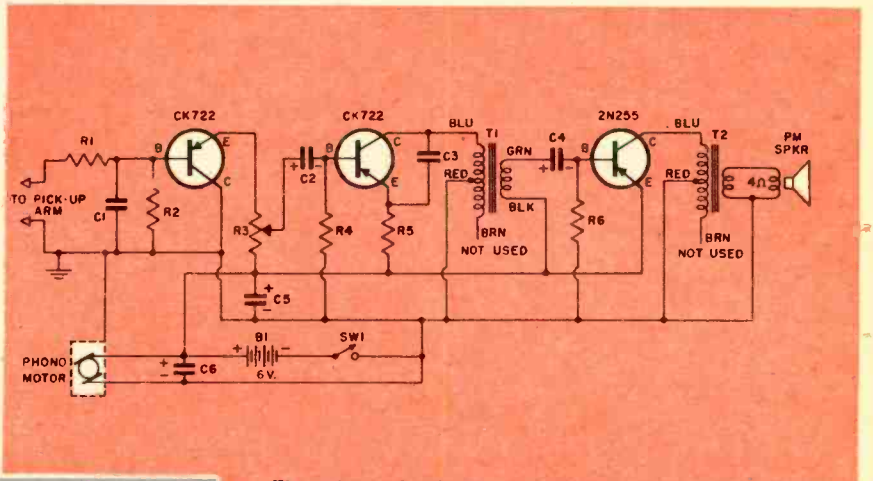


Closeup of amplifier chassis, note the power transistor on the aluminum bracket, left.

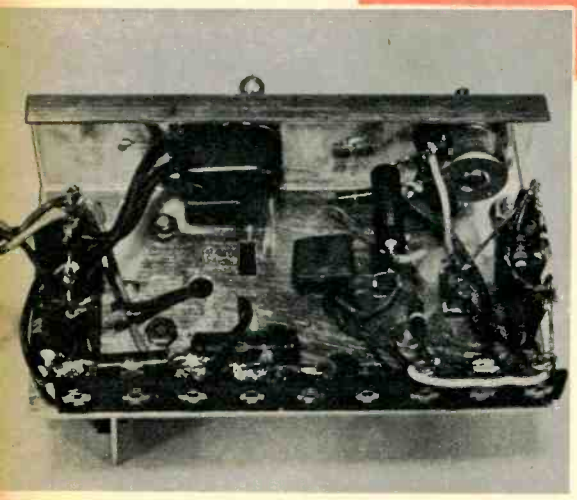


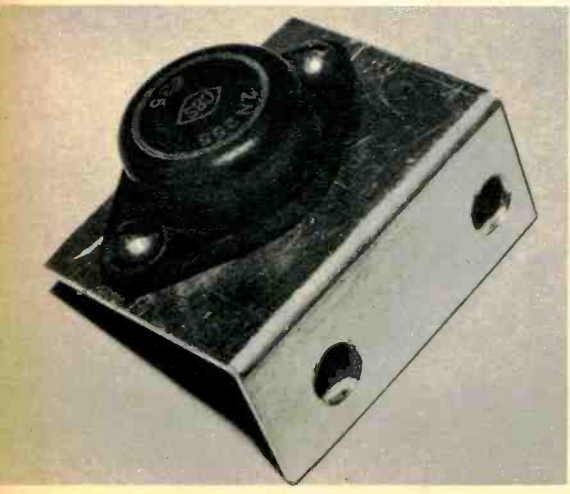
Bottom view of amplifier chassis is shown below. This view corresponds with the wiring guide on the facing page. The long terminal strip along the bottom is fastened to chassis at ends for grounding.

The power transistor is mounted on a bracket to drain off excess heat from unit for good operation.



The schematic diagram of the 3-transistor amplifier is shown above, wiring guide is at right.





coding of the various transformer leads.

You'll want to finish the outer face of the mounting board before mounting parts. Instead of using conventional finishes such as paint, enamel or varnish, the board used in the model was covered with a sheet of adhesive-backed plastic material having a wood-grain design. It is smoothed down and burnished in place.

Finally, mount all component assemblies on the finished board, using machine screws and nuts, wood screws, or other appropriate fasteners. Place a piece of flocked screening or grille cloth between the front of the loudspeaker and the board during mounting.

Output transformer T2 is mounted to a bracket on the frame of the loudspeaker, with its secondary leads connected directly to the speaker's voice coil terminals and its red and blue primary leads twisted together and run over to the amplifier chassis.

A large electrolytic filter capacitor (C6) is connected across the phono motor's terminals. This capacitor helps to reduce electrical noise developed by arcing of the DC motor's brushes. A pair of wire leads are connected in parallel with this capacitor, twisted together and run over to the amplifier chassis.

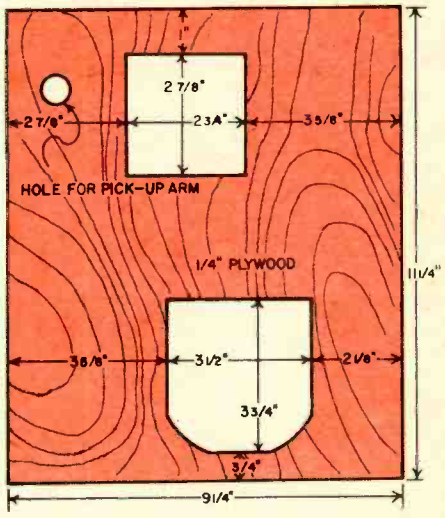
Wire the pair of dual battery holders so as to connect the four flashlight bat-

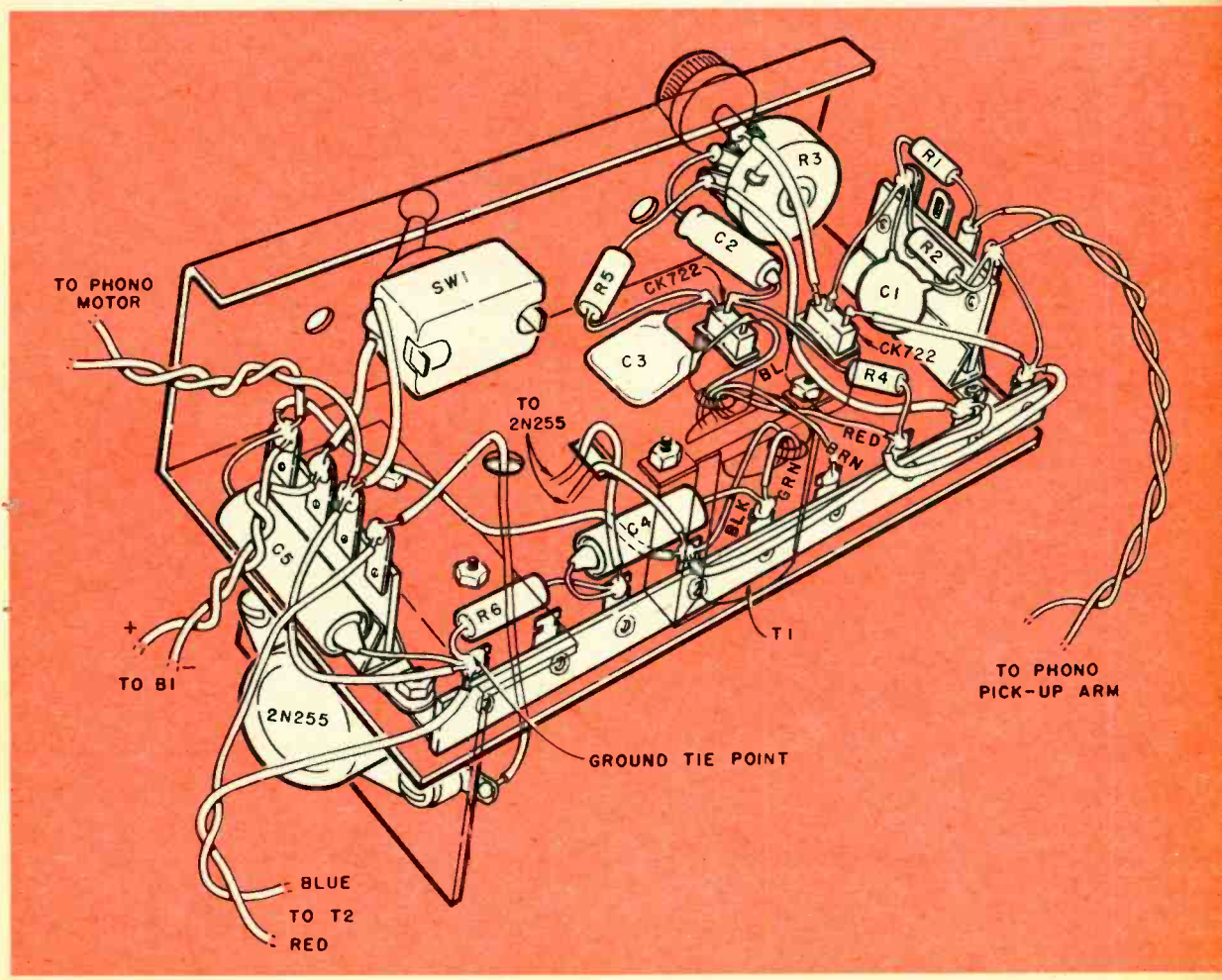
[*Continued on page* 111]

PARTS LIST

R1, R4—100,000 ohm, ½ watt carbon resistors
R2—270,000 ohm, ½ watt carbon resistor
R3—5000 ohm miniature potentiometer
R5—100 ohm, ½ watt carbon resistor
R6—2700 ohm, 1 watt carbon resistor
C1—.002 mfd, disc ceramic capacitor
C2—6 mfd, 15 volt miniature electrolytic
C3—0.1 mfd, subminiature disc ceramic
C4—30 mfd, 6 volt miniature electrolytic
C5—100 mfd, 6 volt miniature electrolytic
C6—500 mfd, 6 volt electrolytic
T1—Transistor output transformer, 500 CT to 8 ohms (Argonne AR-164)
T2—Transistor output transformer, 48 to 3.2 ohms (Argonne AR-503)
SW1—SPST toggle switch
B1—6 volt battery (Four No. 2 flashlight cells)
Transistors—(2) Raytheon CK722, (1) CBS-Hytron 2N255
Loudspeaker—4" to 6" PM Loudspeaker, 4 ohm V.C.
Phonograph pick-up arm with high output cartridge
6-volt phono motor and turntable
Portable phono case (Lafayette No. ML-108)

Layout for the mounting board is at right. Use ¼" plywood or Masonite, cut as shown.





EI Exclusive

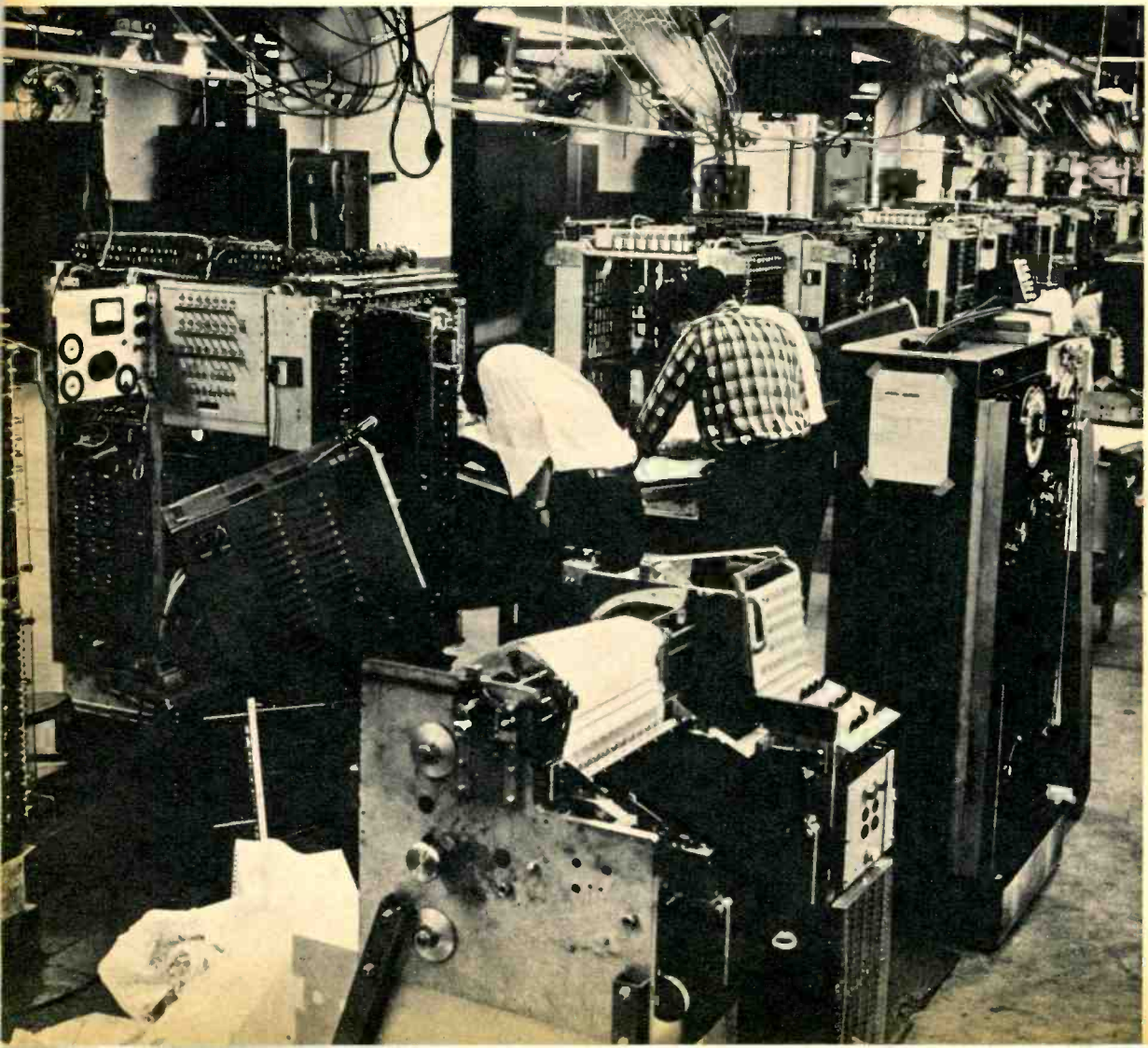
Are Jobs in Electronics Recession Proof?

By Harry Kursh

Yes! Says our expert, if you have training as an electronics engineer or are a skilled technician.

Highly trained men check assembly of part of an electronic computer at Univac. Electronics plants maintain production even during a recession.

Remington Rand Division, Sperry-Rand Corp.

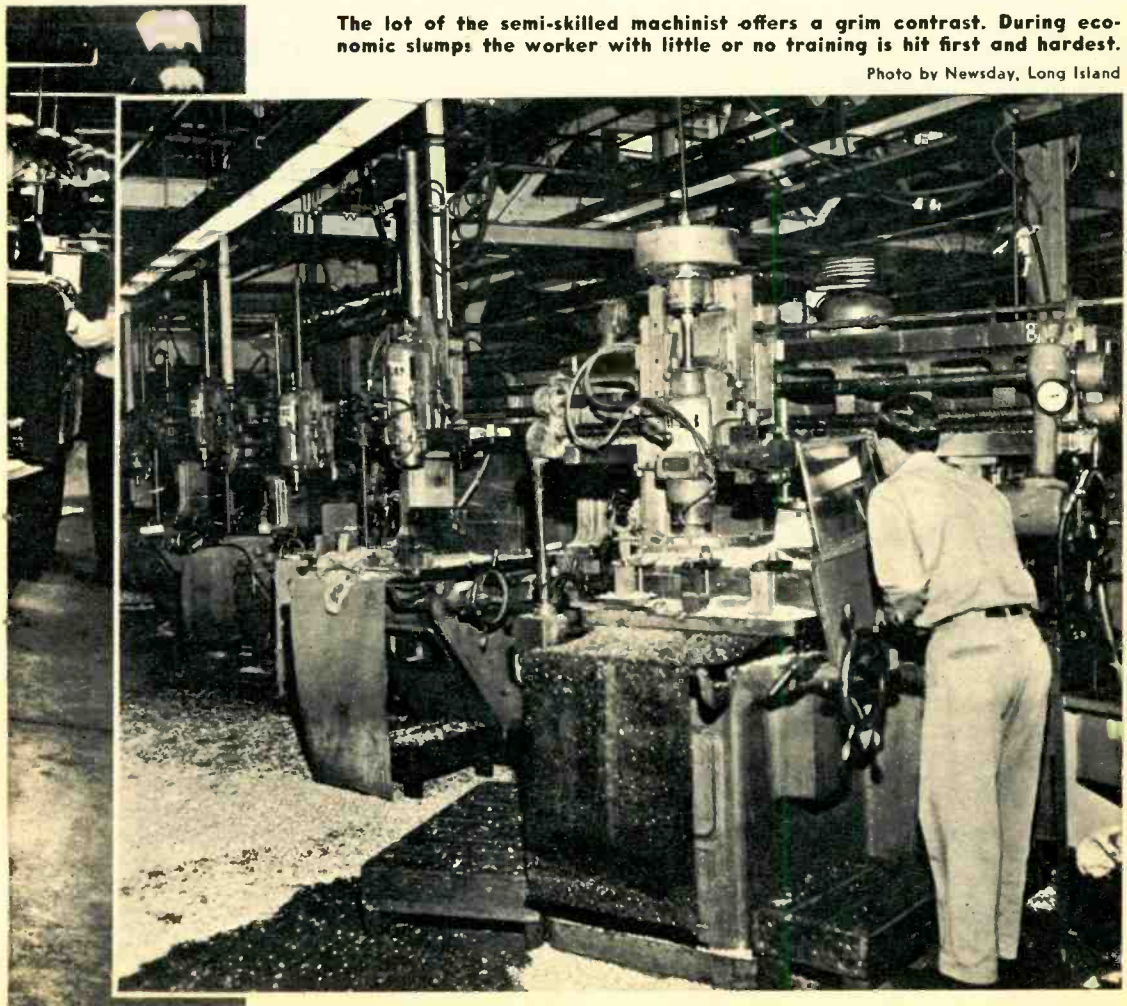


IF RECENT slump-scare headlines set your head spinning about the economic future, you're not alone. Millions of Americans are now taking a second look at their jobs, skills, and business goals. Where do you fit in—if you happen to be working in electronics now, or if you're planning to make electronics the most important thing in your life?

How many times have you asked yourself the burning question: Are jobs in electronics recession-proof?

When ELECTRONICS ILLUSTRATED asked me to find the answers, I studied scores of confidential and public reports and talked with dozens of experts in every conceivable phase of the electronics industry. The eye-opening answers I received and compiled for this report may alter your life.

First, let's put the cards on the table: America has never claimed immunity to economic slumps. As a matter of fact, it's well to remind ourselves that we have had at least two other fairly serious recessions since the end of World War II, to say nothing of the economic panics that have haunted us since



The lot of the semi-skilled machinist offers a grim contrast. During economic slumps the worker with little or no training is hit first and hardest.

Photo by Newsday, Long Island

No slow-down here. Within the last year electronics industries hired more than they fired. Shown here is final testing of oscilloscopes.

Allen B. DuMont Labs, Inc.

The ever-increasing demand for electronics for defense is indicative of the industry's growth. Defense electronics needs research engineers.

Radio Corporation of America

the days of the Continental Congress.

So, unless the future makes an unprecedented switch on history, we may always have our economic ups and downs. No segment of the economy is completely recession-proof, never has been, and may never be.

But—and this is THE BIG BUT—there have always been, depression or no depression, favored industries. In other words, while the economy slid backwards some industries rolled along, more recession-proof than others. Within these favored industries, jobs were more recession-proof, longer-lasting and steadier than in other fields: advancement was rapid and more lucrative; business successes were plentiful; new ideas and inventions paid off handsomely.

This is where electronics stands today—the favored industry of the latter 20th Century. There can be no doubt.

What makes electronics the favored industry? The answer, in a word, is growth. Thanks to zooming industrial automation, television, radar, hi-fi, mobile radio, and the incredibly increasing reliance of defense communications, aircraft, missiles and rockets on electronics, the industry has only begun to climb.

Electronics sales have risen steadily and are now hitting a $7-billion-a-year pace. Gen. David Sarnoff, RCA's celebrated boss, predicts that electronics will be a $24-billion-a-year industry by 1967. Some say he's conservative. An official U. S. Department of Labor report, published only a few months ago, forecasts electronics in the 1960's as "one of the fastest growing manufacturing industries."

Naturally, growth increases employment opportunities. That's why, between 1947 and 1956, even though we suffered two recessions (just before and after the Korean War), *employment in the electronics industry more than doubled.* And the present number in electronics (some 450,000) may double again within the next decade. In fact,

the Labor Department expects employment in electronics to *"increase at a much faster rate than the nation's total labor force."*

If all this is true, then electronics workers should have fared better than any other segment of the economy during the 1957-58 recession, which hit a peak with nearly 6,000,000 Americans unemployed. And they did. It is almost impossible to find a government official, economist, or industry expert who is willing to say that the recession even came near the electronics industry.

At General Electric's heavy military electronics equipment department, employment was increased by 220. Zenith and Admiral Corp. officials said they were hiring, more than they were firing. On the West Coast, Aerojet-General Corp. officers said they expected to add 1,000 new professional and skilled workers by June, 1958.

But if there is one man in the entire country who perhaps knows the electronics industry best—because he has to—that man is William A. Duvel, vice-president in charge of the metals and electronics division of the National Credit Office, Inc. There's little room in Duvel's books for error. Millions of dollars of credit are staked by banks and major corporations on what Duvel has to say about the electronics industry. Scattered throughout the country, Duvel has a team of credit and financial analysts who study every single electronics company in detail. And they filter their reports back to him. Therefore, Duvel sees the electronics industry from the intimate inside, as no other man does.

I asked Duvel: "Has the recession hurt the electronics industry?"

He said, emphatically, "No. This is one industry that has not been hurt by the slump. One fact I am quite sure of—there are more people employed in electronics today than a year ago, and a year from now there will still be more."

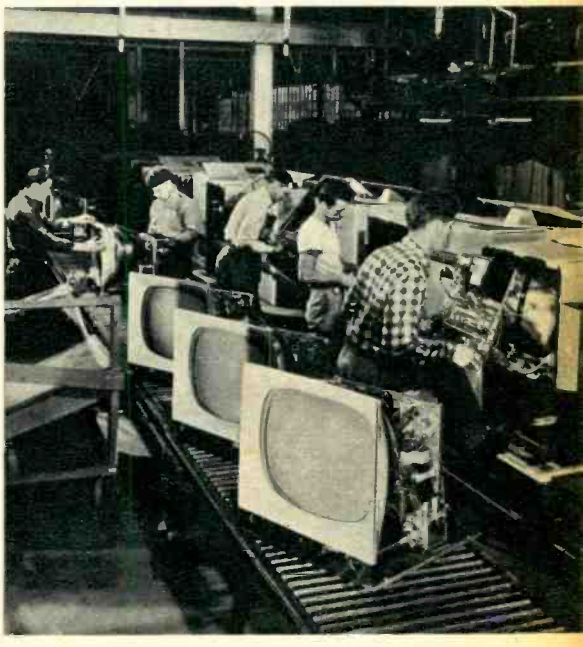
I asked: "If you were interested in a long and relatively secure job future, would you choose electronics today?"

"Definitely," he replied.

[*Continued on page 92*]

Photo by Field

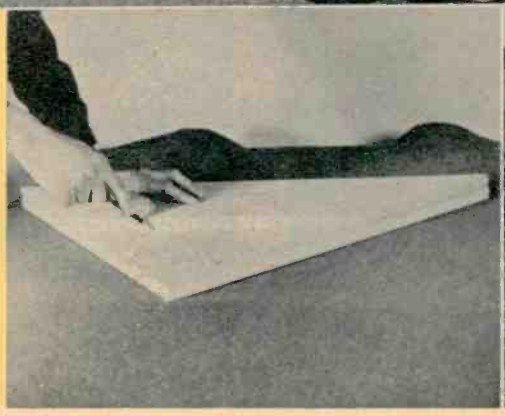
Sales of consumer items like hi-fi speakers and TV sets fall off somewhat during a recession. But speaker designers like the above are kept.

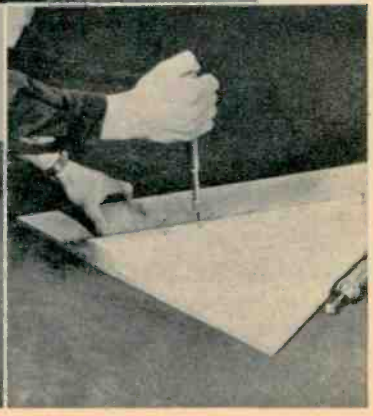


Sylvania Electrical Products, Inc.

The man who packs a consumer product is not essential, the man who designs it is. There is no recession for skilled technicians, engineers.

Completely finished and dressed up enclosure is shown above. Walls of room act as sides. This model cost only $15.





Hi-Fi In The Country

By David Weems

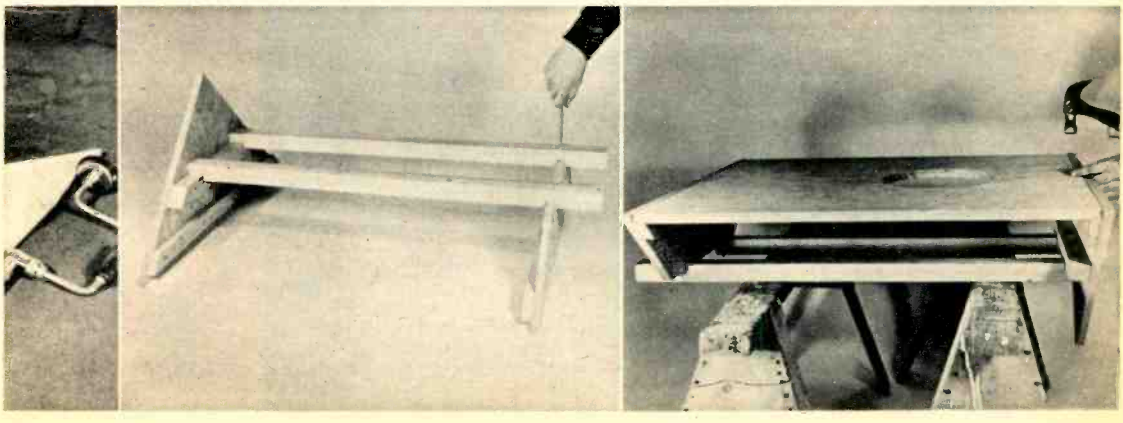
Take this enclosure travelling; it is easy to build, takes little space, costs about $10, and sounds good.

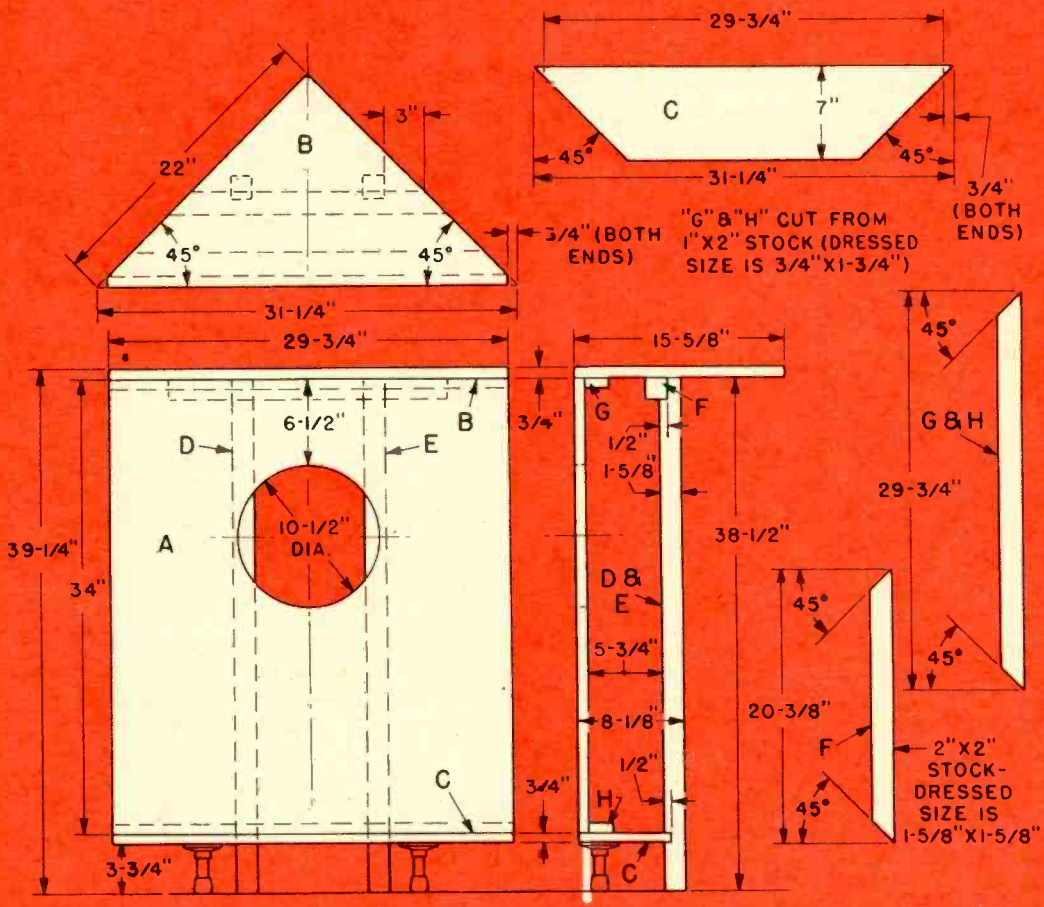
IF you forsake your hot city apartment in the summer for the cool nights at the seashore or in the country and would like to have your hi-fi with you, this speaker enclosure may answer your needs. It is inexpensive, can be built quickly—in one night, can be finished any way you desire, and sounds swell. It can well be the first step to an economy hi-fi setup that can be taken anywhere for long or short trips.

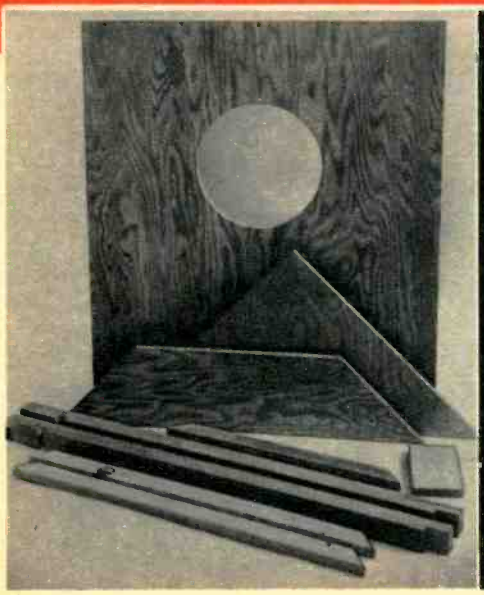
This baffle offers a solution to the problem of good quality at low cost. There is no skimping on material, ¾″ plywood is used throughout, and the corner placement puts the speaker where it can do its best in bass reproduction as well as treble distribution. The unusual economy is achieved by using the walls and floor of the room as back, or sides, and bottom panels, thus eliminating those parts from the bill of materials. The actual cost depends on your taste, or pocketbook, and may vary from about $7.00 to about $15.00.

The parts should be cut out to conform to the dimensional plan with the possible exception of braces *D* and *E*. Those pieces are shown notched to a depth of ½ inch to fit *C* and *F*. The notches add extra strength but are not essential. Also if you should happen to have some 1″ x 2″ hardwood available, it would probably be heavy

Various operations in the assembly of the speaker enclosure are shown below and on the facing page. Using part C to mark off the location of the glue block F on the top of the enclosure is shown in the photo on the far left. Next nail the glue block in place lightly and drill guide holes for screws. Glue the block down before screwing it in place. After the glue blocks are permanently in place on the top and bottom pieces, glue and screw the rear braces down. The front panel is then nailed and screwed.







BILL OF MATERIALS

1—4'x4'x¾" fir plywood
1—5'x2"x2" pine or fir
1—5'x1"x2" pine or fir
1 dozen—# 8x2" flathead wood screws
2 dozen—# 8x1¼" flathead wood screws
1—¾"x3¾"x6" pine or fir (These are actual dimensions. Not needed if pipe legs are used.)
Cotton batting, Fiberglas, or other padding

Optional

1 yard—Plastic grille
2—Pipe nipples, ½" I.D., 3½" long
2—Floor flanges tapped for ½" pipe, and mounting screws to fit
2—Rubber feet for ½" pipe
Enough hardwood veneer plywood for top and hardwood trim

Dimensional plan, bill of materials and parts photo. Note that the front opening is for a 12" speaker; other size speakers can be used.

enough for *D* and *E;* the 2″ x 2″'s were specified with pine or fir in mind.

The first step in the assembly of the parts should be the proper location of the glue blocks, *F, G,* and *H*. *F* can be precisely and quickly located by using the "sub-bottom" *C* for a gauge as shown in one of the pictures. Next each glue block can be lightly nailed into position until guide holes for screws are drilled, then glued and screwed into position. Unless you have a smooth work surface, you'd better protect the top by spreading an old blanket or other material under it for these operations.

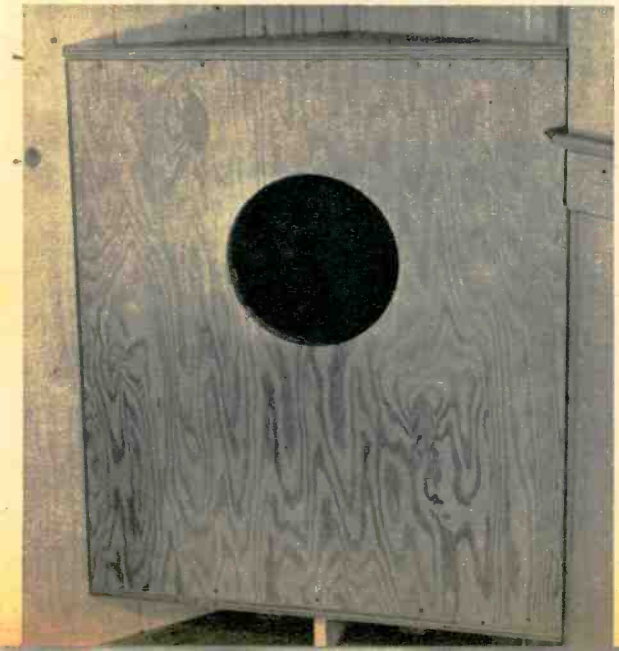
Hold the rear braces, *D* and *E,* in place by nails until guide holes are drilled and then remove the nails to glue and screw the braces into place. Each of the 2″ x 2″ pieces will require 2-inch screws. The front panel will now slip into place and can be attached by using the same procedure as with the other parts. A couple of saw horses are convenient for this purpose, but a table or a set of boxes might be used as well. At some time the corners of the top and bottom should be sawed off to match the width of the front panel unless you should decide to use a bevel edge for the front, in which case you will have to add 1½ inches to the width of the front panel. The square cut, as shown, makes for easier construction.

Now you will have to choose the kind of legs for the front. The least expensive decision is a single piece of wood, ¾″ by 3¾″ by about 6″, set vertically under the middle as shown in the picture of the "stripped down" model. The alternative, which costs about a dollar extra, is to use dual legs of black pipe, or galvanized pipe painted with flat black paint, to give a wrought iron effect. The pipe is mounted by fastening floor flanges in the desired locations with screws and then screwing the pipe into the floor flanges. The rubber feet on the pipe may have to be trimmed slightly to adjust the height of the legs to an even 3¾ inches. Of course, other kinds of legs may be substituted with the exception that they should not be too thick and block the opening under the baffle.

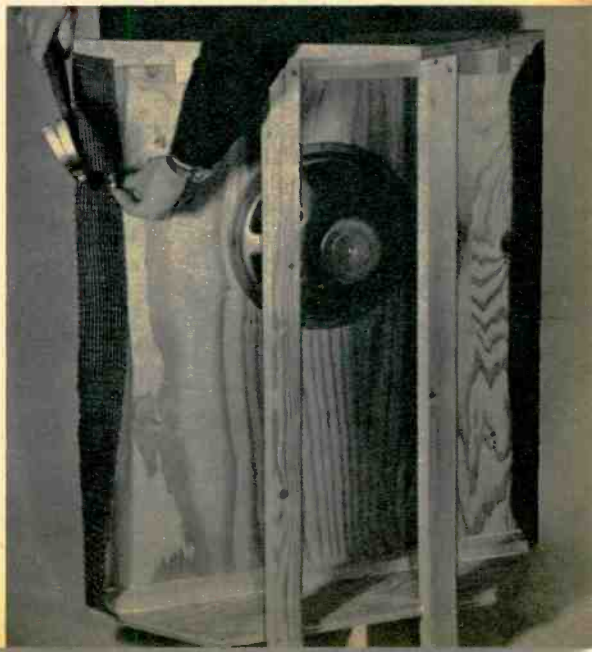
With the feet in place the functional part of your baffle is completed and may be used "as is," painted to match the walls, or finished with a clear varnish or lacquer. If you don't plan to cover the front panel, a small piece of grille cloth tacked behind the opening before mounting the speaker will give the enclosure a finished appearance.

[*Continued on page* 106]

"Stripped down" model for wood paneled rooms, etc. Foot is a single wood block.

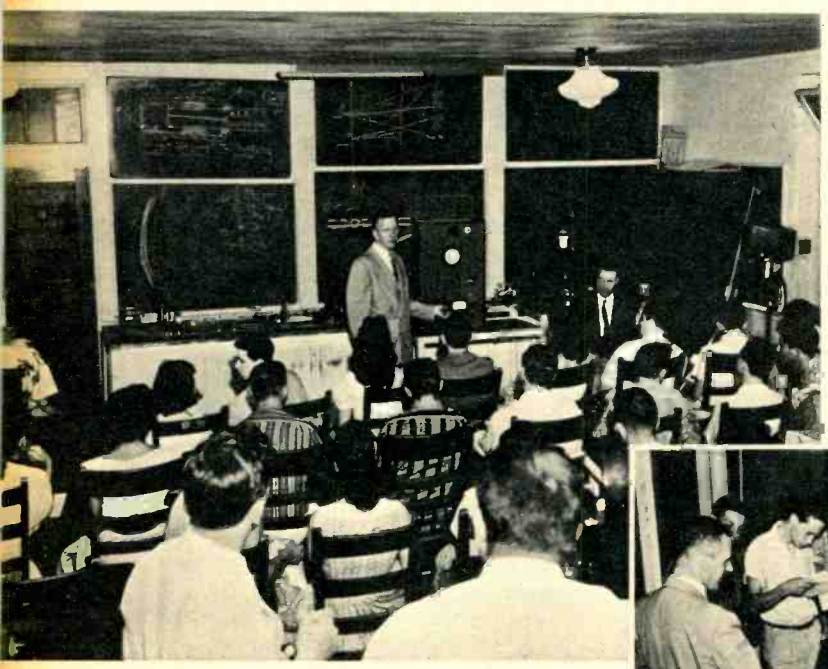


Stretching and tacking down the grille cloth; use vertical line in cloth as guide on edges.



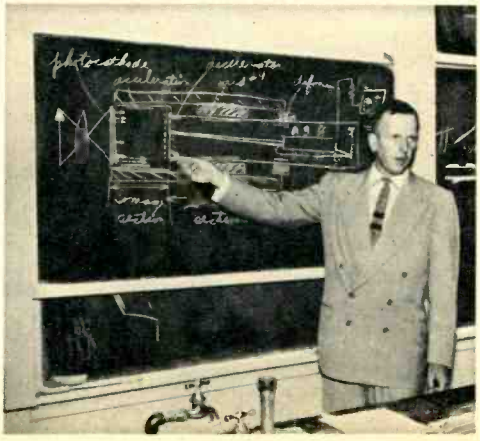
H. S. students learn first-hand from

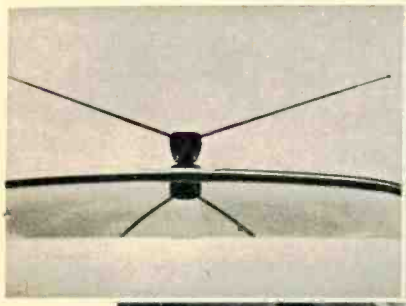
Industry's Top Scientists



Scientists and engineers from Hughes Aircraft Co. tour Los Angeles schools to show current developments in electronics to students. Here, Dr. Edward Michaels, color TV authority, discusses new cathode ray storage tube with eager science students.

MEETING the challenge to develop more scientists among the nation's youth, California initiated an exchange of men and ideas, between industry and education, that has been highly successful. Over 500 students in Los Angeles high schools have each heard eight lectures in the past year, delivered by scientists from the Hughes Aircraft Company. These men cover a wide variety of theoretical and practical subjects in electronics, chemistry and mathematics, demonstrating their talks with up-to-date equipment not usually available in high schools. In addition, many students have had the opportunity to tour and work part time at the aircraft plant to see for themselves how scientific theory is applied to industry. The project was introduced by Hughes in New York City this spring, in the hope that other industrial firms would take part and help enlarge the program.





8" screen TV set installed behind the front seat slips out at end of an automobile trip to serve as a portable. Antenna, far left, is mounted atop rear window of car.

TV in Your Car

Passengers of all ages will find long automobile trips more fun, less tiring, with rear-seat TV.

REAR-SEAT television will be an automobile reality very soon if the Delco Radio Division of General Motors have their way. Several problems unknown to home television have already been licked. One obvious problem was interference from the car's ignition system; shielding and filtering have overcome this. Obtaining the required power from the 12 volt electrical system of the car has been ingeniously solved. When the receiver is used in the car, the tube heaters are connected directly to the car battery; plate voltage is supplied by a small trunk mounted converter which employs a pair of Delco high power transistors and develops a 200 cps square wave which is in turn converted to 245 volts DC by a silicon diode bridge rectifier. When the receiver is removed from the car, built-in relays automatically reconnect the heater and power supply circuits for proper operation from 117 volts AC.

Excess daylight causes reflections on the screen. When this is solved (and some problems due to motion) you too may have TV in your car.

EI tests the new Knight

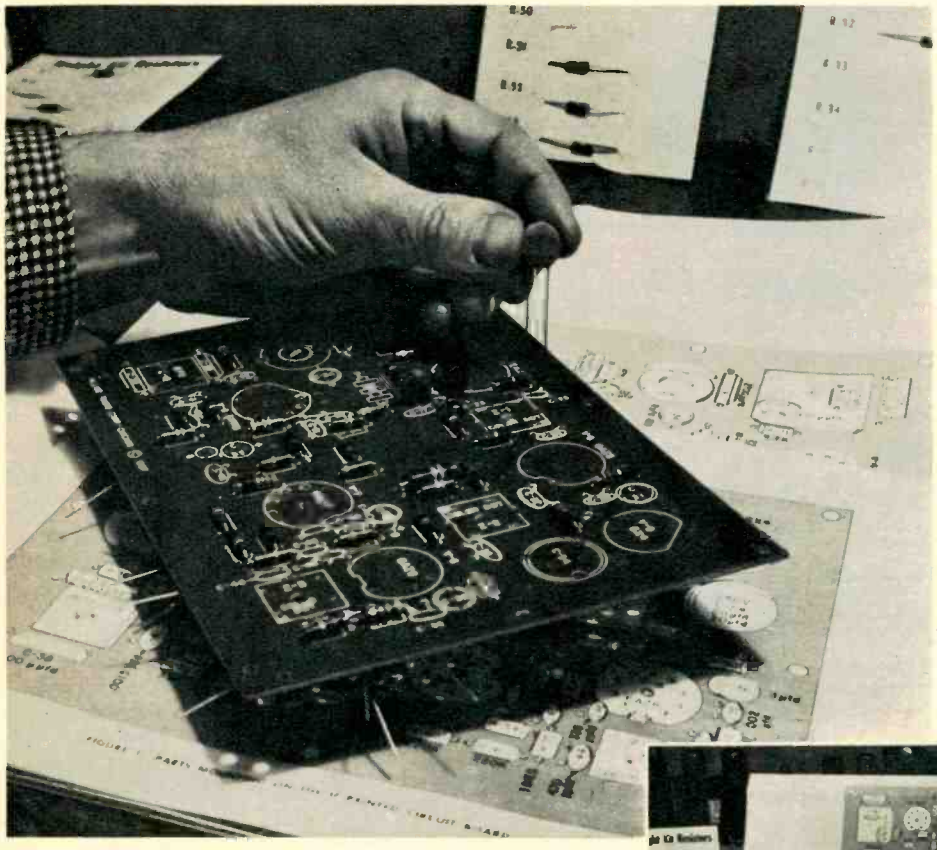
All-Band Receiver Kit

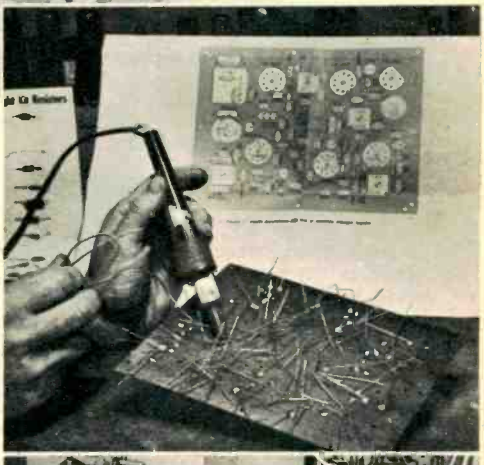
Exclusive report on the first quality receiver kit for radio amateurs and short wave listeners.

"THERE are many good, inexpensive amateur transmitters in kit form on the market. Why aren't there any similar receivers?"

Hams and would-be hams who like to "roll their own," as much for the fun of doing so as for what they save in dollars, have been asking this question for years. The answer is that kit manufacturers for a long time felt that the circuit alignment of a multiband superheterodyne was too difficult for the average con-

The assembled Knight kit receiver with "S" meter is shown at left. First spread out all parts as shown to identify and check them against the parts list in the manual.

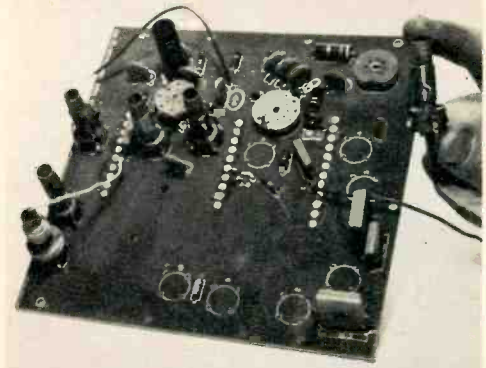


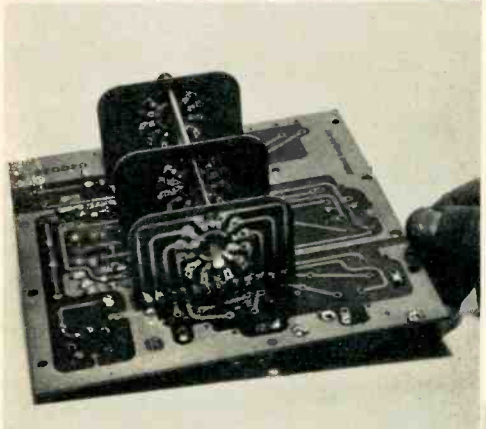


Start with I.F. printed wiring board and insert the numerous resistors and capacitors. Follow the parts outlines and symbols for this.

Next, turn the board over and solder the pigtail leads of the parts to the printed wiring. Snip off finished wires to make room for iron.

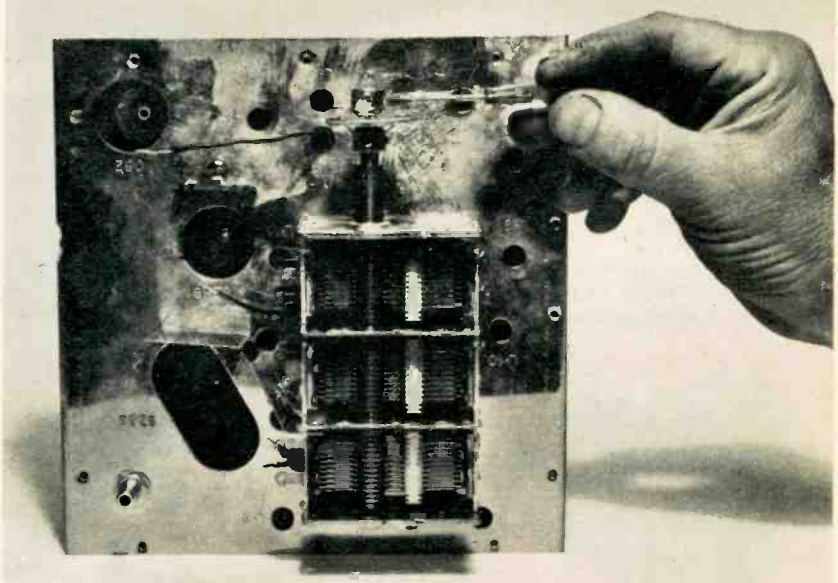
The completed I.F. board has been mounted on the right half of the chassis and the power transformer is added. Hole is for R.F. board.



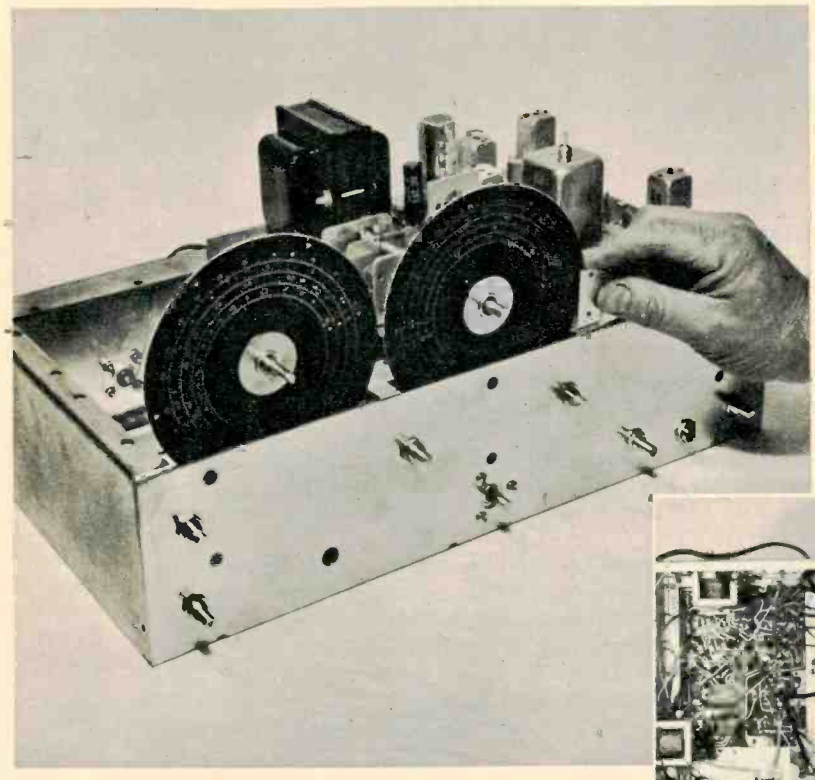


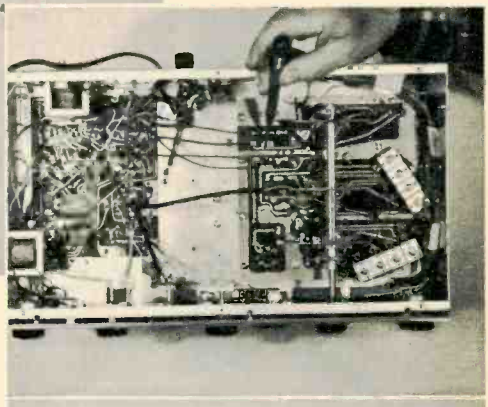
structor. However, they know now from a study of their sales records since the end of World War II that *nothing,* but NOTHING, is too difficult for the present generation of soldering-iron wielders. As a result of their changed thinking, several new kits have been undergoing intensive development and field testing. The first to appear in commercial form is Allied Radio's Knight-Kit job for $104.50, known simply as the "DeLuxe All-Band Amateur Receiver." The writer obtained one of the first production-line packages, put it together strictly in accordance with the instruction book, and is happy to report that it appears to be a real winner.

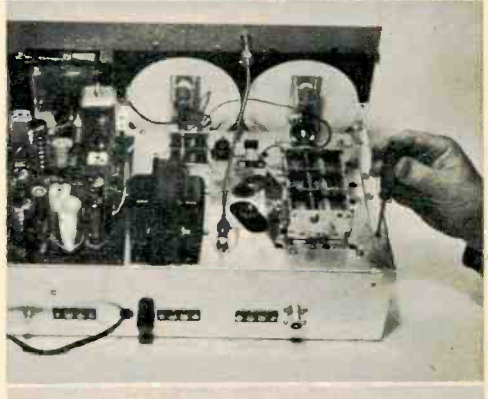
Circuitwise, this is a conventional, foolproof nine-tube, straight AC superhet. The frequency range is divided among four bands: A, .54 to 1.65 megacycles (the regular AM broadcast band); B, 1.6 to 4.6 mc.; C, 4.4 to 12.4 mc.; D, 12-30 mc. Calibrated bandspread is available on the 10, 15, 20, 40 and 80 meter ham bands. Other features include a Q multiplier, a noise limiter,

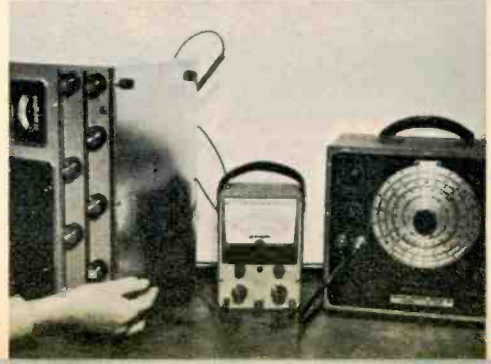


The top side of the R.F. printed board holds the parts such as the tuning coil being inserted. The coil lugs are soldered to underside wiring. Note the three rows of soldered points, these hold and connect the printed, three section band switch to the circuit. The switch is on the underside of the board. The completed R.F. printed wiring board is covered by a shallow, U-shaped shield, on top of which is mounted the main three-gang tuning capacitor. The openings on the left are for tubes.









Front view of the partially completed chassis with the I.F. board, power transformer and bandspread capacitor in place. The latter is coupled to the right dial. The left dial is for the tuning capacitor on the R.F. board. The underside of complete receiver is shown below. A scriber is being used to pick up heavy blobs of rosin from between printed wires. The back view of the receiver shows the flexible coupling used to control antenna trimmer from front. The last view shows signal generator and VTVM used for alignment.

and provisions for the optional addition of an S meter and a crystal calibrator.

The finished receiver has a fine modernistic air, and makes an attractive addition to any den or ham shack. Loud speaker is not included.

Two special printed circuit boards hold most of the circuit elements. One supports the R.F. amplifier, mixer-oscillator and voltage regulator tubes, the main three-gang tuning capacitor and its associated trimmers, the antenna trimmer, and twelve tuning inductors. The other board contains the I.F., second detector, Q, BFO and audio tubes and components. All tube sockets, R.F. inductors, I.F. cans and major filter capacitors plug directly into holes in the printed boards, and they are both secured and connected when their lugs are soldered to the printed lines. Small resistors and capacitors are mounted and soldered by their own pigtail leads in a similar manner. A wiring job that might take a week is reduced to hours.

Another hour-saving device used in

[*Continued on page* 95]

The Thermo-trolled Submarine

By Paul Palanek

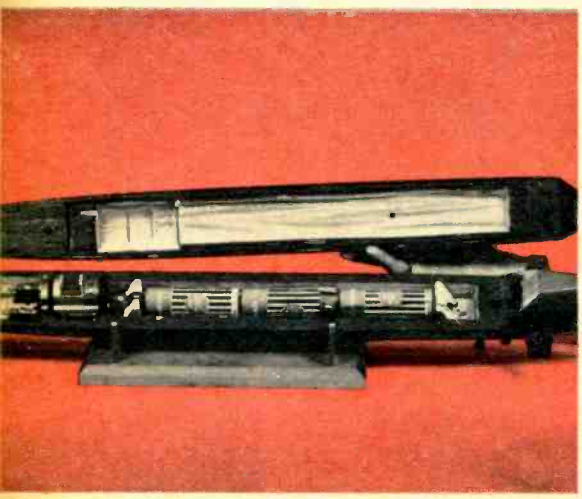
Build this 38-inch model of the first atomic sub then rig it for alternate diving and surfacing.

ONCE a fiction writer's fantasy, then a powerful reality, now a model anyone can build, is the progression of the atomic submarine. In 1955 the United States launched the Nautilus, the world's first atomic-powered submarine. Though those first plans were highly classified, here's a model of that same sub, which you can build and which will provide you with hours of enjoyment.

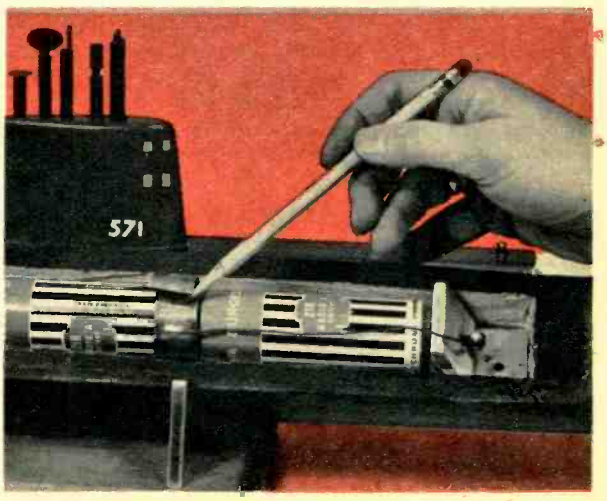
Our scaled down Nautilus is 38 inches long and operates with twin screws in a series of predetermined sequences. Carefully ballasted and properly trimmed, the sub will cruise on the surface, submerge, travel submerged and then surface, all executed automatically through the use of an electronic relay. If so desired, it can also be rigged for surface cruising alone. Scale is adhered to as close as security will permit. Our only deviation is in placing the forward planes well below the water line for a more positive diving and surfacing sequence. In this position they stay in constant contact with the water. Later in the text the power and control used will be discussed further.

Construction is started with the hull which is laminated block balsa. Prepare the block and cut the two sections along the

Top and bottom of hull are hollowed out to accept motor, battery tray and leaf switch.

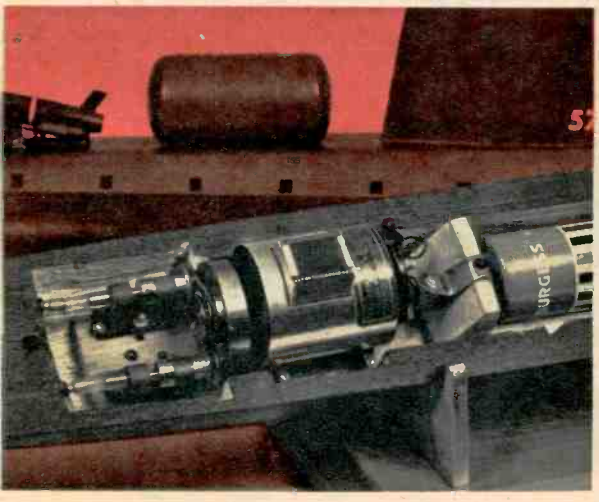


The leaf-type switch closes when pressed down by the radio mast, springs open when released.

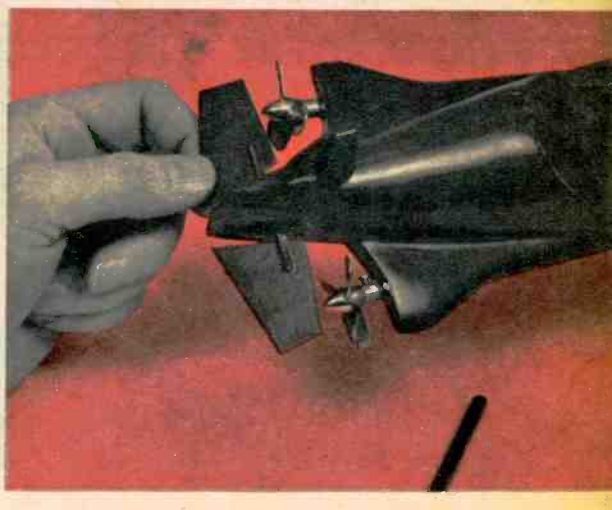


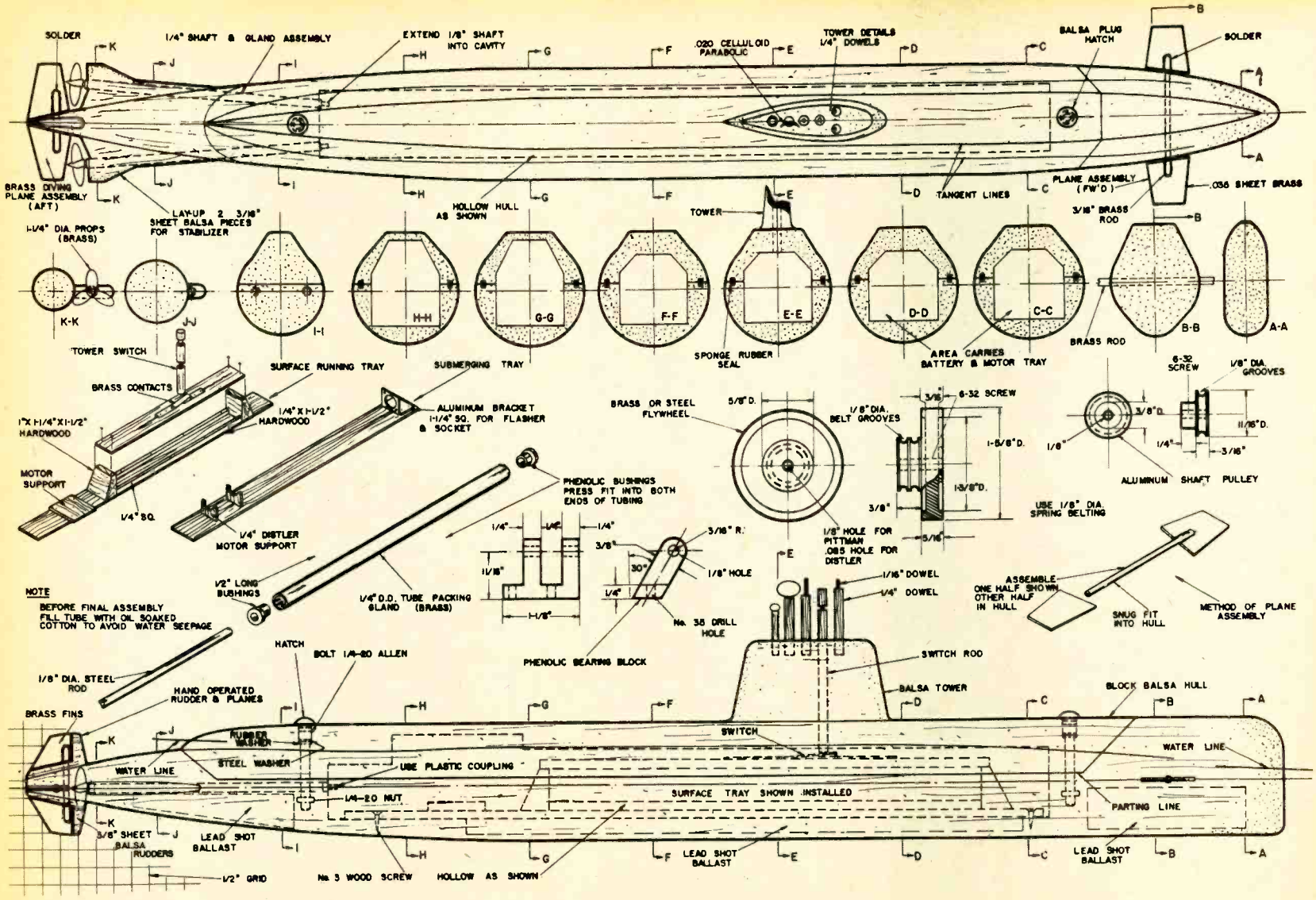
An accurate replica of the mighty Nautilus, this model sub is an impressive sight on a small pond, whether cruising along the surface or diving below.

Pictured is Pittman motor for non-submerging model. Use Distler motor in submerging type.

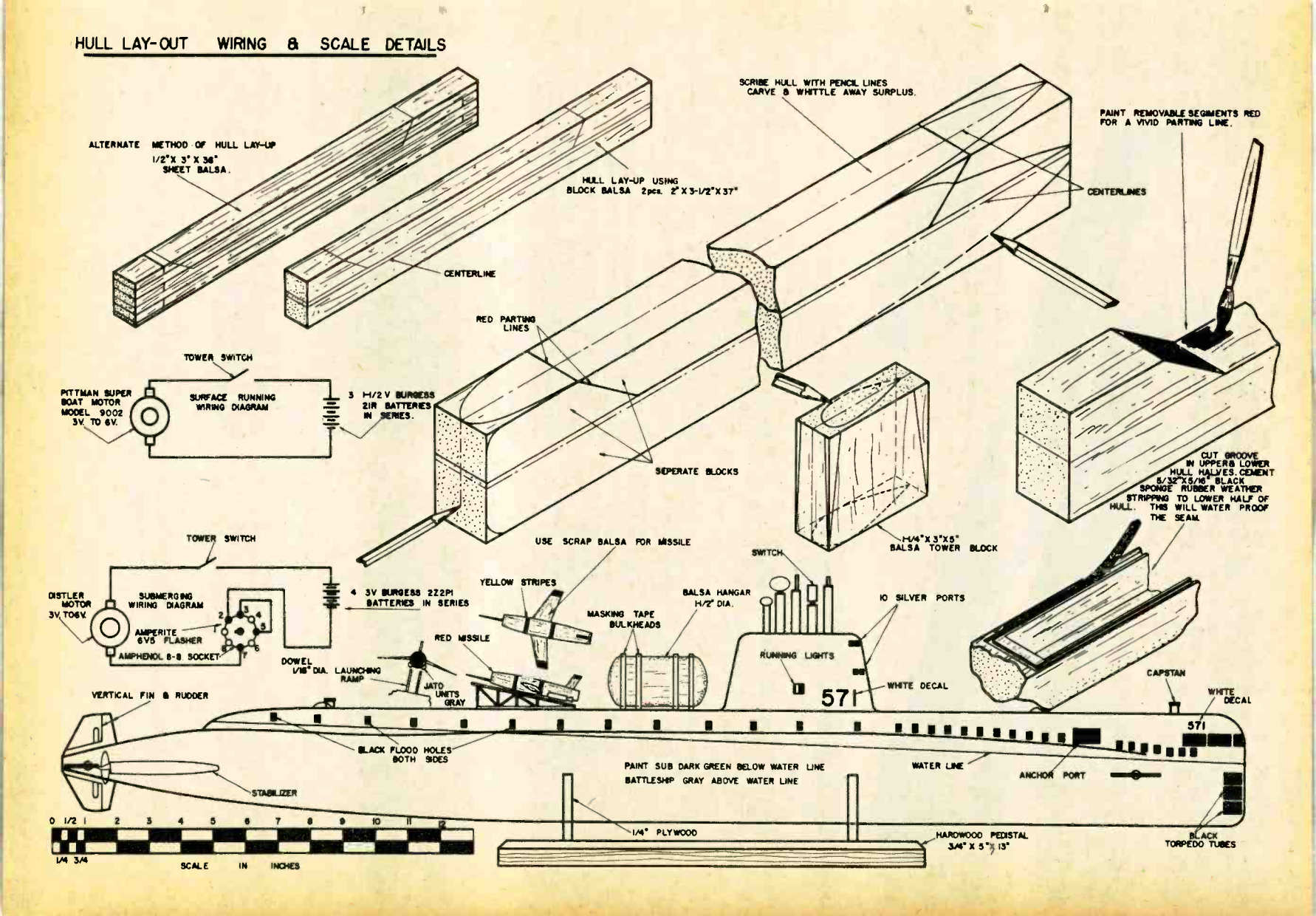


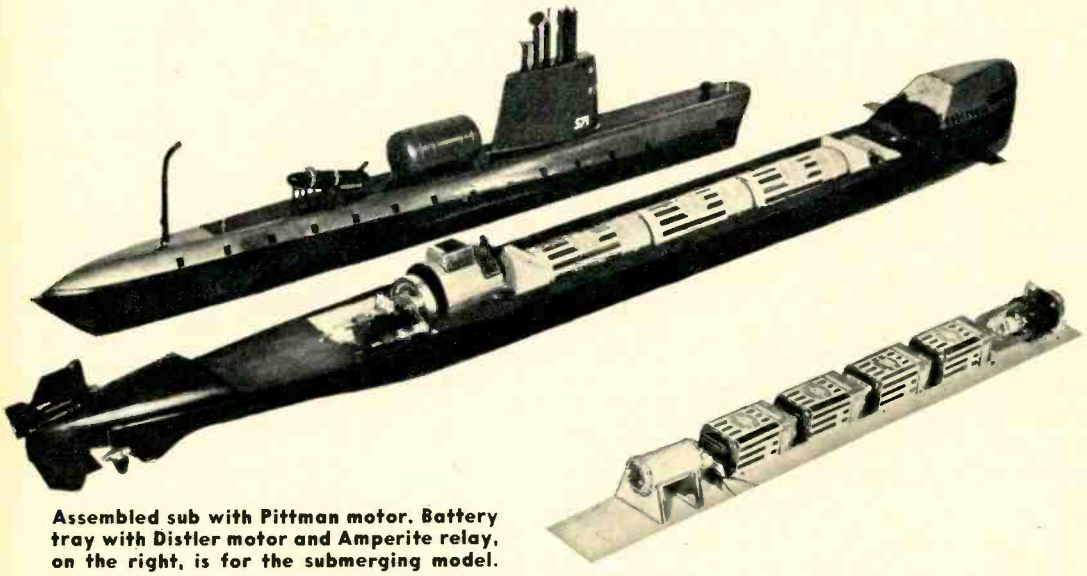
Trial and error establishes the correct angle of the diving planes on the submerging model.




SOLDER
1/4" SHAFT & GLAND ASSEMBLY
EXTEND 1/8" SHAFT INTO CAVITY
.020 CELLULOID PARABOLIC
TOWER DETAILS 1/4" DOWELS
BALSA PLUG HATCH
SOLDER
BRASS DIVING PLANE ASSEMBLY (AFT)
LAY-UP 2 3/16" SHEET BALSA PIECES FOR STABILIZER
HOLLOW HULL AS SHOWN
TANGENT LINES
PLANE ASSEMBLY (FW'D)
.056 SHEET BRASS
3/16" BRASS ROD
TOWER
1-1/4" DIA. PROPS (BRASS)
K-K
J-J
I-I
H-H
G-G
F-F
E-E
D-D
C-C
B-B
A-A
BRASS ROD
SPONGE RUBBER SEAL
AREA CARRIES BATTERY & MOTOR TRAY
TOWER SWITCH
BRASS CONTACTS
SURFACE RUNNING TRAY
SUBMERGING TRAY
1"X 1-1/4"X 1-1/2" HARDWOOD
1/4"X 1-1/2" HARDWOOD
ALUMINUM BRACKET 1-1/4" SQ. FOR FLASHER & SOCKET
MOTOR SUPPORT
1/4" SQ.
1/4" DISTLER MOTOR SUPPORT
PHENOLIC BUSHINGS PRESS FIT INTO BOTH ENDS OF TUBING
1/2" LONG BUSHINGS
1/4" O.D. TUBE PACKING GLAND (BRASS)
BRASS OR STEEL FLYWHEEL
5/8" D.
1/8" DIA. BELT GROOVES
3/16"
6-32 SCREW
1-5/8" D.
3/8"
1/8" HOLE FOR PITTMAN .085 HOLE FOR DISTLER
5/16"
6-32 SCREW
1/8" DIA. GROOVES
3/8" D.
11/16" D.
1/8"
1/4"
3/16"
ALUMINUM SHAFT PULLEY
USE 1/8" DIA. SPRING BELTING
1/4"
1/4"
1/4"
1/16"
1-1/8"
3/8"
3/16" R.
30°
1/8" HOLE
1/4"
No. 38 DRILL HOLE
PHENOLIC BEARING BLOCK
1/16" DOWEL
1/4" DOWEL
ASSEMBLE ONE HALF SHOWN OTHER HALF IN HULL
SNUG FIT INTO HULL
METHOD OF PLANE ASSEMBLY
NOTE
BEFORE FINAL ASSEMBLY FILL TUBE WITH OIL SOAKED COTTON TO AVOID WATER SEEPAGE
1/8" DIA. STEEL ROD
HATCH
BOLT 1/4-20 ALLEN
HAND OPERATED RUDDER & PLANES
BRASS FINS
SWITCH ROD
BALSA TOWER
BLOCK BALSA HULL
RUBBER WASHER
STEEL WASHER
USE PLASTIC COUPLING
SWITCH
WATER LINE
WATER LINE
1/4-20 NUT
SURFACE TRAY SHOWN INSTALLED
PARTING LINE
3/8" SHEET BALSA RUDDERS
LEAD SHOT BALLAST
LEAD SHOT BALLAST
LEAD SHOT BALLAST
1/2" GRID
No. 3 WOOD SCREW
HOLLOW AS SHOWN

HULL LAY-OUT WIRING & SCALE DETAILS





Assembled sub with Pittman motor. Battery tray with Distler motor and Amperite relay, on the right, is for the submerging model.

BILL OF MATERIALS

10 pcs.	1/2"x3"x36" Med. grade balsa or 2 pcs. 2"x3 1/2"x38" Block balsa	Hull
1 pc.	1 1/4"x3"x5" Med. grade balsa	Tower
1 pc.	3/16"x3"x36" Med. grade balsa	Stern fin and elevators
2 pcs.	1/4"x1 1/2"x18" Hardwood	Electrical trays
1 pc.	1/4" OD brass tubing 24" long	Packing glands
2 pcs.	Screw, 3 bladed, 1/8" hole x 1 1/2" dia.	International Models, Inc., 33 Union Square, N. Y. 3, N. Y.
1 pc.	1/8" dia. rod (steel)	Screw shafts
1 pc.	1/4"x22"x6" Micarta sheet	Bearing blocks
2 pcs.	1/4" dia. dowel, 36" long	Tower details
1 pc.	3/4"x5"x13" Hardwood	Pedestal
1 pc.	1/4"x4"x5" Plywood	Pedestal supports
1 pc.	1/32"x6"x6" Sheet brass	Diving planes
1 pc.	3/16" dia. x 12" Brass rod	Diving plane pivots
3 to 6 lbs.	lead shot	Ballast

Material for surface running

1	Pittman 3- to 6v Electric motor	Both available from Lafayette Radio 100 Sixth Avenue New York, N. Y.
3	21R 1 1/2v Burgess batteries	

Material for submerging

4	Burgess batteries #2Z2P1 3v	All available from Lafayette Radio
1	Amperite #6F5 miniature flasher	
1	Amphenol 8-8 socket	
1	Aristo Craft Electric Motor	

Miscellaneous items

Cement; pigmented dopes; dopes; decals; 1/4-20 Allen socket head bolts 1 3/4" long; 5/32"x3/8" rubber stripping; rubber washers; masking tape; solder and paste; 4-40 nuts and bolts; 10' of hook-up wire; #3 wood screws; brads; spring belting 1/8" dia.; 2, 1" dia. grooved pulleys or OK gear box; brass for flywheel.

line indicated in the drawings. Then paint the adjoining areas red as shown and lightly cement the sections together. A pair of C clamps will hold the assembly while it dries.

The next step is to whittle or carve away the excess balsa until the shape in the given cross sections is attained. At this point you will appreciate the prepainted halves since the red line is a vivid marker. Sand the hull smooth, using successive grades of sandpaper and finishing with a very fine grade. Prior to parting, apply a coat or two of clear lacquer followed with three coats of balsa sanding sealer. If pits, holes or nicks are picked up during the process of carving, fill them with balsa filler and proceed with the finish as outlined above.

Next, part the hull along the painted line using a safety razor or very fine wire. Mark off both halves of the hull as indicated and carve the cavities to the given outlines, using a 3/4-in. gouge. At this point, install the groove running around the cavity for future waterproofing. With this completed, assemble the hull and secure with rubber bands. Then mark the area for the locking bolts which are two 1/4-20 Allen bolts 1 3/4 in. long. You will note that both a rubber and brass washer are used. The 1/4-20 nuts are imbedded in the hull at the depth shown.

Our next approach is that of making the twin screw shafts and the tubular packing glands. For the glands, select some 1/4-in. OD brass tubing with a .020-in. wall and cut two pieces some 10 in.

[*Continued on page 98*]

Since new electronic equipment for surveying is so light, and only 2 operators are needed on a job, helicopters are used for transportation between stations along a projected highway.

Electronics Blazes the Trail

New electronics methods save time and taxes on the construction of highways across the nation.

FROM the rod and chain methods of colonial days to radar waves traveling at 186,000 miles per second; so runs the story of highway surveying. On the current scene, millions in money and man-hours are being saved, thanks to a new method of measuring overland distances via radar waves. This method is expected to play a leading role in the construction of the 41,000 mile national highway system.

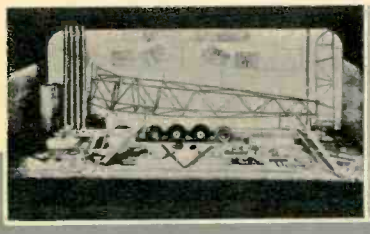
The system uses a portable microwave transmitter and a remotely located portable receiver-reflector. A two-man team

[*Continued on page* 108]

Radar waves, sent out by the transmitter above, travel at high speed to a receiver (below left) and back. Distance is determined by the time needed for waves to make a round trip. Operators communicate via radio-phone.

What Goes Into a Kit?

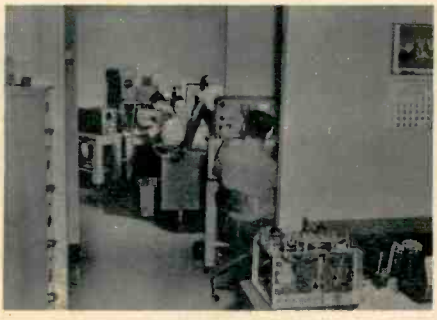
IN A sparkling new, 140,000 square foot building of impressive efficiency, there are many knowledgeable engineers and technicians working towards one goal: the serving of the rapidly expanding build-it-yourself market in the United States. The company is Heath, the products range from hi-fi tuners to electronic brains, with many test instruments and enjoyable gadgets in between. We were out at their plant, shown above, in St. Joseph, Michigan recently, where we followed the sometimes involved but always interesting process of conceiving a new kit, engineering it, adapting it to the needs and abilities of the do-it-yourselfer and finally, packing and shipping it. We thought you'd be interested in this process also.



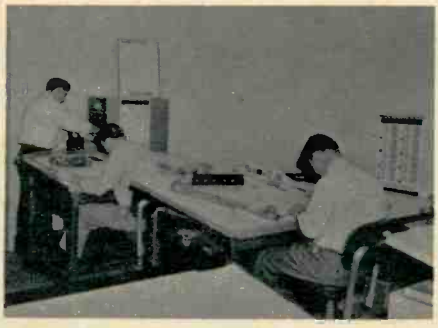
The pioneering Heath Kit was the Parasol airplane which sold to thousands. First produced in 1926.

We'll follow the growth, step by step, of this Heath Stereo Preamplifier Kit, just available.

Department heads decide on need for and ways of handling Stereo Preamp project.



First models are designed and tested in the audio lab. Note new tape recorder.

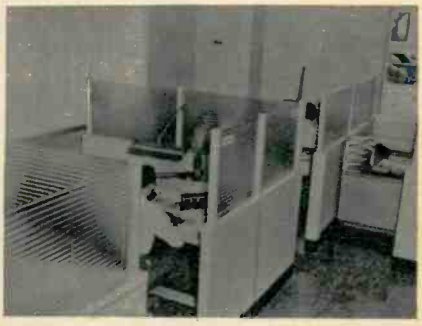


Draftsmen do engineering drawings of the 3 snap-together sections of Preamp.

Kinks are ironed out by testing performance and specifications of the profotype.

Procurement of parts is very important in determining inexpensiveness of kits.

Explicit instructions and clear drawings for the Preamp manual are developed.



Production of the Stereo Preamp calls for special chassis, face plates, etc.

The many resistors, capacitors, etc. for each kit are counted, sorted and packed.

(More photos on page 99)

Two-way Radio for All

By Leo G. Sands

Want to call home from your boat or car? Want to call your truck from the office? Use Citizens Radio.

NOW, any citizen of the United States, over 18 years of age, can operate his own private two-way mobile radio system. No technical skill, not even an operators' license, is required.

This means that you can install a mobile radiotelephone in your car and another in your home or office. The businessman can equip a whole fleet of cars and trucks and as many offices as he wishes. There is no limit except your pocketbook, on how many mobile or fixed radio stations you can operate in the Citizens Radio Service.

There are thousands of Citizens Radio systems in operation. While individuals do use mobile radio for their own convenience

Portable Vocaline transmitter-receiver for about $100 has a limited range but is useable from boat to shore, etc. Another unit is needed on shore.

and pleasure, most Citizens Radio systems are operated by business concerns. These include building materials dealers, such as ready mixed cement dispensers, diaper laundries, television repair shops, messenger services, newspaper delivery crews and many other commercial enterprises which make use of vehicles.

The use of two-way radio by individual was formerly limited to amateurs, who could use radio only for non-commercial purposes and who are required to pass a technical license exam. In addition, governmental agencies and certain specific classes of commercial enterprises have been eligible to use two-way radio. These included fire and police departments, taxicabs, railroads, highway trucks, pipe lines, electric utilities, air lines and buses.

Specifically excluded from using two-way radio, until recently, was the operator of the largest fleet of trucks in America, the Railway Express Agency. If your business required you to transport persons or materials from one city to another, chances are you could have obtained a license to use radio. But, if you delivered materials within the confines of a single city, you were generally ineligible for a radio station license.

This meant that the TV serviceman, who could save countless hours and miles if he could be reached by radio between service calls, could not use two-way radio.

But, this condition has been changed. The broad, 10-megacycle chunk of the precious radio spectrum between 460 and 470 megacycles has been set aside for use by the "citizen." This means anybody and everybody who is over 18 and a citizen of the United States.

This equipment is used to control a fleet of radio-equipped trucks. A dial code sender alerts the truck needed. Such home base units cost about $1000.

Not only can *you* put a radiotelephone in your car and your home or place of business and talk back and forth as much as you like—about anything you wish (no profanity, however) and without payment of toll charges—but you can also use two-way radio for communicating between fixed points. In other words, you can use radio in lieu of a private telephone line.

This means that the summer camp on the island can be linked to the mainland over a private radiotelephone circuit. And the merchant can have the equivalent of a private line to his warehouse without having to lease one from the telephone company.

Don't attempt to build your own equipment. Even if you're an expert you can't afford to design and build Citizens Radio equipment which will meet F.C.C. licensing requirements.

You can have a two-station Citizens Radio system using AM for as little as $200 using a pair of portable transceivers. These sets are available in battery and AC-operated models. They operate on 465 megacycles only. This ultra-high-frequency radio channel is shared by all other licensees using this kind of equipment.

You can use a pair of AM portable Citizens Radio units for communicating between your house and your office or a friend's home. Or you can take one in the car with you. The communicating range is roughly line-of-sight. With one set on the observation floor of the Empire State building you should be able to talk to another similar unit many miles away, perhaps in Ridgewood, New Jersey, Staten Island or out on Long Island.

But, with both sets close to the ground so that line-of-sight conditions do not exist, communicating range is reduced to a few hundred feet. These low priced sets, nevertheless, provide very useful functions. Since all must share the same channel, the limited range makes it feasible.

Then, there is an entirely different kind of Citizens Radio. It talks much further and with great reliability, but it costs a great deal more.

For as little as $500 you can equip your car with a commercial-grade AM mobile radiotelephone with which you can communicate with home base within a 10-mile radius. At home base you must have another $500 radiotelephone plus an antenna system with an effective elevation of 60 feet above surrounding terrain. The antenna, transmission line, and supporting mast may cost you an additional $100 or more.

For purely personal pleasure, this may be a substantial investment. But, for the businessman, two-way radio is a working tool and not an expensive luxury.

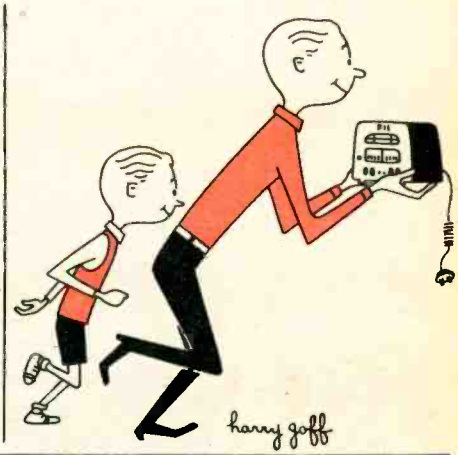
[*Continued on page* 110]

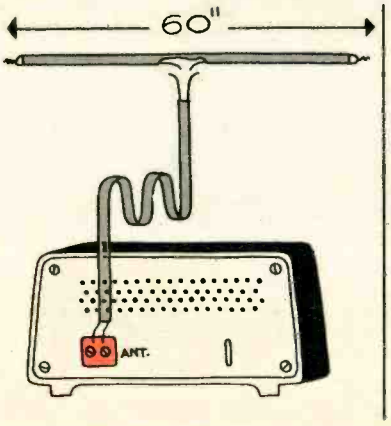
On land or sea, moving or stationary, you can cover a 10-mile range with this Citizens Radio.

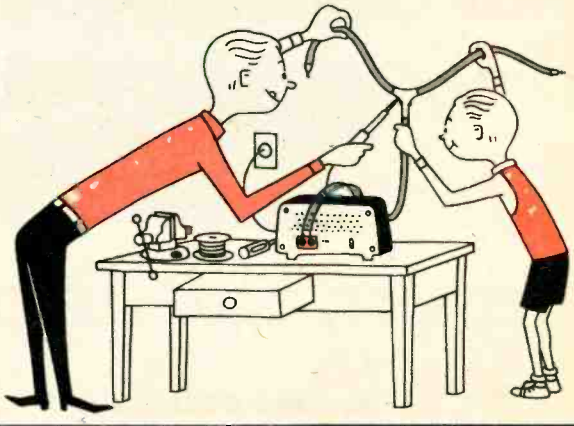
This gal never wonders about calls while she's out. Her mobile radio-phone rides with her.

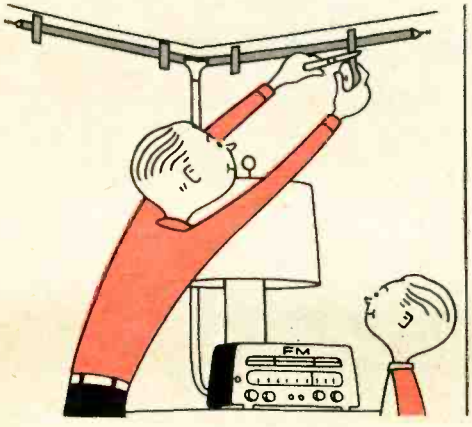
Henry and Me

Electronic Handymen









Automatic Tape Cutoff

By Ernest Wayland

This inexpensive switch saves tape by turning off your recorder when tape ends or if a break occurs.

THERE are certain problems shared by most tape recording fans. The flap-flap-flap as your tape beats itself to shreds at reel's end is possibly one of the most common and annoying. Unless you have a professional caliber machine, you've probably resigned yourself to a tense wait—finger poised over the "stop" button or to a "40-yard dash" at what you hope is in the nick of time. Of course, if you're the devil-may-care type who lets his recorder go its own merry way, then by now you expect the last several inches of each reel of tape to be mangled, and make proper allowances.

The automatic cutoff of the more expensive machines, not only turns the machine off when the tape has finished, but also functions during playing, as a safety device. Suppose there's a tape break during playback. The usual result is a snarl around the cap-

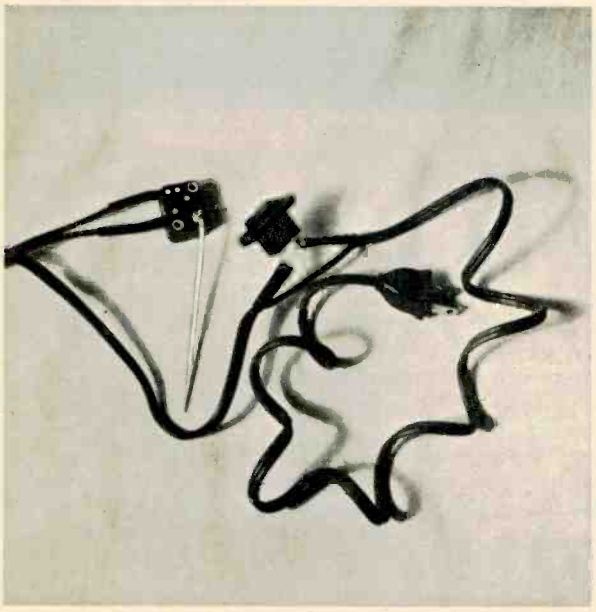
stan and perhaps several ruined inches of your favorite taped musical composition. If an automatic cutoff was in operation, tape movement would have stopped the moment the break occurred. You can install such a cutoff feature on your own machine in about an hour and at a cost of less than $2.00.

The heart of the cutoff device is a Microswitch model V4-12, whose particular physical characteristics make it ideal for this application. A 3″ length of #18 or heavier copper wire, which serves as a "feeler" is soldered to the brass actuator nub. Insulating sleeving (spaghetti) is slid over the wire to present a smooth surface to the tape. This wire is later bent to the appropriate shape for use with your specific tape deck. (Do not use iron or steel for the feeler rod, as it may develop a magnetic charge and induce noise onto your tapes). A 1″ length of heavy spaghetti is slid over each of the AC line cord wires before they are connected to the terminals of the Microswitch. When soldering is completed, the spaghetti is slid down over the terminals to insulate them.

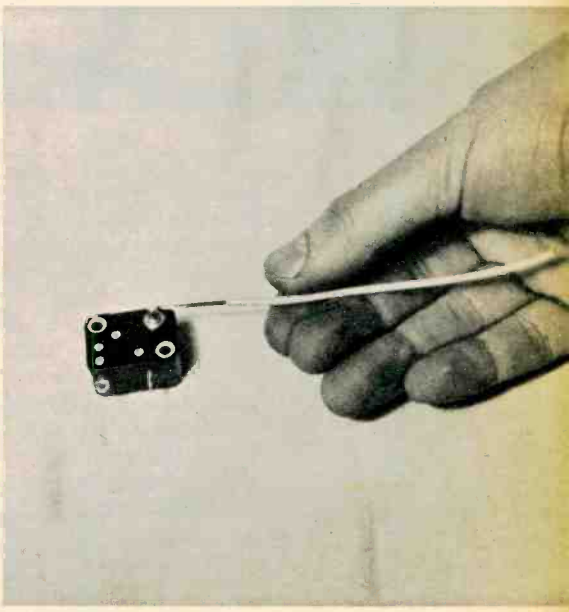
Break into the line cord at a convenient distance from the switch and wire in an AC female outlet. With the AC plug on the end of the wire, connected into a wall outlet, you should now have a simple series circuit with the Microswitch turning on and off any device plugged into the AC female socket.

Placement of the switch on your recorder depends mostly on the physical layout of the transport mechanism. A little experimentation may be necessary, but no difficult problems will be encountered. Placement and adjustment are facilitated because the feeler wire can be bent to provide the exact action desired. The switch assembly can be fixed to the tape deck plate by means of a self-tapping screw or even a good grade of glue.

If the mode of operation of your recorder makes it inconvenient to operate the entire mechanism including amplifier by the Microswitch, then the switch can be wired so as to interrupt the current to the motor(s) only, leaving the amplifiers unaffected. In that case no extra line cords need be run to the AC power outlet.



Assembled parts of cutoff system. Microswitch goes on tape deck, AC outlet is for recorder.



Flexible insulated copper feeler rod, soldered to Microswitch, can be molded to fit as needed.

for background music use

A One-Step Loudness Control

By Len Feldman

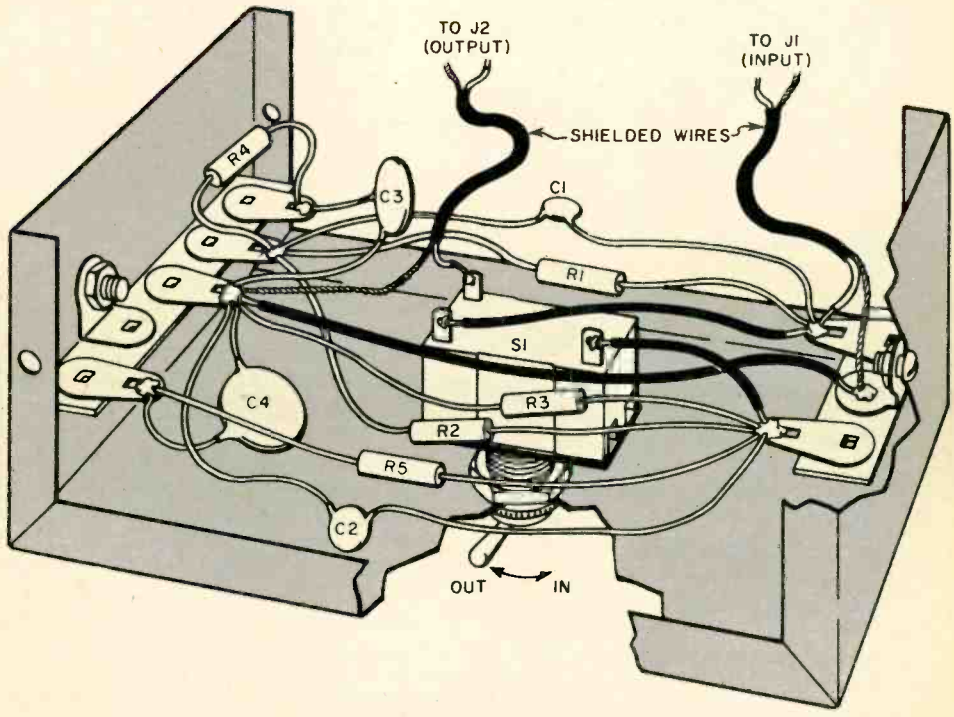
No need to fiddle with the volume or loudness control on your hi-fi system when you are called out of the room, just flick this switch to get preset level.

Photo by Grayson Tewksbury

EVER been called to dinner right in the middle of listening to the third movement of your favorite symphony? You're reluctant to turn off the music completely, yet, if you reduce the volume to low levels, all the bass and some of the treble tones seem to disappear. It's not your amplifier that's at fault. It's your own hearing mechanism. Yes, it's a fact that at low listening levels, all of us tend to be deficient in bass response and, to a lesser degree, in very high treble tones as well. True, many preamplifiers and amplifiers have so-called loudness controls which compensate for this deficiency by boosting the bass (and sometimes the treble too) when the level of sound is lowered. These continuously adjustable controls however, require careful set-up of initial levels to be effective and are not always accompanied by "secondary" level controls to affect proper calibration. Also they take time to set to the proper level.

The one-step loudness control changes concert hall level into pleasant, background volume, properly compensated for bass and treble "hearing defects" automatically with a flick of a switch.

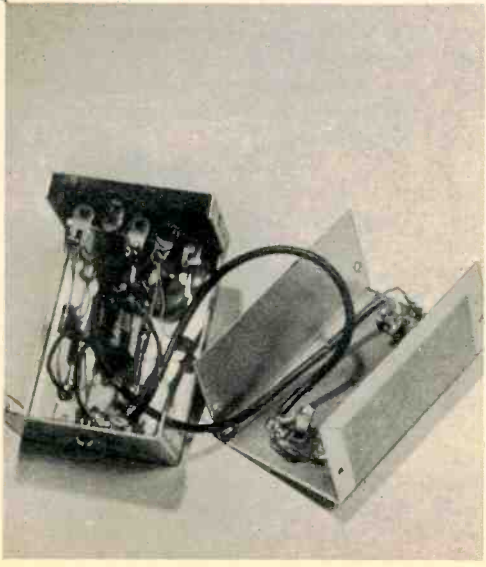
[*Continued on page* 104]

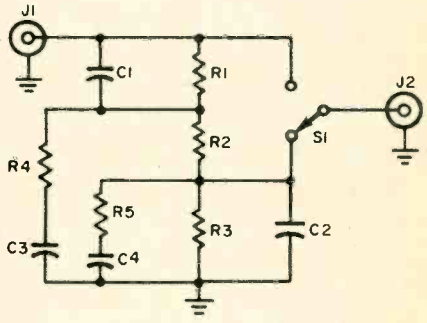


The wiring guide for the outboard version of the one-step loudness control is shown above. If the circuit is wired on the preamp or amplifier chassis, use a six prong terminal strip.

This device is ideal to cut the volume without impairing the bass-treble balance. If you must answer the front door, go to dinner, or answer the telephone, just flick the switch.

The bottom view, below left, with the case open, shows the output and input jacks located on the bottom plate. The second switch contact, see schematic, determines preset level.





PARTS LIST

C1—.001 mfd, 10% disc capacitor
C2—500 mmfd, disc capacitor
C3, C4—.01 mfd, 10% disc capacitor
R1, R2, R3—33,000 ohm, 10% ½ watt resistor
R4, R5—10,000 ohm, 10% ½ watt resistor
J1, J2—Phono tip jack
S1—Single pole, double throw switch
Chassis—Bud #2101 minibox
Terminal strips and misc. hardware

Hi-Fi Clinic

Got a question on hi-fi—how to install, how to repair, how to listen? Send it to us; the clinic will answer your query.

Stereo-Speaker Questions

THE Hi-Fi Clinic received a number of letters about the "Build A Stereo Speaker" article on page 50 in our May issue. Evidently there were some errors in this article which we would like to correct now.

First of all, the four series-connected speakers should, of course, be wired to the 16-ohm output on your amplifier, rather than the 4-ohm connectors as shown in the diagram. There was also some confusion about the order of the steps in modifying the speakers. First, the rim should be slit and the cement applied. After the cement dries, the oil should be put on very sparingly and the vaseline over it more heavily. The toothpicks can be glued in any time during this process. The cone is then sprayed, front and back. When the excess vaseline is removed the Acrylic spray that might have gotten on the rim is removed with it. The layer of vaseline remaining will gradually soak in and give the rim corrugations a cloth-like texture.

Component Matching

I have a hi-fi setup now with components all made by one manufacturer. I'm thinking of purchasing an improved tuner and I prefer the model made by another manufacturer. What problems might develop if I used a different brand tuner and how do I know that the components will match?

Pete Moss, Lake Wales, Florida

When we talk of "matched components" we usually refer to the quality of the various units in a system. Since the ultimate sound of your hi-fi system will be no better than the quality of the least good component, it would seem that the wisest thing to do is buy a tuner that is about equal in quality to the other good components in the system. However, if as you indicate, you plan to constantly improve your system as you are able, then it is definitely advisable to buy the best tuner you can afford, so as to enable you to improve up to its level in the future.

Actually, there is at least one other use for the term "match" in this regard, and that refers to whether the signal output of the tuner is high enough for the amplifier it feeds. This can be determined from the tuner and amplifier signal specifications. Make certain that the tuner you buy has a high enough output to match the requirements of the amplifier you have.

Cabinet Mounting

I've been told that it's bad practice to mount a woofer and tweeter in the same speaker cabinet. Yet I see a number of commercial manufacturers of high fidelity speaker systems do just that. Who is right?

Don Quayle, Macon, Ga.

If the tweeter in question is an open-back cone type then it should not be mounted in the same enclosure as the woofer. The pressures of the lower bass notes from the large speaker in smaller "infinite" baffles and bass reflex cabinets will cause the tweeter cone to move in sympathy and will result in a type of intermodulation distortion. On the other hand, cone-type tweeters with sealed backs or any of the many horn types will be quite comfortable acoustically when bedded down with the woofer.

Strobe light in an ordinary pill bottle plus strobe disc can test the speed of a turntable. At left, lamp cord is soldered to a neon bulb.

Check Your RPM's

By Ernest Wayland

Build this simple device for testing turntable speed and insure hearing records at true pitch.

IF the turntable on your record changer or player is rotating at a speed that is far from the correct one it is set for, you'll know it—the music you play will either sound "sour" or too fast. At this point it needs an overhaul by a hi-fi technician. However, if your record player is slightly off speed it may not be too noticeable, but you will not be hearing the music as it was cut on the record. You can check your turntable speed with an inexpensive strobe disc, obtainable at hi-fi dealer's or from the manufacturer of your record player. For best results, a strobe disc should be used with a strobe light, a pulsed neon bulb which stays lit for only 1/120th of a second. This pulse of light intensifies the stroboscopic effect and makes any apparent shift of the bars or dots on the strobe disc easy to see.

A simple strobe light can be built from an NE-45 neon lamp and either a Sarkes-Tarzian Model 10 rectifier, an International Rectifier Corp. Model D 5410, or Federal Rectifier's Model 1159. Various small silicon rectifiers which are also suitable, are available too.

A plastic tube or pill bottle with one end hollowed out makes an ideal holder for this device. Solder either lead of the rectifier directly to the bottom contact of the bulb. Next solder the other rectifier lead to one leg of a length of standard lamp cord wire. The remaining leg of the lamp cord is soldered to the brass shell of the neon bulb. Install a plug on the free end of the lamp cord, and the job is finished by installing the lamp and rectifier in the pill bottle.

Plug the strobe light into a convenient AC outlet. One of the two electrodes in the neon bulb will glow indicating that the rectifier is feeding pulsating DC to the bulb. Place the strobe disc on your turntable and start it revolving at 33⅓ rpm. Bring the lit strobe light over the band marked for 33⅓ and note whether the bars or dots are moving in

[*Continued on page* 110]

The EI Automatic Lawn Sprinkler

By Byron G. Wels

Your soil "tells" this sprinkler when it needs water and turns it off when it has had enough.

Photos by John Schneider

WITH this unit attached to your lawn sprinkler, you can leave home during vacation or on long trips and never need worry about whether your lawn is being properly watered. As a matter of fact, this can be used all through the summer and fall to relegate lawn sprinkling to the realm of automation.

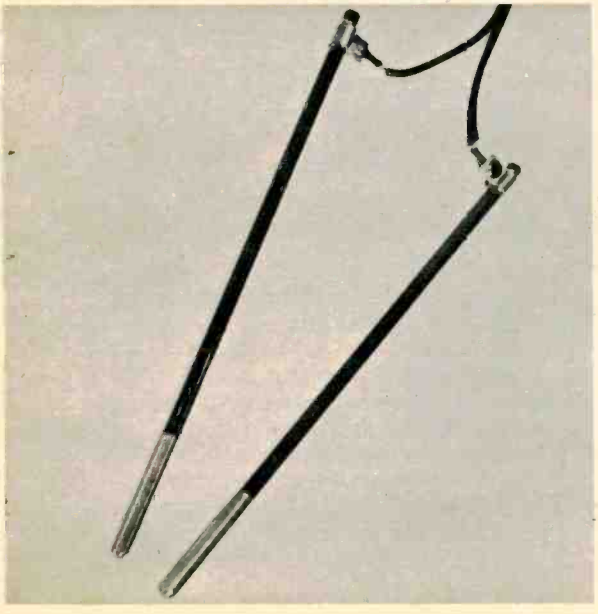
There are three basic requirements in the building of this automatic sprinkling device. These are the solenoid water valve, the rain detector probes and the defeat circuits.

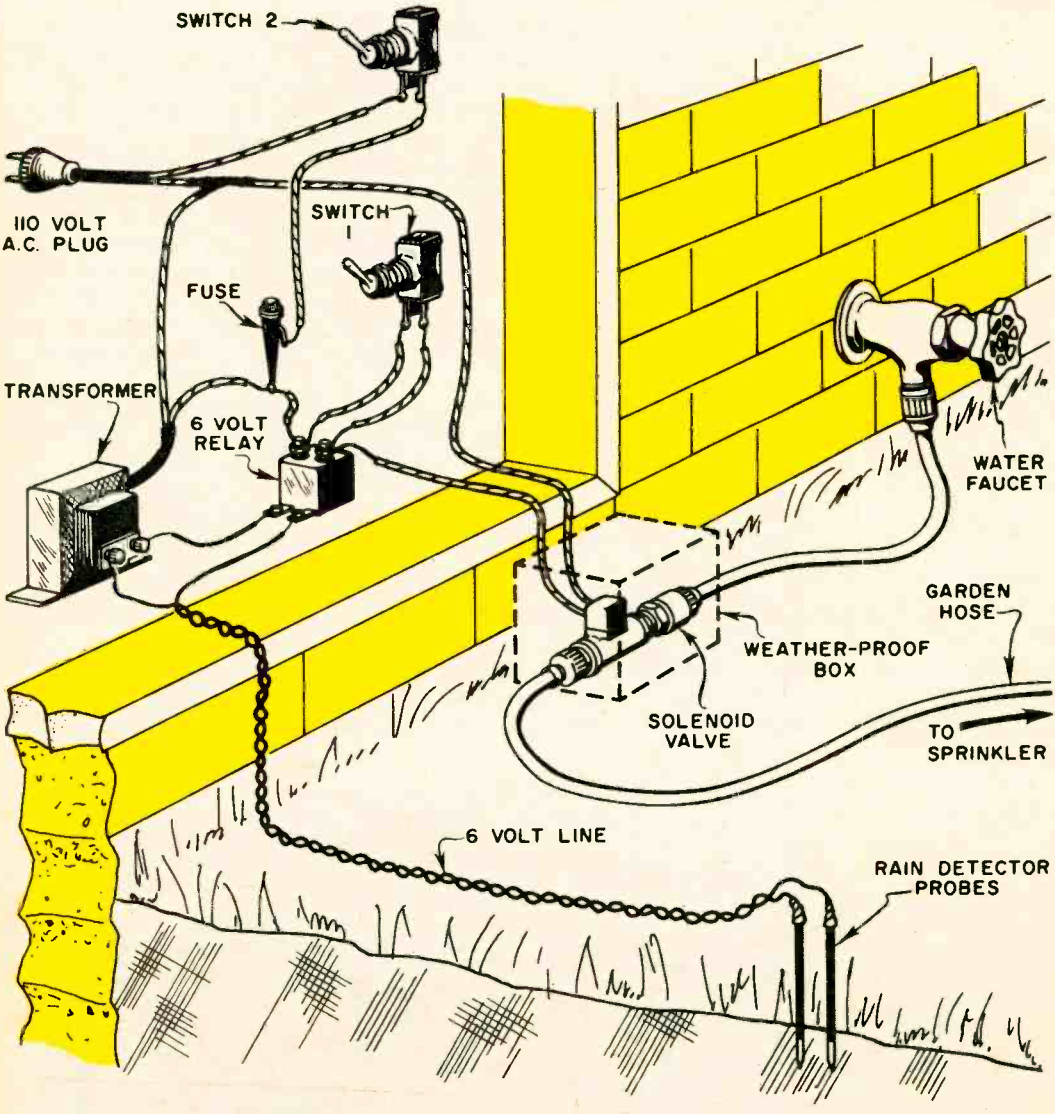
In shopping for a suitable solenoid water valve, the author found many inexpensive units available on the surplus market. Some of these surplus units require minor modifications. For a little more, a unit requiring no modification may be obtained at your local washing machine repair store. These will have garden hose connecting fittings.

As to the second requirement, we need some way for the earth to "tell" the solenoid when it needs water. The pair of "rain detecting probes" described here will do this trick nicely.

The probes are made from ten-inch lengths of aluminum rod, which was chosen for its ability to stand up well under severe conditions of weather and soil action. Use masking tape to mask off two inches of the bottom end of each probe and an area of about ½ inch near the top. Then dip the entire probe into a can of good outside house paint, shake the surplus paint off the probe and allow it to dry. After the tape is removed you will have bare aluminum in two places on each probe. At the top of each probe, fasten a small electronic cable clamp, using a bolt, nut and lockwasher. Also include a solder lug which serves as the

The soil moisture-detecting probes consist of two ten-inch lengths of aluminum rod, painted to within two inches from the bottom, with an unpainted section near the top for connections. Their separation in the soil depends upon the mineral content and porosity of the soil. The solenoid valve, shown unenclosed below right, is connected between the faucet and sprinkler hose.





Wiring guide showing all necessary connections. For safety, solenoid should be in separate box.

terminal for the wire to the rain probe.

The defeat circuit is needed to allow the user to obtain water from the hose for washing his car, for example, or other purposes. This circuit consists of a pair of switches. Flip one switch on, and regardless of the outside condition of the soil, no matter what the probes say about dampness, the water will flow through the valve.

The other switch is included for people who live in areas where the summers are very dry. In such areas, restrictions are often enforced regarding alternate day sprinkling, or restricted hour sprinkling. To avoid violation of any such laws, this switch enables the user to prevent the water from going on regardless of outside conditions.

The probes are inserted into the top soil to a depth at which the top soil ends. However, make certain that the cable clamps on the tops of the probes are at least one inch above the surface. As only the lower ends of the probes are not insulated by paint, these are the

only current sensitive areas, and they are able to sample the soil moisture at a practical depth.

As the soil becomes wet due to the sprinkling, its resistance drops, causing an increase in current flow between the probes. A six-volt bell transformer supplies the energy to actuate this circuit. This avoids the possibility of shock hazard to small children and animals.

In series with the probes and the transformer, is a small relay of the current-sensitive type (like the ones used for model radio control). This relay "pulls in" or closes when increased current flows between the probes, opening the powering circuit for the solenoid and thereby shutting the water.

Switch #1 which is used to override the probes, is connected in parallel with the relay contacts. The other switch is used in the primary voltage circuit which supplies the entire system, and is effectively an ON-OFF switch for the system.

The entire solenoid assembly should be mounted in a sealed aluminum box, such as a chassis cabinet. The sealing can be accomplished by the liberal use of rubber caulking and plastic spray. Remember, there is 110 volts AC at the terminals of the solenoid.

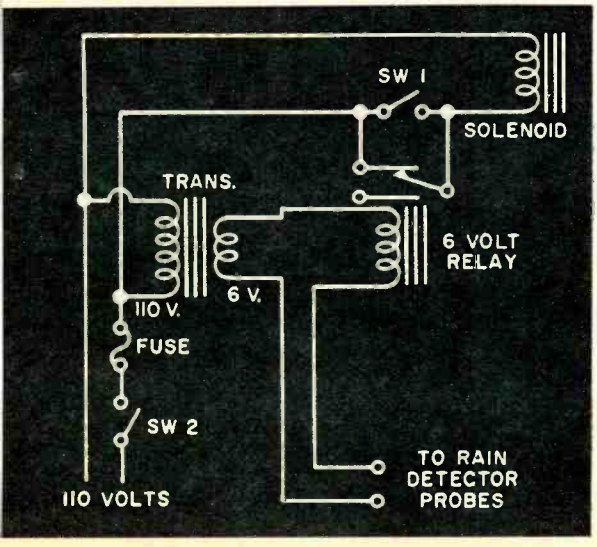
After making the electrical connections to the probe, use a brush and completely coat the exposed contact area.

Since the mineral content of soil throughout the country varies, you will have to determine how far from each other to place the probes in the ground. If you put the probes into the soil and the water does not turn off when the ground appears to be soaked to a reasonable depth, move the probes closer together. If the water will not go on at all, try moving the probes further apart. In either case, if the probes do not seem to have any effect at all, check your wiring for mistakes.

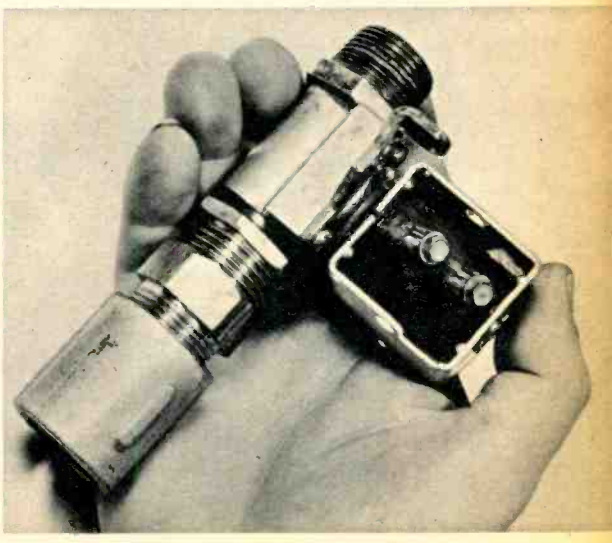
It will prove helpful when making initial tests of your equipment, not to insert the probes to their full depth, but rather, just insert the bare tips into the earth.

A more difficult problem faces those whose soil has low porosity. If your soil is "hard pan" or similar, your property might be flooded before the probes could turn the sprinkler off. In such cases, it may be advisable to dig a small hole somewhere in the sprinkled area and fill this hole with a more porous soil. Seed same as rest of lawn and insert the probes into this section. Calibrate the probes as before.

The 6-volt relay shown in schematic below is a Sigma 41FZ-10 model or an equivalent make.



Typical 110-volt solenoid valve available in washing machine supply or in surplus stores.



A Super-Sensitive Geiger Counter

By Harvey Pollack

Use it to search for uranium or as a radiation detector around your home — it's easy to build.

A SELF-CONTAINED portable radiation counter of the Geiger-Muller type occupies very little space and certainly cannot be considered excess baggage on any vacation trip you may be planning. If your itinerary includes any part of the mid-west or far western portion of the United States you actually cannot afford to be without one, unless you have no interest in a possible uranium strike! Another essential fact should be borne in mind, too: in the event of an atomic war, a radiation detector is an instrument of survival for the entire family. If its battery power supply is religiously maintained during days of peace, it may very well become the most important item you possess should the cold war burst into active flames! Those who insist that "it can't

Because this radiation detector is so sensitive you won't need earphones or meters to alert you to the presence of radioactivity. Instead, you merely carry this trim box under your arm, as the author is doing here, and the warning clicks will sound from the loudspeaker on the side. Perforated phenolic boards serve as speaker grille and radiation window behind which is counter tube.

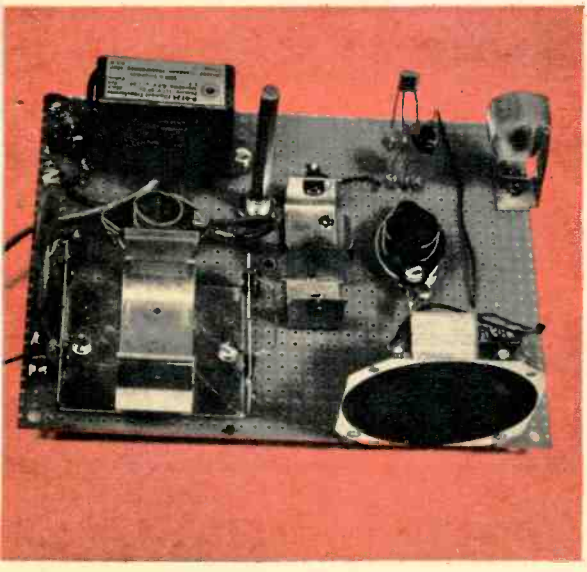
happen here" are guilty of the worst kind of wishful thinking.

The radiation detector described here has some superlative features. The required power is derived from a transistor oscillator operated from a pair of ordinary flashlight cells. There are no buttons to push or capacitors to charge; there is no spark gap or buzzer. The operation is therefore consistently quiet and trouble-free since there are no mechanically moving parts. Headphones are not necessary unless you happen to be using the counter in a very noisy location. Containing a built-in speaker driven by an inexpensive power transistor, the unit provides more than adequate volume for loudspeaker operation. A headphone jack is provided, however. The Geiger-Muller tube is contained within the main case so that the extra manipulation of a probe is eliminated. For all practical purposes a probe is unnecessary as well as bothersome.

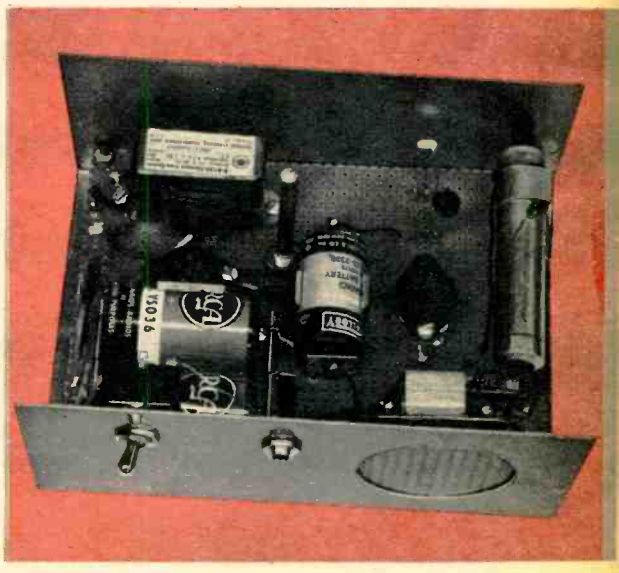
The housing is an aluminum minibox measuring 8" x 6" x 4". Fitted inside the box is a piece of perforated bakelite held up at the corners by four ¾" brass spacers. Except for two components, all of the major parts are conveniently mounted on the sheet of bakelite; only the ON-OFF switch and the headphone jack appear on the side-panel of the case. This type of construction permits very easy wiring since all of the mounting and soldering can be completed before the bakelite sheet is finally secured in place. As a suggestion for commencing the construction, mount and wire all the parts in the dashed box on the schematic diagram. This is the DC power supply portion of the counter. Power transistor TR1 is mounted on a 9-pin miniature socket and the two batteries comprising B1 are secured in a commercially available battery-holder. The other power supply parts are held to the bakelite sheet by means of short machine screws or merely by passing their pigtail leads through convenient perforations and bending them over sharply.

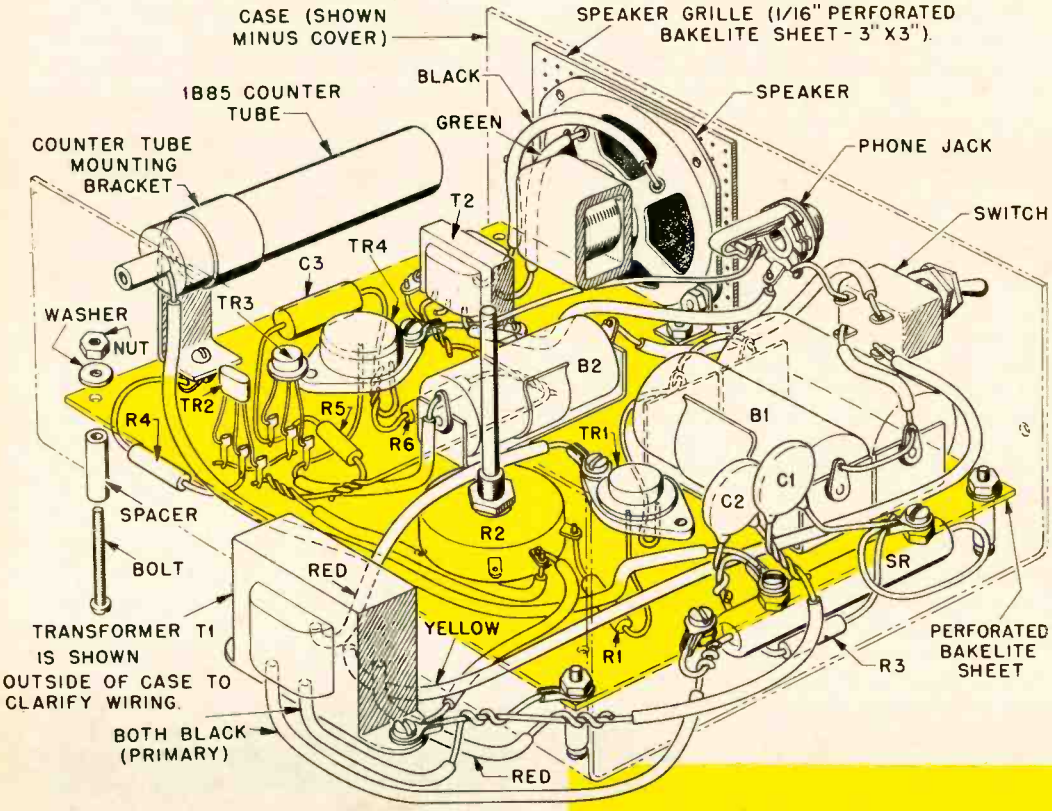
Some use was made of the so-called "flea clips" designed especially for the bakelite boards; these push through the holes and provide a very rigid, easily soldered support for transistors, disc capacitors, and resistors. Careful attention should be given to the color-coding of the 6.3 volt transformer (T1) in making the final connections. Should these be reversed, the power supply will not operate properly. The use of an oversize

Top view of the phenolic chassis shows the position of the various parts; note transistors.

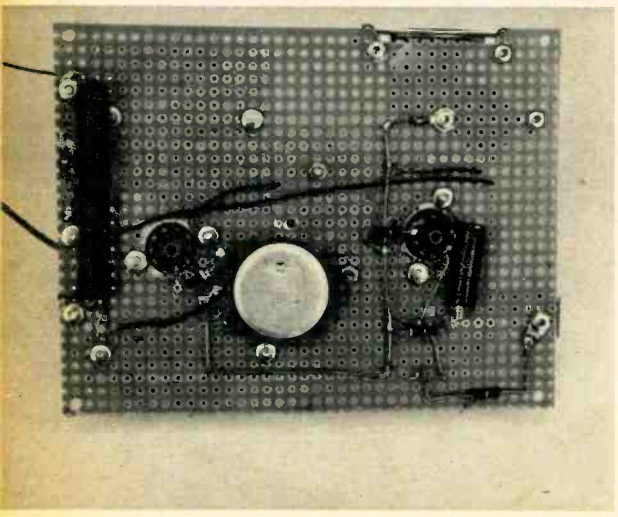


Same view of the detector but now, batteries, counter tube and metal case have been added.





The wiring guide above shows how to lay out and wire the detector. The bottom view of the bakelite board is shown below as an additional aid. For best results use the parts listed to the right, they are all you will need.



PARTS LIST

B1—Battery, 1.5 volts, two 1.5 volt cells in parallel
B2—Battery, 4.0 volts, mercury battery
C1, C2—.02 mfd, 1000 volts, ceramic disc capacitor
C3—4 mfd, 150 v., electrolytic capacitor
J—Jack, headphone, closed circuit type
R1—39 ohm, ½ watt carbon resistor
R2—500 ohm, carbon or wirewound potentiometer
R3, R4—1 megohm, ½ watt, carbon resistor
R5—470 ohm, ½ watt, carbon resistor
R6—2200 ohm, ½ watt, carbon resistor
S1 (A and B)—Toggle switch, double-pole single-throw
SR—Selenium rectifier, high voltage cartridge type (Sarkes-Tarzian or International Rectifier Corp., 2000 v. @ 3 ma)
T1—Transformer, filament type, primary 117 v., 60 cps, secondary 6.3 v. @ 1.2 amp, 3000 volt insulation (Stancor type P-6134)
T2—Transformer, transistor output, 1000 ohms to 3.2 ohms (Argonne AR-138)
TR1—Transistor, power type, Sylvania 2N307
TR2—Transistor, Sylvania 2N35
TR3—Transistor, G.E. 2N45
TR4—Transistor, CBS 2N256
G-M Tube—Victoreen type 1B85
Speaker—Miniature, 2½ inch permanent magnet type (Argonne type AR-42, 3.2 ohm voice coil)
Cabinet—Aluminum minibox, grey hammertone finish, 8"x6"x3½"
Battery Holders—One holder for two side-by-side #2 flashlight cells
One holder for one 4 volt mercury battery
One piece 7⅜"x6¾" perforated bakelite, about 1 dozen flea clips, two nine-pin miniature, bakelite tube sockets, four ¾-inch brass spacers to pass 1½" 6/32 machine screws, misc. hardware

high-voltage selenium rectifier (SR) is also suggested since this little power supply develops well over 1000 volts! Due to the small size of the filter capacitors (C1 and C2) there is very little energy storage so that there is absolutely no danger of lethal shock. Should you accidentally get across the high-voltage the worst that will happen is that you will feel a very short-lived jolt of rather low intensity.

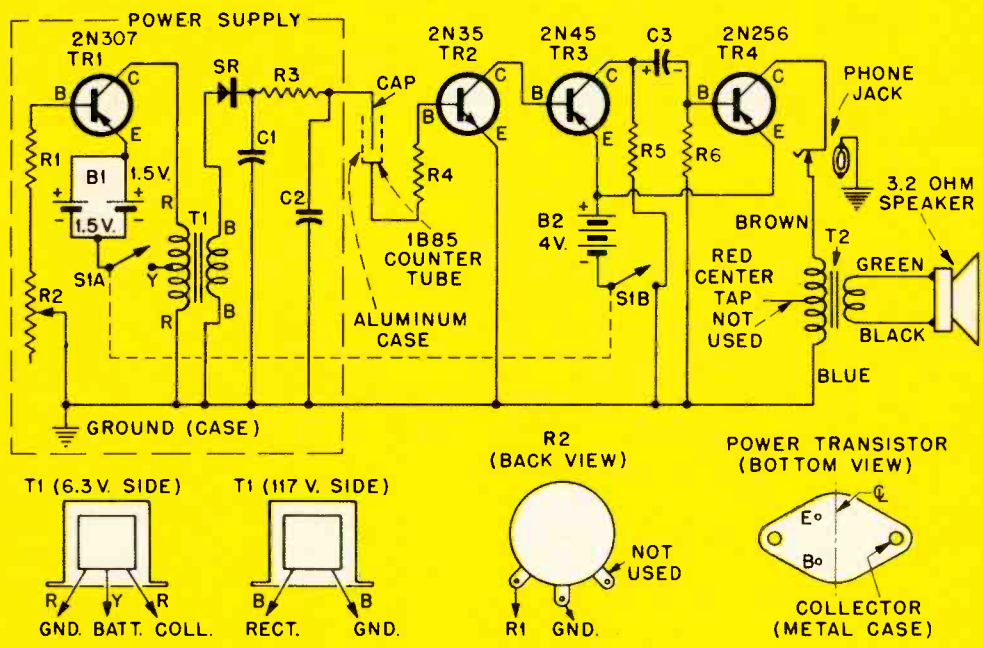
To test the power supply, rotate the shaft of potentiometer R2 fully counterclockwise and connect a vacuum-tube voltmeter, if available, across the terminals of capacitor C2. (If a VTVM is not obtainable, you may use the alternative test method described later.) Close switch S1A. You should hear a soft tone indicating that the oscillator is functioning. This tone comes from the transformer itself, not from the loudspeaker. The VTVM should show a voltage but it will not be a very large one. Now slowly advance the setting of R2 as you observe the meter. The voltage should attain a value of at least 1000 volts. Back the control off until the reading is 900 volts and leave it that way.

Without the help of a VTVM, you cannot test the power supply quantitatively but you can still determine whether or not it is operating. With R2 fully *clockwise*, close S1A for a few seconds, then open it. Quickly short across the terminals of C2 with a piece of insulated wire to determine by spark observation whether or not high voltage is present. The spark will be a definite one but not very "fat". Now back the control off to its full counterclockwise position.

If the high voltage seems low, try reversing one set of leads on T1 if any other but the recommended type has been used. If this does not help, try transistor TR4 in place of TR1. Although these are different types from different manufacturers, either one should enable you to get over 1000 volts. If one does and the other does not, this indicates a defective power transistor.

[*Continued on page* 101]

As a first step in construction, wire in the power supply shown in the dashed box on the schematic.

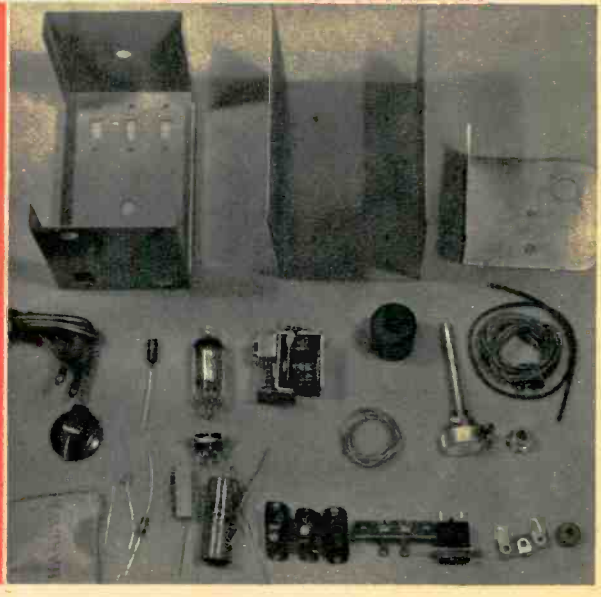


anyone can build this

Photoelectric Eye Kit

Protect your children, protect your power tools, open doors invisibly—an ideal automatic switch.

Set up across a stairway, Jimmy breaks the photoelectric beam as he climbs the stairs, warning mother before he can get where he may fall.



These are all the parts of the complete kit. Lay them out as shown and check them against the parts list as your initial step.

ONE of the problems of mothers who have small children is that of stairs. Most children can climb up a flight, but they have difficulty descending. Sometimes they come down rather forcefully. But you can mount a photoelectric relay at one side of the bottom step and a light source, aiming at it, at the opposite side, and the relay can be wired to ring a bell or a buzzer, warning mother to come and retrieve the child before he can climb to a dangerous level.

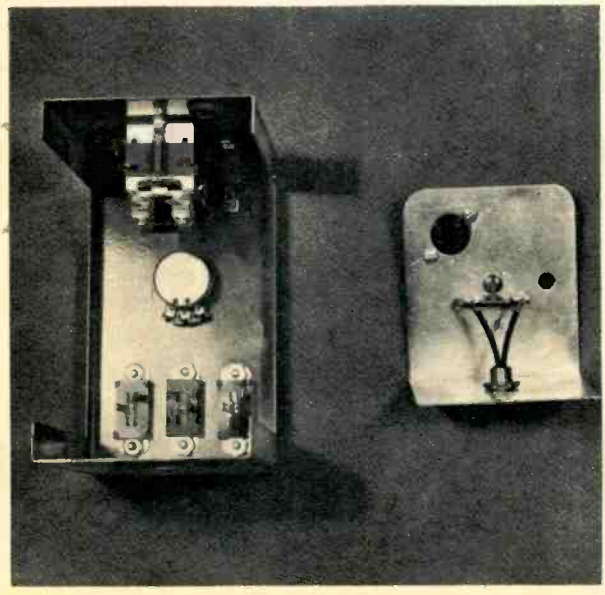
Another household use for a photoelectric eye is that of opening, in conjunction with a small motor or solenoid, a swinging kitchen door for the housewife who is carrying hot food.

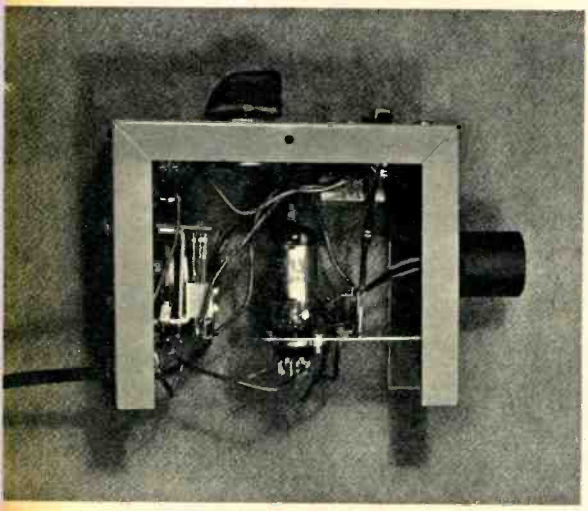
Without a doubt a photoelectric relay is one of the simplest and most useful construction projects the electronic handyman can tackle, and one simple and economical way of obtaining such a relay is to buy one of those available in kit form. The particular one we chose to test is the Lafayette Radio model KT-133 for $12.95.

The heart of the circuit is a cadmium selenide photocell which is extremely sensitive in the red and near infrared region of the spectrum. Therefore the relay can be activated by sunlight, incandescent or neon lamps, and flames. When light shines on the photocell its resistance is greatly reduced, thus increasing the voltage on the grid of a thyratron tube to which it is connected. This bias brings the thyratron gas tube to its firing point, causing the tube to conduct, energizing a relay.

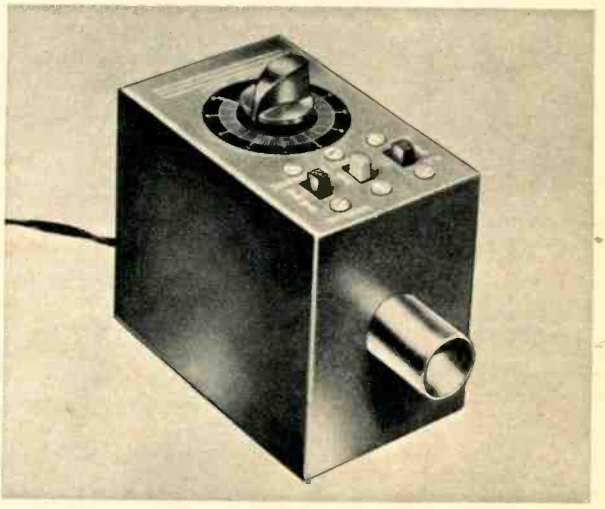
All the components for this photoelectric relay go on two separate chassis enclosed in a case half the size of a cigar box. The

For step 2, mount all parts on the main chassis and the small subchassis that fits into it and holds the photocell. Easy-to-follow instructions are contained in the manual that comes with the kit. When soldering the photocell connections use long nose pliers between the iron and the cell to draw off heat.





Completed chassis without cover. The photocell is in black tube, thyratron in center.



The control on top of box varies sensitivity of relay, switches decide mode of operation.

separate chassis allow for ease of wiring. You must have a separate light source to use with this relay but this can be a common flashlight.

With one exception all the parts fit precisely. That exception was the 117 volt AC outlet socket, which did not align properly with the holes tapped in the case, so an additional hole had to be drilled.

The first stage in assembling the kit was installing the switches, sensitivity control, relay, output socket and terminal strip on the large chassis. It is absolutely necessary these are set in correctly, or the system may not work, or work improperly. Be certain the switch lugs and sensitivity control lugs line up as instruction book diagram indicates.

When the photocell is connected into the circuit it is most necessary to prevent excess heat from going to it during soldering. The instructions tells you how to use a long nose pliers as a heat sink, but there is no illustration of it. The best method is to hold the cell leads as close to their ends as possible with the pliers, and make the solder connection as quickly as possible.

In all, the complete assembly should not take more than two or three hours, at most, even for the most inexperienced.

To check the operation of the completed unit, plug in its power cord, turn the sensitivity control completely counterclockwise, and point the photocell toward a moderately strong light. Turn the control slowly to the point where you hear the relay click. Then turn it back slightly to the point where the relay chatters, and then advance it a hair. At this point it will work properly for that light intensity.

You will, of course, wish to reset the control for varying light conditions, and you'll have to go through the same procedure each time. But once set for a specific intensity, it should not have to be changed.

While the manual gives complete details on the use of the automatic and manual switches, it might be well to mention them. The "auto." position will give you continuous action. The relay will make contact when the light hits, and will open when the light is taken away. This is necessary for continuous operation, such as in counting, opening of doors, warning devices. The "man." setting will cause the relay to close when the light hits it, and the relay will stay closed until the reset switch is depressed.

The photoelectric relay whose construction is shown in the photos worked perfectly the first time it was hooked up and has been working since.

The ABC's of Electronics-3

By Donald Hoefler

Part 3 in this series explains Ohm's Law and describes how to calculate resistance in circuits.

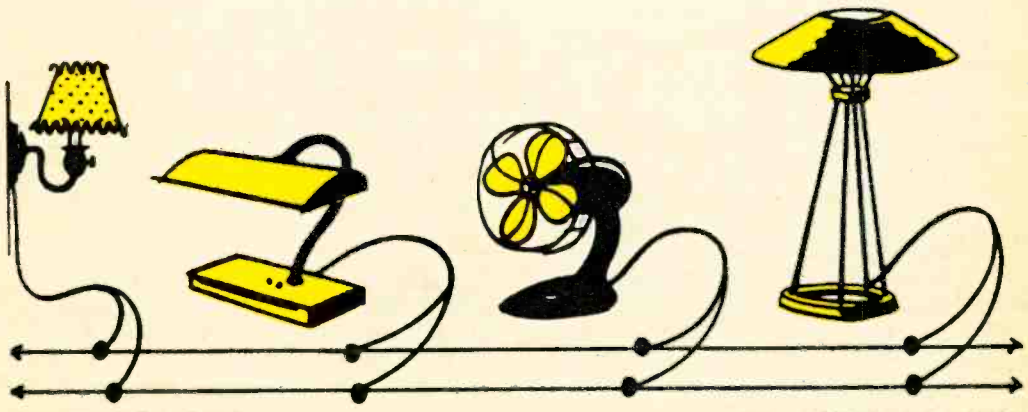
WHEN electrons go rushing through any of the limitless number of possible electronic circuits, they do so because they are being pushed. Something is putting the pressure on them, a pressure known as electromotive force (e.m.f.). The greater this e.m.f., the more electrons will flow in any given time.

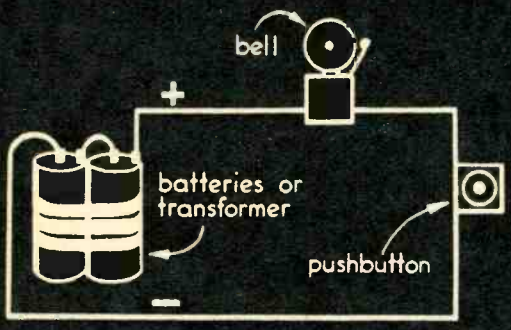
To get some idea of the fantastic number of electrons which are in motion when even small currents flow, just consider this: when the e.m.f. is great enough to send a current of one *ampere* through a circuit, this means that 6,280,000,000,000,000,000 electrons pass a given point every single second!

There are many methods known for generating an e.m.f., but the two most commonly used are chemical and electromagnetic. The first is the basis of cells and batteries, and the second is the basis of electric generators.

Whenever the e.m.f. tends to force current through a circuit, there will be some opposition to the current flow because there is no such thing as a perfect conductor. The most common form of opposition to current flow is known as *resistance*. Every circuit element has some resistance, but when it is specifically desired to limit the current flow to a certain value, a component known as a *resistor* is inserted in the circuit.

These appliances are connected in parallel over the 110-volt home line.





A simple battery, a bell and a pushbutton are components of the series circuit shown above.

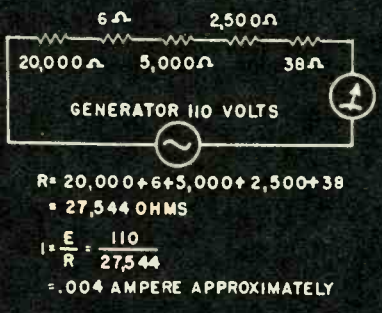


Fig. 1. This diagram shows calculation of resistance and current flow in a series circuit.

Ohm's Law simplified. Cover the unknown, remaining factors show the operation to be done.

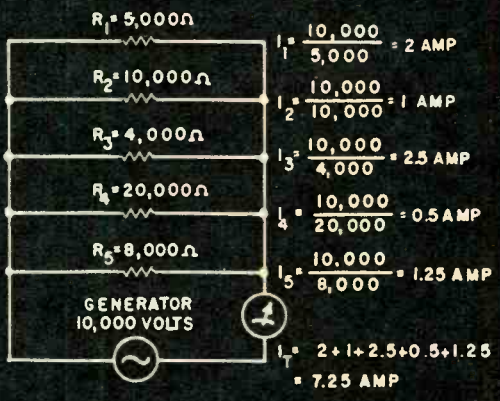


Fig. 2. Using this formula you'll be able to calculate current flow in a parallel circuit.

Resistors come in all sizes and shapes, and their ability to oppose current flow is expressed in a unit called the *ohm*. By international agreement, the ohm is designated as the opposition offered to an unvarying current by a column of mercury of specified dimensions.

Now that we know the ampere to be a flow of a certain number of electrons per second, and the ohm to be the resistance of a certain column of mercury, we can define the unit of e.m.f. This is called the *volt*, and is described simply as *that amount of electrical pressure which will drive a current of one ampere through a resistance of one ohm.* From this definition it is obvious that there is a close interrelationship between volts, ohms and amperes.

If the voltage increases, we would expect the current to go up also. But if the resistance increases, the current will drop. These relationships were expressed in three little mathematical formulas over 130 years ago by a French scientist, after whom they are named *Ohm's Law.* This is one of the most important of all electrical relationships.

We have adopted the letter symbol *I* (intensity) for the current in amperes, *E* for the e.m.f. in volts, and *R* for the resistance in ohms. In one form, Ohm's Law tells us that to find the current in amperes in any circuit, we must divide the e.m.f. in volts by the resistance in ohms. Thus the formula becomes

$$I = \frac{E}{R}$$

As an example of how this works, let's find out how much current a light bulb having a filament resistance of 100 ohms will pass when it is connected to a source of e.m.f. of 117 volts:

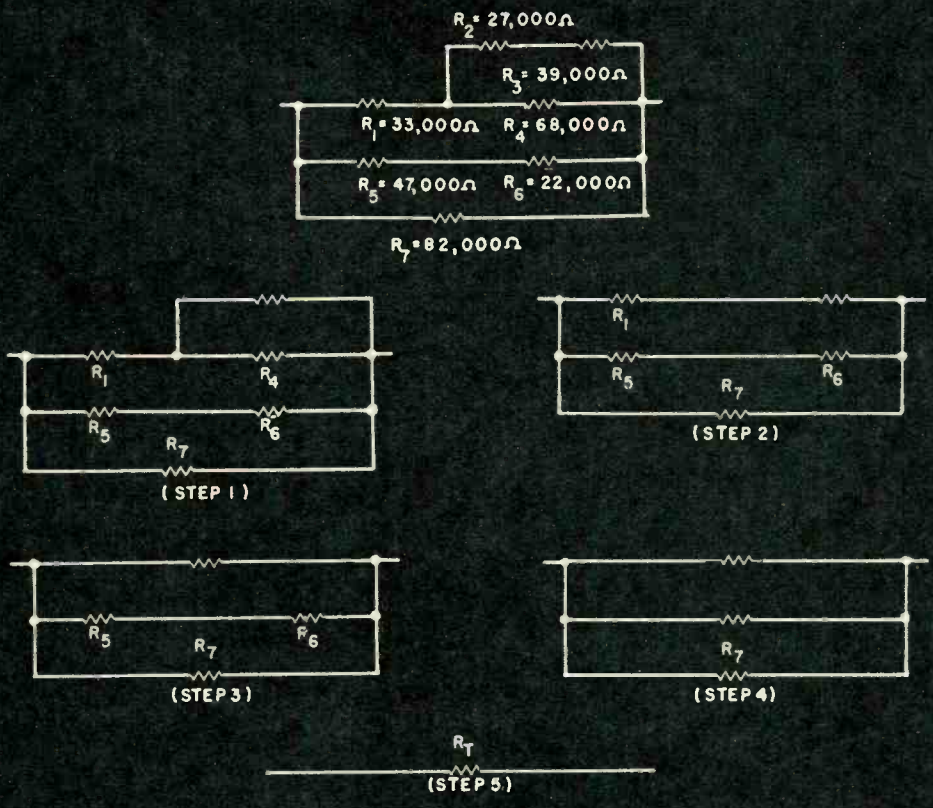


Fig. 3. What is the Total Resistance of the network shown on top? Follow the steps below it, using the method described in the text. Can you do it? See the solution in the October issue.

$$I = \frac{117}{100} = 1.17 \text{ amperes}$$

Now suppose we want to determine the resistance when the voltage and current are known. For example, what is the resistance of the windings of a 12-volt starter motor when the current through them is 2 amperes?

$$R = \frac{E}{I} = \frac{12}{2} = 6 \text{ ohms}$$

Finally, consider the case where the resistance and current are known, and the voltage must be found. Say we have a pilot lamp which has an operating resistance of 4 ohms. When lit to full brilliance it draws a current of 1.5 amperes. Can we use this lamp in a 12-volt circuit?

$$E = I \times R = 1.5 \times 4 = 6 \text{ volts}$$

Since this is a 6-volt lamp, it would quickly burn out if 12 volts were impressed across it. The answer is *no*.

Seldom in electronics do we encounter such simple arrangements, with only a single device connected to the source of e.m.f. Much more often we will find a combination of components and wires making up a complete *circuit*. This is defined as the entire path over which the electrons travel in passing from one terminal to the other of the source e.m.f.

The way in which the various circuit components are connected is known either as *series* or *parallel*, or some combination of both of these called *series-parallel*. In the series circuit, the

[*Continued on page* 100]

Photo by Grayson Tewksbury

Automatic Temperature Control

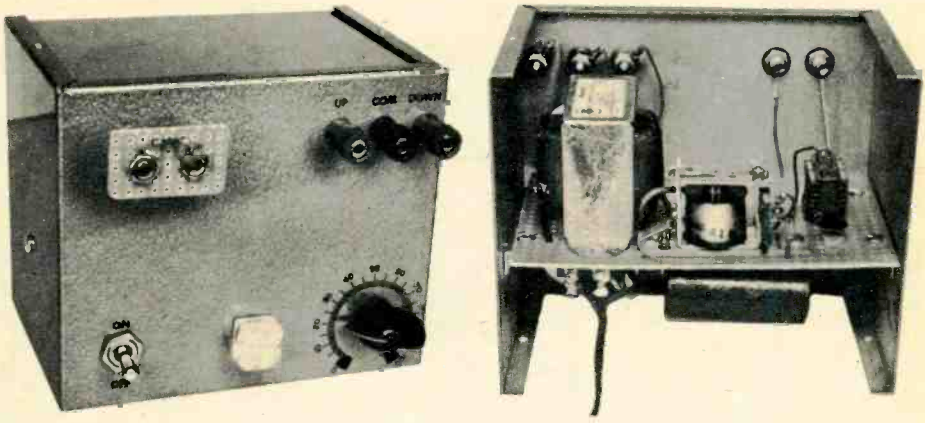
It shuts off your fan when it gets too cool, turns it on again when it's hot; also controls hot houses.

HERE is an inexpensive automatic thermostat which won't take you long to build and has a multitude of uses. This unit responds to both high and low temperatures and will either ring an alarm or trigger a heater or turn on a cooling system depending upon your need.

This unit uses a thermistor sensing element—not a bi-metallic strip. There are no moving parts, and the thermistor may be located anywhere, in or out of the weather, at distances up to a *mile or more* from the control unit.

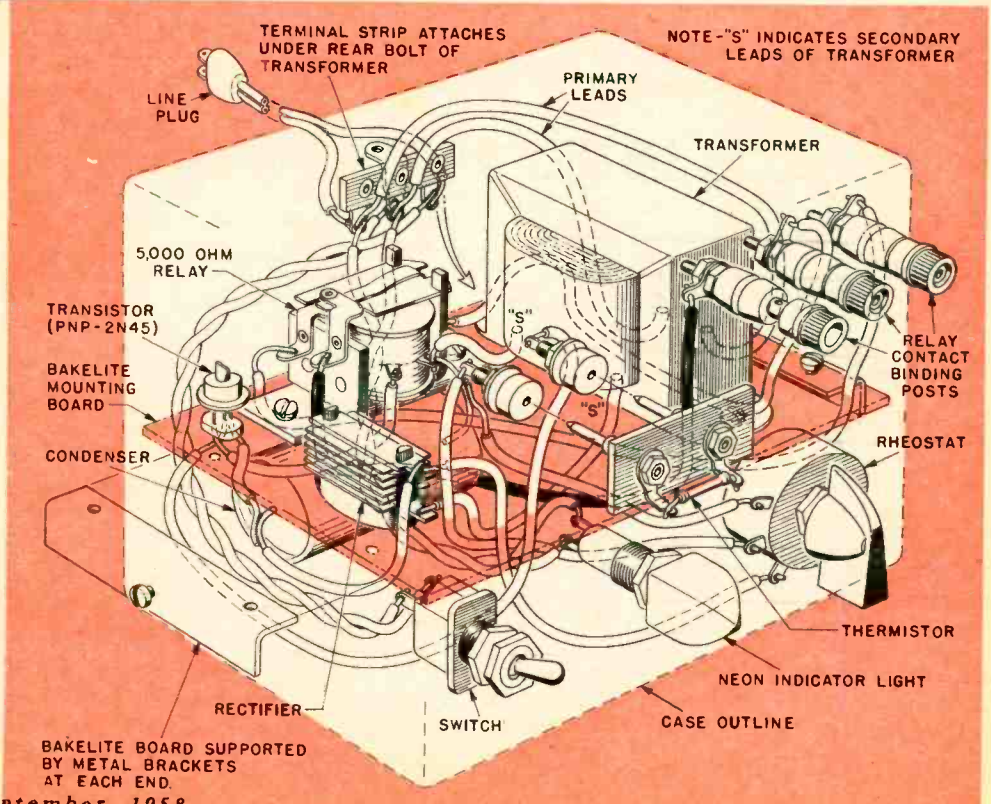
The complete control contains 4 essential sections: the thermistor sensor, a low-cost transistor that multiplies the temperature reaction of the thermistor, an inexpensive relay that responds to the amplified output of the transistor, and a small 25 volt DC power supply. The total power consumption of the en-

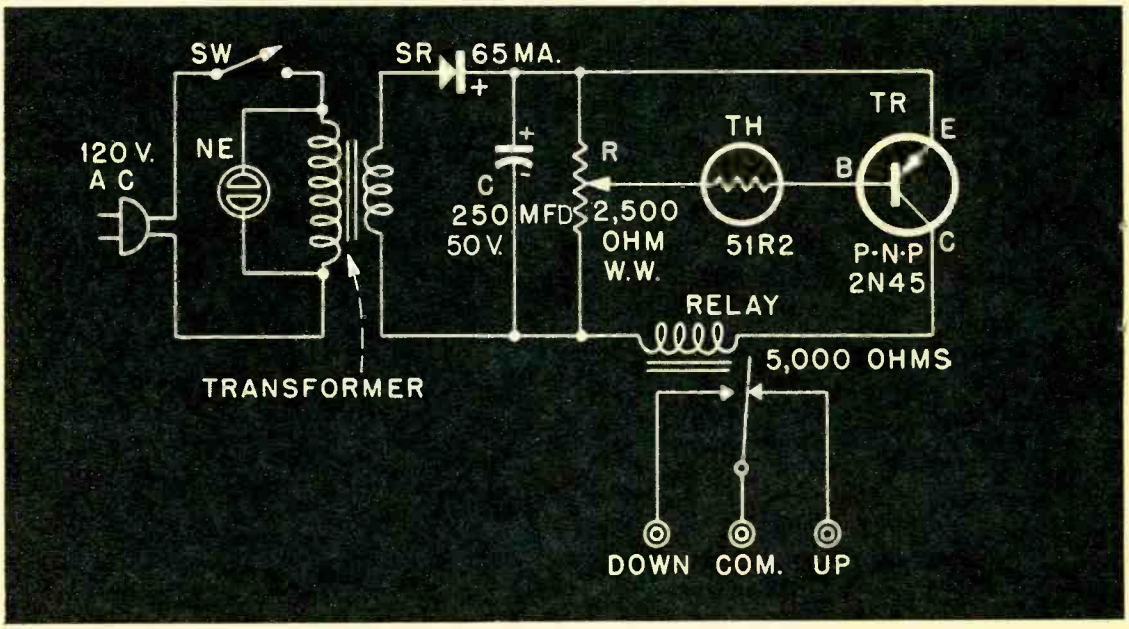
The front panel of the automatic temperature control contains the sensitivity adjust and heat-sensing thermistor; the back view with cover off shows actual parts layout.



When using the control with a fan, as shown at left, it should be positioned so that air will flow by it causing an immediate response when it gets too cool for comfort.

The wiring guide below shows how to put the temperature control together. Refer also to the photos as they will help in locating the major parts properly on the chassis.





Schematic diagram of electronic thermostat shows few parts used. Use the parts specified.

PARTS LISTS

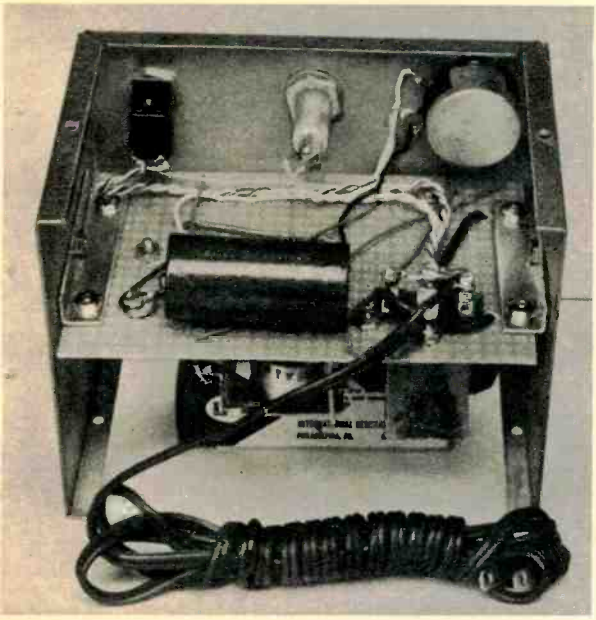
C—250 mfd, 50 v. DC, tubular electrolytic capacitor
R—2,500 ohms wirewound, 4 watt potentiometer (IRC type WPK 2500R)
NE—Neon indicator light, 117-volt type (Drake 105 Postlite)
RY—Relay, 5000 ohm coil, SPDT, 5 amp. contacts (Potter and Brumfield type LB5—5000 ohms)
SR—Selenium rectifier, 65 ma., 120-volt type
SW—Switch, SPST toggle
T—Transformer, filament type, primary 117 v., 60 cycle, secondary 25.2 volts, 1 amp. (Stancor P6469)
TH—Thermistor, 100,000 ohms nominal resistance at 25° C, rod form with leads (Veco type 51R2. Available from Lafayette Radio Co.)
TR—Transistor, PNP, 45-volt collector rating, type 2N45
Case—5"x5"x6" Minibox, aluminum, hammertone finish, (Bud type CU-2107)
Line cord—Standard 117-volt zip-cord with plug
2 Tip jacks
2 Tip plugs
3 Binding posts
Perforated bakelite—1 sheet 7⅜"x6¾", 1/16" thick
Decals, pointer knob, hardware, wire, solder, etc.
Transistor socket, universal type

tire system is slightly over ½ watt and costs about 30¢ yearly to operate.

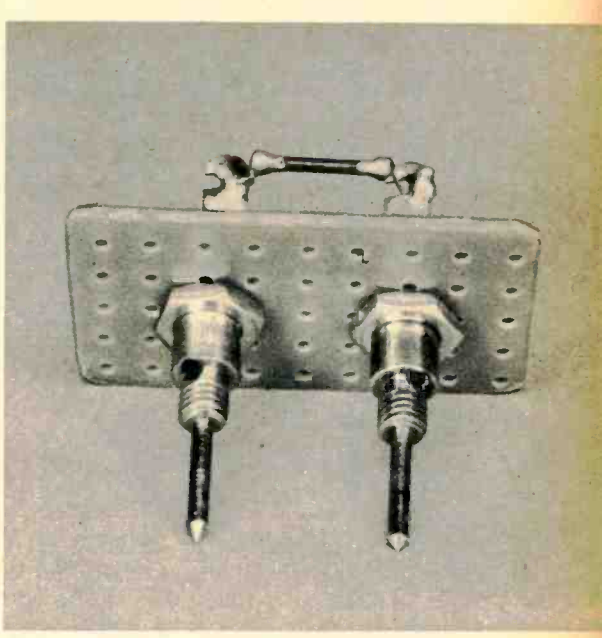
The control is housed in an attractive miniature case measuring 4" x 5" x 6". Aside from the thermistor, a plug-in unit that mounts on the outside, most of the electrical components are located on a perforated sheet of bakelite inside the box.

Begin by cutting a piece of bakelite to fit inside the case; the dimensions are 5¾" by 3¾". Use an ordinary pair of metal shears to cut the bakelite, slicing through the selected row of holes. Mount the transformer, relay, selenium rectifier, and the transistor socket on one side and the filter capacitor on the other. Using scrap aluminum, fashion a pair of brackets to support the bakelite chassis in the case; each of these is approximately 2½" long with ½" flanges bent at right angles. Before securing the chassis to the case, however, locate and drill the holes to accommodate the toggle switch, the control potentiometer, the neon glow indicator, the thermistor tip jacks, and the relay terminal binding posts—all on the front panel. Be especially careful when mounting the tip jacks and binding posts that they are completely insulated from the metal panel. Although they are constructed with extruded insulating shoulders, they must be centered in their mounting holes with some caution.

As the photographs show, the thermistor may be mounted on a small plug-in board for indoor use, or inside a weatherproof plastic box for exposed locations. The indoor plug-in board was



The wiring and parts placement on the bottom of the bakelite chassis is shown in this view.



The heat sensitive thermistor is mounted between two pin jacks on a piece of bakelite.

fashioned from a scrap of the same perforated bakelite used for the chassis and measures 1" x 1¾". For a good hermetic seal, however, one of the little plastic boxes in which small hardware is sold is ideal as the thermistor case. The plug-in pins are mounted on the bottom of the case and the thermistor soldered to the lugs inside. The little door may then be sealed with a generous coating of polystyrene dope or Duco household cement. It should be remembered, though, that the enclosed box-type construction increases the response time of the unit by a few minutes due to its thermal insulating quality.

For remote placement of the thermistor, make up a cable of the required length with a pair of tips on the near end and a pair of tip jacks on the remote terminals. This cable must be protected against moisture, of course, if it is to be run outdoors.

For test purposes, plug in or connect any indicating device (such as a battery and pilot light in series) across the relay binding posts marked "COM" and "DOWN". Without applying AC power, but with the thermistor plugged in, rotate the control potentiometer fully clockwise and manually press and release the relay armature. Note that the indicator glows when the armature is down.

Now plug the line cord of the control into a convenient AC supply socket and rotate the potentiometer counterclockwise slowly. If the relay pulls in as indicated by the glowing light, then no adjustment is necessary on the relay tension provided that pull-in occurs with about ¼ of full counterclockwise rotation still left to go. If you must go further in the counterclockwise direction than this, or if the relay does not pull in at all, it will be necessary to "sensitize" the relay. This is accomplished as follows: remove the single machine screw that holds the armature in place and gently remove the assembly. Bend the tension spring very slightly downward and replace the armature. A series of easy steps like this should bring the tension down to the point where the relay pulls in with the potentiometer rotated about ¾ of a full counterclockwise turn. (If you own a low range milliammeter, 0-5 ma. or 0-10 ma. will do nicely, you can speed up this adjust-

[*Continued on page* 102]

how to build a safe rocket–part 2

Mixing A Safe Fuel

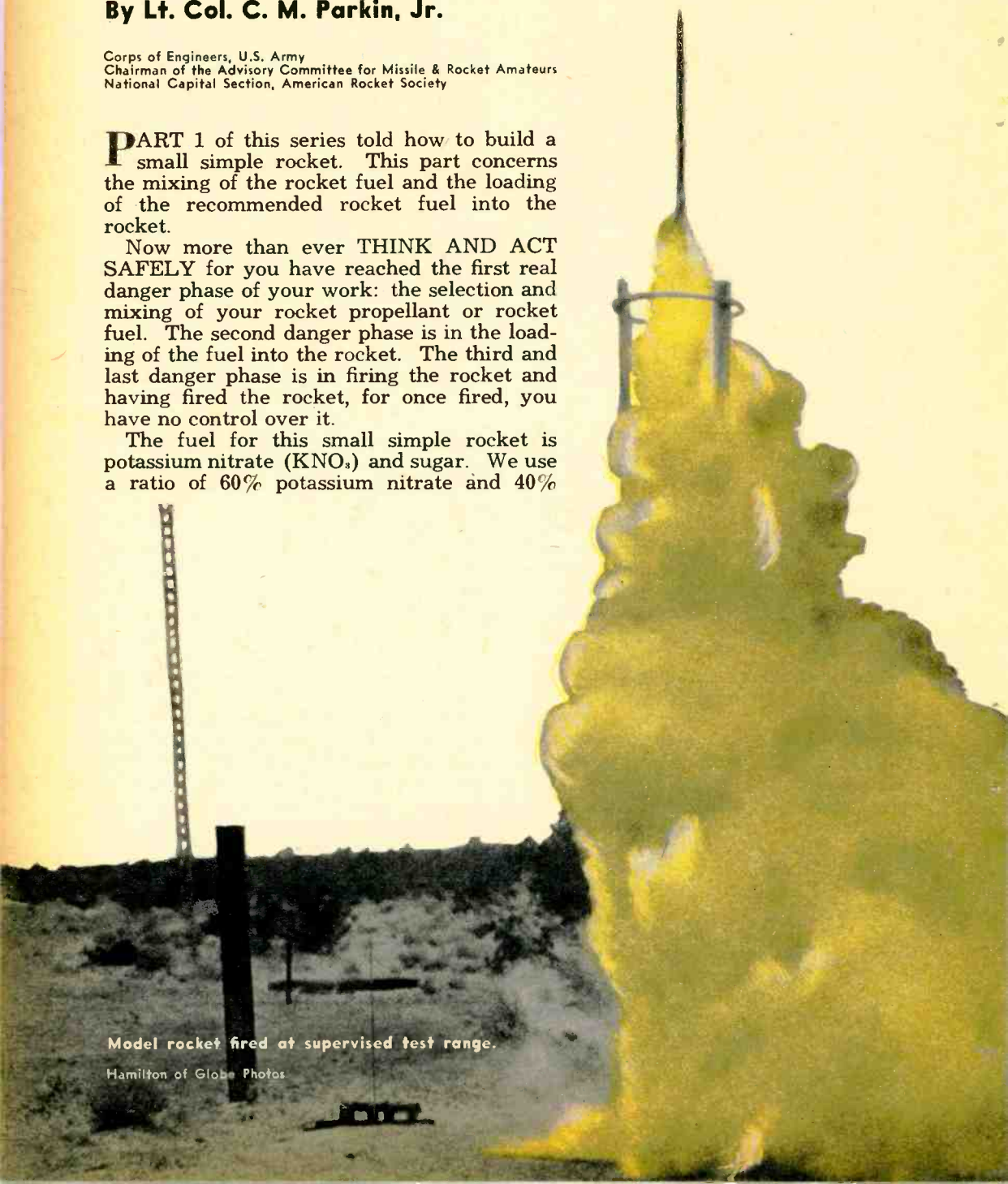
By Lt. Col. C. M. Parkin, Jr.

Corps of Engineers, U.S. Army
Chairman of the Advisory Committee for Missile & Rocket Amateurs
National Capital Section, American Rocket Society

PART 1 of this series told how to build a small simple rocket. This part concerns the mixing of the rocket fuel and the loading of the recommended rocket fuel into the rocket.

Now more than ever THINK AND ACT SAFELY for you have reached the first real danger phase of your work: the selection and mixing of your rocket propellant or rocket fuel. The second danger phase is in the loading of the fuel into the rocket. The third and last danger phase is in firing the rocket and having fired the rocket, for once fired, you have no control over it.

The fuel for this small simple rocket is potassium nitrate (KNO_3) and sugar. We use a ratio of 60% potassium nitrate and 40%



Model rocket fired at supervised test range.

Hamilton of Globe Photos

sugar by weight. PLEASE REMEMBER THAT WHAT I'M ABOUT TO RELATE CONCERNING THE FUEL OF SUGAR AND OXIDANT OF POTASSIUM NITRATE DOES NOT APPLY TO OTHER FUELS AND OXIDANTS OR OTHER COMBINATIONS. Further, until a great deal more work and experiments are carried out in regard to the recommended combination of sugar and potassium nitrate it is unwise to subject even this combination to extreme conditions of heat or cold, shock or grinding action.

A melted mixture of 60% potassium nitrate (KNO_3) and 40% by weight sugar has been subjected to flash tests. Repeated tests have shown that this combination when melted in an open electrical container at average room conditions will eventually flash and burn rapidly at 600 plus degrees F. This fuel has an affinity for water and therefore should not be loaded into a rocket and the rocket permitted to stand or lie around for days before firing.

It was suggested in the safety rules in Part 1, that you be orderly and neat, that you plan your work and that you develop check lists for the different phases of your work. Please read the article several times if necessary and then after you have made out your check list or work sheet, begin.

You will now need the following:

1. Rocket casing, nose plug and nozzle
2. 0.4 lb. of granulated table sugar (no powdered sugar)
3. 0.6 lb. of potassium nitrate, crystal (not powdered)

Warning: Keep container closed and away from combustible material and heat and avoid contact with skin and eyes.

4. A set of scales (you may be able to use the scales in a school chemistry lab.)
5. An electrical fry pan with temperature controls
6. A cooking thermometer
7. A large spoon of the nonsparking type (e.g. monel metal)
8. A protective apron
9. Protective gloves
10. Protective face shield
11. Rubber or gum soled shoes (so that cleats and nails don't cause sparks)
12. An electrical oven
13. A vise with wood protective sides
14. A set of tongs or pliers of the nonsparking type
15. A roll of masking tape
16. Three small metal funnels
17. A flour sifter
18. A roll of wax paper

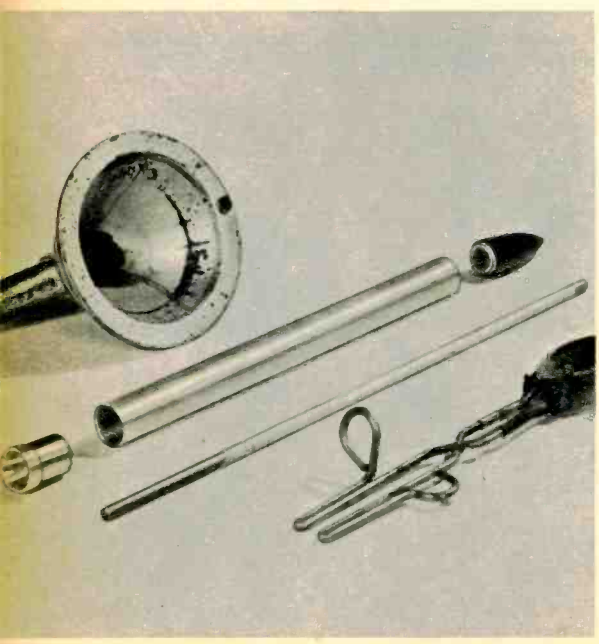
Use insulated tongs, asbestos gloves, apron and face shield when handling the hot rocket.

Here's what you need for making and measuring fuel. Scales may be available at school lab.

Safety Rules

1. Don't work in your basement or attic unless you have a good workshop—one that has good heating, good lighting and good ventilation. In addition there should be fire prevention measures at hand, a first aid kit and a telephone nearby.
2. Never handle components of fuels near open flame or in the presence of oxidizers.
3. Never handle components of fuels unless you know ignition temperature or flash temperature of those compounds, both separately and combined.
4. Never mix fuels without some sure method of measuring temperature of the mixture.
5. Fuels should be mixed in small amounts.
6. Proper protective clothing should be worn when handling components of fuels. This includes face shield, gloves, etc.
7. Never load fuel into a container if the fuel will react with the container. Never pour fuel over or through threaded sections without the use of a funnel.
8. Do not fuel your rocket until you are ready to test or fire it.
9. Do not fuel your rocket with explosives.
10. Do not fuel your rocket with blasting caps or black powder.
11. Don't use compounds that are sensitive to heat, shock or friction such as potassium chlorate, potassium perchlorate, compounds of the picrate, fulminate and iodate families.

Funnel, wax-paper wrapped steel rod, and tongs are for pouring finished fuel into rocket.



19. A 24-inch metal rod, 3/8-inch diameter
20. A well lighted, well ventilated room
21. A first aid kit with a water fire extinguisher

You are now ready to proceed. First, put on the protective clothing with face mask at hand. Next, clean the rocket casing, nose plug and rocket nozzle and make certain that all three go together smoothly so that there is no resistance to screwing one part into the other. Then, turn on the electrical oven and place the following in the oven: rocket casing assembled with the nose plug and three small metal funnels or one fluid funnel. Set the temperature of the oven at 350° F.

While they are being heated, measure out by weight 0.6 lb. of potassium nitrate and 0.4 lb of table sugar. This combination should then be sifted five or six times through the flour sifter. If any large particles collect in the sifter

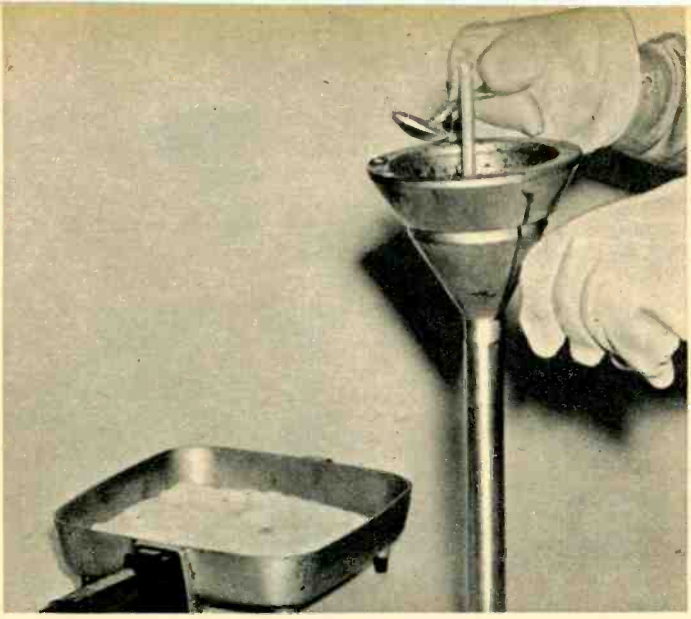
these should be broken up by use of the large spoon or mortar and pestle. Do not try to break up the larger particles by use of your fingers for more often than not, your next move would be to your face and as mentioned earlier the compound as now constituted is harmful to the skin and eyes. This sifted mixture should now be placed in the electrical fry pan with the temperature set at 350° F. The cooking thermometer is used to check the mixture as you proceed. With the controlled heat not to exceed 350° F the mixture is heated until it has the consistency of molasses. The mixture should be constantly folded over by means of the large metal spoon.

You may now wrap wax paper around the 3/8-inch rod. Then remove the rocket casing from the oven with the tongs and insert the tube between the jaws of the vise with the sides of the vise protected with wooden blocks. Insert the 3/8-inch rod into the rocket tube. Next, take one funnel or fluid funnel from the oven and insert it into

Col. Parkin, wearing protective clothes, stirs cooking fuel with a non-sparking metal spoon.

Safety Rules

12. Do not use matches to set off rockets.
13. Do not use time fuses to ignite the fuel of rockets.
14. Use only electrical means to set off rockets.
15. Be absolutely certain that all electrical wire firing leads are shorted (shunted) except when they are being connected for a test or a launching.
16. Remember this simple rule: two ounces of fuel are eight times as strong as one ounce, three ounces are 27 times as strong, four ounces are 64 times as strong and five ounces are 125 times as strong as one ounce. In short, for comparison purposes, the strength of the fuel increases as the cube of the weight.
17. Matter in dust form is dangerous. Flour mills have been known to explode, so zinc dust and sulphur dust can be dangerous too. When pouring, keep the dust down, air itself can set off dust of some metals. Be extremely careful. Check for open flames, exposed electrical heaters, poor electrical fittings and switches and, of course, there should be NO SMOKING at anytime where building, fueling, testing or firing rockets.
18. Once the rocket or missile is fired from the launcher, it is a free flying projection. Therefore every effort should be made to secure adequate firing ranges. Most of these are under the jurisdiction of the Army, Navy or Air Force. It is advisable to make contact with a post, camp station or base of one of the Services far in advance of the desired firing date, and give them in writing all the information about yourself, your organization and your rockets (type of fuel, range, etc.).



When pouring the melted fuel (350° F) into the preheated funnel, asbestos gloves are a must. Fuel flows into the vise-held rocket and around the ⅛" diameter, 24" long steel rod.

the nozzle end of the casing. Use the spoon to ladle the fuel into the rocket by means of the funnel. An alternate method is to place the masking tape over the inside threads of the rocket nozzle and omit the funnel. Another suggestion is to use a small cardboard protective coating over the nozzle threads. What ever method you decide to use the important point is don't allow the fuel to flow into or solidify in the threads of the casing. As the funnel cools the fuel mixture will solidify along its sides. Replace the funnel with a fresh one from the oven as this occurs. Do not put the used funnel with fuel on it back into the oven. Once all the fuel has been placed into the rocket casing allow the fuel to cool and solidify. When cooled enough to handle, the ⅜-inch diameter rod can then be pulled out of the rocket casing.

The last part of the project is to clean up. Hot water will do a good job. Make sure that none of the rocket fuel is left laying around.

Don't be discouraged if you have trouble loading the fuel in the rocket—we all have experienced that difficulty. However, do NOT attempt to load the rocket with more than one pouring. This will increase the burning area to a point where the increased pressure might cause an explosion. Cracks in the solidified propellant will do the same thing. Therefore do NOT attempt to fire a rocket with fuel which has been casted in separate pourings or which is known to possess cracks.

To ignite this charge a commercial electrical squib is recommended. If one is not obtainable one can be made by putting a piece of nichrome wire (any heating element) between the ends of two insulated lead wires and dipping this into a bit of the rocket fuel while the fuel is in a semi-melted condition. When this cools it is inserted into the nose plug end of the rocket casing. The rocket is now ready to be test fired. Always test fire the rocket statically before contacting an agency to help you fire your rocket.

How to build a test and launching pad and how to test and fire a rocket will be explained in the next issue.

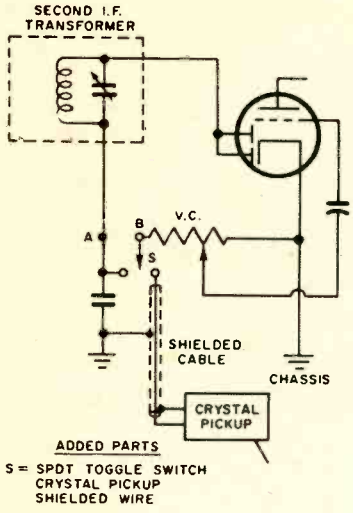
An almost indispensable booklet for amateur rocketeers is now available from the Headquarters of the First U. S. Army, Governors Island, New York. Called "Rocket Safety Tips," it supplies innumerable and invaluable hints on fuel handling and rocket firing, information based upon years of experimental work with small and large units. Also, this and other Army headquarters are anxious to help in the formation of rocket clubs for amateur rocketeers. They cooperate with these clubs in making launching facilities available as well as advice and information. If you are interested, and we urge you to join or form such a group, contact local Army headquarters, or First Army.

The Electronic Brain

Have you a question about anything electronic? Send it in and our ELECTRONIC BRAIN will provide an answer. If the question is of general interest, it may be printed in a future issue.

I have a five-tube radio using these tubes: 50C5, 12BA6, 12AT6, 35W4, and 12BE6. Can you provide me with a diagram showing how I can connect a phono cable to the set so that I may use it as an amplifier?

Prosper Toups,
Baton Rouge, Louisiana



The sketch shown here illustrates the desired connections and includes a toggle switch to permit the use of either the radio or the phono playback. To minimize hum and noise, use shielded wire where indicated and be sure to ground the shield to the B— of the receiver. A crystal cartridge is called for in this circuit. If you want to use another type, as for example a magnetic pickup, it would be necessary to purchase a matching transformer. This procedure is not advised. Most small phono-playbacks utilize high-output crystal cartridges that are ideal for the circuit shown.

After repairing electric irons and other appliances, I sometimes feel that the appliance does not have the true wattage. I would appreciate it if you could tell me how I can make a simple tester for wattage.

Michael Morgans, Brooklyn, N. Y.

The least expensive way to measure the wattage dissipated by a purely resistive device such as an electric flat-iron or a toaster is to determine the current flowing through it with a known line voltage applied. Assuming that your line voltage is constant at about 115 volts, an AC ammeter connected in series with the line cord and appliance will provide the current reading required. The wattage is then obtained by multiplying the line voltage in volts by the appliance current in amperes. To handle a wide variety of appliances, a 0-10 ampere meter would be good.

Inductive devices such as electric motors in vacuum cleaners and the like cannot be handled in this manner. To measure wattage in such cases, it would be best to purchase a wattmeter. This instrument takes power factor into account—a necessary step for precise determinations of power in reactive circuits. This can be done without a wattmeter but the method involves tedious calculations.

Paul Braca of the Bronx, N. Y. has written in suggesting an improvement in the hookup of the switch in the article "A Power Pack for HO Trains," in the May issue on page 70. He suggests rightly that the ammeter should be connected in the plus lead going to the switch (between the switch and rectifier). In this way, the ammeter will not be driven off scale when the switch is reversed. Thanks Paul.

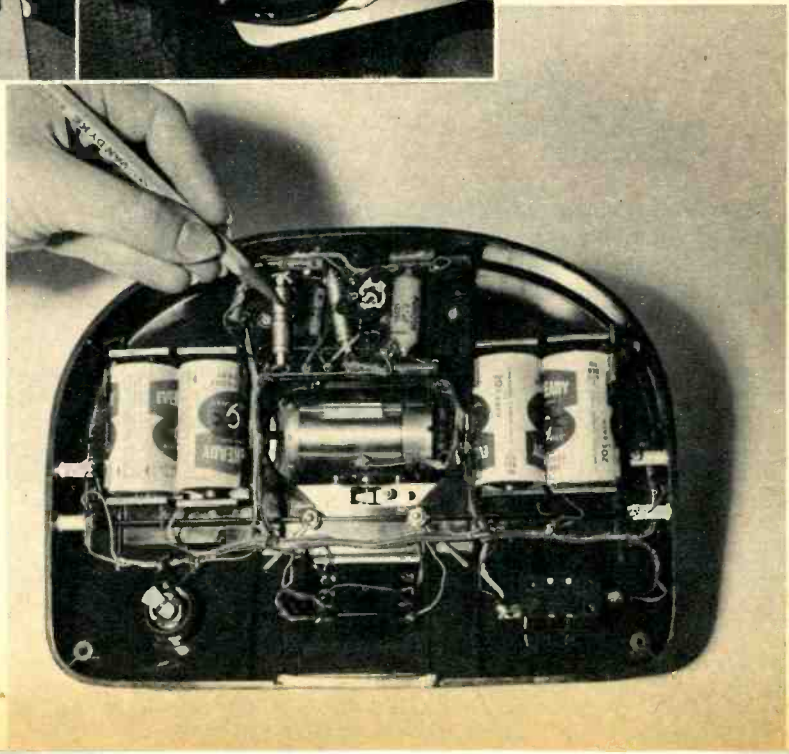
$30 Tape Recorder

YOU can have hours of fun, and save hours at work or school, with the Teltape, a completely portable, battery operated, transistorized tape recorder.

The ingenious mounting of the small motor, which performs without gears, belts or pulleys, provides forward and reverse winding and instant braking action to prevent tape spill-over. Continuously variable tape speed is controlled by a small rheostat connected between the drive motor and its batteries. Standard ¼" magnetic tape is used on two 3" reels supplied with the machine. Among the available accessories is a patch cord enabling you to play recordings through any TV audio system or hi-fi outfit equipped with an input jack. Another cord allows recording directly from your phonograph or speaker.

The Teltape is being imported from West Germany by Filnor Products, Inc., 101 West 31 Street, New York, N. Y., and sells for $29.95.

Housed in a small durable plastic case, the machine weighs 2 lbs., can easily be carried in a briefcase. Pair of earphones and crystal hand mike (far left) are included in the low price.



4 standard "C" batteries supply total power and will normally last 16 hours. In the open view of the recorder's mechanism, note the two-transistor audio amplifier and the drive motor between batteries.

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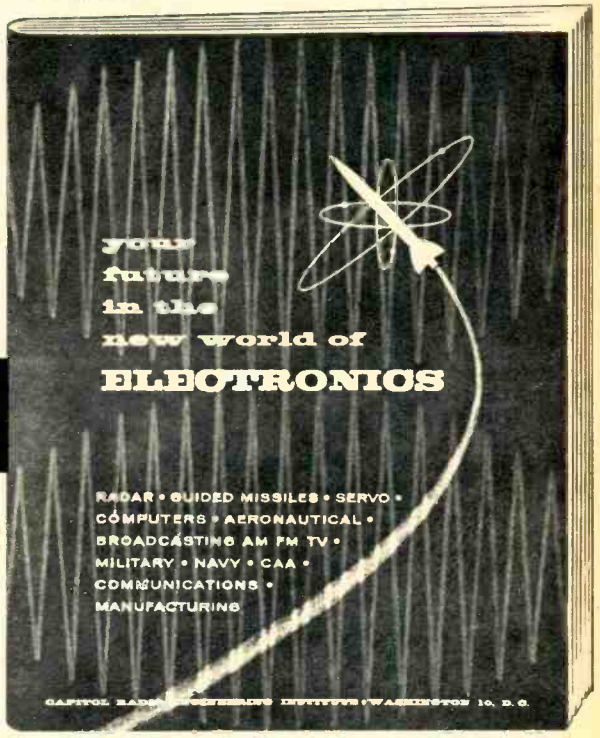

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Jobs in Electronics

Continued from page 37

Now, what about those black-and-white employment statistics in electronics? These are difficult to pin down. Electronics is still such a relatively new industry that officials who count noses among the unemployed do not have a category for electronics employment. When noses are counted among the unemployed, electronics workers are lumped together under the catch-all category of "electrical machinery" workers.

Still, if you dig deep enough, you can come up with some rather revealing indicators.

We know, for instance, that a huge proportion of those employed in electronics are classified as "skilled and professional" workers—either engineers, scientists, technicians, or skilled craftsmen. Thus, instead of running for cover when we see the statistics "6,000,000-unemployed," we should ask *who* were unemployed. Then we find out a striking series of facts:

- The greatest number listed among the unemployed were unskilled or semi-skilled workers. Nearly 25 per cent of them were laid off during the recession.
- In contrast, only about 6 per cent of the skilled workers and technicians were unemployed—and most of them were either in the auto, steel, construction, lumber, rubber and glass industries. Virtually none from the "electrical machinery" industry, which includes electronics.
- The smallest number of unemployed were in the ranks of the professionals, in which category we find our electronics engineers and scientists. Only 2 per cent of this group were out of work—and there is absolutely no evidence anywhere that electronics professionals were hit by the recession.

Skilled computer operator sets up a problem.

However, I went even one step further and took a look at one of the most important but least-known indicators of who's who among the unemployed—the "clearance figures" compiled by the Bureau of Employment Security in Washington. "Clearance figures" are nothing more than inventories of job openings. Whenever the state employment service of one state receives more orders for jobs than there are men available for these jobs, these orders become "job openings" which are "cleared" through central headquarters in Washington. Hence, we can always tell which occupations are in greatest demand in which states.

If the clearance figures for a particular occupation go down steadily, you can be sure a slump is hitting that group of workers. Conversely, if the clearance figures remain active or continue to stay up, workers in that category are still in great demand and not affected by economic setbacks.

In checking the clearance figures for the worst months of the 1958 recession, I found that the highest clearance status was for the category of "electrical engineers," the official category for electronics in employment statistics. Employment offices during these peak recession months had job openings for more than 840 electrical engineers in 37 different states.

To put it another way, according to one official report I saw, during these recession months "reductions in demand were noted for all categories of professional engineers, *except electrical.*"

Translating these figures into plain language, the brutal truth is that all three recessions since the end of WWII, especially the 1957-58 setback, were recessions of the unskilled, the semi-skilled, or the untrained and the unprepared.

But now you ask, "What about all that talk of 'unemployed engineers' in all fields, including electronics, after the defense cutbacks in aircraft, which began in August, 1957?"

I put the question to another top official who ought to know, William T. Cavanaugh, executive secretary of the Engineering Manpower Commission. He replied:

"The impact on defense contract cancellation cutbacks has been grossly overstated. We have been impressed by the real stability of engineering and employment, in spite of defense cutbacks and the economic slump. This is definitely true of electronics."

But the picture is not all peaches-and-cream for the entire electronics industry. A minor—but not unexpected—slump did hit some segments of the industry that caters largely to consumer electronics. Thus, there were layoffs at some plants producing such things as radio and TV components. But even among these plants virtually all the laid-off personnel were unskilled or semi-skilled production workers (many of them women) who were merely trained to do specific, mass-production tasks on the assembly line.

Even so, the experts quickly point out, the slack was substantially taken up by zooming sales in hi-fi and mobile radio equipment.

What does all this add up to? Simple. *Jobs in electronics are the most recession proof! And electronics, as an industry, is the most recession proof of this age!*

Now, how and where do you fit into this picture?

The answer depends on your personal plans: Are you, for example, an engineer or skilled worker in some other industry, eager to switch to electronics? Are you now working in electronics, but anxious to improve your status, maybe to go from research or production into top-management or sales and distribution? Are you a student faced with the choice of a future? Are you an untrained worker who'd like to get ahead in electronics but can't afford, or can't take the time, to pick up a technical education?

Whatever your problem or goal, one

Electronic engineers "flight test" a new plane.

or more of the following sources should be of great assistance to you:

1. *Electronics Industry Association:* 1721 DeSales St., NW, Washington 6, D. C. This is the industry-wide association and a key source for a variety of information and guidance.

2. *Engineers Joint Council, and Engineers Council of Professional Development:* both at 29 West 39th St., N.Y. 18, N.Y. Between these two groups you can get information and guidance about careers in professional-level electronics, about schools and education, and whether certain schools (technical as well as college) are giving *accredited* courses in electronics. Officials here point out that there is really no such thing as an "electronics" college degree. Nearly all electronics professionals are those with degrees in "electrical engineering" but with a heavy background of courses in electronics.

3. *U. S. Bureau of Apprenticeship and Training:* Washington 25, D. C. You can get information here about opportunities in registered electronics apprenticeships and on-the-job training programs in electronics industries. (To aid those who may want step-by-step guidance, I have written a book, "Apprenticeships in America," published April, 1958, by W. W. Norton & Co., 55 Fifth Ave., which by now is perhaps available in most libraries.)

4. *National Association of Manufacturers:* 2 East 48th St., N. Y. 17, N. Y.

Skilled technicians work on transistor circuits.

Since 1949, the NAM has had an Education Department which has aided tens of thousands of Americans in obtaining accurate guidance and information about industry and careers. Of particular interest to electronic-minded careerists is the NAM's free booklet, "Your Opportunities in Industry as a Technician."

5. *U. S. Government Printing Office:* Division of Public Documents, Washington 25, D. C. Made available recently here are two vital bulletins, which perhaps contain the most important and most accurate information ever compiled about the future of electronics. For ten cents, you can order: *Bureau of Labor Statistics Bulletin No. 1215-56,"Employment Outlook for Electronic Technicians."* For fifteen cents, you can get: *Bureau of Labor Statistics Bulletin No. 1215-19, "Employment Outlook in Electronics Manufacturing Occupations."* Nobody in electronics now, or contemplating entering electronics, should be without either of these bulletins.

Where you go from here—and how fast you advance in electronics—is up to you. But keep in mind that different phases of the electronics industry may grow more rapidly than others. Generally, experts consider the electronics industry to be divided into seven different categories: defense electronics; consumer products; industrial electronics; components; distribution; broadcasting; service and maintenance.

Defense electronics (sales, $3.9 billion) is by far the busiest and most important segment of the industry—for the time being. Many experts predict that industrial electronics—for automatic packaging, inspection, measurements and controls—will be the mainstay of the electronics future.

According to ELECTRONIC NEWS, the industry's only weekly newspaper, and perhaps the most influential trade publication in the field, "industrial uses of electronics continued to gain in 1957, with factory sales at $1.3 billion, compared with $950 million in 1956, and with further growth indicated during 1958." In contrast, between 1950 and 1957 home-entertainment electronics products slid from 58 to 21 per cent of electronic factory sales.

So which segment of the industry you choose for your future has a vital bearing on your rate of advancement, and your relative recession-proof status. But in such a fast-moving industry, you can't be sure of yourself unless you seek the best possible advice and keep right on top of the news and developments. It's a good idea, therefore, to keep posted by reading as many of the industry's trade publications as you can. Any librarian can help you obtain them.

Most experts agree that the best job and business opportunities lie in those electronics establishments which are diversified. In other words, a one-product company, especially one that relies solely on defense business, could go out of business overnight. While this may not mean that you will be unemployed in electronics, it could mean a temporary loss of income between jobs —but more important, it might also mean a tremendous waste of time invested in trying to get ahead in one company.

All the experts I queried agreed that the best employment opportunities, for stability and rapid advancement, lie with companies whose electronics business is divided between products for defense, industry and consumers, but with emphasis on defense and industrial electronics.

If you're looking for an absolute guarantee that your future in electronics is recession-proof, you won't find it. There's no such animal in the American economy. But if you want to stick with an industry that is galloping headlong into the future, leaving recessions furlongs behind, stay in the electronics saddle

All Band Receiver Kit

Continued from page 47

this kit is the printed-wiring band switch, an ingenious three-section assembly whose end lugs merely slip into designated holes on the R.F. printed wiring board. The switch sits on the underside of the board and its lugs are soldered to the top automatically completing all necessary connections.

After assembly, the two printed boards are fastened in large cutouts in the heavy chassis, and cross-connected to each other and to the power transformer, the filter choke and the audio output transformer. The three latter units are mounted on the chassis proper.

As a kit project, the receiver obviously represents a huge amount of thought and planning. The parts drop into place smoothly. The few required wires are pre-cut to the correct length. The only tools required are a screwdriver, long nose and side-cutting pliers, a ¼" nut driver, and a soldering iron. The instruction book and the progressive working drawings, on which the success of any kit depends entirely, are very well prepared.

All this sounds grand, but don't get the idea that this is a quick one-night exercise on the kitchen table. It can't be, in view of the need to identify, install, solder and double-check some 64 capacitors, 54 resistors, 16 coils, 5 transformers, 4 switches and numerous incidental fixtures. There's also the matter of alignment, which we'll reach in a moment. The nut-and-bolt work is easy, but the soldering takes patience and good eyesight. The printed lines are quite close, and runaway solder can cause some beautiful short circuits. In the writer's opinion, this receiver should not be tackled by a rank beginner, but only by a builder with at least one previous kit to his credit. An ideal "first" kit is a volt-ohmmeter or vacuum tube voltmeter, the most useful of all electronic test tools, which will be needed anyway for checking and aligning the finished set.

The instruction book makes no bones about the desirability of a signal generator and a meter for aligning the receiver. An alternate method of alignment "off the air" is given, but one must be very naive to think that it can be satisfactory. With 29 different alignment adjustments to make, some of them interlocking, you must have the right equipment or the $105 investment in the kit is wasted.

There was a time when signal generators were expensive and scarce. Today, however, excellent low-priced instruments can be had in kit or assembled form.

The trial receiver produced weak signals on the broadcast band the first time it was hooked up, showing that the circuits were at least unbroken. Only one faint signal could be heard on the top short-wave band, and the writer nearly fell out of his chair when it turned out to be Radio Moscow. Careful alignment with a signal generator and a VTVM soon made the set jump with activity. The I.F. transformer slugs and the oscillator trimmers required considerable adjustment; the various R.F. coils somewhat less.

The broadcast band could be calibrated accurately and easily, since numerous strong stations of known frequency were within easy range. The short-wave bands were checked against the signal generator markings and double-checked against the standard frequency signals of station WWV. As is usual in receivers of wide frequency spread, some slight compromise was necessary in calibrating the upper and lower ends of the three short-wave scales. If the trimmers were set to make the dial read correctly at one end, it was off a bit at the other, and vice versa. The effect is entirely unimportant if the Knight-Kit crystal calibrator is added in the space provided for it on the underside of the chassis. This unit furnishes marker beeps 100 kilocycles apart. You'll be glad you spent the extra $10.50 for it when you go on the air with a transmitter; it will tell you how close you can work to the edges of a band without inviting a reprimand from the FCC.

From unpacking the kit to turning off the signal generator after the last alignment step, the Knight-Kit receiver took this builder a total of 20 hours in six sittings. It was a very interesting and rewarding undertaking.

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Thermo-Trolled Sub

Continued from page 52

long. The holes to receive the glands may seem to present a problem but this is not so. Square off one end of the tubing and sharpen the OD to the likeness of a knife. Mark two lines on the separated hull at the angle shown on the drawing and, starting from the stern, force the tube into the hull rotating at the same time. Check the progress of entry to insure a hole true with the scribe line on the parted hull. Should the hole walk off, proceed from the beginning again and patch up the first attempt after the second has been successful. Both ends of the glands receive phenolic bushings which are slip-fitted. Then place both tubes in the hull with a bushing fastened to the stern end of each gland and secure with waterproof cement.

Using $\frac{3}{16}$-in. sheet balsa, lay out the stabilizer halves while the above assembly is permitted to dry. Groove the halves in the area of the tubing and cement in place. To insure a faired joint, fill in with balsa wood filler. The upper and lower balsa fins can also be installed at this time. Bring these surfaces to a smooth, streamlined cross section.

The moving controls are fashioned from $\frac{1}{8}$- or $\frac{3}{16}$-in. diameter brass rod and 1/32-in. sheet brass. Whatever the choice rod, be certain it fits snug into the holes drilled for the installation. When the brass surfaces are shaped, solder them to one half of the joining member and press fit into position in the hull. Finish soldering the other half of the unit. This procedure applies to the diving planes and rudders as well.

Complete the bulk of the hull by installing the block balsa tower. When it is secured in place, drill the ¼-in. holes for the tower details and switch rods as indicated in the drawings. After completing this addition the hull is ready for painting. Prior to painting, scan the hull for nicks or pits and patch properly.

The color scheme is battleship gray above the water line and dark green below. Complete the gray work first then mask off and apply the green below the water line. It should be mentioned that the hull is bolted together for the lacquering operation. Once dried, paint in all the hull details and install the proper numeral decals. When these have dried sufficiently, install the prop shafts and twin screws, packing the glands (not too tightly) with cotton soaked in machine oil and fitting in the forward bushings. The soaked cotton is excellent for a water resistant packing. Both screws should then turn by hand with a light drag. Set the hull aside.

The final stage of building comes with the construction of the electrical trays. The modeler has a choice of one or both. In any event, the trays are built up from ¼-in. hardwood sheet. For surface running, a Pittman No. 9002 motor is installed using three 1½-v Burgess batteries. For submerging, a Distler or Aristo Craft Electric motor is installed with four 3-v Burgess batteries along with an Amperite relay.

Since two methods of running the Nautilus are presented, we feel reasonably certain that the intrepid modeler will choose the submerging as opposed to the surface running design. The reasons are obvious, the modeler will have far more to show for his hours of toil.

The physical make-up of the electronic assembly are: a master leaf switch operated through the conning tower; Distler motor; Amphenol 8-8 socket; 4, 3 volt No. 2Z2P1 Burgess batteries in series; standard push-back hook up wire and of course the Amperite Thermostatic delay relay. Hook up the components as illustrated in the second plate of plans. Note the pin positions in the Amphenol socket. For bench testing remove the assembled tray by disconnecting the plastic tubes that couple to the propeller shafts.

In reality, the miniature relay, hermetically sealed under glass is nothing more than a second switch placed in the circuit with closed contacts, to be opened by its built-in heating element. The normally closed relay was chosen to permit a long motor run prior to the heating element breaking the circuit. As it is, the circuit remains open for a number of seconds (app. 15) in this period of time, cooling has set in and the relay will return to its normal position, closed.

With the above components wired in series and bench tested, the sub opera-

tion should be something like this. Both fore and aft diving planes are pre-set in diving position (about 30 degrees down angle), the master leaf switch is closed. At this instant the Distler drive motor comes into play actuating the twin screws, also, the heating element in the Amperite relay is drawing sufficiently to soon begin its function. Meanwhile the boat merrily chops along in a partly submerged condition. After about a minute of this, the relay has heated sufficiently to open the circuit, killing the motor at which point the partly submerged sub begins to surface. After a lapse of some 15 seconds, the cycle is repeated and again the boat is on its way. A good point to remember is to set a course that will return the boat to its original launching point.

The twin screws are coupled with the motor through a flywheel and drive pulleys. The bearing blocks are Micarta sheet with a ⅛-in. shaft hole. A ⅛-in. diameter spring belt is used for the final drive at a one to one ratio. A piece of 3/32-in. diameter plastic tubing couples the drive shafts to the pulley shafts proper.

At this point the sub is ballasted by floating it in a body of water, a bath tub being adequate. Bear in mind that each installation will require a different quantity of lead shot ballast. The free running version will require less since the electrical components weigh more in the submerging version. Our model required four pounds for submerging and two pounds for surface running.

Installing the hanger and missile ramp will complete the sub in its entirety. The manually operated controls should receive a drop or two of oil at each pivot point for ease of movement. There is no need for a tether since most any diameter circle is possible by presetting the rudder. During operation, the diving planes should be set to such an angle that the tower does not submerge entirely. This adjustment is accomplished by the trial and error method.

Full scale plans for this model sub are available. Send 50 cents to ELECTRONICS ILLUSTRATED Plans Service, Fawcett Building, Greenwich, Conn., for plan M-241.

What Goes Into A Kit

Continued from page 55

The kit is packed. This may involve from five people to twenty or more depending on the kit.

Labeling and preparing the kit for shipment. The Heath plant contains a Post Office branch.

If the finished Preamp doesn't work, the service department stands ready to lend a hand.

Continued from page 79

components are connected so that all of the electron flow must pass through all of the devices.

In the parallel circuit, all of the devices are connected directly to the source of e.m.f., so that the current has a number of paths through which it can pass. The total current flowing in and out of the source is the sum of the several currents through each of the paths.

To solve Ohm's Law problems, we have to know the total resistance of any given combination of devices. In the case of series circuits, it's easy. The total resistance is simply the sum of each of the individual resistances.

As an example, consider Fig. 1, where five resistors are connected in series. The total resistance is the sum of each unit resistance, as shown. Then the current is easily calculated in conventional Ohm's Law fashion.

Calculation of equivalent resistance in parallel circuits is a little more complex. Consider Fig. 2, in which we see five resistances connected in parallel across a source e.m.f. of 10,000 volts. If we ignore the resistance of the connecting wire, which is negligible, we see that the same voltage from the 10,000-volt supply appears across each resistor.

The total current from the generator I_t, which also passes through the meter, will split five ways through the resistance network, and the amount through any given resistor will depend upon its own ohmic value. Conversely, the branch currents I_1 through I_5 will add up to I_t.

Now to find each of these branch currents, we use Ohm's Law and divide the applied voltage by the individual resistance. And since the total current is the sum of the individual currents, we see that $I_t = E/R_1 + E/R_2 + E/R_3 + E/R_4 + E/R_5$. In this case $I_t = 7.25$ amperes. Then to find the total resistance of the group, $R = 10{,}000/7.25 = 1{,}380$ ohms.

This is an awkward way to find the total resistance, however, having to calculate all of the currents first. But it does show us the way to derive a formula for it without going through the intermediate steps.

Referring to the formula for I_t, we see that the same value E appears in the numerator of each fraction. Simplifying the quantity by dividing through by E, we get $I_t = E(1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 + 1/R_5)$. Then if we substitute this quantity for I in the Ohm's Law formula, the result is

$$R = \frac{E}{E(1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 + 1/R_5)} = \frac{1}{(1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 + 1/R_5)}$$

Well, it's still a monster, but that's about the best we can do. So let's try it out on the circuit of Fig. 2, to see if we get the same answer as before:

$$R = \frac{1}{1/5{,}000 + 1/10{,}000 + 1/4{,}000 + 1/20{,}000 + 1/8{,}000} = \frac{1}{8/40{,}000 + 4/40{,}000 + 10/40{,}000 + 2/40{,}000 + 5/40{,}000}$$
$$= 1 \div 29/40{,}000$$
$$= 1 \times 40{,}000/29$$
$$= 1{,}380 \text{ ohms}$$

It worked! Unwieldy as it is, this is the formula you'll need for most parallel resistance calculations. There are a couple of special cases, however, where shortcuts may be used. When several resistors *of the same value* are connected in parallel, the total resistance equals the value of one resistor divided by the number of resistors.

Where only two resistors are connected in parallel, the effective resistance can be found by dividing the product of the two by the sum of the two. That is, $R = (R_1 \times R_2)/(R_1 + R_2)$. For example, resistors of 50 and 75 ohms in parallel would have $R = (50 \times 75)/(50 + 75) = 30$ ohms.

A combination of resistances in series-parallel is fairly easy to solve as long as you remember that each individual group of series and parallel resistances can be broken down to one equivalent resistance by the methods just shown. A problem of this type is shown in Fig. 3.

Each step in reducing the complex combination to an equivalent resistance is shown, but the values are given only for the individual components at the beginning. You can do it if you proceed slowly, step-by-step. Give it a try, and look for the answer and an explanation here next month.

Geiger Counter

Continued from page 73

After the power supply has been tested, complete the remainder of the wiring. The 4-volt mercury battery is held in a battery holder, transistors TR2 and TR3 are self-supporting by their leads which are soldered to flea clips, TR4 plugs into a 9-pin miniature socket and the tiny speaker is fastened to the bakelite board by means of two small brackets made of scrap aluminum. The Geiger-Muller tube is held above the bakelite subchassis by a wrap-around bracket fashioned from thin roof-gutter aluminum; placed about 1½ inches above the base sheet and very close to the end of the sheet, the radiation tube will therefore be very close to one end of the box. This is the end in which a rectangular hole measuring 1" x 4" is cut. A scrap piece of the same perforated bakelite is then cemented to the inside of the box with household glue or quick-drying cement, thus providing a non-metallic window through which alpha and beta particles, and gamma radiations can easily pass. Connection is made to the aluminum casing of the G-M tube through the supporting bracket and to the insulated cap by means of a wire wrapped around the latter; the wrap is then firmly secured by a short piece of spaghetti tubing slipped over the cap and wire both. Good contact to the collectors of both power transistors (the outer casing for these types) is made by passing short 6/32 machine screws through either hole with a solder lug between the nut and the casing.

To test the counter and amplifier circuits, be sure, first of all, *that you have not reversed battery connections or transistor leads.* One mistake here will cause the loss of one or more transistors! With R2 fully counterclockwise, turn on the power and slowly advance the setting of this control in a clockwise direction. (This instruction applies to the power supply testing procedure in which a VTVM was not used. If the power supply voltage has been set at 900 volts by VTVM, the potentiometer is not to be touched at this point.) At some setting of R2, clicks will be heard issuing from the speaker; these should be clean and without "hash" sounds. If R2 is advanced too far, the clicks will become very rapid and hashy. When R2 is properly set, you should get an average of approximately 50 clicks per minute without radioactive material near the counter. Once this has been established, bring a radium-dial watch or clock near the counter tube. At about 6 inches, the clicks should rattle out quite rapidly.

The kind of headphones used for close listening is very important. I found, after testing four different pairs, that the best results were obtained with a pair of 1,000 ohm magnetics.

Circuit Operation

Power Supply—Transistor TR 1, T1, R1, and R2 together with the battery B1 form a blocking oscillator in which the frequency is determined largely by the inductance of the secondary of T1 and the distributed capacitance of the circuit. In normal operation, the frequency is about 400 cycles per second. Since T1 is used in reverse (i.e., its 6.3 volt winding acts as the primary and the 117 volt winding as the secondary), it might at first be thought that the extremely high voltage obtained in this circuit is the result of simple transformer step-up action. *This is not the case!* Since the transformer has a turns ratio of about 20:1 in this connection, we could not expect to get more than about 30 volts on a pure step-up basis. The answer lies in the waveform of the oscillatory voltage. Blocking oscillators provide a waveform having an extremely fast decay time. The very rapid collapse of the magnetic field causes a high self-induced voltage across the 117 volt winding. The slower rise time of the waveform produces a much lower voltage; thus, reversing the secondary leads in their connection to the rectifier results in insufficient potential to operate the counter. After rectification by SR, much of the audio-frequency ripple is removed by the filter network consisting of R3, C1 and C2.

Amplifier and Counter—The circuit consisting of the G-M tube, R4, and the base-emitter circuit of TR2 is an open one as long as the gas in the counter tube is not ionized. Cosmic rays, radioactive particles or emanations reaching the tube cause a very abrupt ionization in the tube chamber, permitting a small current to flow for about 50 microseconds. This surge passes through the base-emitter circuit of TR 2 and is amplified in the collector circuit. TR2 and TR3 are connected in the complementary-symmetry configuration so that further amplification is obtained in the latter. The click-signal is then passed on to the power transistor TR4 through C3 which, in turn, is coupled to the loudspeaker through the output transformer T2.

Automatic Temperature Control

Continued from page 83

ment by placing the milliammeter in series with the relay coil and adjusting the tension for approximately 3 ma. pull-in current. The relay will then drop out in the vicinity of 2 ma.)

Once reliable operation of the relay has been established continue with the testing: note the position of the potentiometer knob where pull-in *just* takes place. (In this model, a decal scale was secured to the panel under the knob. Some kind of scale is required if you wish to calibrate the control with any degree of precision.) Now back off the knob in a clockwise direction until the indicator goes out and restore the setting to a point very close to the pull-in mark. Hold the glowing end of a cigarette about half-an-inch from the thermistor for a few seconds; the indicator should come on in response to this tiny increase in temperature. This test demonstrates that the control is performing properly to set off an alarm or a cooling system if the temperature rises above a pre-selected point.

To check the action as a frost alarm, plug the thermistor in at the remote end of a two wire cable long enough to reach inside the freezer compartment of your refrigerator and follow this procedure. With the thermistor still at room temperature and the indicator connected to the "COM" and "UP" terminals, adjust the potentiometer setting to the point where the indicator just goes out. Place the thermistor in the freezer and give the assembly enough time to reach the low temperature in the compartment (about five minutes). Some time during this period, the indicator will begin to glow showing that the relay has dropped out. Remove the thermistor from the box and allow it to come back to room temperature. When it does, the indicator will go out.

It is recommended that you make up a calibration chart on a card that can be fastened to the control case.

How It Works

A thermistor is a resistance with a high negative temperature coefficient. This means that its resistance diminishes substantially as its temperature rises and vice versa.

Consider first what happens as the temperature goes up. This causes the thermistor resistance to drop, allowing the emitter-to-base current of the transistor to increase. This small current change is amplified by the transistor so that the collector current rises sharply, pulling in the relay. As the thermistor cools, its resistance increases thus reducing the emitter-to-base current and, consequently, the collector current until the relay armature is released.

There is approximately a 30% difference between the pull-in current (3 ma.) and the drop-out current (2 ma.) of this relay after adjustment. Even with the current amplification available from the transistor, this difference causes a spread of several degrees between relay pull-in and drop-out. Thus, you should not expect to have the control turn on an alarm or other device *and* turn it off, too, unless the temperature changes over a range of at least five degrees or more.

The relay used in the control will handle up to 5 amperes on make and break at its contacts. This is the equivalent of approximately 500 watts. For larger currents than this, the control may be used to trigger an external heavy-duty relay.

One-Step Loudness Control

Continued from page 62

You can install this device whether or not you have a conventional loudness control in your present equipment.

The circuit has a two-position switch. In the "out" position the full volume of sound, as initially determined by your regular volume control, will be heard. When the switch is moved to the "in" position, the volume of sound will automatically be reduced by about 28 db (about 1/25th of its original intensity).

Since we intended to use our one-step loudness control between our separate preamplifier and basic amplifier, we mounted the few parts required in a readily available aluminum box. In wiring up the parts, use sleeving over component leads where necessary, to prevent shorting adjacent components.

This switch can be added to single-chassis preamp-amplifiers by disconnecting the lead presently wired to the arm (center terminal) of the volume control and connecting this wire to the input of the new circuit; the output goes to the volume control. The switch can be mounted on the front panel of your amplifier in any convenient spot. Normal precautions regarding lead length (keep them short) and hum fields (keep the circuit away from power transformers and other AC parts of the circuit) should be observed.

For those having a separate preamplifier and amplifier, connect a pin-to-pin shielded cable from the input of the control box to the output of your preamplifier. Another cable is then connected from the output of the "one step" to the input of your basic power amplifier. In this type of installation, the loudness circuit should be located within six feet of your basic power amplifier. It can be much further if desired.

If you wish to have somewhat less reduction in output when the control is used, simply arrange the output connection to be made at the junction of R1 and R2 instead of at the junction of R2 and R3. Suffice it to say some arrangement will provide a sure way to "switch over" to quiet listening, with full fidelity and even fuller appreciation by your neighbors.

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Hi-Fi In The Country

Continued from page 41

The more sophisticated (and costly) approach is to wrap the front in plastic grille cloth and add trim at top and bottom to cover the raw edge of the plywood. The grille cloth is available by the yard from electronic parts supply houses at a price of about $2.50. When using it, you should paint the front and edges of the enclosure with a flat black paint to prevent the dark speaker from showing through. The grille cloth should be tacked at one side, then stretched to the other side, first in the middle and worked toward the top and bottom.

The trim should match the top and may be held in place by glue and small finishing nails. After the finishing nails are set in and filled with plastic wood, finish may be applied. For a really fine appearance the top and trim should be made of birch or some other hardwood. (Add a few dollars more for those extras.)

If you plan to use a speaker that is deeper than the 5⅝-inch space between the front panel and the braces, you will have to leave one brace unglued so it can be removed to install or remove your speaker. Another possibility is that you may want to add a separate tweeter to improve the high frequency range of your original speaker. That can be easily done by cutting a place for it above the speaker opening, but if the tweeter opening is large enough to weaken the panel, better move it to one side. Also, if you're using the grille cloth treatment, don't forget to cut the tweeter opening before you have the grille in place and the trim glued over it. Of course the hole should be covered with a piece of wood until the tweeter is actually mounted.

A good quality 8-inch or 10-inch speaker may also be used with this baffle, but it's a good idea to cut the opening for a 12-inch speaker and use a reducing ring to mount the smaller speaker so that a 12-inch one can be substituted at any time.

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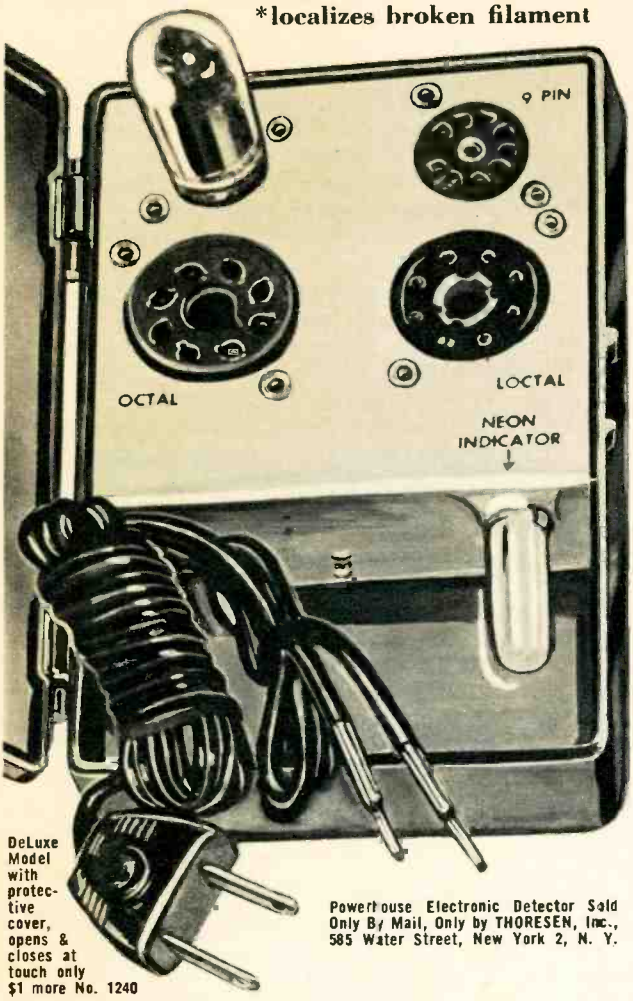

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are radiated from the back of the speaker cone. Fiberglas is often used for this purpose and is available in convenient sheets, but cotton batting works very well and is less expensive. The padding may be added to the walls of the room behind the baffle, on the inside of the baffle itself, or to all interior surfaces if your listening taste desires. Extra padding produces a sweeter sound and a smoother response, but some people think it causes a lack of brilliance.

With the speaker mounted, the padding in place, and your amplifier connected, you're ready to listen. You've saved some money, and you don't have to worry about vibration from the back panels; they're as solid as the walls of your home.

Electronics Blazes The Trail

Continued from page 53

operates these units, communicating with each other by 2-way radio. One operator packs the transmitter to a base line station being used as the starting point for a traverse line, and assembles the device on a tripod. The other man sets up the receiver at the "unknown" point previously set by a reconnaissance crew. By swinging the transmitter around the horizon and watching the strength of radar waves reflected from the receiver on an oscilloscope, the transmitter operator can quickly locate the receiver. Once contact is established the transmitter operator notes the time it takes for a microwave signal to travel to the receiver and back. Such readings are taken in one-thousand-millionths of a second, which can then be rapidly translated into miles and feet. The operator used a band of 20 frequencies, taking five to ten coarse and fine readings to insure accuracy. Temperature and atmospheric pressure, which affect the speed of the waves are measured and factored out, with the result that the probable error is only about one part in 300,000 on distances greater than 500 feet, or 11 inches in 40 miles. This is accuracy far beyond what is required for highway location work.

Continued from page 29

trons could have been knocked off by collision, scientists believe with a fair amount of certainty that neutrons were released in the pinched plasma through fusion.

The new U. S. Atomic Energy Commission's "stellarator" under construction plans to use "magnetic pumping" to achieve 100 million degree temperatures. This uses a rapidly pulsed magnetic field in one section of the toroid.

One of the big problems in getting and maintaining such high temperatures is in keeping the pinch from touching the "cold" walls of the torus. If the plasma touches the wall, it will lose heat rapidly, and no fusion will result. In order to keep the pinch as straight as possible, various methods have been used, but they principally add up to a magnetic field which is thrown around the plasma to keep it stable.

Another problem is that of sustaining the high heat. So far it has only been maintained for thousandths of a second, through the input of thousands of amperes of current discharged from huge banks of capacitors.

Another difficulty is that of getting out of fusion more energy than has been put in. At the temperatures reached up to this time, scientists have not *gained* energy, but have lost it. In other words, they have put far more power into it than they have detected coming out due to fusion. However, with higher temperatures, they expect to gain a net output which will be usable, and thus may make the process self sustaining.

One fascinating aspect of fusion power is that we may be able to get electrical power directly from the process. In other words, as the plasma pinch heats and expands, it would be used to cut the lines of force in the electromagnetic field surrounding it and induce a voltage which could be used directly as power, eliminating heat exchanges.

Perhaps it may be visionary, but we may soon be creating our own suns right here on Earth. At any rate, we seem to be on our way.

Check Your RPM's

Continued from page 65

one or the other direction. A shifting in the clockwise direction indicates that the speed is too fast; a counterclockwise movement of the bars or dots indicates that the speed of the turntable is less than 33⅓ rpm.

A very slow shift of the bars or dots is not important in terms of listening quality. However the markers should not shift more than 10 degrees in one second; if they do, consult the instruction manual for your record player or change for speed adjustments.

Two-Way Radio For All

Continued from page 58

Unlike the cheaper, portable AM sets which can be operated on one frequency only (465 mc), there is a wide choice of operating frequencies for the higher-powered, more expensive FM Citizens Radio units. At the present time, specific frequencies are not assigned to licensees who pick their own channels within the 460-470 megacycle band. Generally, the man who sells the equipment picks a frequency within the band not being used by someone else in the same area and orders the equipment supplied with appropriate crystals, which lock the transmitter and receiver to the desired frequency.

Citizens Band FM mobile radiotelephone equipment is available from several manufacturers including RCA, Kaar, General Electric, Motorola, Dumont and Link. Mobile units for installation in motor vehicles run from $500 to $800. Companion equipment for home base costs from $500 to $1500, depending upon range requirements and gadgetry.

You can buy and even install your own equipment, if you follow the published instructions provided by the manufacturer. In most cases the actual installation is made by the selling dealer or an authorized service representative. You cannot, however, service the transmitter portion of the equipment yourself unless you hold a first or second class radiotelephone license.

The Picnic Music Maker

Continued from page 33

teries making up the power supply in series to furnish 6 volts. Connect an additional lead from the frame (or housing) of the phono motor to the frame of the loudspeaker and, finally, to the chassis of the amplifier, bonding these three components together electrically.

As a final step, insert four flashlight batteries in the battery holders and close the ON-OFF switch (SW1), checking the rotation of the turntable. The turntable should rotate in a conventional clockwise direction. If it rotates "backwards" (counterclockwise), reverse the lead connections to the motor terminals.

In some instances, you may find that the turntable will not revolve when the switch is closed. Many currently available DC operated phono turntables have an "OFF" position for their speed selector lever. When the lever is in this position, pressure is removed from the turntable idler wheel, thus reducing any tendency for the idler to develop a flat spot. Therefore, if you find that the turntable does not rotate, check the position of this lever.

To complete the wiring of the phonograph, connect the shield of the pick-up arm's lead to the amplifier chassis and the central "hot" lead to R1. *Run this lead as far away from other wiring as you can.* The assembled board is then placed in the phonograph case.

You'll find that battery life will depend on how often you use the phonograph and on how many records you play at each session. Since the batteries are used only when the phonograph is in actual use, you'll find that under typical operating conditions, battery life will be long.

One further tip—the small battery motor is not very powerful. You'll find it best to stick to the smaller sized "popular" records, avoiding 10″ and 12″ discs.

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CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue
Dept. 407, Mineola, N. Y.

Please rush the new Model FC-2 FAST-CHECK TUBE TESTER for a 10 day trial period. If I am not completely satisfied I will return the instrument within 10 days without further obligation. If fully satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. No financing charges are to be added. Should I fail to make payment when due, the unpaid balance shall become due and payable at once.

☐ **BUDGET TERMS:** Pay $14.50 within 10 days after receipt of instrument. Balance $11.00 monthly for 5 months, plus shipping charges.

☐ **PREPAID TERMS:** Enclose $69.50 with coupon as payment in full and Century will pay all shipping costs. 10 day money-back guarantee.

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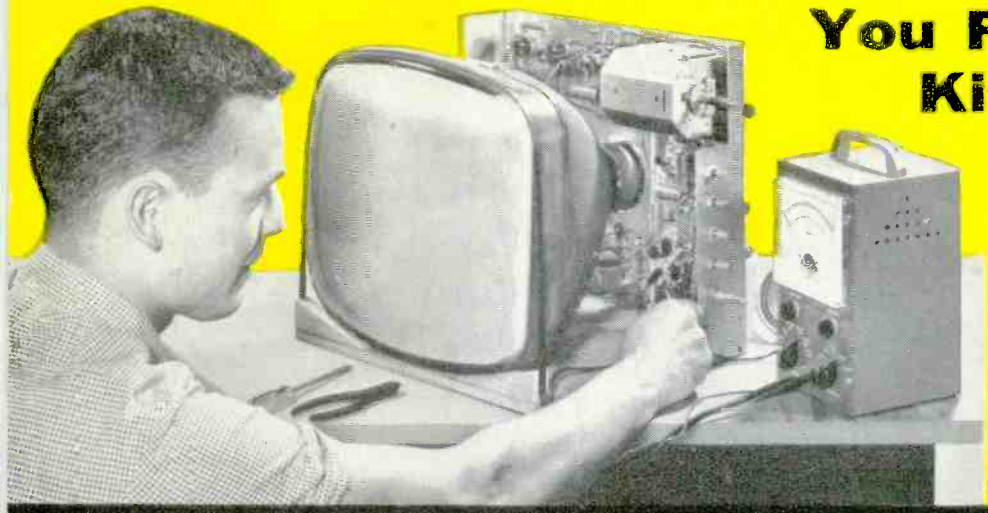

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Many NRI students find it easy and profitable to fix sets friends and neighbors starting a few months after enrolli Use the Tester built with parts NRI furnishes to locate correct Radio-TV receiver troubles. Picking up $10 $15 more a week gives substantial extra spending money. M who start in spare time soon build full time Radio-Televis sales and service businesses, enjoy prestige, respect and sa faction in this fast growing industry.

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Technical know-how brings better pay, fast advanceme Radio-TV-Electronic opportunities are great, and are incr ing. NRI has devoted over 40 years to developing simplif practical training methods. Mailing the card at right can one of the most important acts of your life. Do it now. Reas able tuition, on low monthly payments available. Let us s you an actual Lesson and 64 page Catalog— BOTH FREE. Address: NATIONAL RADIO INSTITUTE, Dept 8JK, Washington 16, D. C.

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the stereo space problem is solved...

with the ELECTRO-VOICE STEREON

matching Electro-Voice and all other high quality systems

Now, for the first time, you don't need two full-range speakers to enjoy the added third dimension of stereophonic sound . . . thanks to a new application by Electro-Voice engineers of a basic principle of acoustics. As early as 1934 it was verified that bass tones below 300 cps do not indicate the location of the sound source . . . therefore, these tones contribute no stereo effect. This is because the ear lacks the ability to qualify direction when sound wave-lengths reach 2½ feet or more between their pressure crests. The *entire* stereo effect relies upon the directional placement of sounds *above* this point. The second sound source in stereo, therefore, need only be a system designed specifically to reproduce that directional part of the audio spectrum above 300 cps. Based upon this fact, Electro-Voice engineers developed the STEREON, an uncompromised second channel loudspeaker to match even the largest bass producer . . . a compact, functional furniture piece allowing greatest placement flexibility for optimum stereo. The STEREON is designed to complement any full-range speaker by reproducing only those frequencies required for stereo, thus eliminating your need for a *second* expensive bulky enclosure.

HERE'S WHAT HAPPENS:

Low bass frequencies from *both* stereo channels are properly phased through the XX3 STEREON Control Filter and channeled into your present full-range speaker to utilize its full-bass reproduction capabilities; the mid-bass, treble and very high tones are fed, one channel to your full-range speaker, the other channel to the STEREON . . . to give you full dimensional stereo . . . inexpensively, compactly.

Stereo—the Electro-Voice STEREON way—gives the impact and true-to-life spaciousness of the original performance . . . puts you in the best seat in the house.

(In larger rooms, by the way, when you'll want stereo with the scope and magnitude of the latest movie processes . . . you add-on two additional STEREONS, placing them inconspicuously around the room. The two central STEREONS simply parallel each of the channels and are adjusted to a slightly lower level to make a smooth sound picture . . . providing directionality and full depth . . . the ultimate in stereo.)

Hear the remarkably versatile Electro-Voice STEREONS demonstrated at your Electro-Voice show room. After one listening you'll agree that STEREONS are THE answer to stereo in *your* home.

GO-ON TO STEREON...FOR SUPERLATIVE STEREO NOW...

For more complete information on the Stereon and other Electro-Voice ways to go Stereo, write for free booklet on choosing stereo equipment.

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Buchanan, Michigan

Foremost in Electro-Acoustics — *Hi-Fi Loudspeakers and Enclosures for STEREO. Microphones, Phono-Cartridges and Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.*

STEREO'S STANDARD

STEREON III—3-way system for use with high efficiency systems. Employs MT30 mid-bass coaxial assembly and T35 VHF driver, built into integral 200 cps taper rate horn. Integral crossover network limits overall input to signals above 300 cps crosses over electrically at 3500 cps to Model T35 VHF driver. Flat response ± 2 db 300 cps to 19,000 cps. Two AT37 level controls at rear provide overall level match to full range speaker system. Quality match assured by individual control of "Presence" and "Brilliance" control. Available in mahogany, walnut, and limed oak. Size: 25" high, 17½" deep, 7½" wide. Shipping weight: 37 lbs. Net. $129.50

STEREON 1A—Identical to Stereon III, for use with normal efficiency systems. Uses MT30B and T35B driver components. Shipping weight: 33 lbs. Net $99.50

XX3 STEREON CONTROL FILTER—For use with Electro-Voice Stereons. Uses matching transformer and crossover network components. All signal of 1st channel above 300 cps feeds Stereon; all signal below 300 cps from this channel is combined with full range output from second channel to utilize full bass reproduction capabilities of a single full range system. Input impedance from both amplifiers 8 ohms, output impedance 16 ohms naminal. Size: 5½" high, 4¾" wide, 5¼" deep. Shipping weight: 8 lbs. Net. $30.00

STEREO begins with the E-V totally compatible STEREO Cartridge—already the accepted standard.