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# ELECTRONICS ILLUSTRATED

December, 1960 Vol. 3, No. 12

A Fawcett Publication




**EI EXCLUSIVE**



**CHRISTMAS PROJECTS**



**OTHER PROJECTS**



**FEATURES**






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# An Open Letter to the FCC

Gentlemen:

Let's face it: The Citizens Radio Service is a mess. It was intended to fulfill a useful purpose..."private communications in connection with business or personal activities, limited to the minimum practicable transmission time"*...but quickly after its inception in September of 1958 it became a playground for a mob of undisciplined microphone maniacs. Using ham procedure but having nothing of the ham spirit, they fill the CB channels with long, inane and pointless conversations, in direct violation of FCC regulations and of the rules of common sense. The people who really need and use CB for business purposes have a tough time bucking the incessant chattering.

I know from personal observation that the problem is national in scope. During the summer of 1960 I monitored the CB bands for about six hours every day of a seven-week trip by car from New York to California and return, a total of more than 9,000 miles over non-duplicating routes. For a while my wife and I kept a time record of ham-type operation versus business traffic, but we gave this up after the first few days because the phony amateurs quite clearly were hogging all of the Class D channels.

Some CB operators talk knowingly of beam antennas, means of improving receiver sensitivity, microphone characteristics, etc. I suspect that more than a few of them use considerably more than the five watts prescribed by law. It must be sheer laziness that keeps these lads from obtaining amateur "tickets." Surely they must know that the numerous ham bands offer vastly greater opportunities for experimenting and long-distance communication than does the single CB band.

The CB channels should be kept as open as possible for mobile communication, CB's greatest field of application. For construction projects, local trucking, delivery and taxi services, auxiliary police, fire and civil defense organizations, and for emergency medical and repair services, intelligently used CB saves time, labor, fuel, tempers and lives. CB is on the right track when, for example, it enables a nurse in an office to relay an urgent call to a doctor in his car and gets him to an expectant mother in time to help, when it is used at a community sports event or when it permits small boat communications. It is on the wrong track when it permits untrained "operators" to monopolize valuable frequencies with juvenile drivel that belongs on the privacy of the land-line telephone, not on the public air.

In communities where there are numerous hobby-type CB stations, the interference they create can be very exasperating to dispatchers and drivers with real busi-

*FCC Rules, Part 19

ness to handle. These people don't mind standing by for a few minutes while another legitimate user of a channel gets his message across, but understandably they get mighty steamed up when they are forced to listen to long discussions of last night's dance or of Tommy's difficulty with his algebra homework. I heard one lady dispatcher for a fuel-oil firm forget momentarily that she was a lady, with good results. She was trying to re-route a truck, but her channel was kept busy by three gossipers. Finally she managed to get into the "net" herself, and then she blasted off.

"Listen, you birds, I've made a tape recording of your last five minutes of chatter, and I intend to send it to Washington as proof of improper use of the Citizen Band."

The silence that followed was wonderful to hear!

It is painfully evident that the Citizens Radio Service is top heavy with communications of the wrong kind. The FCC can and should get tough with present licensees who ignore the FCC rules, and cancel their tickets if necessary.

Respectfully yours,
Robert Hertzberg
2W4922/W2DJJ

*The above open letter to the FCC was written by Robert Hertzberg who is known to many of you as an honest popularizer of electronics and booster of amateur radio. We are in substantial agreement with his views and are publishing this letter in the hope that we may encourage the best use of the Citizens Radio Service and dissuade the FCC from considering more drastic measures such as the elimination of all personal communications from this band.*

Charles Tuttle

# ...electronics in the news

SPEECH SCRAMBLER FOR YOUR PHONE... wiretappers, extension eavesdroppers will be thwarted by this invention, designed to be used with ordinary telephone handsets...no direct connection needed. It turns speech into gibberish which an identical unit at the other end of the telephone line "unscrambles." Scramblers are sold only in matched pairs or sets that "understand" only each other's noises...units from other pairs won't work. Even a "bug microphone" hidden in the telephone mouthpiece is helpless, since the mouthpiece "hears" only the output of the scrambler....This device should become a "must" with businessmen and lawyers, and of course lovers and perhaps certain criminals. For the citizen, it is the first effective countermeasure we have seen against possible encroachment by "Big Brother," who may be watching you, all right, but would have trouble hearing you...."Delcon Security Telephone" was developed and is manufactured by The Delcon Corporation, 943 Industrial Avenue, Palo Alto, California. Price: $219. It is self-contained and battery powered....

• • • • •

"SIGNALS" FROM SATURN...Michigan University scientists report the first conclusive reception of radio noise from the yellow planet, using an 85-foot radiotelescope and ruby maser amplifier. Temperature, density of Saturn's famous rings will be studied....

• • • • •

ATOMIC POWER PACKAGE...developed by General Electric, this compact, lightweight nuclear energy source generates up to 30 kilowatts thermoelectrically: by direct conversion of heat into electricity. It has no moving parts. 30 kw is the equivalent of 40 horsepower: the little atomic powerhouse compares more than favorably with small car engines and other familiar compact power sources. "Modular" design may permit capacities up to 300 kw....Designed for use in satellites and manned space vehicles, it may eventually find ground jobs, too, though such are uneconomical now....The girl's name, fellows, is Toni Wahlen; that's all we know....

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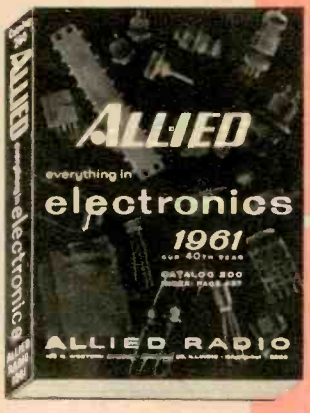


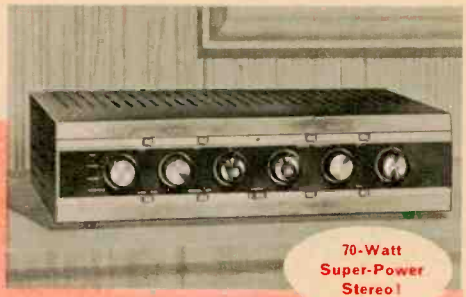

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# . . . News


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—o—

Village inventors, where are you? The space and missile race has produced highly useful "measures" and "countermeasures" by wild combinations of devices and techniques that would have been called "crazily impractical" a few years ago. We have a need, for instance, to detect unannounced satellites, as soon as possible after launching. Now Electro-Optical Systems, Inc., is working on a project for the Air Force which involves an all-sky telescope (spherical mirror, correction plates, etc.) carried about twenty miles up by balloon. What the telescope sees will be radioed to ground. This brings in a new form of television as well as telemetering. It is expected to detect unannounced satellites moments after launching, and start collecting tracking data on them at once. Thus a warminded nation would not be able to place nuclear bomb satellites in secret orbits. The world would know, and could apply sanctions and countermeasures. Watch for fuller details in an early issue of *Electronics Illustrated.*

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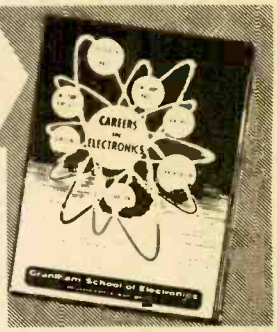


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# . . . News

Home Interphone, a telephone system which also permits communication from room to room, door answering from any phone, baby sitting and hands free talking, will be made available by the Bell Telephone System early in 1961. The new telephones will be equipped with a small speaker which can be positioned near the phone. To use the phone as an intercom, merely press a small button on the phone after the receiver has been lifted off its cradle. For door answering, the speaker is installed outside the door and callers may be questioned by using any phone. An initial charge for installation, and monthly service charges will be made.

—o—

Homewood Industries has announced their Model 7 speaker enclosure designed to accommodate any 2 or 3 way speaker system or an extended range single speaker. It is sold complete assembled in unfinished wood with acoustic damping material installed. Dimensions are 29″ high, 28″ wide and 16″ deep. Enclosure has adjustable port. $33.95 from 26 Court Street, Brooklyn, New York.

—o—

General Electric is now manufacturing two germanium tunnel diodes designed for use as circuit reference elements. The diodes, priced at $5.50 and $6.00 are designed to switch at specific current levels and are ultra stable over their entire temperature range.

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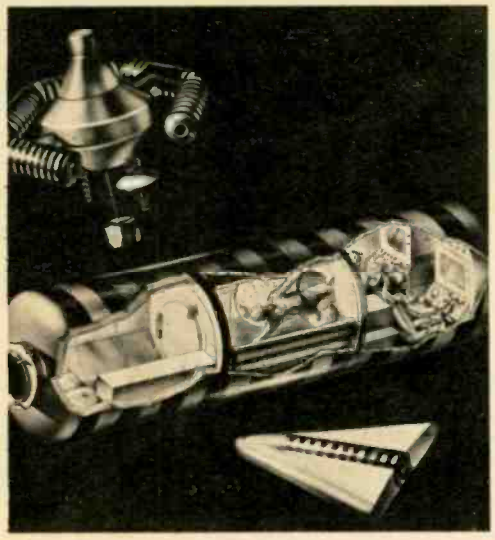
## . . .News



A team of scientists and engineers at the Aeronutronic Division of Ford Motor Company, Newport Beach, Calif., concerned with the development of a three-man orbiting space vehicle, has designed a stiffened cylindrical shell with double walls for the "ship's" primary structure. The "skins" could act as shields against solar and cosmic radiation. About 7x15 feet, the cylinder would be internally compartmented, so that a section punctured by a meteorite could be sealed off. One compartment would be a "storm cellar" completely shielded from radiation. Shells could be used to make up complex satellites, winged ships.

—o—

Jerrold has announced an addition to its line of mast-mounted "De-Snower" preamplifiers—the DSA-202. This unit comes complete with a remote power-supply which eliminates the hazard of running 110-volt AC power up to the preamplifier location. The all-band preamplifier is said to provide high quality reception of both TV and FM to fringe area homes. Complete information available from Jerrold, 15th and Lehigh Avenue, Philadelphia, Pennsylvania. Price is $79.95.

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

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

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

## THE KIT FOR EVERYONE

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

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

## PROGRESSIVE TEACHING METHOD

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

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

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

## THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a Hi 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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- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

## SERVICING LESSONS

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

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."

## PRINTED CIRCUITRY

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

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

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

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1186 Broadway, Dept. 531AE, Hewlett, N. Y.

# . . . News

Scientists in the picture are looking at the new "Astracon" image amplifier tube, which Westinghouse is now putting into production. It is said to be sensitive to single photons of light, which makes it just a little better than the dark-adapted human eye. It is expected to increase the sensitivity of astronomical telescopes many times over, and enable physicists to see light-trails of high-energy nuclear particles in luminescent crystals. It works on the familiar photo-multiplier principle, in which light energy striking a sensitive surface releases electrons which strike another surface, which in turn releases more electrons, and so on to the end of the multiplier chain. This is a method of "amplifying" light, and it lessens the need for extremely long photographic exposures to record extremely weak images of distant stars. It may help with the problem of photographing details on planets like Mars.

—o—

Model 10-10 "Space-Saver" 3" DC oscilloscope for wave form observation and voltage, frequency and phase shift measurements has been put on the test instrument market by Heath. The kit features vertical and horizontal DC-coupled amplifiers, external sync binding posts, external capacity binding post for sweep frequencies lower than 5 cps, transformer operated power supply and voltage regulated B+ and bias. Further specs are available from Heath in Benton Harbor, Michigan. Price is $79.95.


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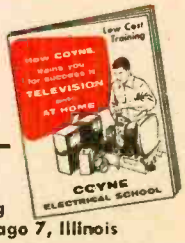


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# . . . News

## A Science is Born

A NEW SCIENCE, "BIONICS," has been quietly gestating in our midst, and was "delivered" and named recently at an Air Force-sponsored Symposium on Bionics. This can be defined as the design of machines through the study of living prototypes. Computers, for instance, will operate, internally, like living brains, rather than merely perform some brain functions. One instance of the application of "bionics" is the designing of a machine for overall reliability, rather than component reliability. A device would be designed as a *network,* in which individual component failures could be overlooked while the rest of the machine took over the functions of the faulty section. After all, in a living organism, it is not necessary for every cell and every organ to be functioning for the animal or plant to survive and cope with environmental demands, or be productive and reproductive. More than that, the way live organisms "do" things can be profitably copied by machines. A unique ground-speed indicator for airplanes has already been developed using "techniques" learned from the study of the eyes of beetles.

Bionics will engage the knowledge and talents of scientists from many fields: biologists, physicists, electronic engineers, chemists, etc. The new science was born of the "cross-fertilization" of ideas between the different fields.

# . . . News


A 9-transistor portable radio featuring 2 diodes, 2 IF stages, AVC amplifier, 4 audio stages including push-pull audio output and separate mixer and oscillator has been announced by Lafayette Radio. The radio uses Z cell batteries and is priced at $26.95 including leather carrying case, batteries and earphone. Lafayette is at 165-08 Liberty Avenue, Jamaica 33, New York.

—o—

The noisiest spot in Evanston, Illinois has been built by Shure Brothers. Inside a 6′ x 6′ room, engineers can produce the ear-shattering roar of a jet engine at 500 feet as well as a pure tone at 130 db which can cause pain in a human. The purpose of all this noise is to help develop and test special purpose microphones that can be used in, needless to say, noisy environments such as an intercom system in a factory, etc.

—o—

A six-transistor kit for use in portable transistor radios is under production by U.S. Transistor Corp. of Syosset, Long Island. The kit is priced at $2.75 which is below the cost of similar Japanese made units and is said to compare favorably with higher priced components. This is believed to be the first instance of a transistor manufacturer undercutting components made by Japanese firms.

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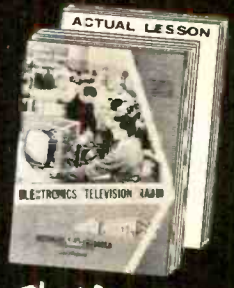


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## SUCCESS IS THEIRS; IT CAN BE YOURS TOO!

When I enrolled with N.T.S. last November, I was trained as a Seismograph Observer. I was promoted to that job on May 1st of this year. With your school and my practical work in the field, my superiors recognized that I was capable of handling the job of Seismograph Recording. My superiors highly praise your school. The day I enrolled started me off to success.

Edgar Wesatzke

Thanks to N.T.S. I have a business of my own right in my home. I am still in the Air Force but I have paid for all my equipment with money earned servicing TV sets. Yes, N.T.S. gave me my start in television.

Louis A. Tabat

As field director of Berean Mission Inc., I have complete charge of our radio work. With the expert advice and training I am receiving from you I can do my own repairs on our recorders and P.A. systems, besides keeping our radios going. My training from N.T.S. helps keep us on the air. I feel privileged to be a member of such a fine institution.

Rev. Enoch P. Sanford

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it has been going real good. I started part-time but I got so much work that I am doing it full-time. Thanks to National Technical Schools.

Alvin Spera

SEE OTHER SIDE

## ALL 8 PHASES IN ONE MASTER COURSE

**PHASE 1**
**TELEVISION INCLUDING COLOR TV**
90% of homes have at least one set. Color TV is becoming more popular daily. TV Stations grow in number, need technicians. Maintenance and repair offer big opportunities.

**PHASE 2**
**RADIO—AM & FM**
Radios in homes, cars, schools, all need expert upkeep. Stations expand as FM becomes popular. Now transistors boom entire field.

**PHASE 3**
**ELECTRONICS**
Computers, Data-Processing machines, Electronic Controls, Guided Missile Systems are new fields where Electronics play a vital role.

**PHASE 4**
**SOUND SYSTEMS**
New popularity of Hi-Fi-Stereo, as well as industrial sound systems and business intercoms make this a highly specialized and important field.

**PHASE 5**
**FCC LICENSE PREPARATION**
FCC License holders have a wide range of top jobs open to them. FCC License now a requirement for most Communication jobs.

**PHASE 6**
**RADAR AND MICROWAVES**
These are the communications systems of the future, already used in tracking and contacting satellites.

**PHASE 7**
**AUTOMATION & COMPUTERS**
Automation and Computer electronics are the new tools of industry and commerce. Skilled Technicians in these fields are in great demand at top pay.

**PHASE 8**
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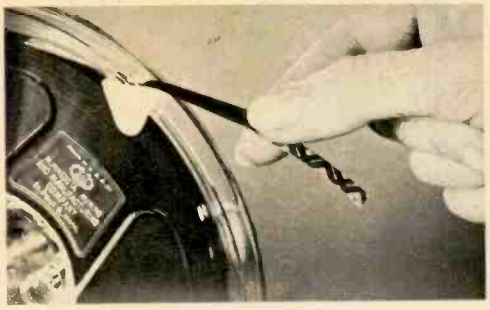


A plastic clip to hold down the end of a reel of recording tape and eliminate loose ends is available at 35¢ per package of ten. The "Scotch" Tape Clip fits between the flanges of the reel and is easily pulled out. At your dealer's. Minnesota Mining and Mfg. Co., St. Paul 6, Minn.

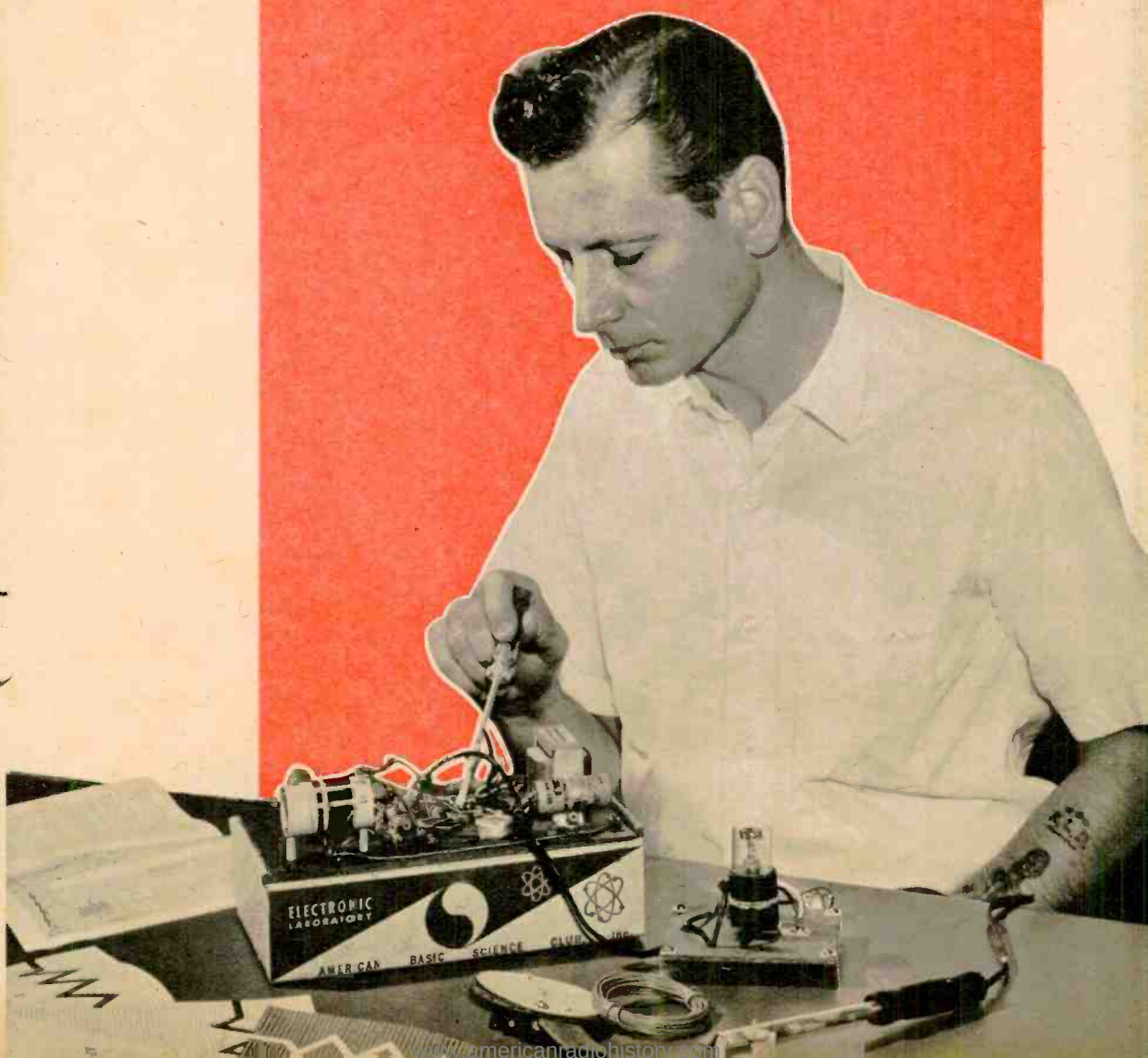
Your pockets, your bookshelves, and your kitchen shelf are cleared for other contents with a compact new wall radio by Toshiba. Uses two 3-inch speakers, seven transistors, is supplied with battery and mounting bracket. $69.95. Transistor World Corp., 52 Broadway, New York City.

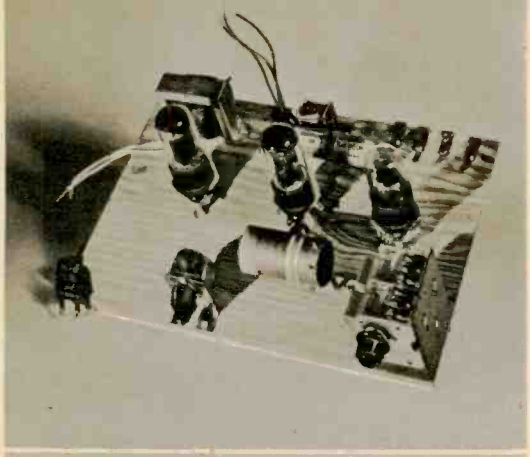
◀ See Page 24 for the BEST BUYS in CITIZENS TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS.

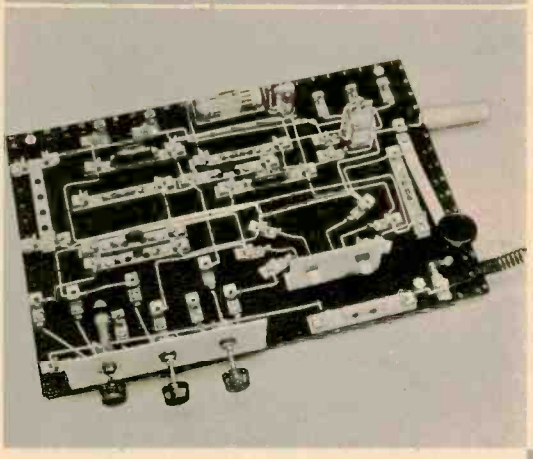
# Kits that Teach you Electronics

**Learn-by-yourself kits for yourself or for gifts: Good points and flaws evaluated by the *EI* staff.**

PRACTICALLY all electronics kits are supposed to teach you about electronics. As the ads usually put it, they are "educational." While this is true to a degree, almost all manufacturers of kits now recognize the need and the market for self-teaching "*laboratory*" kits. These are the "10-in-1" kits and their relatives. While up to a dozen or more gadgets can be built from each of these kits, in most cases the "end product" is secondary. Guided





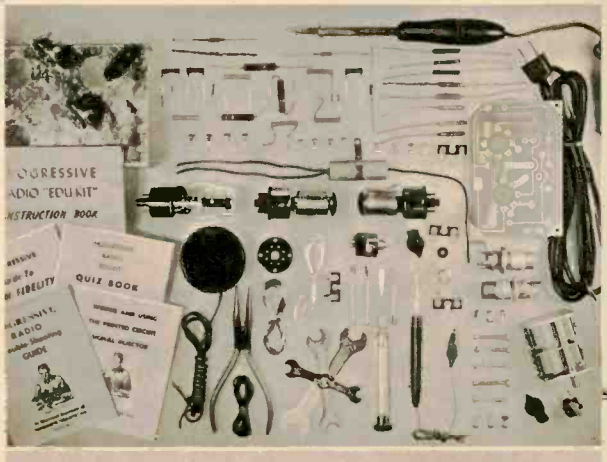


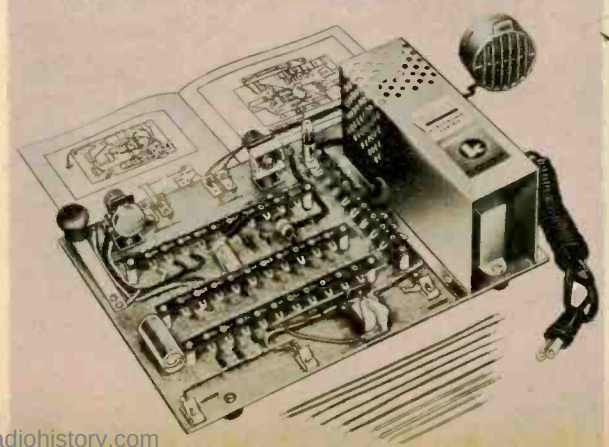
**Adult kits, top to bottom: Arkay International's 10-in-1 tube lab; Lafayette 20-in-1 Transistor experimenter's kit, $18.95; Progressive Radio "Edu-Kits" Inc.'s 20-circuit lab, $26.95; Allied Radio Corp's "Knight-kit" 12-in-1 tube lab kit, $14.95. Arkay kit uses a wooden breadboard to eliminate shock hazard. Lafayette kit employs "module" principle similar to A. C. Gilbert's (see pictures of children's kits) but user builds modules, too. "Edu-kit" supplies all tools, solder, and iron but is AC-DC circuit. Knight kit is transformer powered for safety.**

experiment is their reason-for-being. There are even laboratory kits for children, and we are very glad to see this idea take hold.

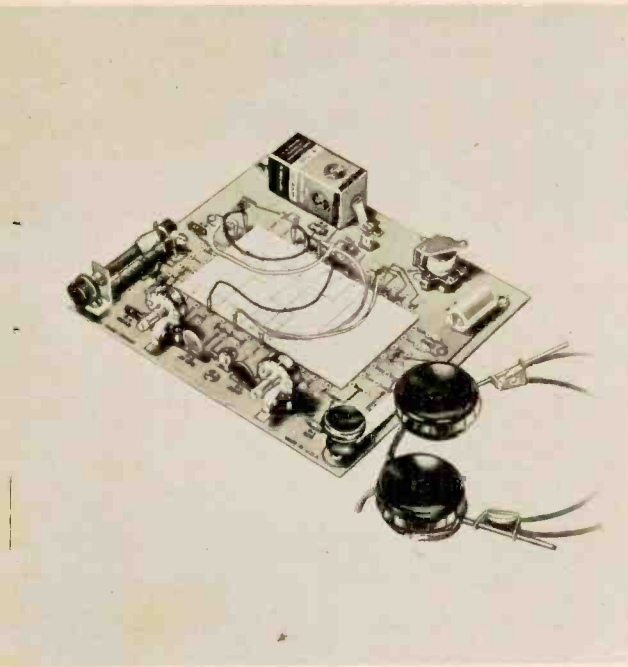
Our purpose here is to "review" a selection of self-teaching kits for you. Kits were requested from every manufacturer we could reach; some firms submitted several. Staff members and other associates of *Electronics Illustrated* "built" them and submitted reports. Kits were tried out by long-experienced editors and by wives and secretaries who had never touched electronic parts before. For children's kits, we used children.

We are going to mention the faults and flaws we found in our sample kits. These need not put you off. Many of the kits—especially children's kits—had a part or two missing. This may have been due to the haste in which pre-production run samples were rushed through for us. Practically every manufacturer had his fall or Christmas production run scheduled to begin after our deadline.



On Knight transistor kit, builder does some basic wiring (requires solder), then makes circuits via clips and separate circuit cards.



Heathkit EK-1 Basic Electricity kit culminates in simple volt-ohm-milliammeter, useful for all later experiments or work in electronics.


Mistakes in method or approach are another matter, which we shall discuss mercilessly below. However, if you know what pitfalls to expect, you can meet them more easily, or give a kit to a friend or a child with confidence that you can handle any difficulties. We have reported to the manufacturers, but it will take them time to correct mistakes or deficiencies and get all the "bugs" out of new products.

Kits come in two obvious categories: adult's and children's. The "adult" kits are certainly all right for people of high school age, or even for bright or advanced children in some cases. Some of the children's kits, too, might be used profitably by adults.

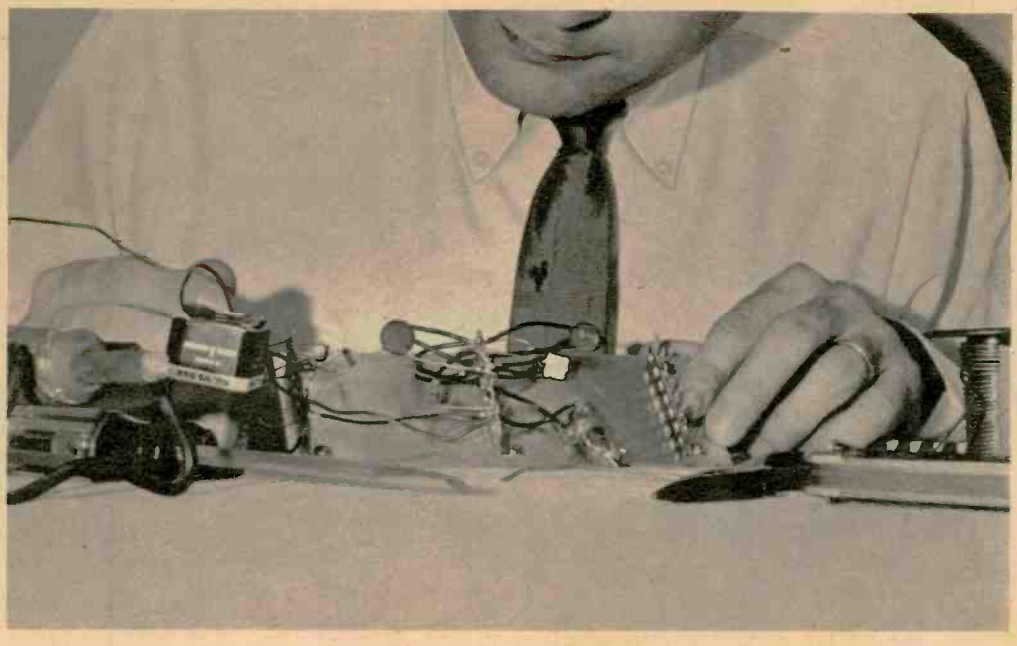
In each category, we take on the manufacturers one at a time, giving a review of the "sample" kit we built, and listing others in each line, with prices. We also give the manufacturer's address, since most have mail order departments. Many kits, especially the new children's lines, will be available at your local parts supplier or toy shop.

Special attention is given to the children's kits, and we hope you will read our general and specific comments carefully.

### The Adult Kits

*The American Basic Science Club, Inc.*, 501 East Crockett, San Antonio 6, Texas. Highly recommended. This is a "kit of the month club" plan. It has eight kits, for $3.45 each. The first four deal with electronics.

The simplicity, ingenuity, and *completeness* of the *ABSC* experiments and kits are really remarkable. Each monthly kit comes in a very small unglamorous packing box. Each kit builds on the ones preceding, and there is so much to the entire "course" that description is very difficult. It is worth an article by itself. The first kit begins with the classic experiments with static electricity and very quickly takes the user into electroplating, the electrolysis of



Precise's T1 transistor kit features simple aluminum plate with three terminal strips. Circuits "obviously" follow schematics. Instruction book excellent.

Heathkit Jr. Experimenter's Kit requires "three hands." Child holds "chassis" foot in teeth to mount parts with tiny screws, no nutdriver.

Having finished Heathkit Jr. transistor diode radio in one evening, child confidently starts wireless broadcast kit despite difficulties.

**American Basic Science Club's first kit starts with basic electricity experiments, lays good foundation in electronics, general science.**

**First kit leads to advanced experiments, electronics. Transformer power supply lessens shock and burnout hazards. Used in all 8 kits.**

water, induction, and transformers and relays. The power transformer is in use and the circuit board ready for Kit No. 2, which contains a soldering iron and soldering instructions.

Kit 2 covers heat and electricity (building a thermocouple), resistance and Ohm's Law, power, the vacuum tube rectifier, and resistors and capacitors and their circuits.

The third kit's experiments with an amplifier tube lead to a two-stage amplifier, burglar alarm, proximity detector, oscillator, and ripple tank, and wide exploration of vibrations and sound. The fourth kit puts a headphone into the oscillator circuit, produces a regenerative receiver which becomes code and phone transmitters (with a carbon microphone the user *builds*), and finally an 80-meter receiver and a signal tracer. The booklet ends with a condensed code course, and an extra booklet, "Steps to a Ham License," is provided.

By this time, the user should have become adept at re-arranging the circuits to get a variety of devices and instruments. These he will use with the next four kits, covering spectroscopy, ultraviolet, microscopy, photography, astronomy, atomic energy, and other subjects.

Our reporter on the *ABSC* kits suggests a "Things You Will Need" list at the head of most experiments for Kit No. 1. The designer assumed that certain "household" items—swatches of wool cloth, silk or nylon cloth and thread, etc., would be readily available in every home. Sometimes, believe it or not, they aren't! Halfway through an experiment, "13 feet" of wire may be called for (*now where's my ruler?*), or one is to remove all the insulation from a length of wire (*how?*) or cut the wire (*with what? Mother's sewing scissors?*). Some trouble was had with electroscope experiments in damp weather. Otherwise, the kits were fine.

The best preparation for an amateur





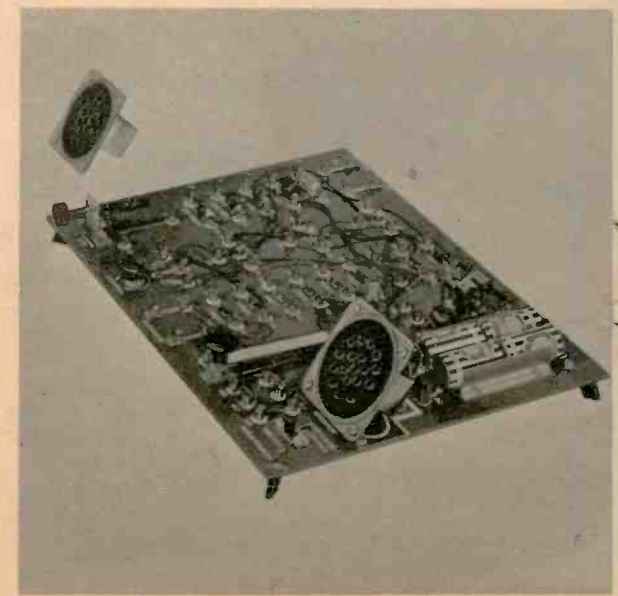
license (*any* class!), at least in this price range, we have seen, and also the best and most foolproof home science course and the most useful science "lab." While the experiments are carefully described and explained, the user sees and understands everything and the "cookbook" approach is avoided.

*Terms:* $2.00 with application coupon, $3.45 C.O.D. for each of eight monthly kits, or $29.60 in advance.

●

*Precise Electronics and Development Corp., Oceanside, N. Y.:* T1 Transistor Lab Kit. An excellent 59-page booklet explains conductors and semiconductors in terms of simplified atomic theory, "N" and "P" materials and "electron" and "hole" conduction, and the transistor itself. 16 experiments using two 2N38 transistors. The "chassis" is a 3x7″ aluminum plate and three 7-lug terminal strips, on which circuits

**Children's kits, top to bottom: A. C. Gilbert Co.'s No. 11072 "Erec-Tronic" electron tube set, 15 circuits, $21.98; A. C. Gilbert No. 11062 "Erec-Tronic" transistor set, 9 circuits, $14.98; Educational Electronics Co.'s No. 110 2-in-1 radio and broadcaster kit, $9.95; Educational Electronics No. 208 transistor lab kit, 10 circuits, $12.95; Heath Co., Inc's "Heathkit Jr." Experimenter's Lab No. 3, No. R-160, 20 circuits, $29.95.**



are wired quickly and easily from straightforward schematics and adequate photos. Experiments require use of VTVM and audio signal generator (or filament transformer and resistors), oscilloscope or broadcast receiver, and 1.5- and 4.5-volt batteries. Soldering required. We would like to see these needs listed at the beginning of the book, along with a parts-contained list for initial checking.

●

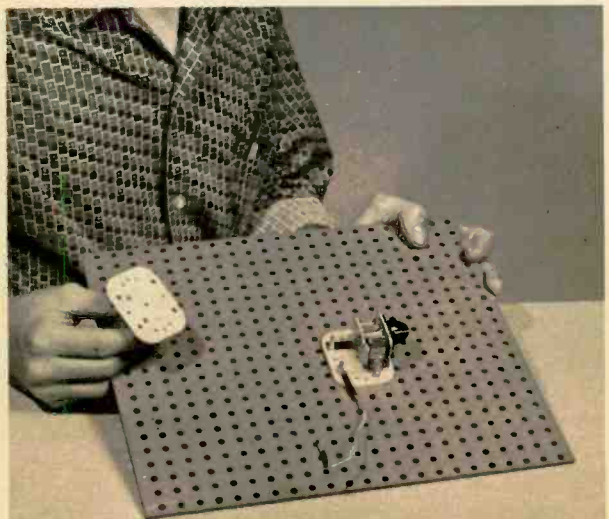
*Heath Company, Inc., Benton Harbor, Michigan:* Model Ek-1 Basic Electricity Kit. 117-page book explains electricity in terms of atomic theory (familiar "electron flow"), and series and parallel circuits, using flashlight cells, pilot bulbs, classic compass-and-coil, etc. Then it instructs user in wiring DC milliammeter and shunts. With these exeriments completed, voltage, resistance, and Ohm's Law are explained, and user wires voltmeter and ohmmeter. With the completed instrument, user verifies Ohm's Law and the Maximum Power Transfer Theorem. Final chapter has instructions for checking electrical appliances and automobile circuits. User now has DC VOM, understanding of its principles and experience in its use, good grasp of electrical fundamentals.

Assembly and wiring of the kit presented no serious difficulties. Entire kit was up to the excellent standard of this kit pioneer, and instructions thought of everything—including advising the user to re-read, repeatedly, any passage he did not understand at once. "This is studying." $19.95.

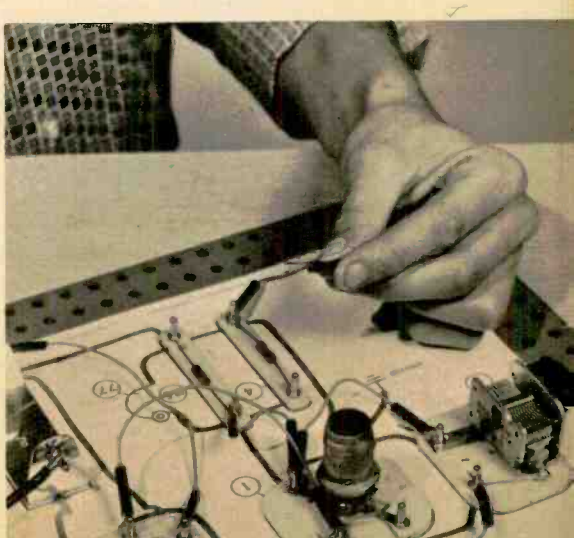
●

*Allied Radio Corp., 110 N. Western Avenue, Chicago 80, Ill.: "Knight-kit"* 12-in-1 Electronic Lab Kit. Clear, concise manual, and extra, wall-sized diagram. Uses one 12K5 tube, transformer power supply. Chassis board holds large multilug terminal strips on which circuits are wired, after preliminary wiring underneath. Power supply and tube protected by metal cover. All circuits are changed by soldering and unsoldering leads from lug strips. Care should be taken not to get leads too short in preliminary wiring, especially in power- [*Continued on page* 97]

**A. C. Gilbert's "Erec-Tronic" circuit board. Each part mounted on "module" to fit evenly-spaced holes in board and pictorial sheets.**



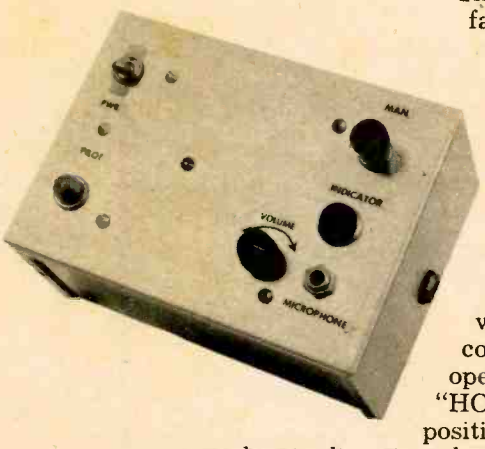
**Heart of "Erec-Tronic" system is snap-on "Jiffy Clip" which attaches to pins on each module. Each pin easily holds several clips.**



# Voice Control Your Model Trains

**Simple commands mysteriously start, stop, and reverse your trains without touching a switch!**

**By R. Goldring**




Thrill the junior railroad tycoon in your family with this easy to construct electric train voice control. By choosing your words, as you speak into the mike, you can control the movements of an electric train as if it were your slave.

After the train set is put away, you will find many uses around your home for this versatile device. Just to name a few: a "baby sitter" that will signal you in another room when the baby is crying, a door lock control or horn-operated garage door opener. Since most "O" gauge and some "HO" gauge electric trains have a three-position stepping relay in the locomotive to control train direction, the voice-control relay will cycle the train from forward, to stop, to reverse, and back to forward by simply interrupting the power.

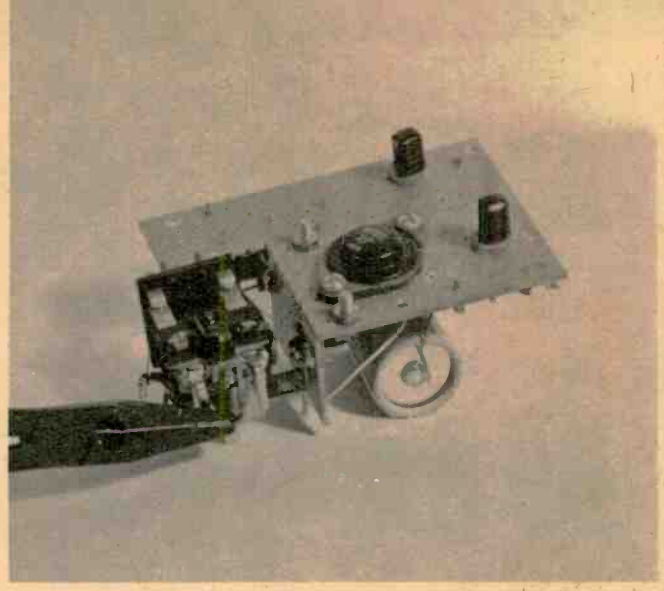
The voice control responds to single syllables, in effect "pushing the button" once for each syllable spoken into the mike. Compose your commands of one syllable words, such as "go," "halt," "now back." Avoid the word "stop," because the sibilant "s" acts as a separate syllable and tends to trigger the circuit by itself.

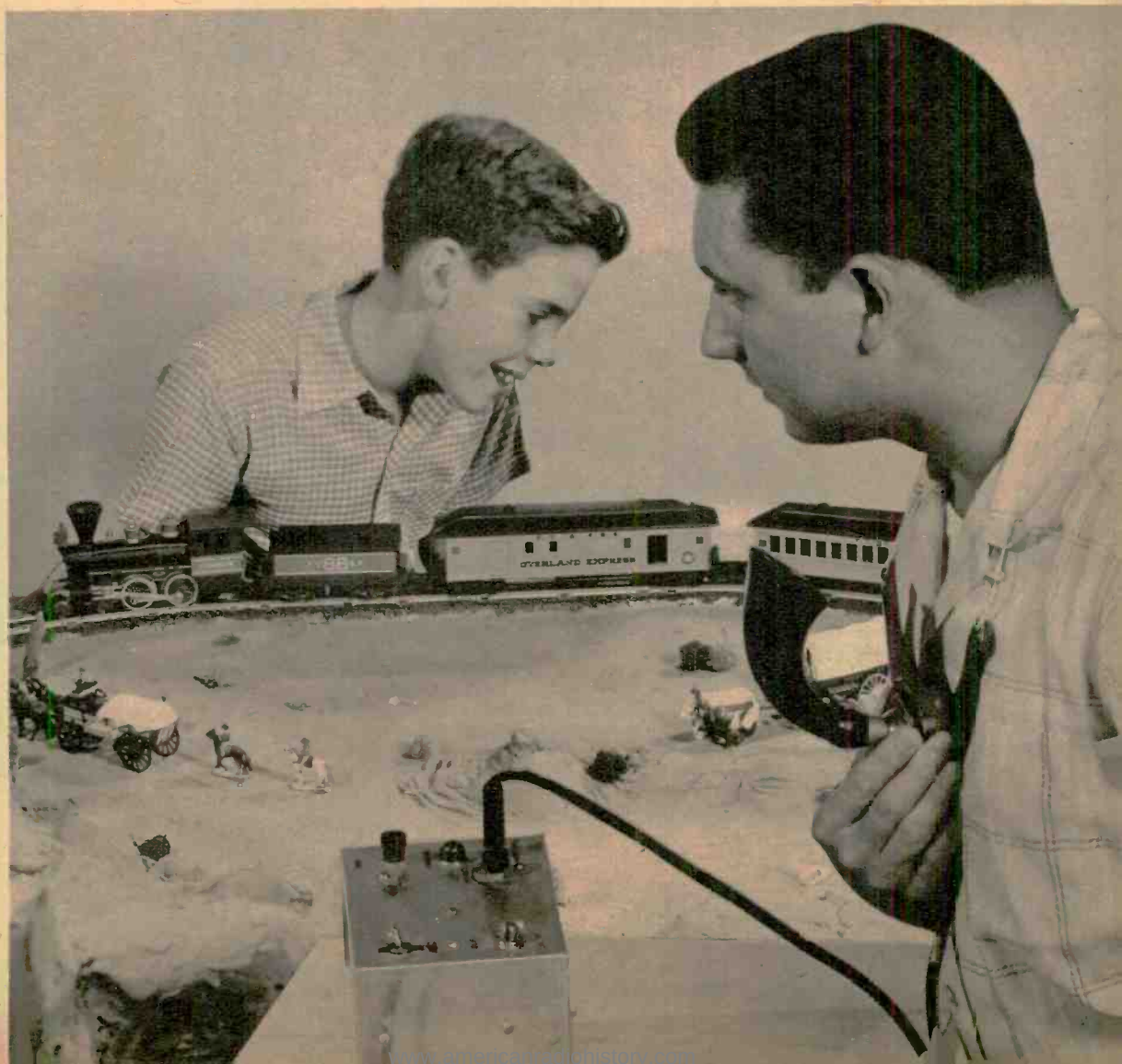
Remember the "forward-stop-reverse-stop" cycle when composing a command. One syllable will always stop a moving train, regardless of direction of motion, while two syllables will reverse the direction of motion. For example, if the train is going forward, "go back" will reverse it, and "for-ward" will set it going forward again.

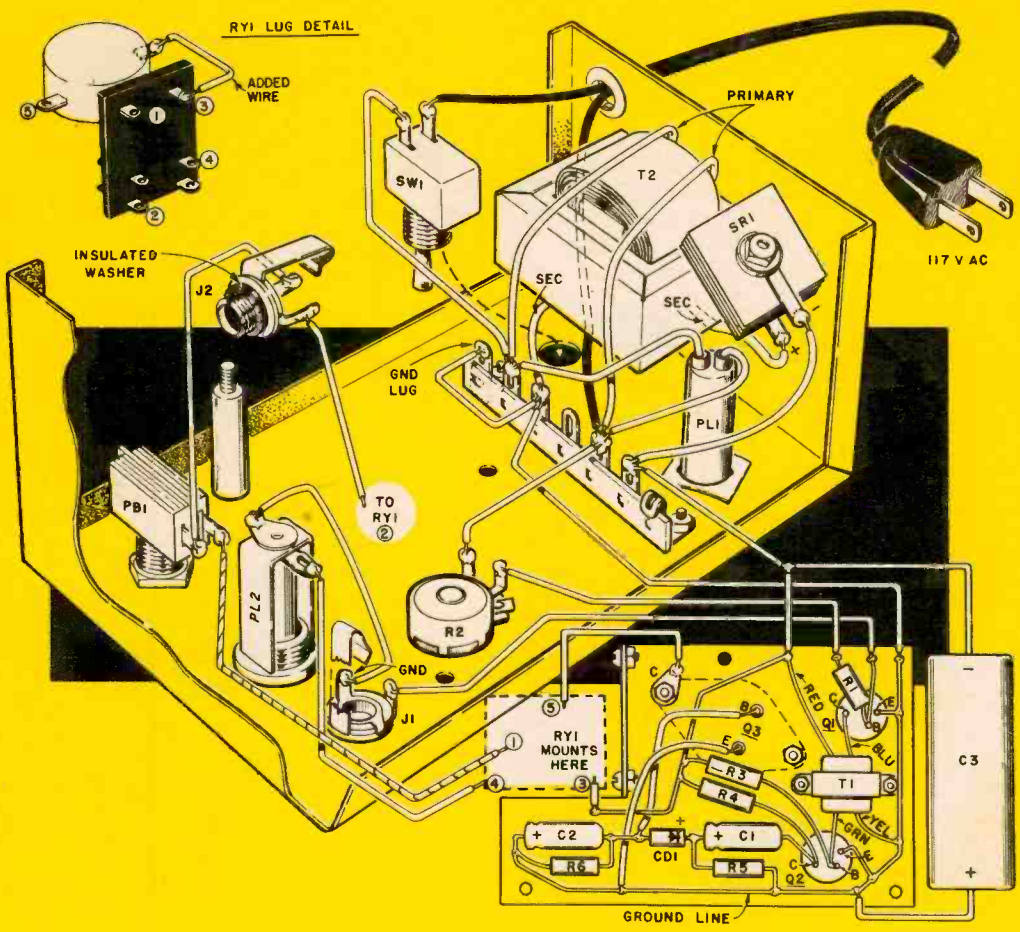
Transistors Q1 and Q2 amplify the output from the carbon microphone. The resulting audio frequency alternating current is rectified by diode CD1 and filtered by electrolytic capacitor C2. The DC produced is applied to the base of power transistor Q3 and is amplified, pulling in relay RY1, opening the train power circuit and causing the train's stepping relay to advance one position for every syllable spoken into the microphone.

Potentiometer R2 serves as a volume control, varying the

Relay RY1 is bolted to cutout of Bakelite subchassis board. Both audio transistors plug into surface mounting sockets.








sensitivity of the circuit. The AC power supply incorporated may be replaced by a standard 7.5-volt radio "C" battery, if desired.

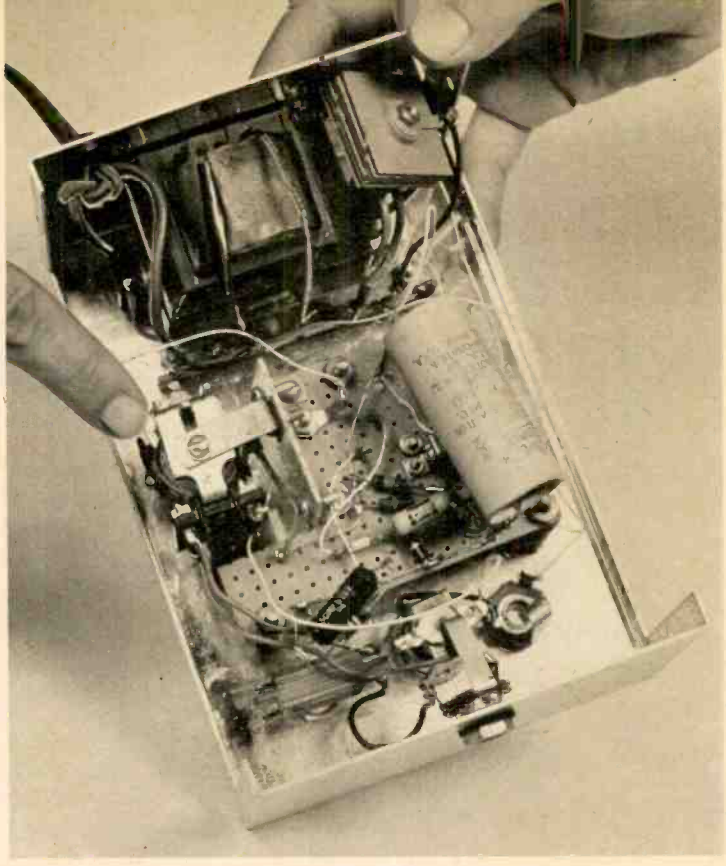
The amplifier is constructed on a perforated Bakelite subchassis which is bolted to the case using insulating spacers. Sockets are used for the two audio transistors, Q1, Q2 and flea clips serve as terminal points for wiring on the subchassis.

For manual operation there is a push-button switch (PB1) inserted in series with R1 and J2. It interrupts the power when pushed, allowing conventional operation of the train set without removing the voice-control device from the circuit.

A pilot lamp (PL1) flashes each time the relay closes indicating proper operation of the unit.

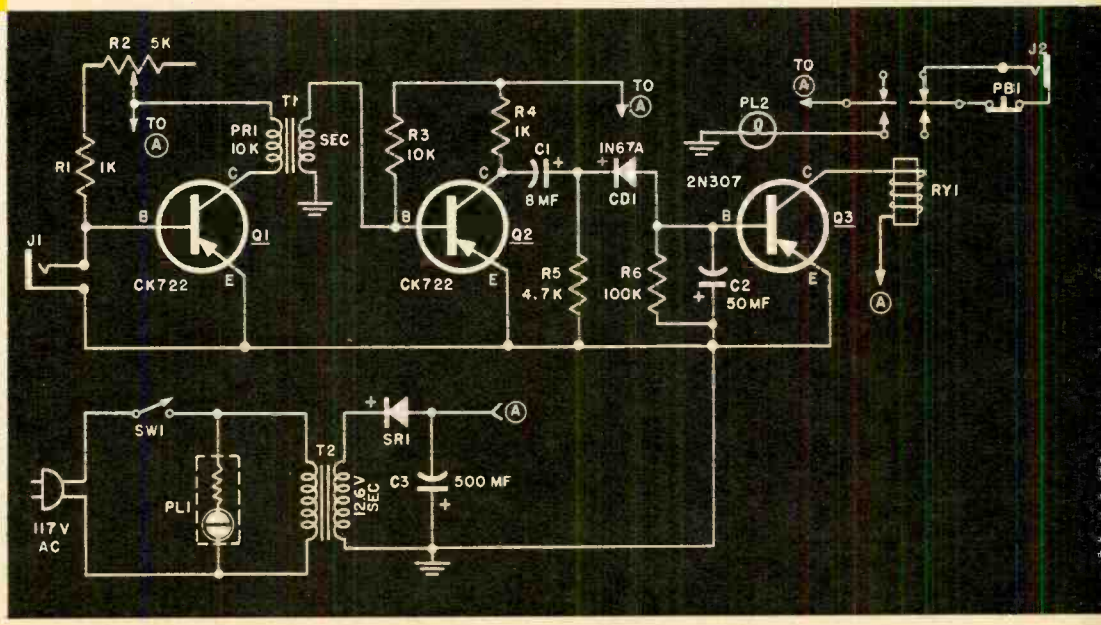
PARTS LIST

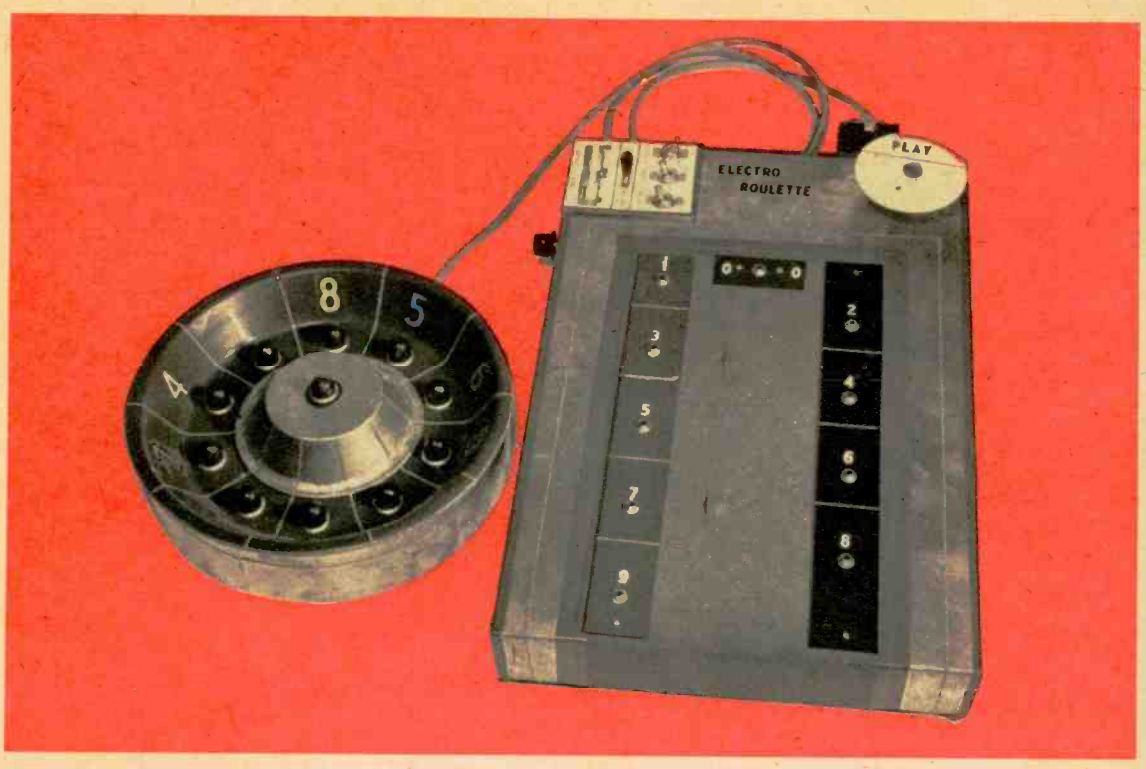
Resistors: ½-watt, 10%
R1—1,000 ohm
R2—5,000 ohm miniature potentiometer
R3—10,000 ohm
R4—1,000 ohm
R5—4,700 ohm
R6—100,000 ohm
Capacitors: 15-volt miniature electrolytic
C1—8 mf
C2—50 mf
C3—500 mf
Q1,Q2—CK722 transistor
Q3—2N307 transistor
T1—transistor driver transformer 10,000 ohm primary; 2,000 ohm secondary. (Lafayette TR 96 or equiv.).
T2—filament transformer 12.6 v @ 2 amp
RY1—6-VDC relay DPDT, (Potter & Brumfield KA 11D or equiv.).
SR1—65 ma selenium rectifier
CD1—germanium diode—1N67A or 1N34A
SW1—SPST toggle switch
PB1—SPST push button switch, normally closed
PL1—117-volt neon lamp pilot assembly
PL2—No. 47 pilot lamp and assembly
1—chest mike Burstein-Applebee Co. Stock #17B22 ($1.95)
Misc.—7"x5"x3" aluminum case (Bud CU-2108); perforated Bakelite board, flea clips, transistor sockets, hardware, etc.



Interior view. Observe polarity of rectifiers and electrolytics. SR1 is mounted on bracket with screw holding one side of T2.

Input audio is amplified by Q1, Q2 rectified by diode CD1, reamplified by Q3 to operate relay RY1. Switch PB1 provides manual control.






# Electronic Roulette Wheel

**An advanced Christmas project that will provide you and yours with hours of electronic enjoyment.**

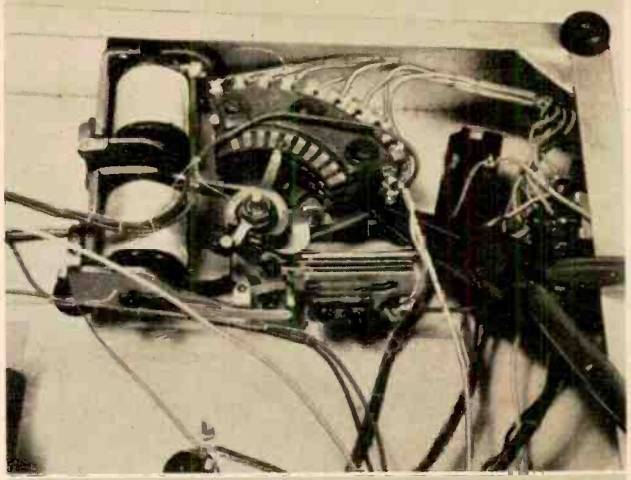
**By Ronald Benrey**

"PLACE your bets," the croupier cries as he prepares to start the electronic roulette wheel spinning. Players weigh the probabilities carefully, and place electric "poker chips" on the numbers of their choice.

Everyone is tense as the croupier presses the "play" button. The "wheel" spins, quickly at first, then more slowly, a moving light replacing the conventional metal ball. After a few seconds the "wheel" comes to a halt—one light remains lit, and a poker chip glows brightly; almost as brightly as the winner, who is busy raking in his new-won loot.

The heart of this intriguing electronic casino is an electro-mechanical device known as a stepping relay. It is actually a multi-pole rotary switch that advances one position every time a pulse of current is sent through a solenoid. By connecting the switch terminals to individual lamps and a power supply, and arranging the lamps in a circular array, the light will move, in a rotary manner, about the lamp array.

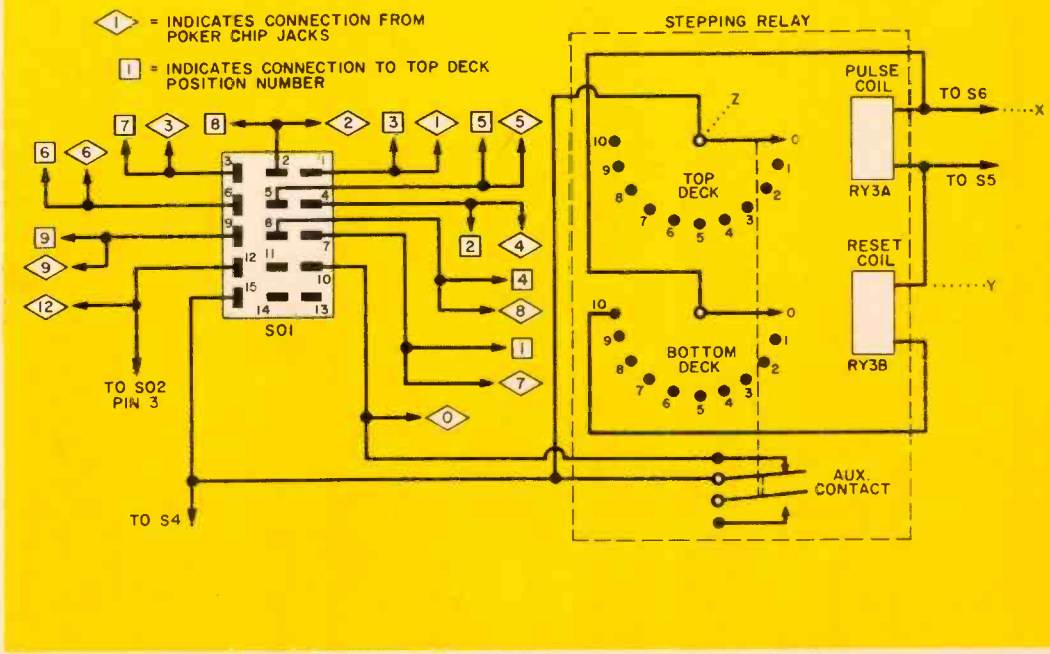
The stepping relay Fig. 1 is advanced by the pulser unit Fig. 2. This device feeds correct voltage pulses to the pulse coil. The

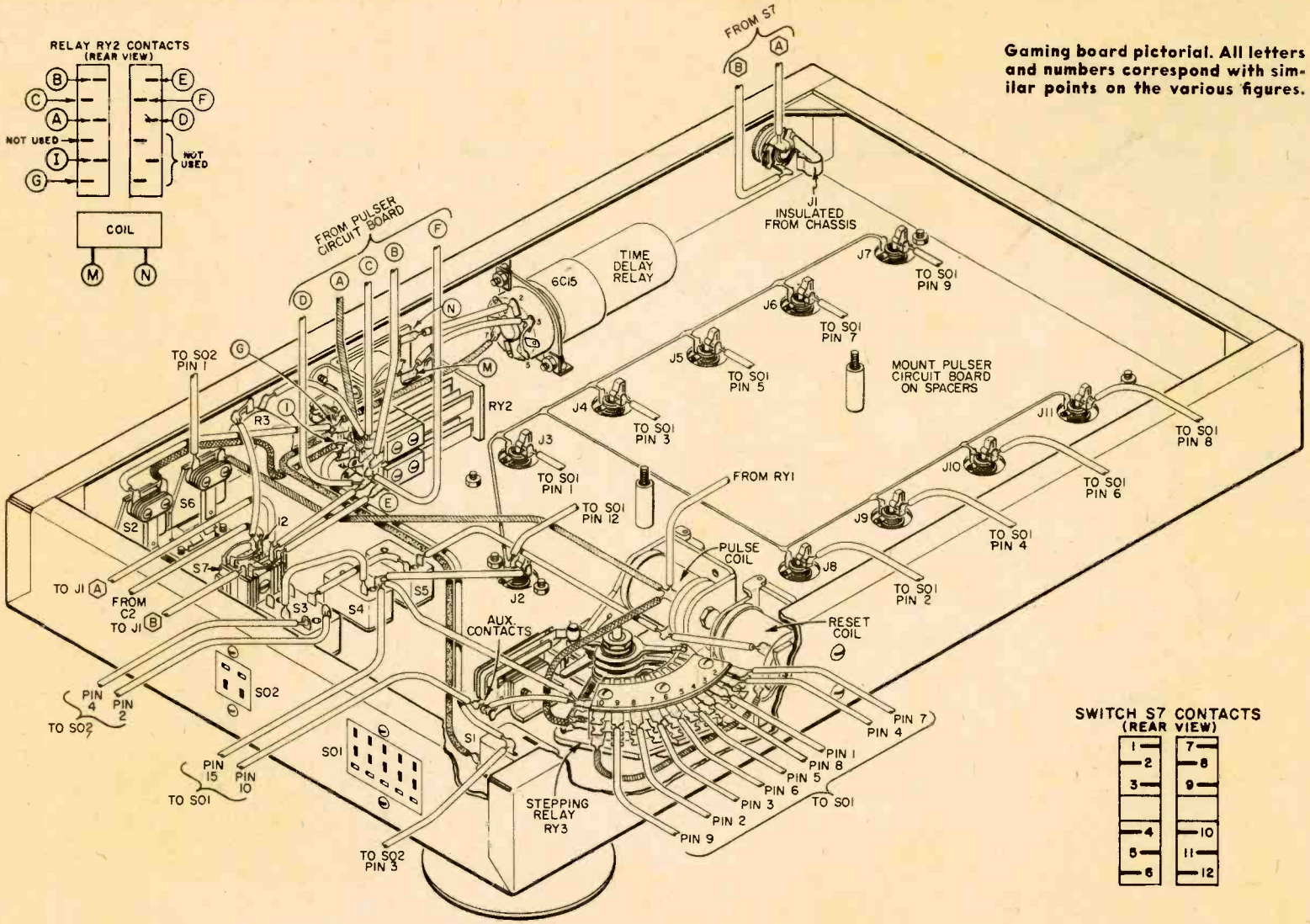


Adjustment of reset coil RY3B spring with long nose pliers may be necessary.

Remote switch S8 connects to panel jack J1. Operates table manually if desired.

Fig. 1 Stepping relay, RY3 is an electro-mechanical switch which cycles lamps.






**Gaming board pictorial. All letters and numbers correspond with similar points on the various figures.**

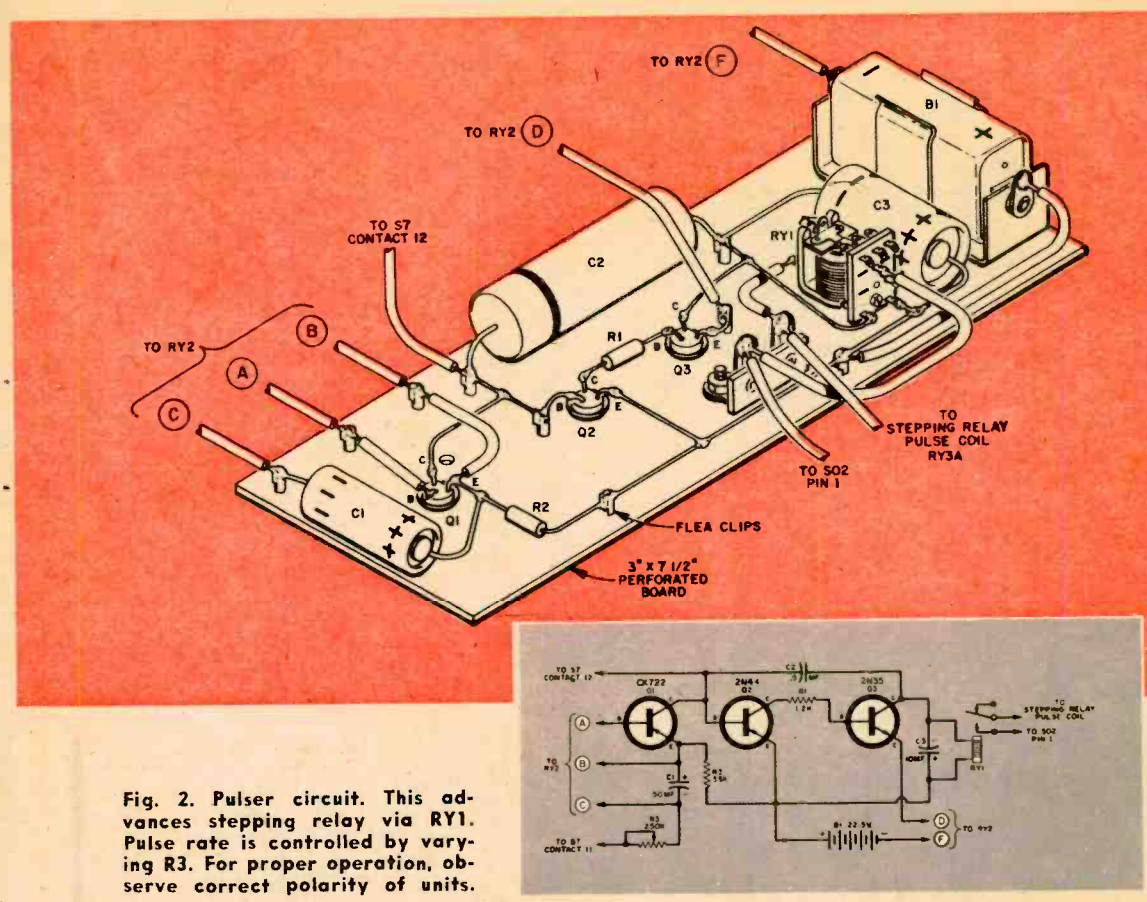






**Fig. 2. Pulser circuit. This advances stepping relay via RY1. Pulse rate is controlled by varying R3. For proper operation, observe correct polarity of units.**

step rate, or the number of times per minute that the relay advances, can be controlled automatically or manually by varying S7 and R3. In automatic position the pulse output rate starts fast and slows down, finally stopping. In the manual position, the "wheel" remains in continuous motion, the speed being controlled by a panel mounted potentiometer R3.

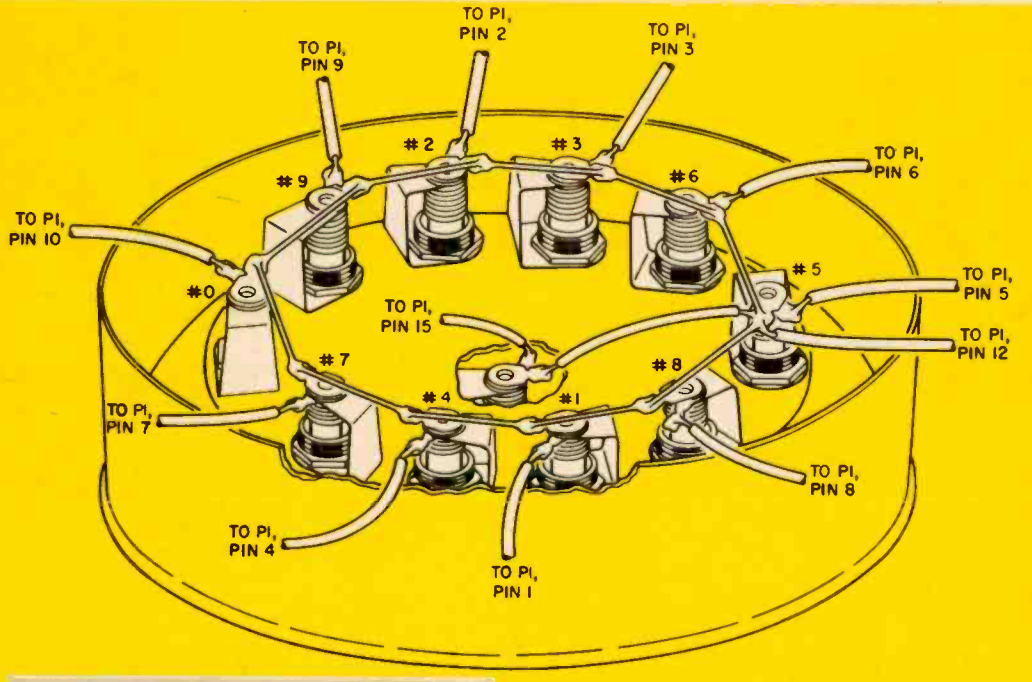
PARTS LIST

*Pulse Unit:*

R1—1200 ohms
R2—33,000 ohms
R3—.25 megohm linear taper potentiometer
C1—50 mf, 25 volt electrolytic
C2—.5 mf, 150 volts or higher
C3—10 mf, 25 volt electrolytic
Q1—CK-722 transistor
Q2—2N44
Q3—2N35
RY1—SPDT relay 5,000 ohm coil (Lafayette F-260)
B1—battery 22.5 volts (Burgess Y15 or equiv.)

**Relay Control Circuit—Gaming Table**

RY2—relay, 6 VDC coil (Guardian Series 200 or equiv.)
Time Delay Relay (Amperite 6C15)
S1—SPST pushbutton switch (Hart & Hegeman 3391GL or equiv.)
S2,S6—SPST intercom type lever switch (Lafayette SW-69 or equiv.)
S3—DPDT toggle switch
S4,S5—SPST toggle switch
S7—4PDT telephone lever switch (Lafayette SW-20)
J1—Open-circuit phone jack with insulating shoulder washers
J2-J11—miniature phone jacks
SO1—wheel connection socket, 15 contact panel type (Cinch Jones S-315AB)
SO2—4-contact panel socket (Cinch Jones S-304-AB)
P1—15 contact plug (Cinch Jones P-315-CCT)
P2—4-contact power plug (Cinch Jones P-304-CCT)
RY3—stepping relay, 3 deck; 10 position (available from Advance Electronics Co., 6 West Broadway, New York 7, N. Y. approx. $7.95
B2—battery, 12 volt
B3—battery, 6 volt
Number Lights—Eight 6.3 volt bulbs and sockets
Misc.—Perforated board, battery holder, flea clips, transistor sockets, terminal post, 12 conductor cable, 4 conductor cable, hardware. Paint, chassis and wheel construction materials are left to choice



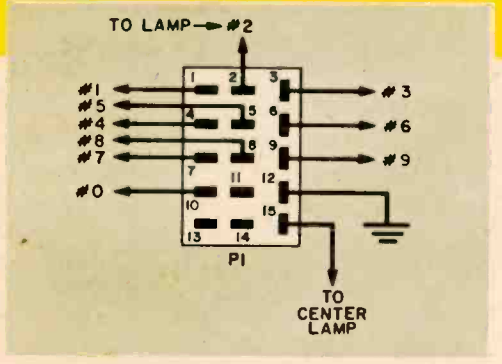




**Fig. 3. Roulette wheel. Pilot lamps in circular array replace moving metal ball normally used. Plug P1 is wired for proper sequence.**

## Assembly

A novice should have no trouble building the device. *All* components are insulated from the chassis.

Each subassembly should be built separately and checked for correct operation before connected with the other subassemblies.

The complete cost of a roulette wheel, identical to the one pictured, will be under $40 if all new components are used, but can be considerably less if parts are shopped for carefully.

Assemble and test the pulse unit and stepping relay first, as together they comprise the basic "works."

Stepping relay (RY3) has three decks or poles with 10 positions on each deck. It will not reset automatically from position "10." A reset coil RY3B (located closest to the switch bank) actuates an armature releasing the wiper returning it to "0."

Position "10" on the lowest deck is used to operate reset coil (RY3B) while the "auxiliary" contact becomes position "0." The auxiliary contact is located on the relay frame to the right of the coils away from the switch decks. It closes whenever the relay is in position "0." RY3 will now cycle from "0" through "9," and reset automatically.

RY3B must be modified slightly to reset properly.

Stretch armature spring of RY3A (lower of two springs at base of switch deck) with a pair of needle nose pliers. Be careful not to overstretch it. Test the modification by connecting points "X," and "Y" and "Z" in series with a mo-

[*Continued on page 96*]

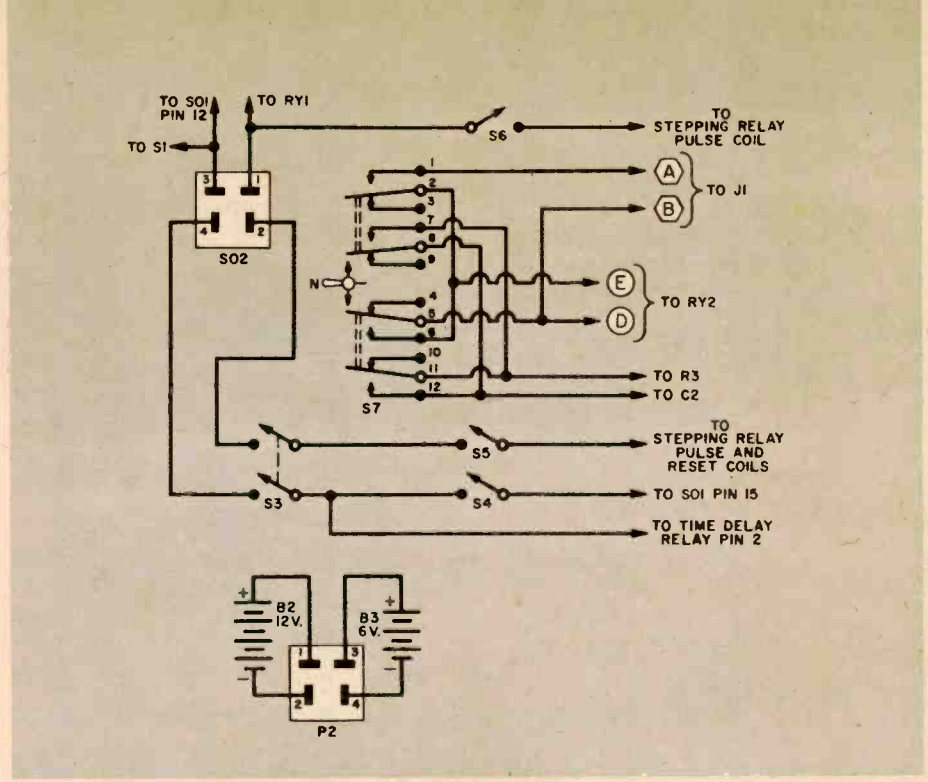



Fig. 4. Switch panel. Blocked letters correspond to same points on their respective schematics. Batteries B1 and B2 connect to rear terminals on plug P2, lower left.

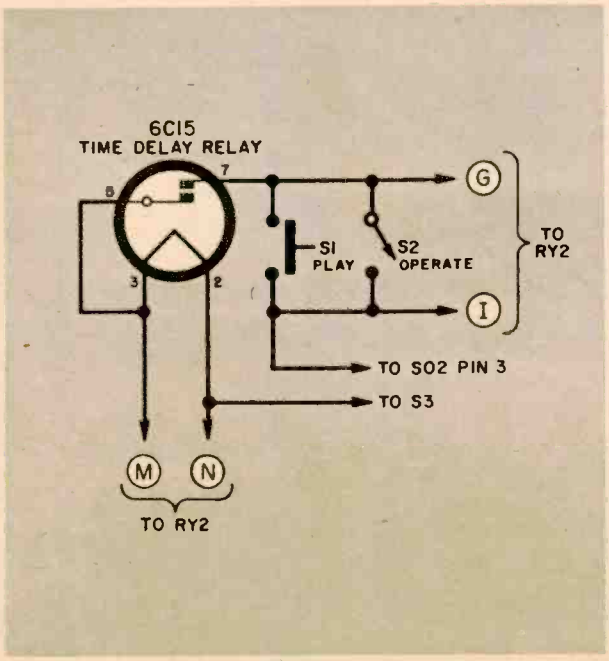



Fig. 5. Time delay permits wheel to slow down before stopping action. Letters coincide with terminals marked on RY2 diagram.

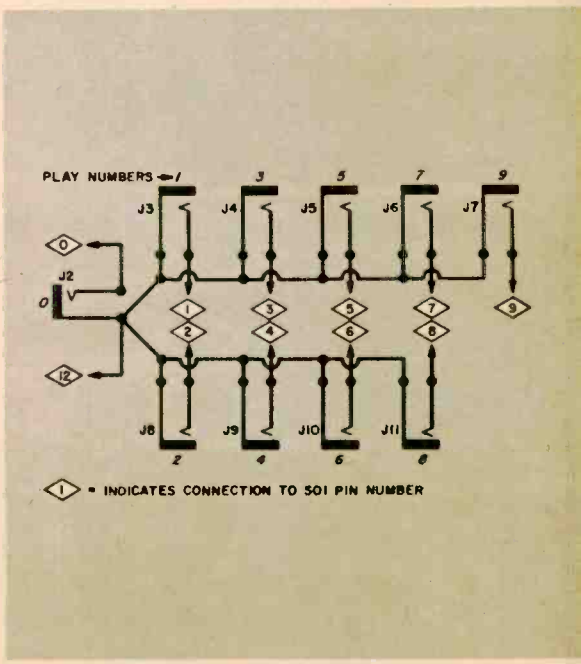
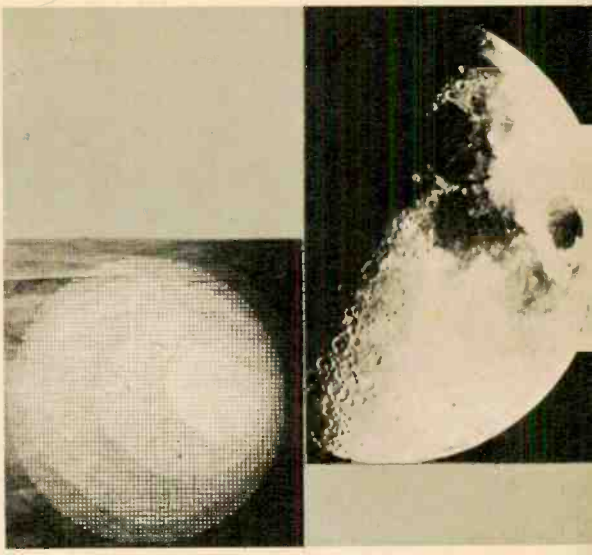



Fig. 6. Board jacks. Poker chips are 6.3 v. lamps which are connected to miniature panel jacks. Numbered points relate to socket SO1.

Right, Kenneth Stevens at the receiver of his home-built radio telescope, visible through garden door behind him. This is the third instrument he has constructed.

Below, Stevens inspects wire-mesh parabola. Box holds motors and controls that enable 'scope to track in any part of sky. Diameter is 22'8".

Photos by B I P S



Stevens translates receiver output readings to scale of white dots of graduated sizes. Using telescope to scan sky or object in view, he can build up a "picture" of the radio-energy distribution. At right, a moon "picture" (compared with visible-light photograph) shows reflected energy pattern at 37,500 mc. The garden radio telescope normally operates at 200 mc, well within the capabilities of the amateur. Mr. Stevens is a mechanical engineer.

# Radio Telescope

## *in his garden*

### Amateur's new radio astronomy technique excites professional astronomers, gives new way to "see."

RADIO astronomy is so new that amateurs are few and far between, and at first glance there seems to be little hope of the amateur achieving anything worthwhile. In optical astronomy, the amateur with a small telescope is a mainstay: the professionals will assign him certain variable stars to keep track of, for instance. Since there are only a few hundred professional astronomers in the world, the thousands of amateurs are relied upon for a lot of the legwork. Radio astronomy has been another matter. Radio telescopes usually consist of immense parabolic reflectors beyond the resources of the amateur.

Kenneth Stevens of Littleover, Derbyshire, England, not only built a fine radio telescope, but originated a technique of recording his readings that has caught the attention of scientists at England's Jodrell Bank Observatory, where the first of the giant radio telescopes was set up, and which is the "capital" of the world's radio astronomy. Said one of the scientists recently, "We are most interested in what Mr. Stevens is doing and have asked him for regular reports. They will receive [*Continued on page* 113]

## America has many

# Skilled Rocket Amateurs

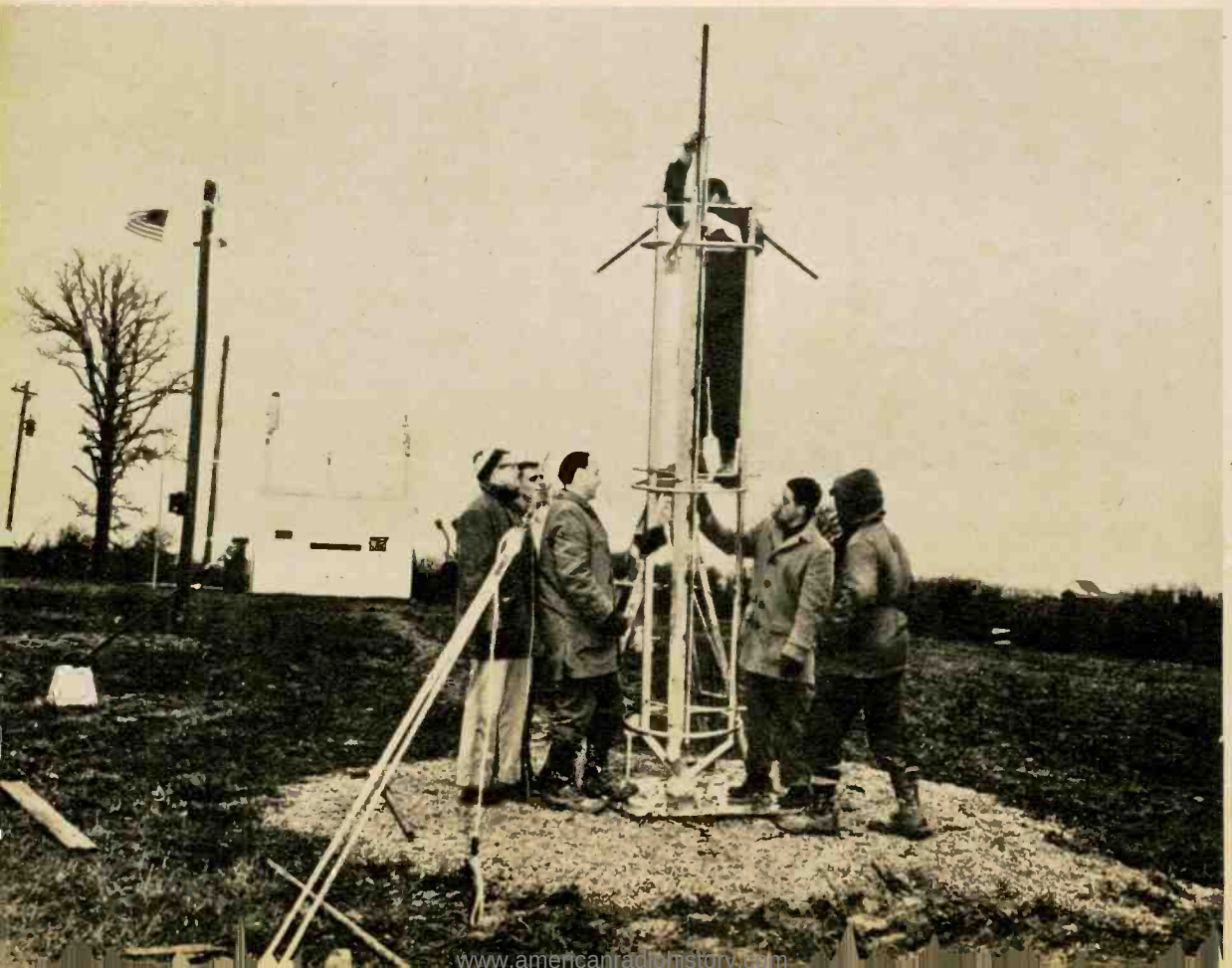
***A reply to last month's account of frivolity and fireworks: our serious amateurs are second to none, have impressive achievements and scientific spirit.***

**By Bertrand R. Brinley**

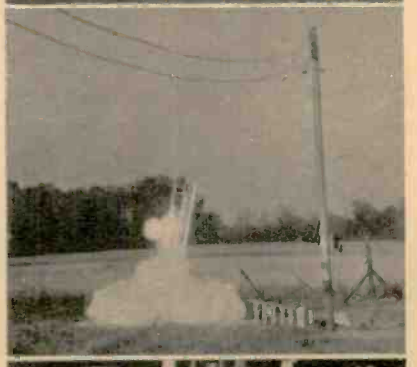
Major, U. S. Army Reserve

WHEN I read Lloyd Mallan's article on amateur rocketry in last month's *EI*, I imagined an English journalist reporting on his first sight of American baseball. This is what he might write for his readers back in England:

"To begin with, there wasn't a player on the diamond over five feet tall—except for one huge oaf who was doing the bowling (or pitching) for the team that eventually emerged the winner. Without exception the players were woefully inept. They allowed routine ground balls to trickle through their legs, and they were



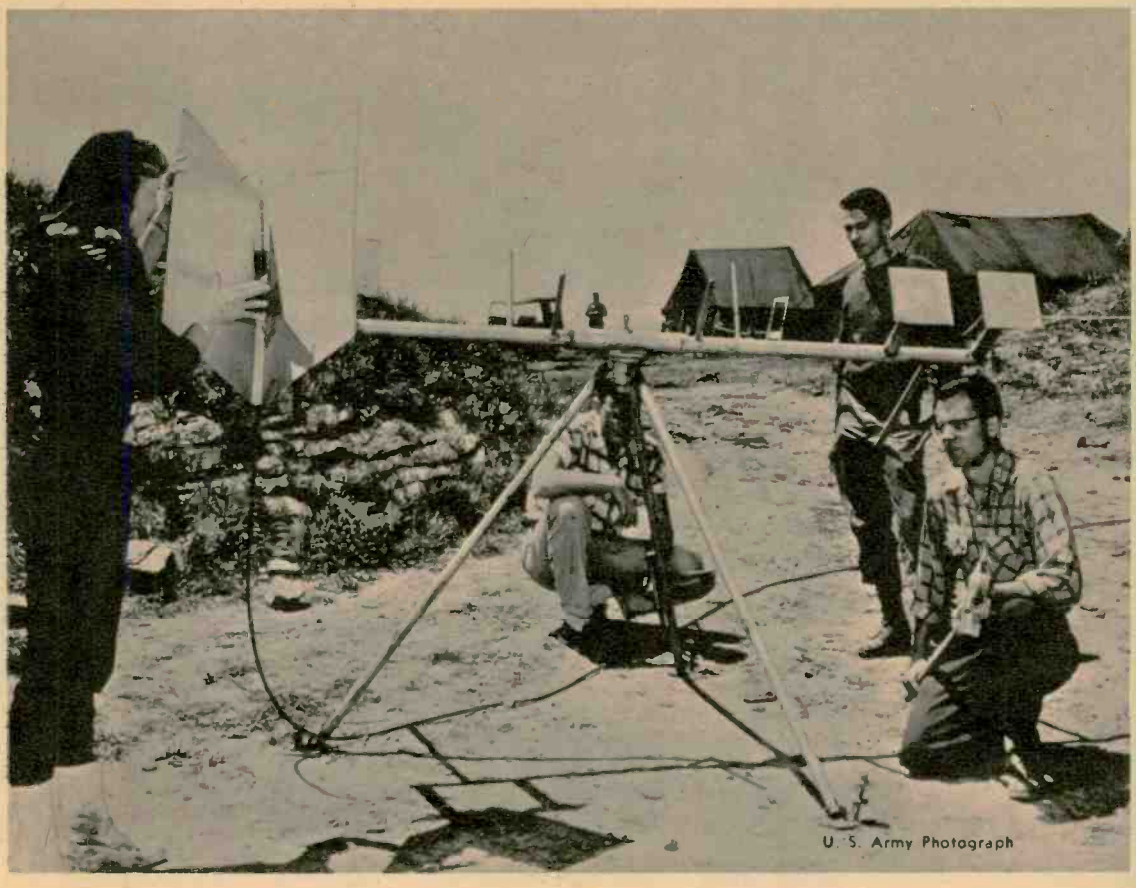

Members of Redkey Explorer Post 2214, Rochester, Indiana, in blockhouse of their firing range (opposite page). Routines are scientific, safe.



Static test of nozzle by Redkey group. Night firing improves photographic records kept of all tests for analysis and study of successes and failures.

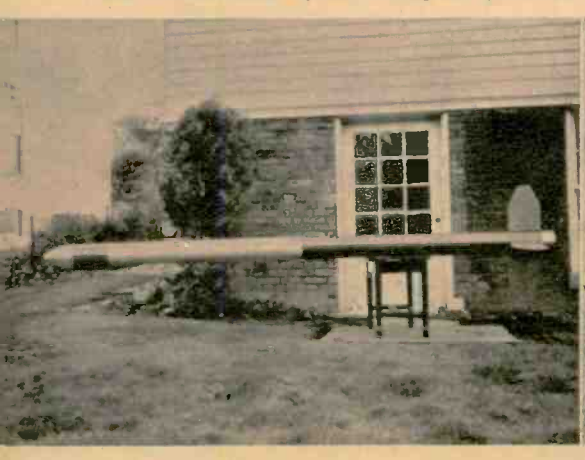
The group has an occasional fizzle, but instrumentation and photography show way to success. Photos are made from inside the blockhouse.

Explosion had damaged launcher and pad, shock wave caused audible sound in 96% soundproof blockhouse. Safe routine made "failure" valuable.




**Members of Southwest Rocket Society adjust their radio tracking device at Fort Sill, Oklahoma. Rocket carries instrumentation and tracking radio.**

**This research probe by Alex Gerardo, 17, of Orange, N. J., is designed to rise 34 miles, has radiosondes, ejects biological package.**



**Colorado rocketeer adjusts a test motor on static test stand designed and built by his group. Instrument measures developed thrust.**

totally incapable of executing the simplest infield plays with the snap and precision one ordinarily associates with games of this type. If a player hit the ball as far as forty meters, it was considered a stupendous feat and all the spectators stood up and cheered . . ." And so on, until:

"On the basis of what I have seen it is difficult to see how the game of American baseball can make any enduring contribution to the history of sport."

If you read an article like this it would probably make you hopping mad. After you had thought it over awhile, it would make you laugh. You would realize that everything the author wrote was perfectly true. We have all seen these very same things on any day during the baseball season. Yet the game described can hardly be considered representative of American baseball. The author simply went to the wrong game and never saw a big league team in action.

What author Lloyd Mallan saw on the Army range at Fort Knox was admittedly pathetic. But he was in the same position as our hypothetical Englishman who was watching the Little League game and thought he was seeing real American baseball.

The participants in amateur rocket firings—at the few Army posts where they are conducted—are in no sense representative of even average amateurs, let alone the best. The best amateur groups in the country have never gotten close to an Army range. Neither can such events be described as "national meets," and I don't believe that anyone involved pretends that they are. They are simply occasions on which amateurs are permitted to fire rockets under supervision. No more, no less.

What one must understand about the Army program for amateur rocket societies is that it is not a *program* at all. It is simply a policy. A good policy, and probably a sound policy—but that is all. The applicable directive (Army Regulation 360-5) merely permits local commanders to cooperate with amateur scientific groups to whatever extent they deem feasible. Nothing more.

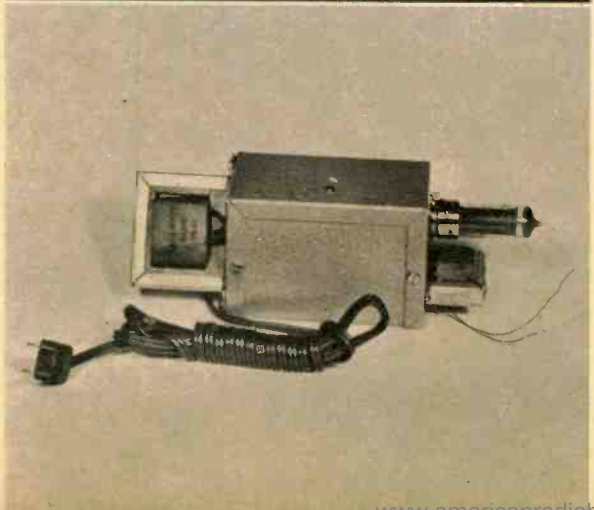
The amateur is usually required to fill out an application form for permission to fire his rocket. The application asks a lot of seemingly technical questions regarding [*Continued on page* 104]

**Part of instrument package of High Altitude Research Vehicle (HARVY) by Michael Tate, 16, of New York. Movie camera can be seen at top, pressurized chamber, bottom.**

# A Child's Phonograph

**We think we have anticipated all tortures to which the average boy will submit his phono.**

**The mounting board for the turntable may be ordered with the unit, already cut out. The sides are 1" x 4" x 12"; the cover sides are 1" x 3" x 12"; the speaker cutout is 2" x 9". Stain wood.**



**The complete amplifier is mounted on the cover of the metal box as shown. The isolation transformer is at left; the filament dropping resistor, R2, should also be on the outside of case.**

HAVE you ever watched a child destroy a toy? Oh, it may not be a deliberate act on his part, just normal impatience or high spirits, but the object will be submitted to a type of torture unknown in relatively polite testing laboratories. When we set out to design a phonograph for a child's use, therefore, we tried to anticipate what a child could (and would) do to it and reinforce it accordingly. The result is the phono presented here.

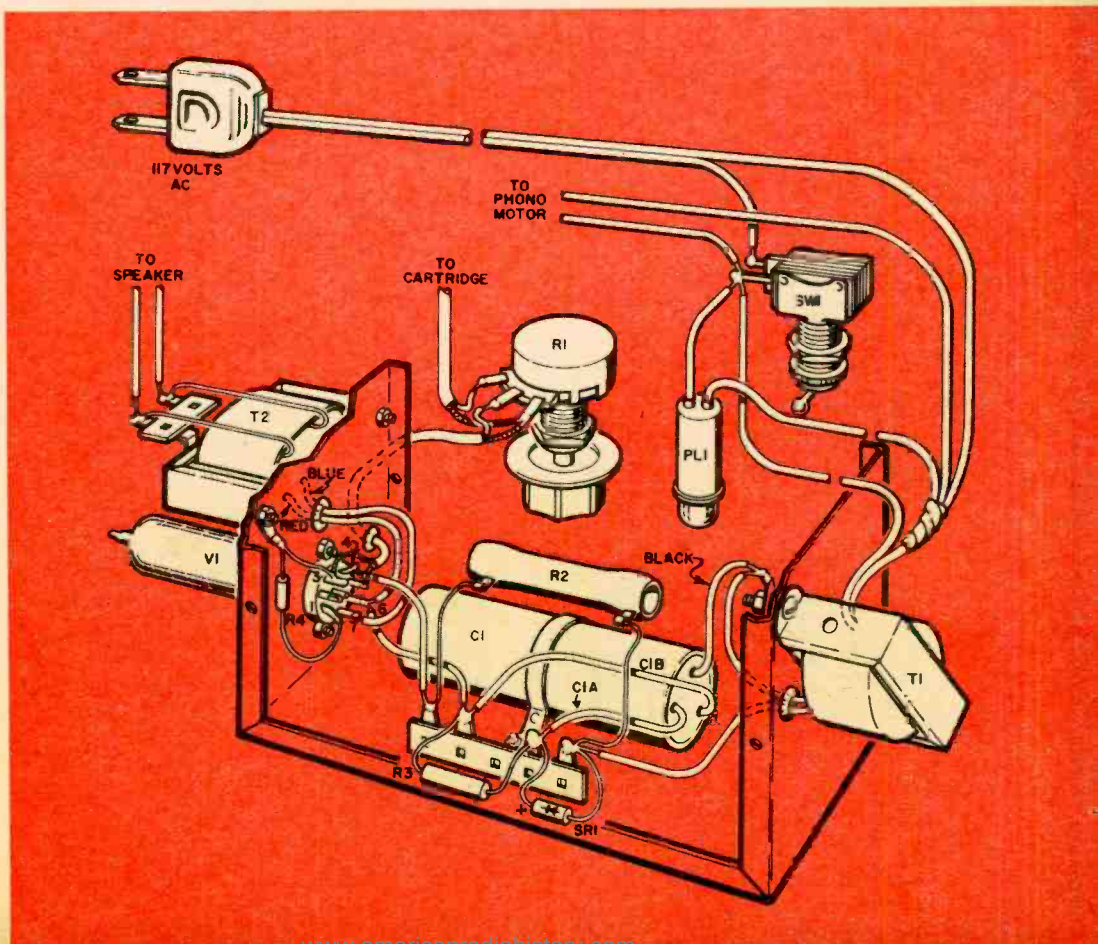
Danger point: *The case is frequently thrown into a toy box and heavy objects hurled onto it when the child is "cleaning up his room."*

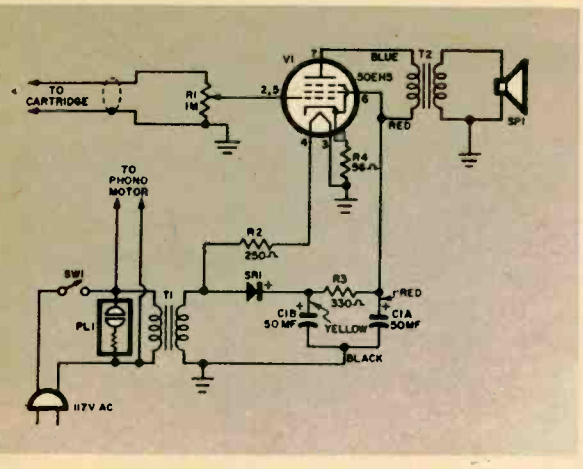
Our solution: Our case is extra thick, extra strong with no projections. A fancier case may be bought from electronic supply stores and mail order houses if looks are more important or if you would rather not build one.

Danger point: *The tone arm gets rough treatment and is frequently plopped onto a record doing damage to the stylus, cartridge and record. Also, the arm is frequently not set into its holder when the phono is to be moved (polite name for "roughed up").*

Our solution: The tone arm is restricted in its movement sideways and vertically by a bar through it. This in no way impedes

**Wiring guide of amplifier. Note that all parts are mounted on cover of box.**






**Schematic of amplifier. Insert a .001 to .02 mf capacitor from pins 6 to 7 of tube to cut treble.**

PARTS LIST

R1—1 meg potentiometer (audio taper)
R2—250 ohm, 20 watt wirewound resistor
R3—330 ohm, 1 watt resistor
R4—56 ohm, ½ watt resistor
C1A,B—dual 50 mf@ 150 volts electrolytic capacitor
T1—isolation transformer (Lafayette Radio TR-91)
T2—output transformer (50L6 type)
V1—50EH5 tube
PL1—120 volt neon pilot lamp assembly
SW1—SPST Toggle switch
SR1—Any miniature silicon rectifier 130V @ 50 ma
SP1—2½"x10" speaker (Burstein-Applebee Co. #228282)
1 phono arm with 2.5 volt output cartridge (Lafayette PK 157 or the equiv.)
1 3 or 4 speed turntable
1 aluminum chassis box 2"x3"x4" or larger

its ability to do its job (the bar does not touch the arm at any point in its normal record playing movement) but it does prevent the arm from being lifted and dropped onto the record and acts as an arm rest during movement.

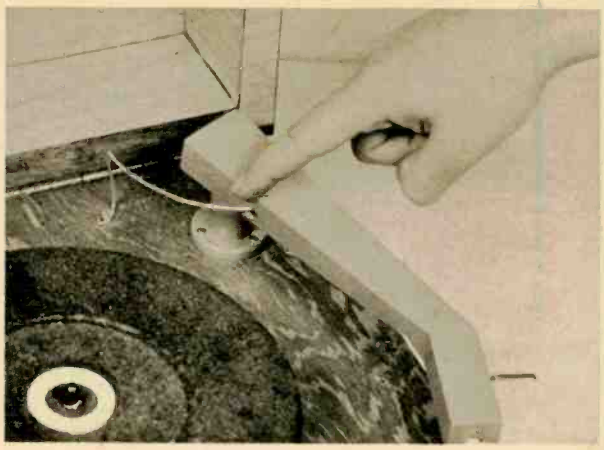
Danger point: *Children get their fingers into places where they shouldn't and get shocks and worse.*

Our solution: The amplifier has a shock proof chassis, an isolation transformer is used to keep the AC house current away from controls, etc.

The circuit for this amplifier is novel in that it uses a relatively new tube that can put out almost 1.5 watts of audio on a small input signal, such as from a crystal cartridge. Thus a single tube does all the amplifying with a resultant sound that is better than that usually obtained from such economy phonos.

In actual construction, all of the circuitry is mounted on the cover of the chassis. R2, the 20-watt filament resistor, should be mounted on the outside of the amplifier case with its leads insulated. It does get hot. The tone arm should be mounted so that its pivot is 7 inches from the turntable spindle. Make certain the arm is clear of the cover so that the latter may be closed. Adjust the set screw on the arm so that the bottom of the arm is parallel with a record on the turntable.

**Bar through tone arm may be No. 14 bussbar or coathanger. Curve it and anchor with screws.**



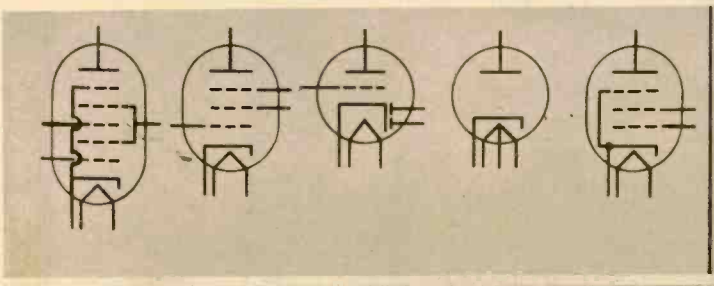
The tone arm is supplied with an extra piece of thin shielded cable, use part of this cable for connecting the amplifier to the volume control. Number 14 bussbar or stiff coathanger wire may be used for the bar that goes through the arm and the hole in the arm may be made by electric drill or hot soldering iron and then reamed to elliptical shape. The bar will have to be curved to permit free motion of the arm. Although a chain was used on our model to keep the cover from falling over when opened, special hardware is available at hardware stores to support the cover.

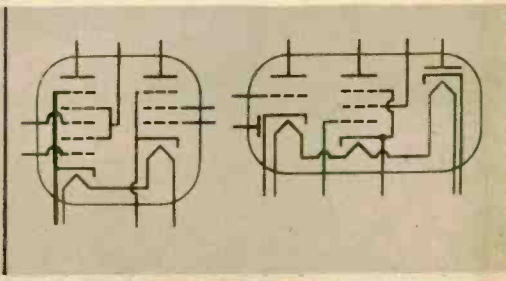
The top of the cover is constructed of ¼" masonite, 12" x 13¼", the same dimensions as the turntable mounting board. The bottom cover of the phonograph is 10½" x 12", constructed of perforated masonite for ventilation. It is mounted onto two strips of 1" x 1" moulding 10½" long nailed to the inside of the case ¼" from the bottom.

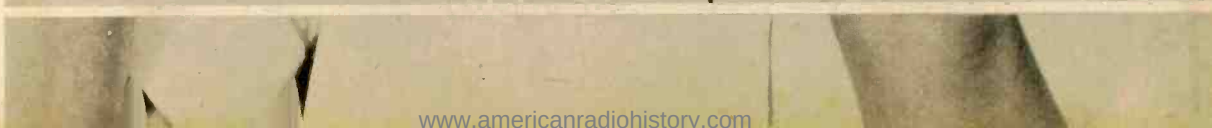
# The Compactron

**A new look in tubes: many elements and functions in single bulb make for compactness and economy.**

IN spite of the hullaballoo in recent years as new uses for transistors and other semiconductors came along, the vacuum tube is still very much with us. As everyone knows, there are still some jobs that tubes do better than transistors, or that transistors cannot do at all. There are other tasks that tubes still perform as well as transistors, and even as economically, given proper design of the tubes or the circuits. [*Continued on page* 103]







# How to Buy A Transistor Radio

**You can be taken in by a simple electronic fraud. Insist on quality, beware of "miracle" novelties.**

**By Richard Stollmack**

General Manager, Transistor World, Inc.

THE sign on the window outside read "ALL-TRANSISTOR RADIOS GOING BELOW COST. MUST SELL NOW!"

In the store, a smiling customer lured by the rows of glistening sets in the window listened happily as one station after another came in on a $7.65 set sitting on top of the show case.

What he did not know was that when the set was brought home he would be lucky if it brought in more than one or two stations with enough volume to permit listening without an earphone.

In his search for a bargain, he had bought what is only a toy, containing only two of the "miracle transistors" that are now powering almost every portable sold today. What he also did not know is that he had been taken in by ole-debbil *induction*. In this instance, a longwire antenna strung under the glass of the showcase on which the demonstration set was placed.

**The author shows part-packed, obviously complex design of good sets to prospective shopper. Mr. Stollmack is a radio engineer. Sets by Toshiba.**

**Novelty set performs well if held near induction loop of long-wire antenna (which may be hidden under counter) but works poorly away from it.**

Confronted by attractive boxes of various shapes and sizes, and by a welter of claims that make almost all sets sound alike, how is the shopper to know which set is worth buying?

Everyone can use the following guides to select a set that will give satisfactory service and give full value for money spent:

- Make certain you buy from a store you know, or one that has a good reputation. You'll find that a reputable retailer will not misrepresent the merchandise he sells, and that he will stand behind the radio's warranty.
- Don't buy a radio with fewer than six transistors, if you want worthwhile performance. Look also for a superheterodyne circuit. A quick check of this is the tuning capacitor: it will have at least two sections. Five transistors merit an "adequate" rating; less than five, the set should be considered a toy or novelty. It takes at least five to make a superhet circuit.
- Insist on handling the radios shown you. Take them outside the store or close to a window to see how they play. Turn the set upside down to make certain it continues to work: some of the cheaper ones won't. As you revolve the set, discount the directional effects of the built-in ferrite antenna. The set should play, even though it is turned 180°.
- Insist on having the set opened. Compare the inner construction with a higher-priced set. Shoddy construction or a paucity of parts, no matter how large the case, are a warning signal.

# E I Picturescope

**The suit may look stuffy, but the man inside is a lot cooler than he would be without it. It shields him from intense electromagnetic fields, like those produced by big radar sets.**

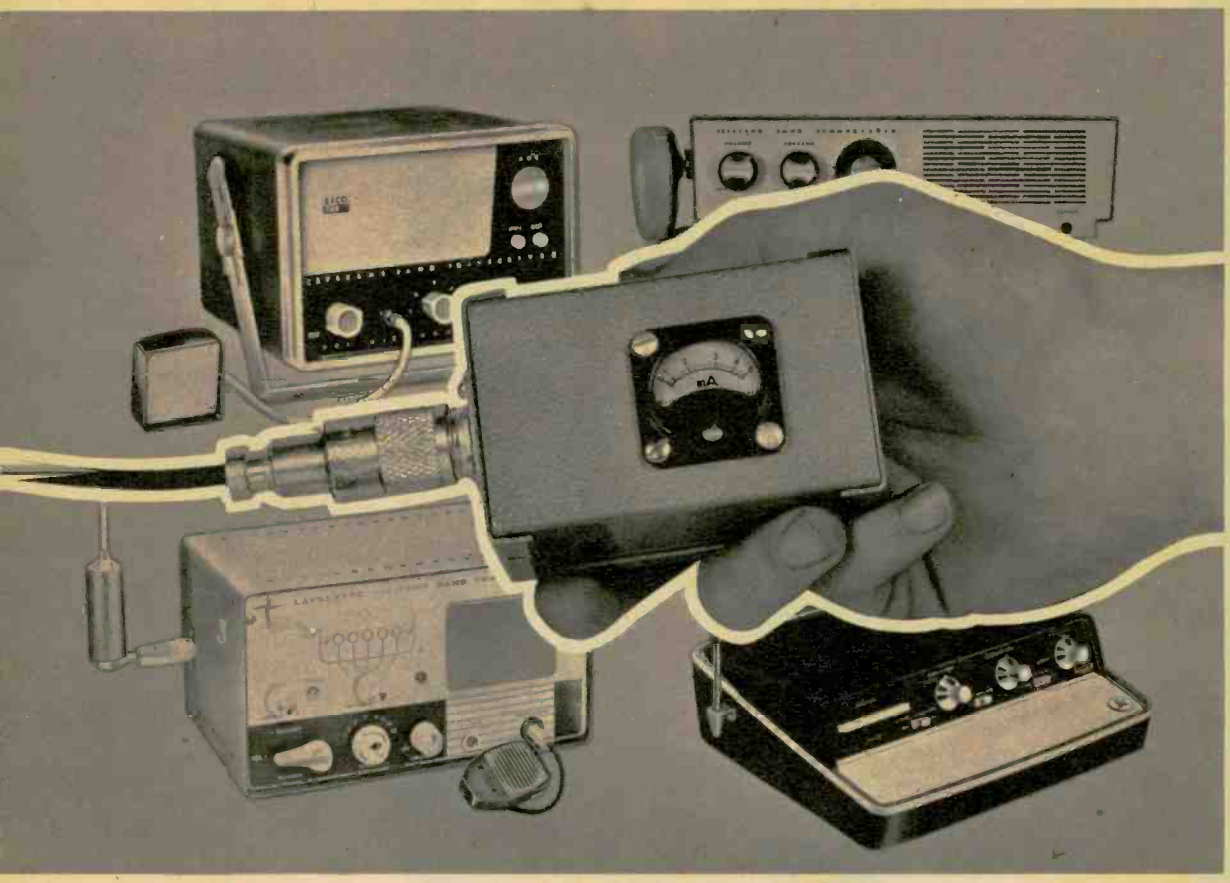
Courtesy Filtron Co., Inc.

**There are no dial lights in this tuner. Dials and labels are printed on a new electroluminescent panel manufactured by RCA. Panel is intended for decorative lighting, safety signs, home night lights, advertising, and other uses.**

English-built Pye Monster Slave Manipulator can handle radioactive specimens, wrestle heavy machinery, or delicately pick up skirt. Girl is neither monster nor slave.

This surveyor uses what may be the world's smallest *mobile* radio to direct piledriver crew, talk with other surveyor across harbor.

Hams, attention! Why labor to put up a beam? Hiller Co. helicopters put up two beams at Stanford U. Radioscience Lab in 16 minutes.



# CB Power Output Meter

**By Leo G. Sands**

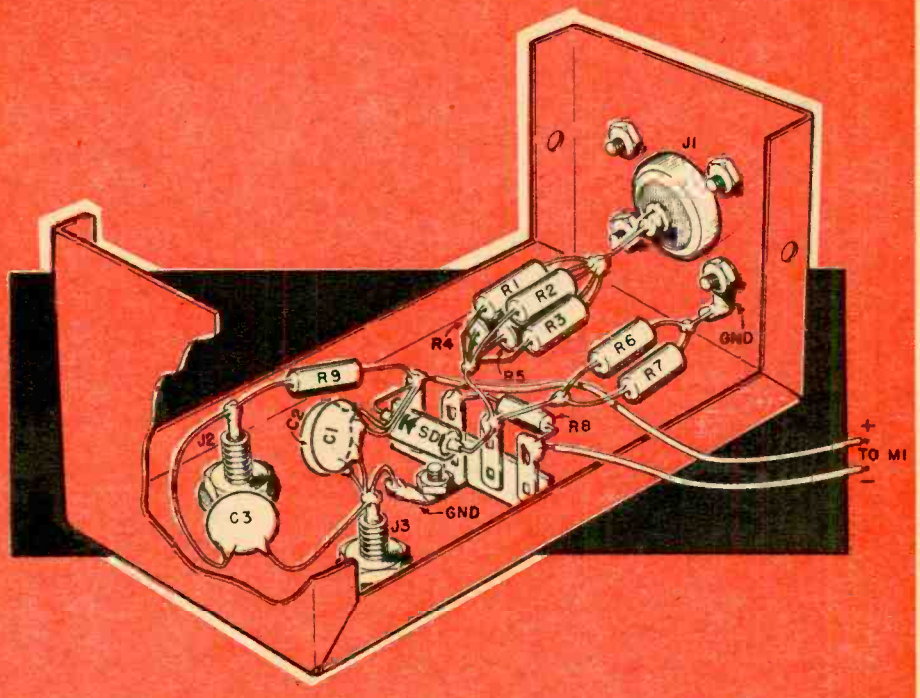
THE FCC allows class D Citizens Band stations to operate their transmitters at up to five watts *input*. But, as far as "getting out" is concerned, it's power output, that matters. Even if the power input is five watts, or close to it, the power output may be anywhere from less than one watt to as high as three watts. It depends upon the efficiency of the transmitter which in turn, is determined by the circuit, tube condition, the activity of the crystal, and the tuning.

Often, a No. 47 pilot lamp is used as a dummy antenna when tuning a CB rig which also serves as an indicator of relative power output. The brighter it glows, the higher the power output. But quantitatively—how much?

You can answer the power output question by making your own RF power measuring meter. It will not be as accurate as a $100 laboratory-grade instrument, but is accurate enough for use by the CB devotee and service technician.

The output of the transmitter is fed through a short length of RG-8/U or RG-58A/U coaxial cable into a 50-ohm dummy load

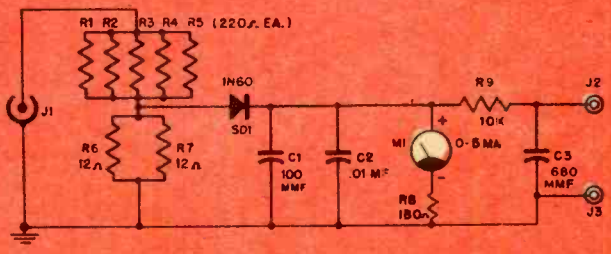
All components fit into the compact case without crowding. Pin tip jacks J2 and J3 are insulated from chassis.

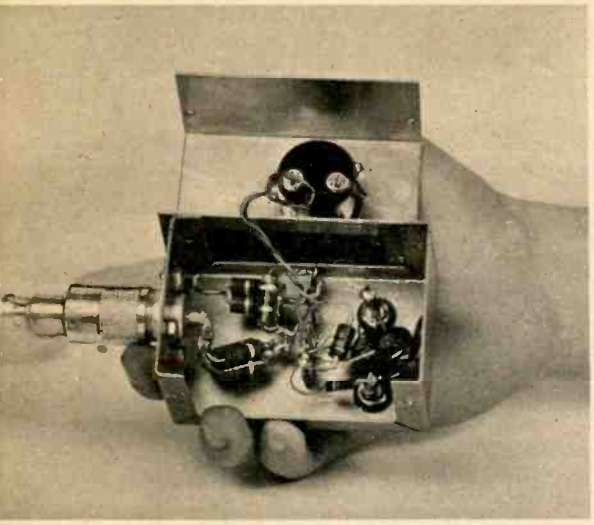



Tip jacks J2 and J3 enable use of a VTVM or an oscilloscope to observe the modulation pattern.

PARTS LIST

R1 to R5—220 ohms, 10%, 1 watt resistor
R6,R7—12 ohms, 10%, 1 watt resistor
R8—180 ohms resistor (see text)
R9—10,000 ohms ½ watt resistor
C1—100 mmf disc capacitor
C2—.01 mf disc capacitor
C3—680 mmf disc capacitor
SD1—1N60 diode
J1—chassis-type RF receptacle (Amphenol SO-239 or equiv.) with matching cable connector (Amphenol PL-259 or equiv.)
J2,J3—insulated pin tip jacks
1—2 foot length of RG-58A/U coaxial cable





**The coaxial cable has a PI-259 plug on one end to mate with a SO-239 socket (J1) and a plug at the other end to match CB connector.**

(R1-R7) built into the box of the Output Meter. Power is determined by rectifying the RF voltage across R6-R7 and measuring the resulting DC voltage.

When the transmitter power output is two watts, for example, 10 volts of RF will be developed across the entire dummy load. Of this, 12% or 1.2 volts (across R6-R7) is fed to rectifier SD1. The DC voltage developed across C1 is measured by meter M1.

The 5 ma meter used by the author has an internal resistance of 50 ohms. With this particular meter a 180-ohm series resistor provides full-scale reading when the transmitter output is 16 volts or 5.1 watts. A 180-ohm resistor serves as R8 if you use the meter specified in the Parts List (or a meter with the same internal resistance). Otherwise you will have to experiment to find the proper value. Substitute a 300 ohm pot for RB and adjust it to determine the correct value.

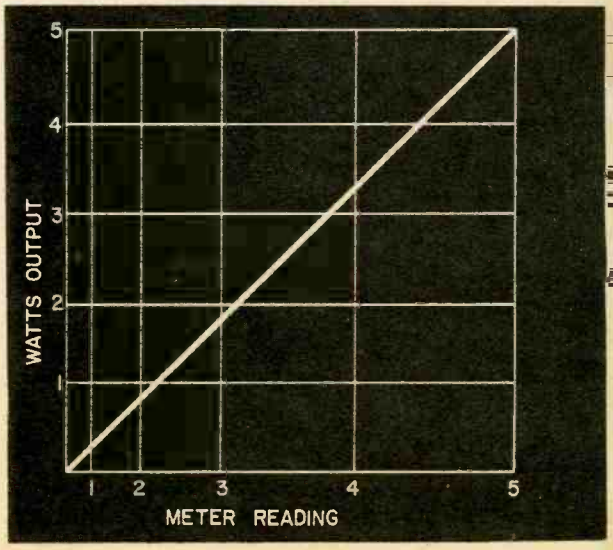
### Calibration

To make a rough calibration, connect a 12-volt dry battery (such as a transistor battery) to input jack J1. Try various values of R8 until the meter reads about 75% of full scale. The meter indicates voltage changes which must be transposed into terms of power as is shown in the graph.

The power measuring system can be very helpful when testing and tuning a CB transmitter since it serves both as a dummy antenna (preventing the transmitter from causing interference) as well as a tuning indicator. It can also be used for measuring modulation. When someone is speaking loudly into the microphone, the meter reading should rise 22.5% when the transmitter is being modulated 100%. A 22.5% increase in meter reading indicates a 50% rise in transmitter power during modulation. Most Citizens transmitters are capable of almost 100% modulation; none should be modulated more than 100% because distortion and unlawful interference will result.

While this type of RF power measuring device is not as accurate as a laboratory type RF wattmeter, it is nevertheless very useful and adequate for most purposes. As a dummy load it closely approximates a commercial 50-ohm antenna system. In testing the device, the writer found that only very slight readjustment was required when peaking up a transmitter to a live antenna after initial tune-up with the power measuring device.

**Power output graph. Read up at meter reading obtained until diagonal line is met, then read across for the corresponding wattage output.**



# Electronic Ventriloquism

**Transistorize your stage shows with this remote-control and voice-operated ventriloquist's dummy.**

Jerry Mahoney Dummy courtesy of Juro Novelty Co., Inc.

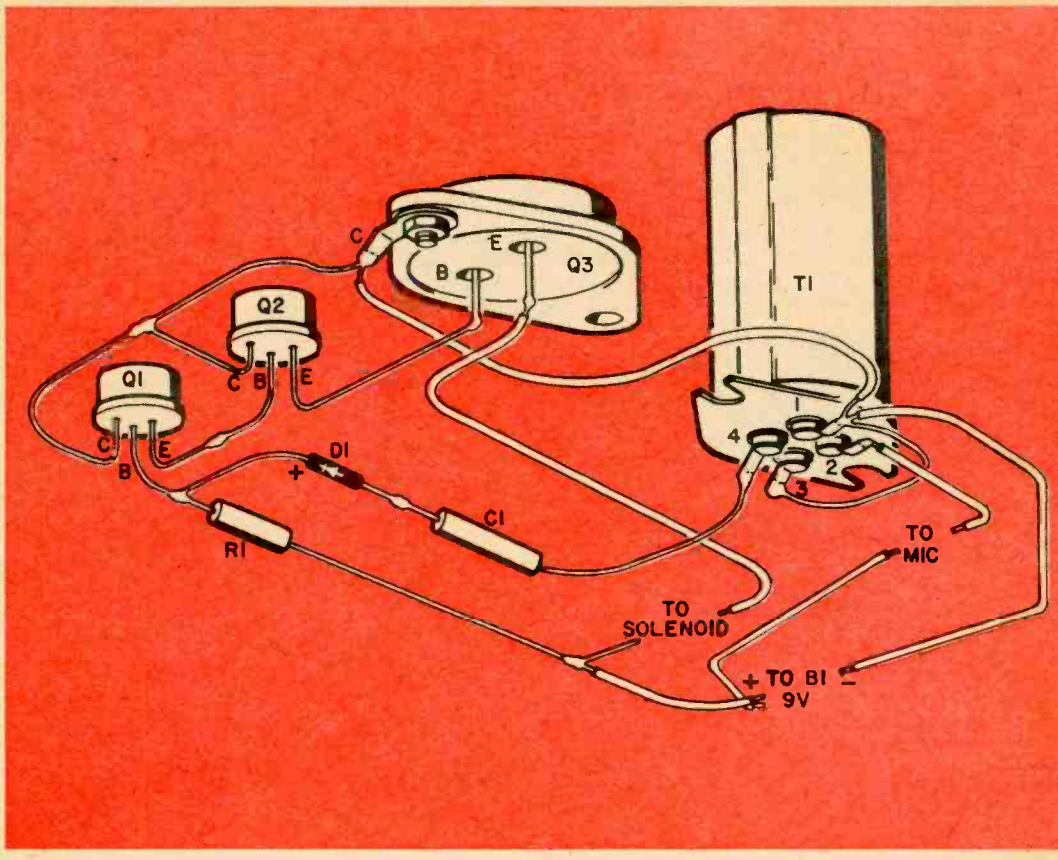
VENTRILOQUISM is a stage illusion almost as old as mankind. Attempts to fake a voice for the inanimate cate from the time pagan priests made stone images speak with the Voice of the Gods—right to our present day Charlie McCarthy and Jerry Mahoney.

Now, you can become an *electronic* ventriloquist by a simple modification of a standard dummy. No talent is needed (other than electronic) to enable the dummy's jaw to wag automatically in time to your voice. All you have to do is speak into the microphone of the control amplifier and a transistor-driven solenoid will pull the dummy's jaw string in synchronization with your voice.

You can also connect the dummy to a radio or tape recorder. All you have to do is disconnect both leads of the radio's output transformer at the points where they connect to the radio's speaker. Now connect the radio's output transformer leads across terminals 1 and 2 of transformer T1 in the dummy's control amplifier. Do *not* keep the microphone in the circuit.

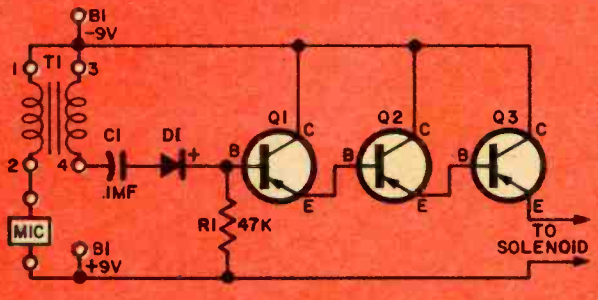
The control amplifier may be constructed in any one of a number of ways. A perforated board may be used as a chassis. Battery voltage can range from 9 to 12 volts and since battery life is moderately short, it's best to use heavy-duty or rechargeable types.

If desired, you can use the voice-control train relay (See page 36 of this issue) instead of the control amplifier shown. You will have to use a different pair of contacts on relay RY1 for the output connection. Connect the solenoid and its power source to terminal 1 and the terminal *between* 1 and




**Arrangement of components is not critical. Use lamp cord for connection to the solenoid. Heat sink the leads when soldering to transistor lugs.**

**Transistor amplifier for jaw mechanism. Direct-coupled stages are used to drive the solenoid directly. A twelve-volt battery supply may be used.**




PARTS LIST

Q1,Q2—2N1266 transistor (Sylvania)
Q3—2N256 transistor
T1—Carbon microphone transformer supplied with carbon microphone button
(Available from Burstein-Applebee, 1012 McGee St., Kansas City 6, Mo. Stock No. for both items 18A533 $1.49 plus postage)
C1—.1 mf low voltage type capacitor
D1—Any general purpose diode (1N34 or equiv.)
R1—47,000 ohm, ½ watt resistor
1—Solenoid, Ledex 6-volt DC rotary solenoid available from Universal Relay, 42 White Street, New York 13, N. Y. ($2.00)
1—Carbon microphone (see T1)
1—Heavy duty 9-12 volt battery

2 on the pictorial diagram on page 38.

A rotary solenoid serves to pull the dummy's jaw string. The solenoid is a special type which combines low current drain with sufficient power. It will be necessary to loosen the jaw action of the dummy to have the solenoid work properly. In the Jerry Mahoney dummy used, this can be accomplished by pulling the dummy's jaw *forward* and unseating it from its swivel pin. Carefully note the position of rubber band holding the jaw in place. Now substitute a lighter weight rubber band so that the jaw will still close by itself, but with a minimum of restoring force.

The rotary solenoid used was mounted with wood screws and two ½" standoffs. There is nothing to prevent you from using other types of solenoids; a stroke of about 90 degrees and 5 ounce-inches is required.

The control circuit for the dummy's jaw solenoid was especially designed for this project. Three transistors are used in a direct-coupled configuration that works like this: when you speak into the carbon microphone, the voice pulses are fed through matching transformer T1. At the secondary of T1, diode D1 converts the AC voice signal to DC and feeds it through the DC amplifier circuit formed by Q1, Q2 and Q3. The small current at the input of Q1 is amplified sufficiently to throw the low-resistance solenoid connected at the emitter of Q3.

For full remote operation and to heighten the illusion, you can install a small speaker in the hollow space in the dummy's chest. This can be driven by the radio or tape recorder amplifier or a separate amplifier can be hooked up in parallel with the solenoid control amplifier, both driven by the same carbon microphone.

Because of the many types of dummies available, a certain amount of the construction details will have to be left up to the ingenuity of the builder. The basic principles are here however, and it's up to you to make use of them.

**Solenoid is mounted on dummy's head stick. Solenoid arm stroke should pull jaw string.**

**Jaw string must be adjusted critically to solenoid lever for pull and return action.**

## EI's Money Making Careers in Electronics

# Menu Music Nobody Hears

**Carefully-chosen, "unheard" background music makes profits for local supplier. Could this be you?**

**By James Joseph**

MUTED music can make money. It has for 37-year-old Joe Bein, a kind of in-business-for-himself disc jockey who counts every listener a liability.

Bein's electronic specialty is background music, the nebulous melodies which soothe restaurant diners (but never disturb their table talk), calm the doctor's waiting patients (without upping their blood pressures), ease fatigue along production lines (without distracting busy fingers) and warm the most austere of corporate offices.

"Mine," concedes Bein, "is music calculated to woo no listeners."

And that's what Joe's more than 300 clients want: music that keeps to the background.

Unobtrusive though it may be, it has shoved Joe—as it can you—into the economic forefront.

For background music, though big business, is uniquely tailored to the local little fellow . . . the electronic careerman who hankers to pull bankable C-notes out of thin air.

And you can when, like Bein, you "menu" music nobody hears.

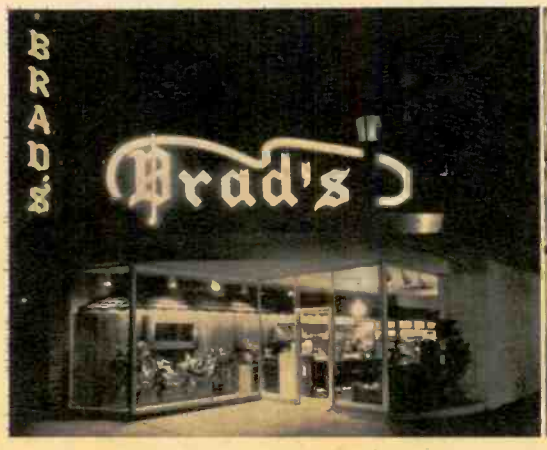
Nor must you be a financial gourmet to do it. Some backgrounders jump into the business with [*Continued on page* 106]


**Joe Bein, owner of Pan American Broadcasting Co., checks installation in big restaurant. He leases gear, "sells" music to businesses.**

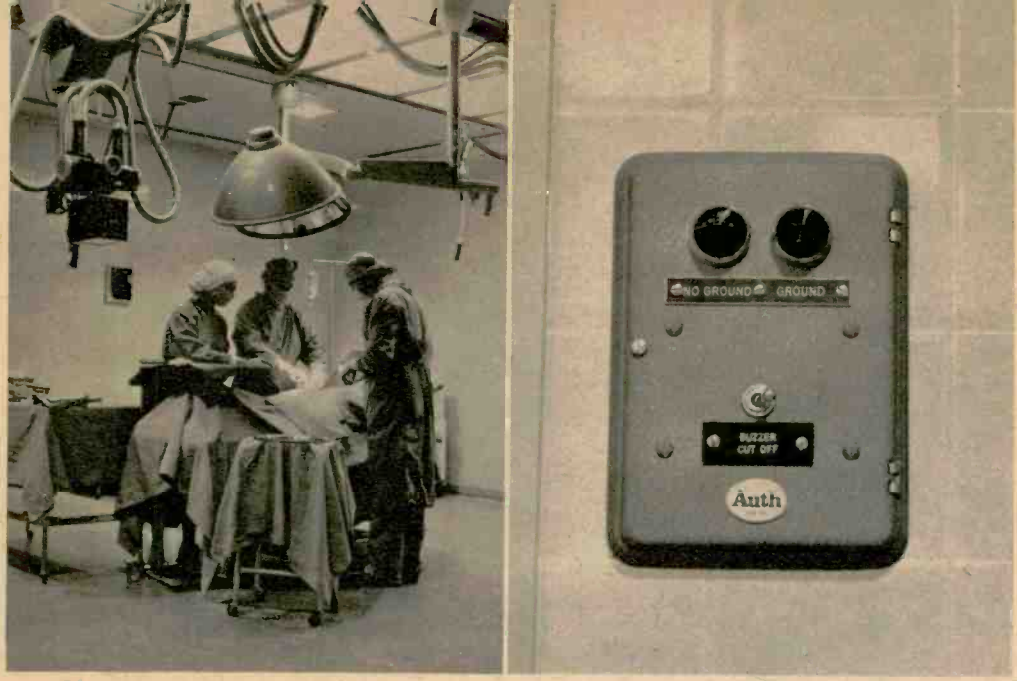
**Bein's 4-man maintenance crew tends sound systems in business premises of 300 clients, ranging from doctors to industrial plants.**

Bein selects tapes to be played over FM station that feeds his "network."

Restaurants are big buyers of background music. It must soothe and stimulate customers without intruding, competing with table talk.




Industrial researchers say music can increase production by 20%. Many plants use it. Tempo and rhythm changes help workers fight fatigue.




The operating room floor is conductive at Long Beach Memorial Hospital. This lessens danger of static sparks building up and setting off explosions in anesthetic gases, as charges are constantly drained to ground. If floor loses conductivity, sensing unit, right, responds with alarm.

# Electronic Hospital

## New patient comfort and more effective treatment result when electronics saturates a hospital.

ONE by one, electronic devices have become standard items of hospital equipment. Perhaps the earliest, except for specific therapeutic items like diathermy, was the public-address paging system. Now, a hospital has been built that was designed as an "all electronic" hospital from before the architect touched a pencil to his drawing board.

From central computer and "memory" banks at its switchboards to a knob that raises a patient's bed, Memorial Hospital at Long Beach, California employs electronics for two kinds of tasks: those that humans cannot do (like guarding the conductivity of an operating room floor) to those that humans cannot do as well (like testing blood samples). The entire operation of the hospital is made more efficient, more convenient, more effective and more comfortable for the patient because of carefully pre-planned electronics.

For instance, the telephone switchboard "nerve center" is more than a telephone switchboard. All of the hospital's different kinds of alarm systems are wired into it, and for emergencies that require outside assistance, such as fire, the alarm goes out of the building to the proper recipient automatically.

Oxygen is piped into all patients' rooms to eliminate delays required with portable oxygen-tent equipment. If there is a malfunction in the lifegiving system anywhere, the "nerve center"

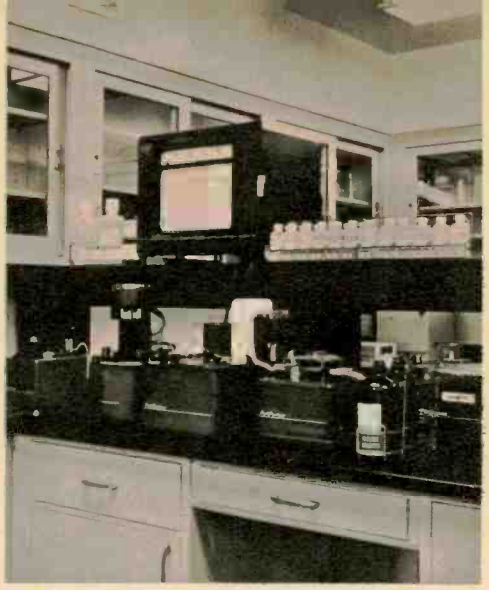
Photos by GLOBE

Red and white blood cells are counted quickly and with high accuracy by new electronic Coulter counter, which replaces slow "human" method.

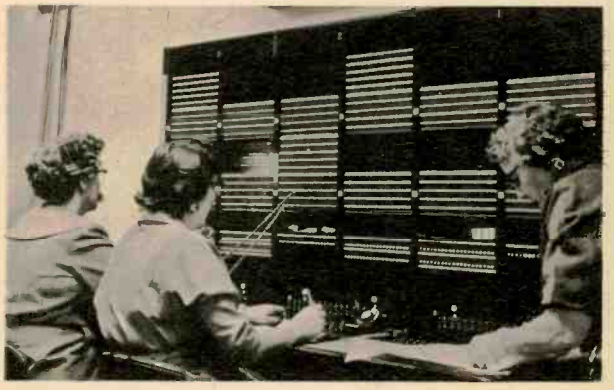
Clinical gas partitioner analyzes oxygen-$CO_2$ relationship in heart patient's blood, helps determine how much physical work he may safely do.

Nurses carry pocket paging radio. Bedside panel has patient's telephone, entertainment radio-TV control, pillow speaker, bed controls.

Chloridometer replaces old, slow chemical titration method of measuring chloride-ion content of blood serum with higher accuracy.



Auto-analyzer for blood plasma does three times as many samples as older methods, at five times the accuracy in same working time.



Switchboard "nerve center" also keeps track of doctors, senses all alarm system impulses, has two paging systems, closed-circuit TV.

Doctor's "memory unit" flashes his arrival and departure to switchboard, tells him of messages. He need not report to receptionist.

knows it and can initiate corrective action immediately.

Closed-circuit TV cameras guard halls and entrances throughout the night; unauthorized persons or unusual situations are instantly detected at the switchboard.

The "nerve center" has two major electronic "memory" banks. One of these keeps track of all doctors entering and leaving the hospital, and tells each one whether to call the switchboard for messages. As a doctor enters by any door, he picks up a wall phone and dials a number assigned to him. The memory unit registers his arrival, and if there are messages for him it gives him a "beep" signal. He then dials the operator. As he departs, the doctor repeats the procedure. [*Continued on page* 106]

Were pioneer devices "simple?" This coherer would seem to be, but whole big breadboard holds only a detector circuit, equivalent of single tube.

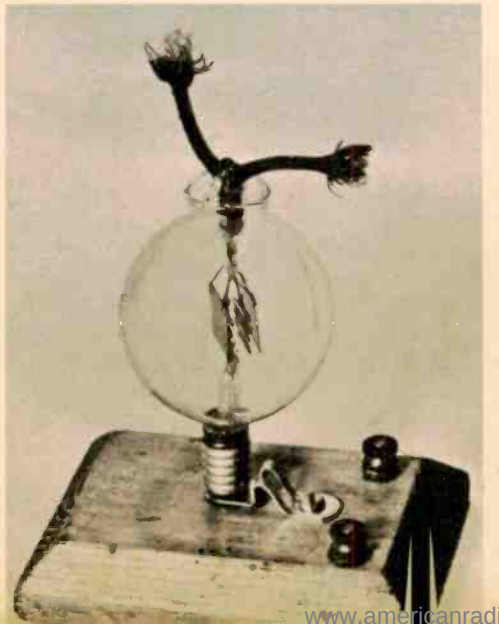
# A Page from the Past

## What can you do with a spoonful of iron filings? Pick up a transatlantic signal, the way Marconi did.

**By Howard S. Pyle, W7OE**

IT wasn't a "crystal detector" that served Marconi so well that night in December, 1902, when his first transatlantic signal reached Newfoundland from England. It was a more complicated contraption called a "coherer." At first glance nothing could be simpler than this gadget, and yet you will understand vacuum tube and transistor theory a lot easier and faster than you will understand what *really* went on inside a coherer.

Does this early DeForest "Audion" look like a light bulb? Edison just missed inventing it.



The coherer is the long, thin object in center of picture above. It is a small-diameter glass tube containing a small amount of dissimilar metal filings. (Usually iron and nickel were used.) The ends of the tube were sealed with metal plugs that formed the contact with the filings.

Just lying there, the filings were a poor conductor, and not enough current from the equipment's batteries flowed through them to pull the relays or do anything else. When an RF "impulse" came down the antenna, however, the filings stuck together or "cohered," and they became a good conductor. Battery current flowed, relays threw, sounders clicked, and oh, yes, there was that doorbell. [*Continued on page* 109]

# How to Get That QSL

**Proof of your DXing prowess is the verification card. To get it, give the station what it needs.**

**By Gene A. Statler**

SOONER or later, after a short wave listener has logged a number of stations, he is likely to be bitten by the QSL bug. When this happens he looks forward to decorating the walls of his "shack" with colorful pasteboards from old favorites such as Radio Switzerland, Radio Australia, Radio Nederland, and Radio Japan, or rare ones like Katmandu.

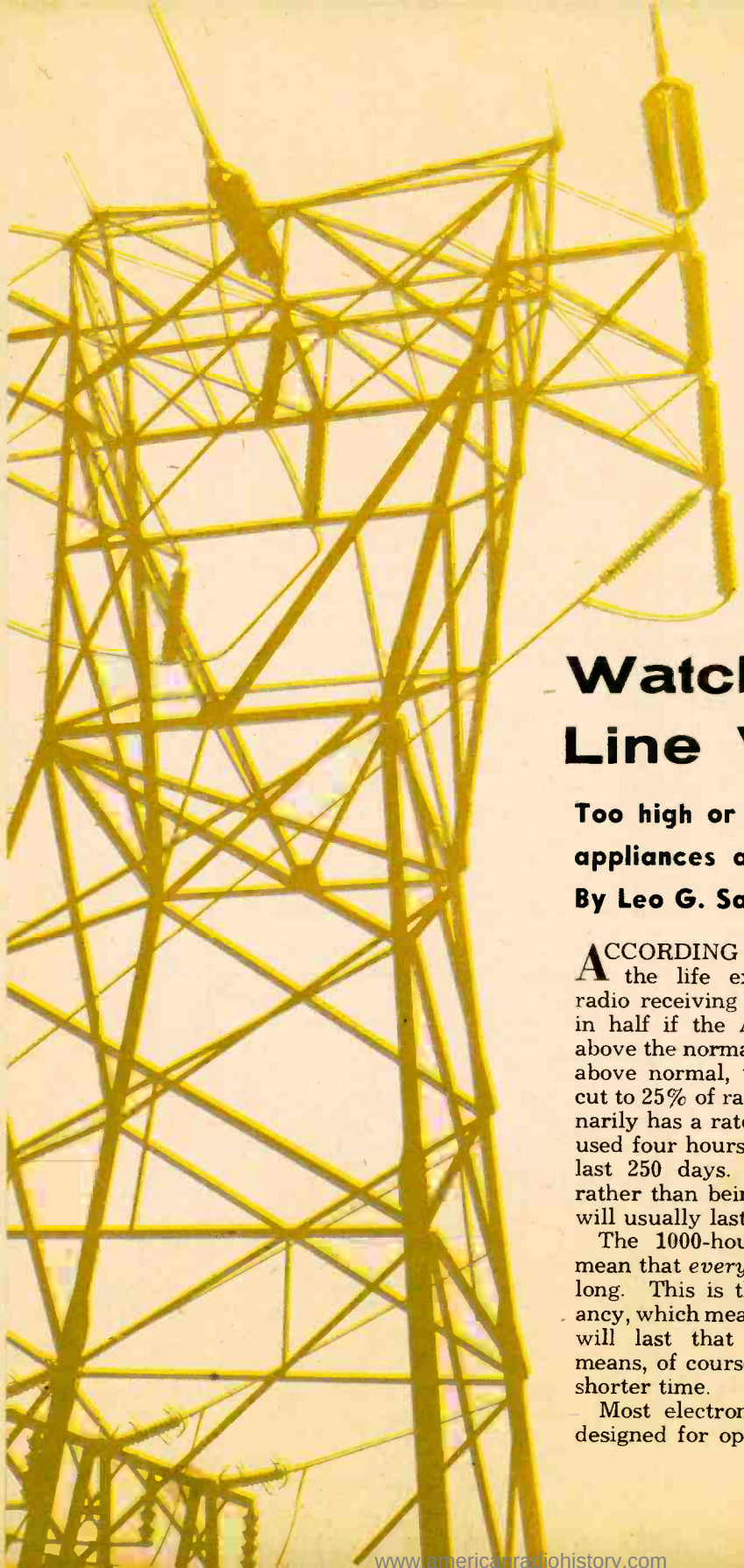
Of course, as every SWL knows, QSL cards aren't collected for their color and beauty alone. They are the verification or proof of reception of distant stations.

Listeners are the lifeblood of any radio station, and the short-wave station engineer especially is interested in reports from distant listeners. Returning verification cards, or QSL's, involves some expense, but this is accepted in order to encourage reports of reception.

There is a lot more to collecting QSL cards than merely opening your mail. Ample time and consideration must be given to the subject matter of reception reports. A few basic rules must be followed in order to insure good returns.

To begin with, along with the name of the station, and its call letters (if any), the *time* of reception of the particular station should be noted. That is, the times of the sign-on and sign-off, or whatever interval in which you happened to be listening. Of course, you must include the time zone that you are employing. Some SWL's prefer to use GMT (Greenwich Mean Time). A handy rule for the conversion of this factor is to add five hours to Eastern Standard Time, six hours to Central Standard Time, and so on, to get GMT. Many SWL's are also partial to the 24-hour system of time keeping. It seems a little hard to learn, but it is very efficient and serves to eliminate the need for the a.m. and p.m. suffixes.

[*Continued on page* 105]



# Watch Your Line Voltage!

**Too high or too low and your appliances are in for trouble.**

**By Leo G. Sands**

ACCORDING to a recent GE bulletin, the life expectancy of ordinary radio receiving tubes is cut just about in half if the AC line voltage is 5% above the normal 117 volts. If it is 10% above normal, tube life expectancy is cut to 25% of rated value. A tube ordinarily has a rated life of 1000 hours. If used four hours per day, a tube should last 250 days. If used continuously, rather than being turned on and off, it will usually last much longer.

The 1000-hour rated life does not mean that *every* new tube will last that long. This is the *average* life expectancy, which means that 50% of the tubes will last that long or longer. This means, of course, that many will last a shorter time.

Most electronic equipment today is designed for operation from a 117-volt

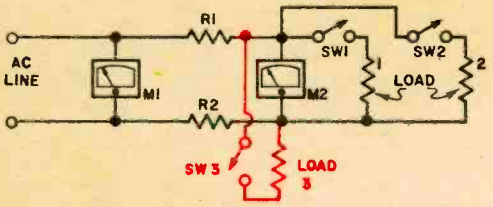



**Fig. 1. Ideal no-load voltmeters M1, M2 read line voltage according to switch positions.**

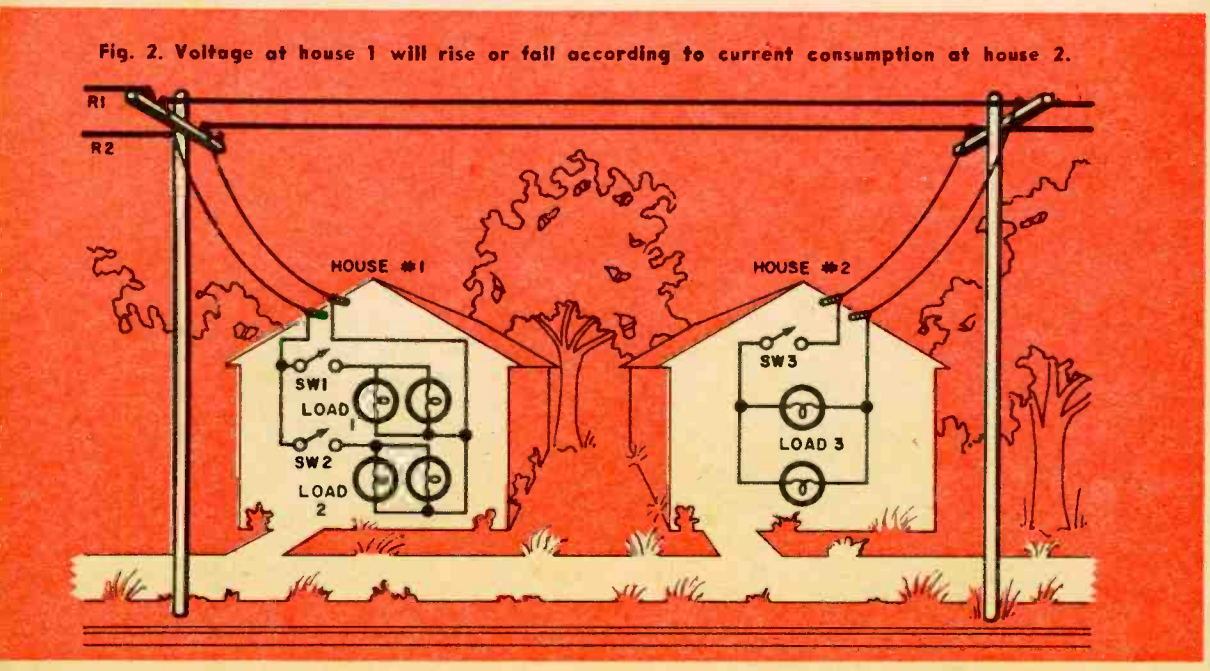
AC source. If the line to which it is connected provides 117 volts at all times, optimum performance and satisfactory tube life should be expected.

Line voltage is high, low or varies for several reasons. The power line wire itself acts as a series resistance using up some of the available power. Naturally, the smaller the diameter of the wire and the longer the line, the greater is the resistance. As current flow through the line rises, the voltage drop in the line increases.

If, for example, the line resistance is one ohm, one-half ohm in each wire, as symbolized by R1 and R2 in Fig. 1, "ideal" no-load voltmeters M1 and M2 will indicate the same voltage as long as switch SW1 and SW2 are open. But, when SW1 is closed, current flows through R1 and R2 as well as load 1. If the load "pulls" 10 amperes through the line, there will be a 5-volt drop across both R1 and R2 ($E = IR$) resulting in a 10-volt total drop in the line voltage reaching load 1. Voltmeter M1 will continue to indicate 117 volts but M2 will indicate only 107 volts. When the current drain is increased to 20 amperes by closing switch SW2, the voltage drop in the line is doubled and the voltage read across either load will be only 97 volts.

Now let's look at the situation as shown in Fig. 2. Here, we are showing the loads as houses, and another house fed from the same power line has been added and called load 3. When switch SW3 is closed, there is a further voltage drop in the power line because the load of the second house is bridged across it and the current consumed by both houses flows through the line. The voltage at house No. 1 rises and falls according to the current consumed at house No. 2. To insure adequate power delivery to all customers, power com-

**Fig. 2. Voltage at house 1 will rise or fall according to current consumption at house 2.**



| Equipment rating | Current drain | SERIES RESISTOR For 5-volt Drop | | For 10-volt Drop | |
|---|---|---|---|---|---|
| Watts | Amperes | Ohms Resistance | Power Rating | Ohms Resistance | Power Rating |
| 30 | .26 | 20 | 4 | 40 | 5 |
| 60 | .51 | 10 | 5 | 20 | 10 |
| 100 | .85 | 5 | 10 | 12 | 20 |
| 150 | 1.28 | 4 | 10 | 7.5 | 20 |
| 200 | 1.71 | 3 | 20 | 5 | 25 |
| 250 | 2.14 | 3 | 20 | 5 | 50 |

panies boost the line voltage so that the voltage at the last house on a line will be adequately high. Thus, the line voltage at any particular house may vary as the demand for electricity varies.

If your tubes burn out too frequently, check your line voltage. If you don't have an accurate meter available, ask your power company to measure the line for you.

High line voltage appears advantageous in that your lamps glow brighter, your electric range heats faster and your TV set has ample picture size. But, your lamps and tubes won't last as long and your electric bills will be higher.

There are several ways you can cut the line voltage down to normal. You can use a series resistor or an auto transformer. The right size resistor for cutting down line voltage 5% or 10% is listed in the chart for equipment of various input wattage ratings. The resistor should be mounted outside the chassis for adequate ventilation.

An ordinary 10-volt filament transformer can be used as a 3-step autotransformer, when connected as an autotransformer with the 5-volt secondary in series with the primary. The windings can be connected to aid or oppose each other, as shown (right). A single pole, 4-position rotary switch permits selection of +5 *volts*, "normal,"—5 *volts* and *off*.

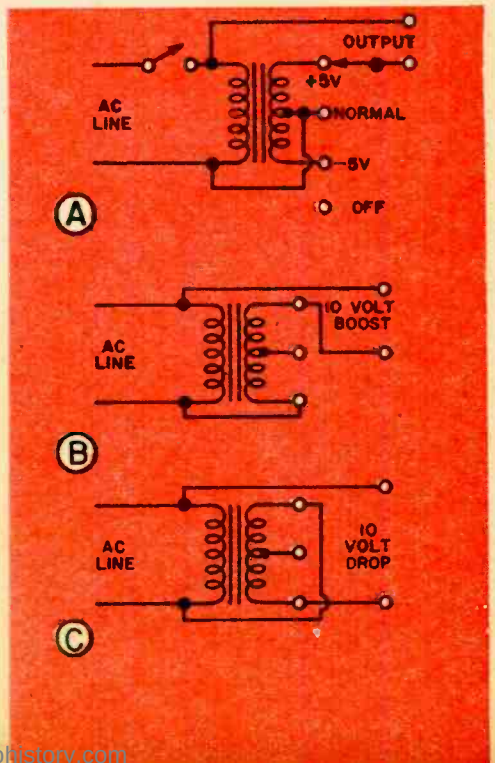
A variable autotransformer such as the Variac or Adjust-A-Volt, which permits adjustment of input voltage to any value between 0-132 volts may be used. Of course, you need an accurate voltmeter to set it right.

Best of all is a voltage regulating transformer between the equipment and the line. These transformers maintain line voltage constant to within ±3% of the nominal value, offsetting line voltage increases up to 130 volts and decreases to 95 volts, but this unit is expensive.

### Low Line Voltage

Low line voltage on the other hand, may increase [*Continued on page* 110]

**A shows hookup of a filament transformer used with four position switch. B is a filament transformer hookup for a 10-volt boost and C is reversed phased for a 10-volt drop.**



# Electronic Brain

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

### Tunnel Diodes

*I have been seeing some advertisements in the magazines for "tunnel diodes." What are these and how are they used?*

*A.C. Carter, Smithtown, Long Island*

The tunnel diode is a radically new semiconductor device somewhat like a transistor. It can perform switching and amplifying functions like the transistor and is expected to be easier and therefore less expensive to make with higher frequency capabilities. It is also smaller, more stable and more resistant to nuclear radiation and temperature change.

Tunnel diodes are expected to find wide use in computers, earth satellites, missiles, and high frequency communications equipment. The original tunnel diodes were made of germanium, but newer types fabricated of gallium arsenide have now made their appearance. Gallium arsenide is a little known and rarely used semiconductor material. It has unique electrical properties and offers some advantages over both germanium and silicon.

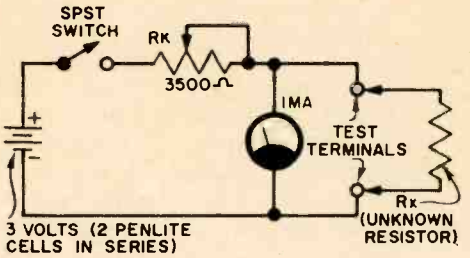
### Low Resistance Ohmmeter

*Can you provide a circuit for a "low-ohm" ohmmeter suitable for measuring resistances below 2,000 ohms? I would like to use a basic 0-1 ma meter movement.*

*M. Driskell, Selma, Alabama*

A simple circuit that will give very precise results is shown in the accompanying figure. In the form shown, it is necessary to use a simple formula for finding the unknown resistance, but a calibration chart can easily be drawn up once the instrument has been constructed and tested.

Since $R_k$ is adjustable, it can be set so that exactly 1 ma flows when the unknown resistor $R_x$ is *disconnected* from the terminals. If the battery voltage is exactly 3 volts, then $R_k$ will be 3,000 ohms for 1 ma under these conditions. Next, $R_x$ is connected to the terminals and the meter reading again noted. This will be less than 1 ma since the unknown resistor is shunting the meter. By substituting in the formula below, $R_x$ is easily obtained.




$$R_x = \frac{I_a \times R_m}{1 - I_a}$$

where $R_x$ is the unknown resistor, $I_a$ is the current read with $R_x$ connected across the terminals, and $R_m$ is the resistance of the meter movement. This latter value should be known accurately and may either be measured or obtained from the manufacturer's specifications for this instrument.

### Antenna Trimmer

*When a long-wire receiving antenna is used with a multiband receiver, would the reception be improved by the use of an antenna trimmer? What size should the capacitor be?*

*William E. Burke, Albany, New York*

Yes, indeed!

Any antenna should be electrically "trimmed" with the help of a trimmer capacitor to afford optimum signal strength, hence the best signal to noise ratio.

You will find that a trimmer capacitor of the air variable type with a maximum capacitance of about 150 mmf should improve the performance of your receiver on all bands.

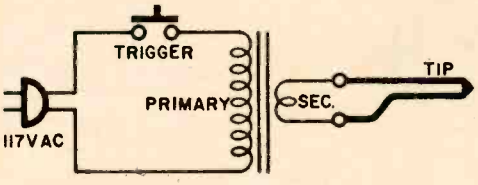
## Soldering Gun Operation

*Can you explain the operation of the "instant-heating" type of soldering gun? Why can't I get a voltage reading across the tip contacts when the iron is turned on? How can zero voltage produce a large enough current to produce all that heat?*

*Robert Home, Simla, Colorado*

Let's answer the last part of your question first: *zero voltage cannot produce any current at all* in the tip of the soldering gun. Hence, at least one of your premises is incorrect.

A soldering gun consists mainly of a special step-down transformer with a 117 volt AC primary and a very high current, low-voltage secondary. In a medium duty gun, the secondary wires are usually B & S gauge #6 or #8. This winding contains very few turns.




When the trigger is squeezed, the circuit to the primary is closed. Since the tip has very little resistance, the current that flows (even as a result of the stepped-down voltage) may be comparatively enormous. For example, suppose that the voltage under load applied to the tip is only 1/10 of a volt, but with a tip resistance of only 1/1000 of an ohm, the current would rise to *100 amperes.*

To measure the voltage applied to the tip, you would have to use an AC voltmeter; furthermore, the voltmeter would have to have a very low range.

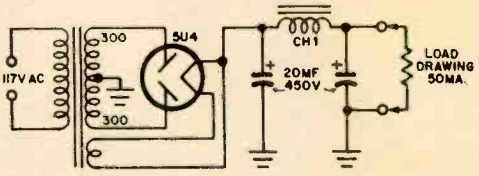
## Filter Chokes

*What is the value of the filter choke in the accompanying power supply diagram? How is this value determined?*

*Thos. B. Maugham, Highland Park, N. J.*

A choke in a power supply is generally selected on the basis of the amount of ripple-reduction required of it. Thus, it is not possible to specify the value of a choke without knowing the maximum hum rating of the power supply.

On the other hand, the schematic diagram included with your letter shows that the power supply is quite conventional; the fact that it is a capacitor-input type using a single pi-section for filtering indicates that the ripple reduction specifications are not especially severe. On this basis, we can suggest a filter choke that will work well with the filter capacitors given in the diagram. A 15-henry choke, rated at 75 ma will provide more than adequate inductance




for good ripple reduction and, at the same time, is over-rated by 50% with respect to current for complete safety. Since the load on the supply is to be 50 ma, a choke rated at 75 ma will have its maximum inductance and run cool.

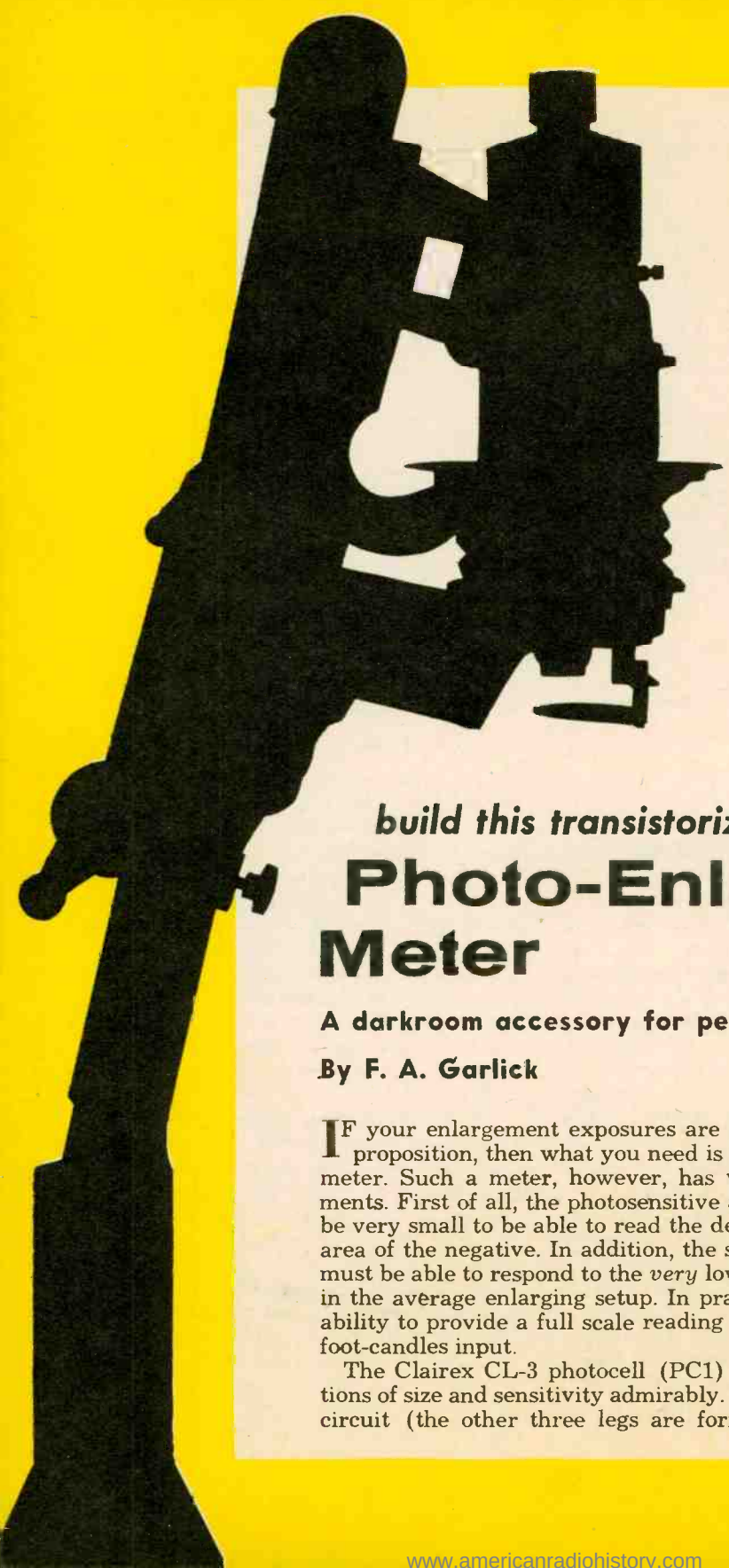
## Vacuum Tube Glow

*Can you tell me whether vacuum tubes that show a violet glow on their glass shells are faulty? What does the glow indicate?*

*Jonathan Kesselman, Louisville, Ky.*

If the glow is clearly visible on the glass itself, there is probably nothing at all wrong with the tube. This effect is due to the fluorescence of impurities often found in glass caused by the bombardment of stray electrons that have somehow managed to break away from the main stream between the cathode and plate.

On the other hand, a violet glow in the evacuated space in the tube envelope indicates the presence of excess gas. Such tubes are said to be "soft" and should be replaced to restore the equipment to normal operation. Even though the seal of the tube may still be perfect, gas ultimately gets into the tube by a process called *exudation.* Small amounts of oxygen, nitrogen, carbon dioxide and other gases are absorbed in the metal of the electrodes during manufacture and is released slowly into the envelope during the life of the tube.



## *build this transistorized*

# Photo-Enlarging Meter

**A darkroom accessory for perfect prints.**

**By F. A. Garlick**

IF your enlargement exposures are usually a hit or miss proposition, then what you need is an enlarger exposure meter. Such a meter, however, has very special requirements. First of all, the photosensitive area in the unit must be very small to be able to read the density of a very small area of the negative. In addition, the sensitivity of the unit must be able to respond to the *very* low values of light used in the average enlarging setup. In practice, this means the ability to provide a full scale reading with only about four foot-candles input.

The Clairex CL-3 photocell (PC1) fulfills the qualifications of size and sensitivity admirably. It is wired in a bridge circuit (the other three legs are formed by R2 and R1)

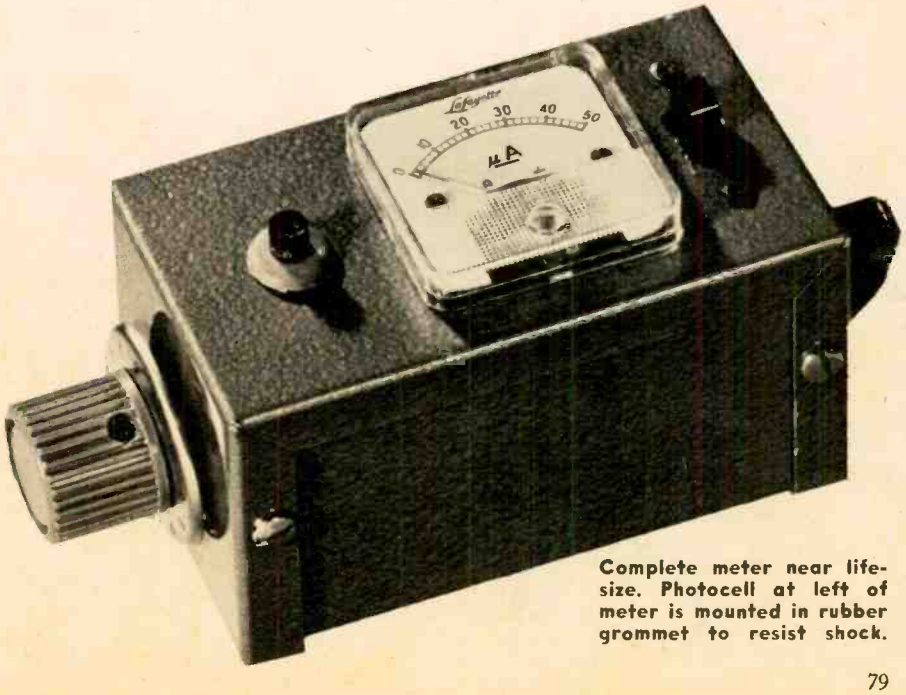
powered by B1. The DC output of the bridge is fed to the base and emitter of transistor Q1 which drives the 50 microamp meter movement M1.

### Calibration

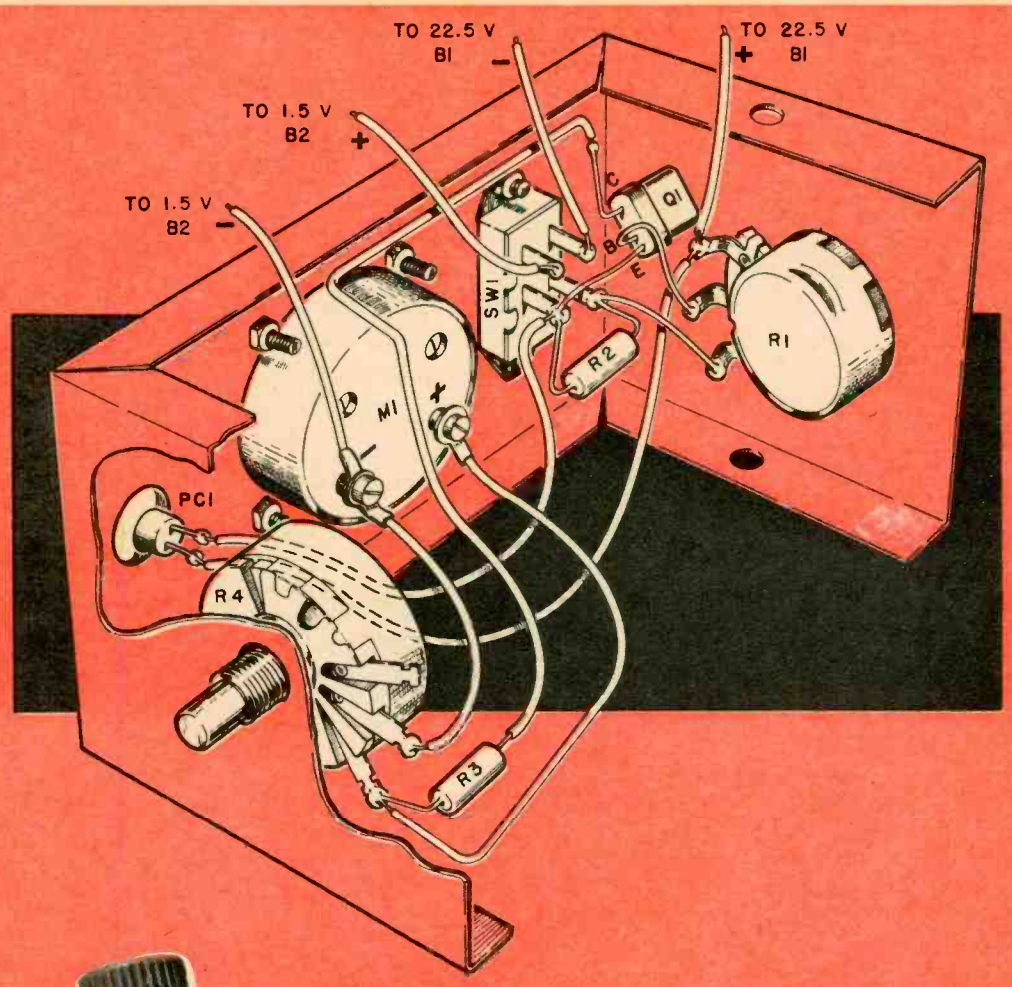
As this instrument is extremely sensitive, be sure to do your calibration under darkroom conditions. The enlarger should be turned on and its lens opened to its widest setting. Set the calibration knob (R4) to "0" (full counter-clockwise) and R1 to the highest point where the meter can be still zeroed by putting an opaque object (not your finger) over PC1. When the cell is uncovered, M1 will read between 10 and 20. Slowly turn up R4 to bring M1 to full scale. Try for the lowest setting of R4 that will provide a full scale drop when the enlarger lens is slowly closed down to its smallest stop. If the calibration knob is set too high, the meter will drop too fast. It can be set to drop the full scale over about 1 *f*. stop of the enlarger lens. However, the minimum drop per *f*. stop will give the best readings.

### Using the Meter

The exposure meter has two main functions: to read the contrast of the negative; and to give an exposure time for making the print. The contrast of the negative is determined by the variation in density of its lightest and darkest part. The light contrast scale of a scene may be about 1000-1. A negative can give as high as 300-1 while most paper has a maximum of about 30-1. Enlarging paper is generally listed in four grades: No. 1 soft, or low contrast, (for very contrasty negatives); No. 2 medium (for average contrast negatives); and No. 3 high contrast (to be used where more "snap" is wanted in average or slightly thin negatives). A contrast




**Complete meter near life-size. Photocell at left of meter is mounted in rubber grommet to resist shock.**




Tight quarters of case requires careful positioning of components. Note batteries tucked within cover.

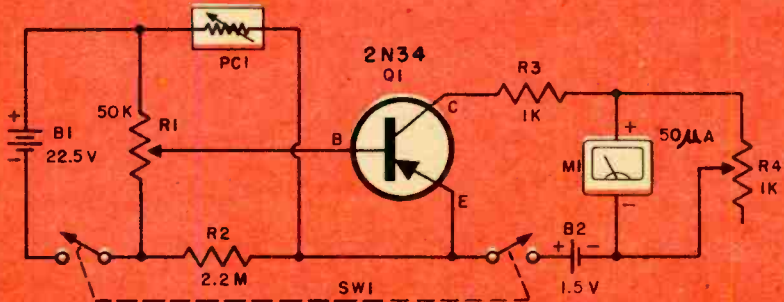
check can be made by placing the meter under the enlarger with a negative in it and the lens wide open. First place the meter under the thinnest part of the negative and adjust the calibration knob for a meter reading of 50. Then move the meter to densest part of the negative. A reading of 0-10 shows a very contrasty negative, 10-15 average, and a higher reading indicates a flat or low contrast negative. Remember that the less contrast a negative has the less variation the meter will have. A few darkroom tests with various negatives will determine the ranges for each paper contrast. A chart can be made up to quickly give you the reference you need.

To determine the exposure, first place the meter under the darkest part of the negative and then close the enlarger lens down until the meter reads zero. Make an exposure step test of say 10, 20, 40 and 60 seconds, then develop the print. A second step test that is between the step that is just over and under a good print will give you the correct exposure time. This is the time that the lightest part of the print (i.e. the darkest part of the negative) needs to just barely affect the lightest tone of the print paper. Similarly, bringing the lightest part of the negative (or shadow portion) down to a given setting on the meter dial will do the same thing. Dodging or burning in will have to be determined by experience, but the meter will give you constant exposures with varying degrees of enlargement of the same negative. It will also give you proper exposure with the various types of paper. Each grade of paper will have a different timing with the lens stopped down to the same amount of light. This can be determined by test, and noted on the side of the meter. Each type of printing paper will have to have separate tests to determine the time of exposure for them. When these tests are completed for your own setup, you will have an exact method of determining exposure for your enlargements.

Of course, the reader must keep in mind that though this device can be very useful in the photo darkroom, there is no substitute for human experience and judgment. For a really good print, not only must illumination and contrast be taken into account, but the nature of the negative development itself and what results are to be achieved.

PARTS LIST

R1—50,000 ohms potentiometer
R2—2.2 megohms, 1/2 watt resistor
R3—1000 ohms, 1/2 watt resistor
R4—1000 ohms wirewound potentiometer
Q1—2N34 transistor
PC1—photocell (Clairex CL-3)
M1—0-50 microammeter (1 1/2" Lafayette TM-200 or equiv.)
SW1—DPST slide switch
B1—22.5 volt battery (NEDA 215)
B2—1.5 volt "C" cell
Cabinet—4"x2 1/4"x2 1/4" (Bud Minibox CU2103A or equiv.)
Misc.—2 battery holders, 4 rubber feet, calibration knob numbered 0-10 with 300° arc (Lafayette KN-54 or equiv.), screws, nuts, etc.

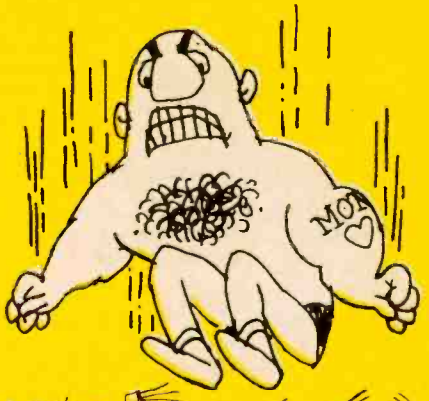



**Light striking PC1 unbalances bridge formed by R1, R2 and PC1. Bridge output is amplified by Q1. Meter M1 is calibrated by manipulating R1 and R4 slowly.**

# Are You Destroying Transistors?

By Robert Tomer

CBS Electronics




## Battery Eliminators

Part II

MANY of the standard battery eliminators are not suited for powering transistor circuits. Aside from the question of hum due to inadequate filtering of the eliminator, the big problem is voltage regulation.

Let's see what regulation means with regard to a standard six-transistor radio. By connecting a milliammeter in series with one lead from the 9-volt battery, we find that the current drawn by the set with the volume control turned down is about 4.5 ma. However, on station, with volume turned up, the current drain hits as high as 25 ma.

A poorly regulated power supply, if adjusted to provide 9 volts to a radio with the volume turned down, may fall to as low as 6 volts when the radio is playing loudly. This low voltage shows up mainly in audio distortion and lack of sensitivity. On the other hand, if the voltage output of the battery eliminator is adjusted to provide the full 9 volts output when the radio is blasting, as soon as the program stops, or the audio level falls, the power supply voltage will immediately rise higher than the normal 9 volts required. This, in turn, may well result in transistor damage.

Such poor regulation will make troubleshooting difficult, if not impossible. Wherever possible, batteries should be used to supply power. In the case of the auto radio, a battery shunted by a DC supply is ideal. The battery will filter and stabilize the output from the battery eliminator and the eliminator will in-

sure that battery is always at full charge.

It is important to note that transistor radios not only won't work if the battery terminals are connected backwards, but you may ruin them while trying to figure out what is wrong.

The previous precautions are all aimed at preventing transistor destruction. Naturally, these are not the only reasons for transistor failure. Among other causes are mechanical defects in manufacturing which produce intermittently shorted leads inside the transistor's case. Sometimes these leads are so close, they test open when cold, but after heating up, they short out. Some transistors develop opens because leads are improperly soldered to the elements. Heat causes these leads to break free and an open element results. A less frequent cause of failure is contamination of the surface. This results in leakage currents which cause distortion or loss of gain.

### Effects of Air Temperature

There are two forms of transistor trouble which create some perplexing problems. Transistors, being resistors of a very special sort, are greatly affected by temperature. When they are very cold or very hot, they lose much of their gain and most of their power output. In the northern parts of the country some people find that on a sub-zero morning their car radio sounds very strange. However, after driving a few miles with the car's heater on, the radio functions normally again.

A similar situation can occur on a very hot summer day. The audio output of the radio will be distorted and much of its sensitivity lost. Although the designers of transistor radios go to great lengths to stabilize the circuits, these situations are unfortunately still more or less normal and correct themselves as soon as the equipment is restored to a more usual temperature. There is no solution to the problem with presently known techniques. You'll find an extra diode in some of the later model sets designed specifically to serve as a stabilizing element.

As we've tried to indicate in these articles, transistors are certainly not a cure-all for the problems of the electronics industries. However, it would be most unfair not to recognize the great strides forward which semiconductors have already taken and the bright future which they unquestionably have in store for all of us.

# EI's Hi-Fi Doctor. . . .

## Audio "Wonder-Drugs"

Veteran audiophiles who can remember back to some of the first Hi-Fi Shows held across the country probably need no reminder that each year's shindig comes up with at least one "cure-all" which claims to have licked everybody's hi-fi problems all by itself. Each year's gimmick—usually an extra control knob on a preamp—promises to break down the last barrier that keeps Duke Ellington from actually walking out of your speaker cabinet into your living room.

This year, while browsing through the New York Hi-Fi Show, I was afraid for a while that no cure-all was going to show its head to liven up the proceedings. But a visit to one of the half-dozen exhibits featuring reverberation gadgets made me stop worrying.

Anyone who tried his hand at building the reverb control featured in the August 1960 *EI* probably found it well worth the effort, since a reverb unit can give a real boost to the impact and "realism" of recorded sound in your living room. But the makers of reverberation units at the show were hinting—as usual—that this one gimmick was all you needed to turn your living room into a concert hall, whether you use it with a pair of Klipschorns or a couple of rusty speakers found on your last spear-fishing jaunt. The units featured at the show were similar to *EI's* do-it-yourself version (except in price), and so were their effects. They did their job pretty well, but old-timers in audio could only smile knowingly at their claim of supplying the "last word" in sound.

It might be interesting to take a look for a moment at a pair of wonder drugs from previous audio shows to see why they did not live up to their advance billing. At the top of the list of perished hopes is the variable damping control for amplifiers—once touted as a remedy for any and all deficiencies in speaker systems. Today's amplifiers usually feature a high damping factor—ten or above—to keep a speaker's voice coil under tight control and sharpen its transient response. A while back, though, damping controls on amplifiers offered low—and even negative—settings to "improve" a speaker's performance.

As cure-alls, variable damping controls promised to do everything from improving a speaker's bass response to matching its impedance curve at all frequencies. But the technique used by all of them was simply to reduce amplifier control over a speaker and let it wander off on its own. It didn't take long for audiophiles to discover that any apparent improvement in frequency response offered by low or negative damping was easily offset by muddy transient response and enough amplifier instability to drive an oscilloscope wild.

Another miracle drug for hi-fi that proved to be a "who needs it" item was the "presence control." By boosting an amplifier's mid-range response, the presence control brought Mr. Ellington not only into your living room but into your lap. But the cost of this achievement was listening fatigue and the loss of those silky highs and soul-satisfying lows that audiophiles had spent time and money to get. Like variable damping, the presence control only upset the balance of a good hi-fi rig.

Coming hi-fi shows are bound to bring more magic elixirs, but old-timers will go on taking them with a few grains of audio salt.

# and Clinic

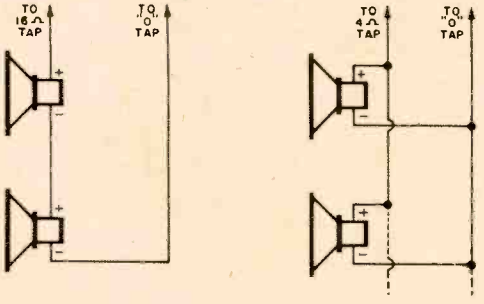
**Hi-fi questions are all answered by mail. If of general interest they will appear in this column.**

### Speaker Connection

*I have two speakers of different manufacture that I want to connect to a single amplifier. How do I find out their impedance and what connections do I use?*

*John Stroble*
*Minneapolis, Minn.*

When you wish to operate several speakers of different impedance from a single amplifier, you must determine if a parallel or a series connection is best. For example, two 8-ohm speakers in parallel could be connected to the four-ohm output tap of the amplifier. Wired in series, they would be connected to the 16-ohm output. Two 16-ohm speakers would usually be connected in parallel (to provide 8 ohms) because most amplifiers do not have a 32-ohm output




connection. If two speakers of dissimilar impedances are used, they should be connected in parallel to the amplifier tap with the same impedance as the lower impedance speaker.

In any case, an impedance mismatch as high as 2:1 is of negligible importance with most hi-fi equipment. There will be a slight loss in power output, but no increase in distortion. If one speaker plays louder than the other, it may be fitted with an L-pad.

You can make a rough check of a speaker's impedance with an ohmmeter. Multiply whatever reading is obtained across the voice-coil connections by 1.3. In general, a series connection of your speakers will result in slightly less damping on each individual voice coil—and hence, more bass. A parallel connection will give you a "tighter" sound.

### Speakers: Systems or Separates?

*Should I buy a preassembled speaker system or a separate speaker and cabinet?*

*Marvin Chelton*
*Darien, Mass.*

It is vitally important that the speaker be matched to the enclosure. A mistuned enclosure can degrade the sound of a good speaker, and a properly matched speaker and enclosure will enable the speaker to put its best acoustic foot forward.

Most speaker manufacturers are only too glad to provide build-it-yourself data for enclosures to match their loudspeakers. (See page 84 of the Nov. '60 *EI* for a listing of the publications available.) If you have woodworking talent, you can save money and build an enclosure at least as good as the manufactured item.

If you already have an enclosure and you wish to match a speaker to it, you had best write to the speaker manufacturers providing details of the enclosure and asking for recommendations. Of course, the purchase of an integrated speaker system will avoid woodworking problems and insure proper match. However, the burden of selecting the proper speaker-enclosure system for *your* ears is still up to you.

# Cosmic Clock

**A brilliant piece of do-it-the-hard-way electronics, this "syncopated clock" keeps the time out of joint.**

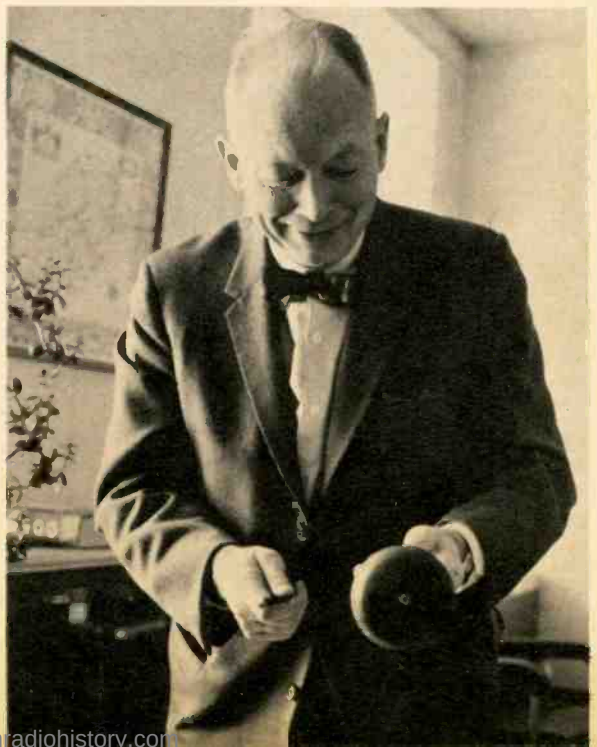
**By Alexander Dorozynski**

THE most sophisticated but uselessly complex device ever brewed by homo sapiens may well be a 200-year-old grandfather clock nervously ticking away in a corner of a living room in Yorklyn, Delaware. It is the world's first cosmic clock, a sort of scientific monstrosity out of a Rube Goldberg cartoon, that tells time by counting bursts of cosmic radiation emitted by distant stars and hydrogen clouds. The antique is stripped of spring, weight and pendulum; instead, 108 transistors, 215 silicon and germanium diodes and some 1,000 assorted condensers and resistors flash eerie lights and translate cosmic rays into seconds, minutes and hours.

The clock ticks in a disconcertingly random fashion, disrupts meetings of the weekly bridge club, causes unaware guests to spill their drinks, may require a repair crew of skilled electronic engineers, and would not work in Gov. Rockefeller's fallout shelter. Nevertheless it keeps time, its designers claim, with a deviation of no more than 30 seconds a year. It was built by the staff of the DuPont de Nemours [*Continued on page* 107]

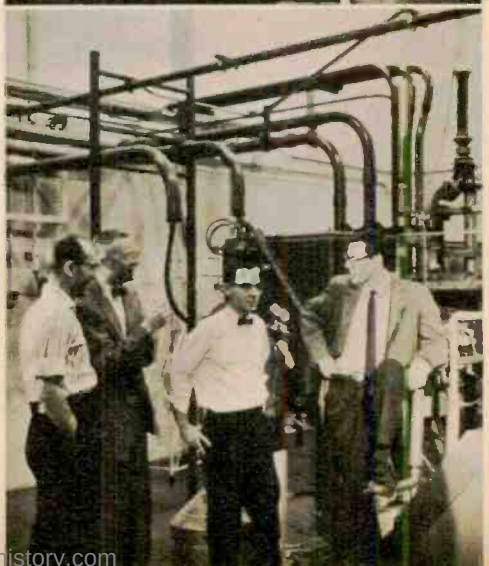
**Dr. V. F. Hanson, radiation physics lab chief at DuPont de Nemours, inspects "works" of 25th anniversary gift, a cosmic-ray clock.**

**A last nostalgic tap of original antique gong. Electronic substitute gives eerie chime like essence of all grandfather's clocks ever made.**

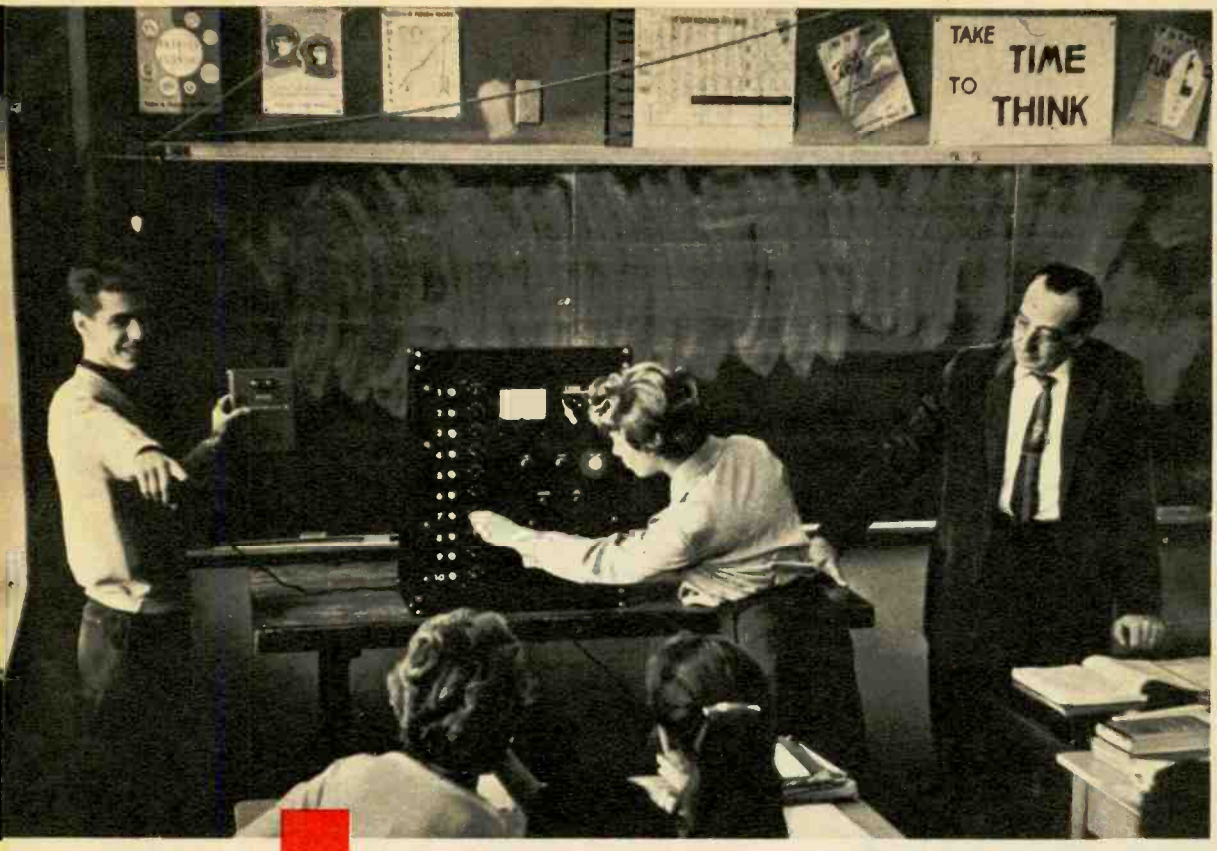


Above, the clock's erratic ticking distracts bridge players. Random arrival of cosmic ray pulses plus memory circuits are responsible.

Right, you can't just wind up a cosmic clock and set its pendulum swinging. Presentation party goes on while circuits get final check.



Below, technicians and physicists who helped build clock meet briefly in room containing linear particle accelerator in radiation lab.




Class captain points to girl selected randomly by nixie tube gadget to answer next question. Assistant sets answer into quizzer as teacher looks on.

# Teacher's Electronic Quizzer

**By Harvey Pollack**

**Versatile and unique tester and "answer computer" adds spice to high school physics review lessons.**

CAN the classroom teacher be replaced by electronics? We don't think so, but Forest Hills High School (New York City) now has an electronic device that automatically handles several important but tedious instruction chores, leaving teacher free for other necessary tasks such as lesson planning.

The machine was designed and constructed by the author, a physics teacher. Originally set up as a "private tutor" for physics students reviewing for examinations, the unique quizzer is now being used successfully in review lessons involving an entire class. Here's how it works.

The quizzer is essentially a testing and automatic scoring device with several built-in dramatic features. Ten "question dials"

are positioned along the left side of the large panel. Each is labeled A, B, C, D, and O. The last is the setting used when an answer is to be omitted. Questions of the multiple choice variety are presented to the pupil, who sets each dial to the letter corresponding to the answer he has chosen. No indication of "right" or "wrong" is given by the machine at this time.

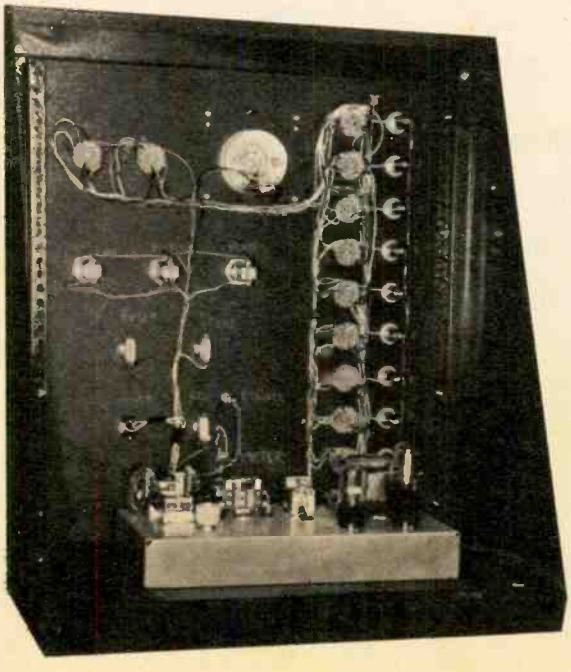
Before the actual selection of answers, the pupil rotates each of the CODE SET knobs to the code letters specified in his instructions for that particular group of questions. When this is done, the quizzer is automatically programmed to accept only *one* particular sequence of answers. Since each of the CODE SET dials has four possible positions, 16 entirely different quizzes (160 questions) are possible at one complete programming.

When the pupil has completed his selections, he presses the SCORE button momentarily. At this instant, the green READY light that has been on throughout the test blinks out and an adjacent red SUMMING light flashes on to indicate that the machine is in the process of "computing" the score. After a lapse of five seconds, the SUMMING light goes out and an amber READ SCORE lamp comes on. Simultaneously, the final score is displayed on a large meter on the main panel. If this has been a test situation for a make-up or absentee examination, the pupil now knows his grade in percentage. But if the machine is being used as a tutor or reviewer, the pupil then starts the "follow-through" procedure.

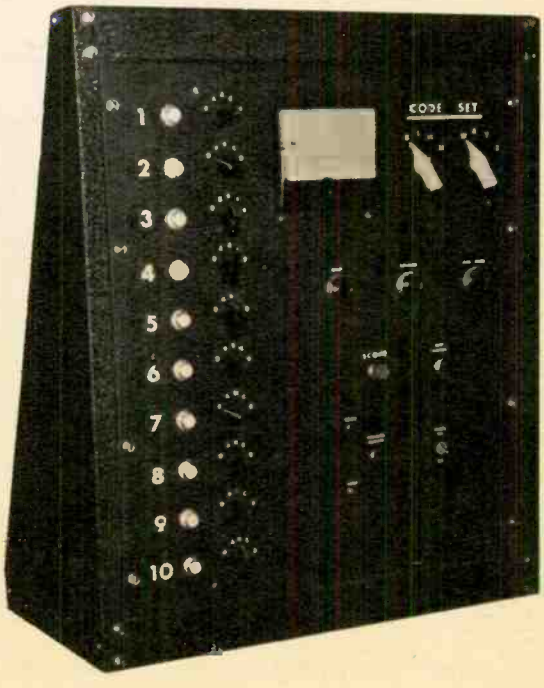
He presses the INDICATOR SELECTOR button momentarily. A tiny amber neon light extinguishes while another neon lamp, this time red, flashes on. At

[*Continued on page* 108]

**Rear view shows simplicity of design and construction. Quizzer was awarded a prize by National Science Teachers Association.**



**Each question for each program has separate dial with four possible answers. Test score is read off meter as percentage.**



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**Continued next month**

## Electronic Roulette Wheel

*Continued from page 45*

mentary contact switch using clip leads (S2 can be used temporarily), and the 12-volt battery. When S2 is operated rapidly, RY3 should run through the complete cycle from "0" through "9," and reset back to "0" when the tenth position is reached. If not, stretch the spring a bit more.

All lamp wiring is done on the top deck only. When completed, RY3 should be shock mounted in the gaming table with rubber grommets.

The pulser unit (Fig. 2) is constructed on a piece of perforated Bakelite board and mounted with long bolts and brass spacers.

The wheel (Fig. 3) can be fabricated using an aluminum pie pan as the recessed section of the wheel. A small aluminum "muffin cup," and a scrap tin "skirt" completes the assembly. All metal sections are cemented together with Plastic Aluminum, and the completed assembly was painted in accordance with "gaming table" colors.

The gaming table houses the control panel (Fig. 4) and poker chip components as well as the pulser unit and RY3. Relay RY2 controls the pulse signal unit, turning it on at the start of play, and off after the proper time has elapsed to simulate the slowing down of a roulette wheel. The time delay relay (Fig. 5) controls action of RY2.

The poker chip jacks J2-J11 (Fig. 6) are not mounted directly on the gaming table. Instead, they are mounted on scrap pieces of insulating material (such as plastic or wood) which is bolted to the table. The bases of the jacks protrude through 5/8" holes cut in the gaming table.

The poker chip feature may be eliminated if desired, or more chip positions can be added by paralleling additional jacks with those in the schematic.

The play button is made by bolting an aluminum disc on to the plastic button supplied with push button switch S1.

*Description of Controls:*

S1—Play button; starts automatic cycle when switch S7 is in automatic position
S2—Play lever; same function as S1; enables play to be controlled from panel
S3—Main power switch S4—Lamp power switch
S5—Stepping relay power switch
S6—Single pulse; advance stepping relay one position each time it is operated.
S7—Function switch; in automatic position game operates as described in text. In test position the pulse unit is controlled by the remote switch (S8) on the cable connecting to the small panel jack J1. The time delay relay is removed from operation and the pulser remains "on" continuously (or as controlled via panel jack). Pulse rate can be controlled by potentiometer R3.

## Kits That Teach Electronics

*Continued from page 35*

supply cage. On relay, connections "D" and "E" are very close; careless soldering would short them. Soldering iron not supplied. How each project works, function of each part, well explained. All projects work, though some suffer from poor quality of microphone provided. Also, no headphones are supplied, a serious deficiency. Otherwise a well-planned kit, good "course." $14.95.

●

*Allied Radio Corp.: "Knight-kit"* 10-Circuit Transistor Lab. Basic parts are soldered in place on and under a printed circuit board. Several dozen pin-type jacks provide one or more connections for each part. Ten circuit guide cards are supplied, any one of which is placed in the center of the board. Lines on the card end at pin jacks on the board, and it is only necessary to plug in precut, pin-tipped leads following the lines on the card, to complete circuits. No trouble to wire up circuits using the guide cards alone. The kit suffers from two faults: the pin jacks do not always hold the lead pins snugly and in firm contact, and the battery holder assembly does not hold the battery tightly and in positive contact. This latter fault is endemic among transistor kits, we have found. Battery, headphones, supplied; phones double as "mike." $15.75.

●

*Progressive Radio Edu-kits, Inc., Hewlett, N. Y.:* "Progressive Radio Edu-kit." Includes all tools needed, from screwdriver to soldering iron, three tubes and all parts for 20 circuits, some of which are built in a small metal chassis, giving the user the "feel" of working with commercial-type radios. (Others go on a new printed circuit board.) Diagrams are simple to the point of being primitive, but certainly easy to follow. Considering that Progressive's products have been on the market for over a decade, we were disappointed to find a transformerless, or "AC-DC," power supply. This presents a shock and short hazard, especially when using the signal tracer circuit with an AC-DC radio, even though capacitor isolation is used. What if the capacitor breaks down, or the operator inadvertently touches both chassis? Shock hazard is insufficiently discussed. The 85-page basic booklet is good in many ways, but while it tells what each part does, it does not tell *how* it does it, or what it does in each circuit. The user thus gets scant understanding of resistance, capacitance, inductance, etc. However, there is much additional study material. $26.95.

### The Children's Kits

The children's kits, by and large, are magnificent—or so it seemed to us at first glance. All of our editors were "Boy Edisons," and there were murmurs of "I envy today's kids" as we opened boxes and saw all that potential for experiment. "Everything is there"—no searching for weeks, waiting for weeks, no endless scrounging. Any child can be a Boy Edison or a Boy Marconi—"*just like that!*"—on Christmas morning.

That, alas, is the way it *ought* to be. We found some flaws in this picture. There were inevitable frustrations for anyone who built almost any of our "review" kits. For children, frustrations are devastating.

*You* had better be available to bail a child out of possible difficulties. Most children's kits fail, to some degree, to recognize the limitations of children.

Instructions may be oversimplified and overcondensed. Assumption is made that a child, reading the simple English of an instruction, will do exactly what it calls for, and only that. Children do not read or think this way. Instructions should be expanded at certain critical times to tell the child what NOT to do.

Nothing is more upsetting to a child than a missing or unrecognizable part. Open the kit and check it yourself before wrapping it for the Christmas tree. If it's too late to send it back, you can often supply the part yourself. (In that case, be sure to send the manufacturer a scathing note.)

Kit makers who warn adults to "read each instruction all the way through before you execute it" fail to warn the child about this. It leads to difficulties.

In practically all of them, the child isn't warned he needs batteries until the end of the construction phase.

●

*Heath Company, Inc., Benton Harbor, Michigan:* "Heathkit Jr." Electronic Experimenter's Lab No. 3. 3 transistors. 20 circuits. A good idea, but it sins on practically all the above counts. Nevertheless, two children who are not famous for perseverance worked doggedly at this and the other Heathkits reviewed, because their attractive design stimulated them. A 13-year-old took several long evenings

[*Continued on page* 102]

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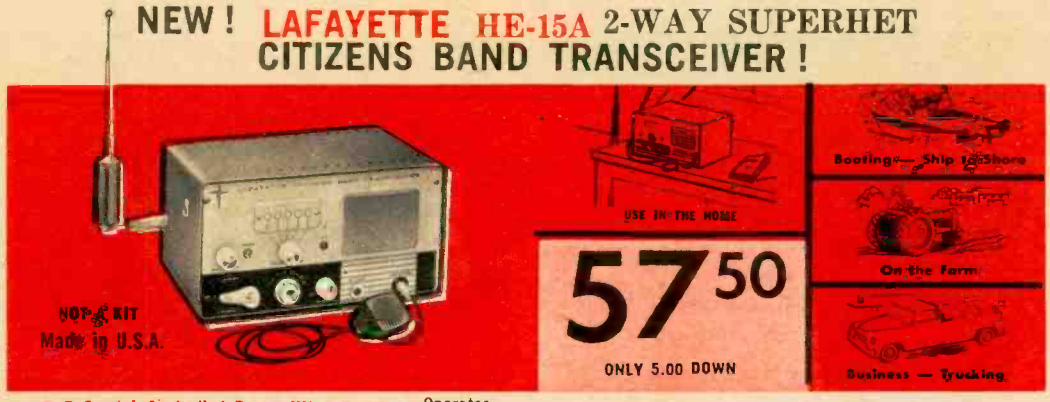


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Made by famous Garrard of England to superb specifications. "Plug-in" cartridge feature. Rubber matted heavy turntable is shock-mounted, and idler wheels retract when turned off to prevent flat spots. Powered by a line-filtered, four-pole induction motor at 16, 33⅓, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. Assembles in minutes; mechanism and vinyl covered mounting base preassembled, arm pre-wired. With 12″ record on table, requires approximately 15″ W. x 13″ D. x 6″ H. Color styled in cocoa brown and beige. 10 lbs.

**Mechanism Only:** Less cartridge, base and cables. Model AD-30, 8 lbs., . . . . . **$22.95**

AA-50 **$79.95**

### HI-FI RATED 25/25 WATT STEREO AMPLIFIER-PREAMPLIFIER KIT (AA-50)

A complete 25/25 watt stereo power and control center (50 watts mono) . . . 5 switch-selected inputs for each channel . . . new mixed center speaker output . . . stereo reverse and balance controls . . . special channel separation control . . . separate tone controls for each channel with ganged volume controls . . . all of these deluxe features in a single, compact and handsomely styled unit! Five inputs for each 25 watt channel are provided: stereo channel for magnetic phono cartridge (RIAA equalized); tape head input; three high level auxiliary inputs for tuners, TV, etc. There is also an input for monophonic magnetic phono cartridge, so switched that monophonic records can be played through either or both amplifiers. The automatically mixed center speaker output lets you fill in the "hole-in-the-middle" found in some stereo recordings, or add extra monophonic speakers in other locations. Nearly all of the components are mounted on two circuit boards, simplifying assembly and minimizing possibility of wiring errors. Handsome cabinet features new "visor" effect, with vinyl-clad steel cover in black leather-like texture with gold design. 30 lbs.


AA-20 **$34.95**

AA-30 **$45.95**

### ECONOMY PREAMPLIFIER KIT (AA-20)

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### HI-FI RATED 14/14 WATT BASIC STEREO AMPLIFIER KIT (AA-30)

Two 14-watt high fidelity amplifiers, one for each stereo channel, are packaged in the single, compact, handsomely styled amplifier (AA-30). Suitable for use with any stereo preamplifier or with a pair of monophonic preamplifiers, it features individual channel gain controls, speaker phase reversal switch and convenient pilot light. Output accommodates 4, 8 and 16 ohm speakers. Handsome satin black expanded-metal cover, gold colored chassis. (AA-30) 21 lbs.

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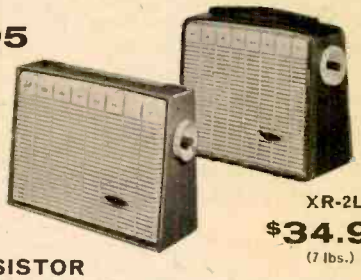

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**Vibrator Power Supplies:** VP-1-6 (6v.), VP-1-12 (12v.). 4 lbs. kit; $8.95 ea., Wired; $12.95 ea.

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*The convenience of Local Heathkit Sales and Service costs but a few dollars more.

*Continued from page 97*

just to get the basic circuit board wired. *There ought to be projects which can be tried with the board only partly wired.*

In attempt to make circuit-changing easy, Heath has produced a helix-spring connector into which wire leads are simply to be thrust. Where several connections are to be made to one point, putting in third or fourth wires causes the other ones to pop out. The idea is good, but the spring ought to be redesigned—possibly just larger. There are 68 of these springs, each fastened to the chassis board by means of a tiny screw and nut. The pigtails of transistors, capacitors, resistors, etc., fasten under the nuts. The screws are just too short, especially as the spring connector exerts some back-pressure.

NO nut driver was provided, in spite of all these tiny nuts, though nut drivers are provided in simpler "Heathkit Jr." kits (see below). Wiring the circuit board is a "three-hand" job.

Several screw sizes were used—and sometimes the screws would not go through the connector holes. Tiny self-tapping screws had to be driven into brittle switch-lug holes, a terrible job for a child. Also, lugs on switches and speakers and other parts had to be bent with precise right-angle zig-zags so that terminal or mounting holes would match those on the board—resulting in broken lugs, or, on a speaker, broken plastic backing. *Such bends should be made in the factory.*

Heath supplies a good clip to hold the body of the battery, but the spring contacts are poor—just simple bent strips of metal. The child is not told to make sure good contact is being made.

Nevertheless, this kit has much to recommend it, and if an adult is available to help a child over obstacles, it might provide almost endless stimulation and fun—assuming the adult is experienced in electronics, or perhaps is a born teacher. It is certainly a bonanza of parts. However, the company must get over the idea that instructions must be "simplified" for children—simplified to the point of being inadequate. $29.95.

*Heath Company:* "Heathkit Jr." Transistor Diode Radio. One of several non-experimental projects in the "Junior" or "Science Explorer" line. We were a bit doubtful of their value—how much will a child really learn from putting together a cookbook project? Then we remembered that our own favorite way to introduce a child to electronics is to show him how to build a crystal set, that *works* as soon as the antenna and ground are attached. So we tried this one. In about three and a half hours our "test child" had assembled the whole works, in its little case that makes it "look like a radio." (This is sometimes important to children.)

There was the usual trouble about lug-bending. An attempt to correct a wiring error caused the destruction of the tiny, glass-barreled diode (*which we replaced with a fat, husky 1N34, and this is what the manufacturer should provide*). Ironically, Heath, which can be so generous with diagrams when it is telling an adult how to mount a component, and publishes a great big drawing of a transformer, its screws, washers, lock washers, and nuts, all over and under an "exploded" chassis, merely tells a child to "mount the tuning capacitor on fiber washers" and that's all!

But it worked, after only a few hours of labor, and the child was tickled. With no trepidation she took on the next project, below. The diode-transistor radio is $9.95.

*Heath Company:* Transistor Radio Broadcasting Station. This one featured a plastic nut-starter which the child forgot to use until near the end. The project took several evenings, and we suspect that Heath has not yet worked out the best order of assembly. The booklet was better provided with "lineup" diagrams showing how screws, nuts, washers, etc., go together than was the other, but there were many awkward phases in the assembly.

The explanations in the pictorials, of how parts work, and what happens in the circuit, are very good. The cartoon showing the "gate" or "valve" action of a transistor can be used to explain vacuum tubes, too.

Other kits in the Heathkit Jr., line: Diode "Micro" Radio, a rocket-shaped crystal set with separate headphone, $3.95; Diode Personal Radio, crystal set in "radio" box, $5.95. Both include antenna wire. Electronic Experimenter's Lab No. 1, one transistor, one diode, seven circuits: $12.95, probably a better bet for a school-age child than No. 3, reviewed above; Electronic Experimenter's Lab No. 2, 2 transistors, 12 circuits, $17.95.

The *idea* of these kits is fundamentally sound, and we expect Heath to make them as foolproof as its superb adult kits.

●

*Educational Electronics Co., 1227 W. Loyola Ave., Chicago 26, Illinois:* "2-in-1 Broadcast Radio Kit." Regenerative receiver and "wireless home broadcaster." Strangely, while this company has "lab" kits, which we requested, it sent us this one to represent its line. A plain 8-page

booklet explains the circuit and gives assembly instructions, which are less than a page of plain prose—no step-by-step, check-it-off procedure. Connections are to Fahnestock clips—no soldering. But no hookup wire was supplied, there are no schematics, the one pictorial is small and unclear. The receiver would not work without a ground—*we* had to tell our "test child" where to attach it. Price, $9.95.

●

*A. C. Gilbert Company, Erector Square, New Haven 6, Connecticut:* "Erec-Tronic" Electron Tube Set, 11072. 15 circuits. This long-time leader in children's engineering toys has come up with a beauty. For the child who is only ready for "cookbook" stuff, the circuits zip together in minutes, and they work. For the more inquiring child, or for the adult who would like to guide a child into learning more, a concise 27-page booklet manages to tell all: what the parts do, how they do it, what the circuits are all about, etc.: a masterful job. All parts can be checked quickly *using the set itself*. The checking procedure teaches much about electricity.

All parts are mounted on foam plastic blocks, or modules. Each module has two mounting feet that simply fit into evenly-spaced holes in a mounting board that looks something like "pegboard." On top of the mounting board a paper circuit template is placed, and holes are pre-punched in it to match mounting feet on the parts.

Each module has contact pins, something like big tube pins, but sticking *up*. Precut wires in several lengths, tipped with Gilbert's "Jiffy" connectors, clip to the contact pins. All the child need do is "copy" the "wires" drawn on the template and he has a working circuit in no time. However, the booklet encourages him to wire from circuit diagrams, too. "Jiffy" connectors snap right on, do not crowd each other.

This one is $21.98. Other Gilbert "Erec-Tronic" kits: Radio Set Kit, 11042, three diode receivers, $5.98. Transistor Set, 11052, four circuits including code oscillator, $9.98. Transistor Set 11062, nine circuits, $14.98. Broadcast and Receiver Set, 11082, 19 circuits, $34.98.

●

*American Basic Science Club:* see the discussion above, under the Adult Kits. Depending on the age and achievement level of the child, the *ABSC* kits can be challenging, inspiring, and very rewarding.

Summing up, almost all the children's kits have drawbacks, and all but the Gilbert "Erec-Tronic" line still require an adult as consulting engineer at least now and then.

## The Compactron

***Continued from page 55***

There is life and progress yet in the vacuum tube industry, and with progress and growth comes change. Now we have a new type of tube, the "Compactron," developed by General Electric, which may become the model for a whole new family of receiving-type tubes.

The Compactron has two innovations: a wide, twelve-pin base, and the combining of many tube functions in one envelope. This second idea may not seem so new: we have had dual tubes (like the 6SN7, 12AT7) for many years, and the "converter" tube in the average small superhet combines oscillator and mixer functions in one set of elements. However, the Compactron design permits two, three, four and possibly more functions to be combined, and it can use as many sets of *separate* elements. The only element common to the Compactron's different sections is the heater or "filament."

As the name implies, the Compactron is very small. Its ¾" wide pin circle is wider than that of a conventional miniature tube, but since, as the picture shows, two Compactrons can take the place of five standard tubes (in the usual "kitchen-radio" All-American Five circuit), a great deal of space is saved. The typical Compactron bulb will be one to two inches high. Its diameter is 1⅛" for receiving types and can be wider for special functions.

The broad 12-pin base offers circuit advantages. It adapts well to printed circuitry, since the large circle provides adequate space for making all connections. By locating the heater connections on pins 1 and 12, additional space is available to bring a heavier printed circuit to the heater leads if a heavy-current heater is needed.

In some Compactrons, there will be only one set of elements and one tube function. Power output tubes and small transmitter tubes are a case in point. The bulb is big and heavy enough for good heat dissipation. In radio, TV, audio amplifier, and transmitter circuits, only one-size chassis holes need be punched, as in the days of all-octal-tube circuits, and there need be fewer holes and fewer sockets, since low-power-level circuits can have all their "tubes" in one envelope.

Fewer chassis holes, fewer sockets, fewer and shorter wiring connections will make for economy in the finished product. Chassis and cabinets can be smaller since the Compactron tubes are not very high.

## Skilled Rocket Amateurs

*Continued from page 51*

its design and construction. But it is obvious that no real analysis of the rocket is made by Army technicians before the boy is told whether or not to make the trip.

There are actually many sincere and dedicated amateur groups in the country who should be given help and an opportunity to demonstrate what they can do. There are some immensely talented young scientists among their members. There are also a great many *lone wolf* type geniuses in the teen-age population who have constructed some mighty sophisticated rockets —some too large and potentially too powerful to be fired on any existing Army range. It would be tragic to sell these boys short with the hasty judgment that they are motivated solely by a fascination for fireworks, and are years behind the pioneers of thirty or forty years ago.

Without any attempt to survey the entire field (for which there isn't space), and excluding the few large and highly-organized adult groups which function as amateurs (e.g. the Pacific Rocket Society, Rocket Research Institute, Reaction Rocket Society, etc.), let's take a look at some advanced amateurs. They are fairly representative of what is going on in American amateur rocketry—and they didn't happen to be around the day Lloyd Mallan visited Fort Knox.

The American Rocket Research Society was launching small rockets from the flatlands in the Canarsie section of Brooklyn as early as 1952. This group, none of whom was more than 16 years old at the time, documented hundreds of firings on performance graphs and film. They produced a half-hour color film covering four years of experiments, constructed elaborate test equipment for measuring motor performance, and developed a laminated fiberglass hull for high altitude sounding rockets which drew an offer of a Navy development contract.

Most of the members are now in their freshman or sophomore years in college. They have abandoned the original society name and incorporated themselves under two organizational titles. One is REAC, Inc., which specializes in motor development projects and in the construction of rocket and satellite display models for store windows and exhibitions. During the year 1959, REAC did more than $10,000 worth of business as a part-time enterprise.

The other titular heading the boys operate under is called the Society of Applied Rocketry (SOAR). It is devoted to developing practical uses for small rockets. Through an alliance with a philatelic organization, SOAR has concerned itself recently with a long-term program aimed at the development of a practical mail rocket. Three 15-foot prototypes of this rocket have been built and fired. Early last spring one of them successfully ejected a sealed mail carton containing 3000 letters over the waters of Penobscot Bay in Maine. It was lowered to the surface of the bay by parachute and recovered by the local postmaster in a small boat. (Philatelists throughout the world will pay from one to three dollars for covers representing such "firsts.") This rocket rides a radio beam to its destination. The carton capsule is ejected by radio command, and it carries a radio beacon transmitter to aid in its recovery.

Or let's visit the Richland Rocket Society in the state of Washington. These boys are much younger and are Johnny-come-latelies in the field. They have only been organized for two years, but have managed to launch more than 200 rockets in that time from a range located on land belonging to the Atomic Energy Commission's Hanford Atomic Works. They specialize in small hardware, relatively simple in construction but quite refined in design.

During the past year they managed to assemble enough second-hand and surplus parts to build their own Doppler radar system for tracking the first few hundred feet of a rocket's flight.

Down in San Antonio, Texas the Astrophysical Society of Trinity University merged with a group of local high school students two years ago, and embarked on a long range program of rocket experimentation under the guidance of a refugee Hungarian engineer who was teaching physics at the university. Within a year the group had launched or static tested over 400 rocket engines, had its own launching site in the desert, and had equipped its own proving grounds in an abandoned gravel pit. At the last reading the "Muddy Pit Proving Grounds" were still being improved, but already included: a central control bunker, a firing control bunker, a camera and instrument bunker and a fuel storage bunker (all constructed of logs reinforced with sandbags and dug underground, and all featuring concrete floors, ventilating fans, overhead type periscope view slits and electric lights); a static test stand for thrust measurement of solid fuel motors; a horizontal launching

rack for short-hop, wall-to-wall free flight tests of small rockets within the gravel pit; a one kilowatt generator with power lines to all bunkers; and a telephone switchboard connecting all bunkers and test facilities. Being installed were: a shelter for the power plant; a power plant control panel; and vertical and horizontal static test stands for liquid motors.

Back on the east coast again in Orange, New Jersey, lives 17-year-old Alex Gerardo whose XSSM-1 Research Probe is designed to reach an altitude of 34 miles. The eleven-and-a-half-foot missile is packed with an AN/CPT-2 radar beacon whose antenna will fold outward when the instrument package is ejected, a biological package containing various types of bacteria, a radiosonde modulator and transmitter, associated electronic equipment and two parachutes. A barometric switch will trigger the ejection mechanism at maximum altitude. Alex has already won a science award with his rocket and has excited the admiration of engineers in several industrial concerns who have helped him with technical advice and some hard-to-get parts. He is aiming at a career in electronics.

These few examples should serve to emphasize the point that America's young rocket enthusiasts are *not* thirty years behind the model airplane builders of pre-World War II. They have done things far beyond the scope of anything ever attempted with model planes, and have had to acquire a depth of knowledge in the physical sciences that the model builder never had to approach.

## How To Get That QSL

***Continued from page 72***

In the 24-hour system, all hours are written to look like "hundreds," though each "hundred" has only sixty minutes. All times have four digits. Midnight is 0000 (though "2400" is commonly seen) and the a.m. hours are 0100, 0200, and so on, up through 1100, 1159, and noon, or 1200. After noon, minutes and "hour hundreds" are simply added to 1200. One p.m. is 1300, two p.m. is 1400, etc. A time that is not a whole hour, such as 11:36 a.m., is written 1136 with no colon, and without the "a.m." Similarly 10:24 p.m. becomes 2224. The rule is simple: all times smaller than 1200 are "a.m." hours and all times greater than 1200 are "p.m." hours.

The exact frequency of operation in megacycles, or kilocycles if you prefer, should by all means be listed. Never report that you heard a certain station "somewhere in the 25-meter band."

Mention should also be made of the names and times of principal programs heard. If a name of a song or singer or some important speaker is included, the people at the other end will know without a doubt that you heard their station and not something else on an adjacent frequency.

However, the most important part of any report, by far, is the signal and interference description. This is also very interesting to the engineer, as it helps him determine how his station is getting out. One of the best systems for this purpose to be devised is the "SINPO" code. This code is a relatively new thing among SWL's, and is rapidly taking the place of the old RST code, which was originally meant for amateurs. The SINPO code is as follows:

| | |
|---|---|
| CODE S, *signal strength:* | 5—excellent<br>4—good<br>3—fair<br>2—weak<br>1—barely audible. |
| CODE I, *interference from other stations:* | 5—none<br>4—slight<br>3—moderate<br>2—severe<br>1—extreme. |
| CODE N, *atmospheric noise; static:* | 5—none<br>4—slight<br>3—moderate<br>2—severe<br>1—extreme. |
| CODE P, *disturbed signal; fading:* | 5—none<br>4—slight<br>3—moderate<br>2—severe<br>1—extreme |
| CODE O, *intelligibility; signal quality:* | 5—excellent<br>4—good<br>3—fair<br>2—poor<br>1—unintelligible. |

Thus, if you heard a station that had good signal strength, moderate interference, no static, slight fading, and fair intelligibility, it would be written like this in your report: SINPO 43543.

Before you rush out to mail your report, here's one final suggestion. It is true that several of the larger shortwave stations mail their QSL cards at their own expense. However, many of the smaller, lower-powered stations have a limited budget and can't afford to supply postage for the returning cards. Therefore, it is best if you include return postage in the form of International Reply Coupons, which can be obtained from any post office.

## Menu Music Nobody Hears

*Continued from page 67*

but a few thousand dollars, most of it invested in FM tuners.

Typically, and unlike such big-name competitors as Muzak and Musicast, Joe neither operates an FM broadcasting station nor, at the moment, employs a secretary.

Rather, his Los Angeles-based Pan American Broadcasting Co. "buys" music round-the-clock from a local FM station (KMLA), dispenses it via the ether to his clients' places of business. Installed in each is a 14-tube Cal-Best FM receiver (cost: about $125) which, thru amplifiers, may feed as many as 120 concealed speakers.

Explains Bein, "Ideally, you bathe a place with super-subdued sound . . . use a lot of small speakers rather than a few big blasters."

As a fellow who wears many hats—and all of them well—Joe fields a 4-man maintenance crew; peddles his low-keyed product to prospects; subs as a disc jockey (helping his FM channel to select the just-right musical entrees); designs sound systems geared to background melodies, and monthly grosses a five-figured income.

No matter how you run it, however, the background business boils down to essentials: you supply music to clients who, in turn, pay you a monthly fee for the service.

Like Bein, you may purchase music on a 24-hour, 7-day a week basis from a local FM station (the fee: perhaps $5 per month per client).

Some FM stations (among the 660 commercial outlets now operating) program dual-purpose music: melodies calculated to please the at-home listener as well as the background music buyer. Receivers in restaurants, offices, banks and factories are rigged to filter out the commercials and pass only the music.

Others, thru the new dual channel set-up called *multiplexing,* simultaneously air music for FM homebodies and entirely different stuff for backdrops. The background sub-channel can't be picked up by the usual FM home receiver.

You don't, of course, have to hook up with an FM station. Where there is no FM, you can supply music from 8-hour tapes or even from long-play discs, routing melodies over leased telephone lines to your paying clients.

"The average small restaurant," says Bein, "spends only $150-$250 or so initially for sound. This includes our engineering services, the speakers and wiring, but not the $125 master FM receiver, which we retain and whose rental is included in the $25-$40 monthly fee that a client pays for background service."

Of the $25 a client pays for music, $5 goes to the FM station. Depending on your operation, another $5 or so goes as music royalties (to the two big composers' guilds, ASCAP and BMI). Allow another $5 for maintenance and, with luck, you may net $10. Obviously, you're aiming for volume: for the $1000 monthly that 100 clients may mean, or the $3000 inherent in 300 clients.

Like Joe Bein, you get started by contracting with an FM station for music. Or, you may program music on tape for telephone line distribution.

Typically, an FM station may charge you a flat monthly minimum, the rate based on a minimum number of clients. For $250, let's say, you can wire-in 50 customers before paying more than the minimum rate.

"Actually," beams Joe, "there's hardly a town in the country that won't support a 100-client operation. Your prospects? Every restaurant, bar, bank, factory, doctor's office and retail store."

## Electronic Hospital

*Continued from page 70*

He can enter or leave by any door with no need to report to the receptionist.

In the laboratory, where various counts and analyses go on all the time, electronic devices have both speeded up the turnover and increased accuracy many times.

At the patient's bed, an electronic panel serves many of his needs. He can push a button and call a nurse, but if he wants his bed raised or lowered he can pick up a hand-held control box, and turn knobs that will move either end or the middle of his bed up and down for him—he doesn't have to wait. He can select radio or television programs (pillow speaker is there) or pick up a telephone and call his home. If he needs his nurse, she need not be waiting at a call board—she carries a pocket paging receiver, and the "nerve center" can relay the call to her anywhere.

Electronics has so improved and streamlined patient care and comfort that higher rates might be expected in this hospital, but its rates are at the same level as in conventional hospitals, and in some categories lower. This is because of savings made possible by increased efficiency. Long Beach Memorial Hospital may become a model for new hospitals built from now on.

## Cosmic Clock

*Continued from page 87*

radiation physics laboratory in nearby Wilmington as a gift to lab chief Victor F. Hanson for his twenty-fifth anniversary with the company.

The authors of "VFH-25" are top high energy physicists at DuPont: Paul Hoell, senior researcher, formerly on the Manhattan Project team; Richard Bennett and Ray McCarthy, youthful Yale-bred physicists; and Dr. Werner Brandt, a World War II captain in the German infantry and a graduate of physics' hall of fame, the "Niels Bohr" physics institute of Copenhagen, Denmark.

Though delighted by the gift, Hanson, also a Manhattan Project graduate, complains the clock has disrupted his household. "If there's a sensible way of keeping time, this isn't it. The erratic ticking creates suspense—it's like a dripping water faucet. You never know when it will start rattling away. And I hope the public never finds out how much this thing cost!"

Considering some of the hair-raising projects that were seriously mulled over by the self-appointed gift committee, Hanson nevertheless thinks himself lucky. For while the foursome settled on the symbolic time-keeping device appropriate for an anniversary, modern science has many ways of making time tick. The gift could have been a "maser" type clock that can keep time with an accuracy of one part in a billion by counting vibrations of ammonia molecules. This was rejected because the near absolute zero refrigeration system a maser requires would have taken half the space in the Hanson living room.

When the cosmic clock was mentioned, "everybody clicked," says Paul Hoell. "It was weird enough to please us, yet we felt Vic wouldn't have us fired. We immediately set out to find a good antique clock, and started taking cosmic radiation intensity readings near Vic's home. It took us four months to arrive at an accurate average." Research and development took six weeks of night work in Dick Bennett's basement, for if the principle running VFH-25 is relatively simple, the execution took the miniaturization skill required for packaging a satellite's payload.

VFH-25 registers cosmic rays from outer space on a standard Geiger counter, partly shielded so that its average output is one pulse per second. Cosmic rays, however, come not at regular intervals of a second but in bursts, or "showers," which click off

as many as 30 Geiger pulses in a fraction of a second. Since the mechanism of the clock cannot tick that rapidly, it was found necessary to store the pulses in a binary register, an electronic memory that doles pulses out at a rate acceptable to the second hand—no more than "three 'seconds' per second," a speed limit for the clock. The memory storage unit consists of five transistor "flip-flops" that can count up to $2^5-1$, e.g., to 31.

The output of the Geiger counter is coordinated with the adjusted output of a crystal that oscillates 18,000 times per second, acting as a control to erratic radiation. "The randomness of cosmic radiation tells the clock when to move, and the crystal tells it when to ignore randomness. This is cheating in the most pleasant way," says Hanson. Impulses are transmitted through a series of relays which transforms them into mechanical energy running a stepping switch, "a quantized water mill."

Power is provided by ordinary house current. Mrs. Dorothy Hanson, once enervated by the unpredictable ticking that resulted in "the most traumatic bridge game" she ever played, pulled the plug. "But the thing kept running. I called my husband, and he told me 'they' thought I might do that, and 'they' put in a battery that will keep the clock running for several days without outside power." The bridge club is slowly adjusting, and even Dorothy now wouldn't think of parting with the grandfather clock. "Before the clock, I had never realized that natural radiation is far larger than any atomic fallout. I had never thought about it, and the clock taught me a lesson," she says. "It may be psycho, but it has personality. Besides, it's a lovely Scottish 18th century case, and I've always loved antiques."

## Teacher's Electronic Quizzer

*Continued from page 89*

the same instant, the meter reading drops to zero and pilot lights in the vertical row alongside the question dials begin to glow, showing which questions were answered correctly. Pilot lights associated with dials that were incorrectly set remain dark. The pupil may now find the right answer by rotating each of the "wrong" settings until its pilot light comes on. This tells him where his study emphasis should be placed.

A typical full-class review lesson utilizes a class captain, an assistant, and a random-number selector consisting of a pair of nixie digital readout tubes connected to

two tiny battery-operated electric motors. As these motors operate, they spin a pair of brushes against a pattern of "commutator" segments. When the button is released, the motors stop and leave the brushes touching two segments connected to the number pins of the nixie tubes. Thus, any number from 0 to 39—the segments are wired to provide this range—appears randomly in the tube windows. Each physics pupil is customarily assigned a laboratory number anyway, so that the nixie device becomes a random pupil selector. The captain first reads out the question from his pre-coded sheet, giving all four possible answers. Then he operates nixie and calls on the pupil whose number comes up. When the question is answered, the assistant sets the ANSWER knob as directed and the captain proceeds to the next question. After this, the procedure is the same as described above.

This electronic quizzer has brought a spirit of lively competition into the classroom, and will be used more and more as new applications suggest themselves.

## A Page From The Past

*Continued from page 71*

The electric bell had its clapper adjusted to strike the glass tube, just lightly, to "decohere" the filings after each impulse and thus make the equipment ready for the next one. The gong was usually removed from the bell set, as it served no useful purpose.

The coherer was invented by a French physicist, Edouard Branly, in 1890, and also by the Russian, Alexander Popoff, in 1895. There were others, but the device is still thought of chiefly as the Branly coherer. Marconi's "magnetic detector" was really an improved version of it.

The "light bulb" or "ivy bowl" looks like an odd shape for a vacuum tube today, but it was more or less the original shape. The picture shows an early DeForest Audion, circa 1910. Notice the dual grids and plates. Filament leads were taken out through the miniature screw base; plate and grid leads from the wires at the top. Edison all but invented the vacuum tube in the early days of the incandescent lamp: he discovered that electricity would flow, invisibly, through a vacuum from a hot filament to a positively-charged plate inside the bulb. He duly recorded the fact in his notes—it is known as the "Edison effect"—but since he had no practical use for the discovery, he just shelved it.

## Watch Your Line Voltage

*Continued from page 75*

tube life dramatically, but at the cost of deteriorating equipment performance.

If your TV picture is smaller than the face of the tube or if your hi-fi system distorts when you turn up the volume, low line voltage can be the cause.

With two simple measurements you can determine whether your line voltage troubles originate inside or outside your house. First, measure the voltage at the fuse box with all the lights and appliances turned off. (The meter need not be very accurate.) Then turn them all on and note if the line voltage has dropped. If it dropped more than 5 volts, your service wires (pole to house) may be too small for the load. Now, connect the meter to the terminals of the electric outlet into which your electronic equipment is connected.

Turn on the electronic equipment and note how much the line voltage drops. If the meter reading at the outlet drops 5 volts or more, your house wiring is inadequate.

If the line voltage *varies* widely, a voltage-regulating transformer is the only adequate cure. A *stable*, but low line can be boosted with some type of not too expensive variable autotransformer which can be set to provide desired voltage.

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ___ | 0Z4M | .79 | ___ | 4BZ7 | .96 | ___ | 6AV6 | .40 | ___ | 6DE6 | .58 | ___ | 12AE6 | .43 | ___ | 12CR6 | .54 | ___ | 17D4 | .69 |
| ___ | 1AX2 | .62 | ___ | 4CS6 | .61 | ___ | 6AW8 | .89 | ___ | 6DG6 | .59 | ___ | 12AF3 | .73 | ___ | 12CU5 | .58 | ___ | 17DQ6 | 1.06 |
| ___ | 1B3GT | .79 | ___ | 4DE6 | .62 | ___ | 6AX4 | .55 | ___ | 6DQ6 | 1.10 | ___ | 12AF6 | .49 | ___ | 12CU6 | 1.06 | ___ | 17L6 | .58 |
| ___ | 1DN5 | .55 | ___ | 4DK6 | .60 | ___ | 6AX? | .84 | ___ | 6DT5 | .66 | ___ | 12AJ6 | .46 | ___ | 12CX6 | .54 | ___ | 17W6 | .70 |
| ___ | 1G3 | .73 | ___ | 4DT6 | .55 | ___ | 6BA6 | .49 | ___ | 6DT6 | .53 | ___ | 12AL5 | .45 | ___ | 12DB5 | .69 | ___ | 19AU4 | .83 |
| ___ | 1J3 | .73 | ___ | 5AM8 | .79 | ___ | 6BC5 | .54 | ___ | 6EU8 | .79 | ___ | 12AL8 | .95 | ___ | 12DE8 | .75 | ___ | 19BG6 | 1.39 |
| ___ | 1K3 | .73 | ___ | 5AN8 | .86 | ___ | 6BC? | .94 | ___ | 6EA8 | .79 | ___ | 12AQ5 | .52 | | 12DL8 | .85 | ___ | 19T8 | .80 |
| ___ | 1L6 | 1.05 | ___ | 5AQ5 | .52 | ___ | 6BC8 | .97 | ___ | 6H6GT | .58 | ___ | 12AT6 | .43 | ___ | 12DM7 | .67 | ___ | 2?EX6 | 1.49 |
| ___ | 1LN5 | .59 | ___ | 5AT8 | .80 | ___ | 6BD6 | .58 | ___ | 6J5GT | .51 | ___ | 12AT7 | .76 | ___ | 12DQ6 | 1.04 | ___ | 25BQ6 | 1.11 |
| ___ | 1R5 | .62 | ___ | 5BK?A | .82 | ___ | 6BE6 | .55 | ___ | 6J6 | .67 | ___ | 12AU6 | .50 | ___ | 12DS7 | .79 | ___ | 25C5 | .53 |
| ___ | 1S5 | .51 | ___ | 5BQ7 | .97 | ___ | 6BF6 | .44 | ___ | 6K6 | .63 | ___ | 12AU7 | .60 | ___ | 12DZ6 | .56 | ___ | 25CA5 | .59 |
| ___ | 1T4 | .58 | ___ | 5BR8 | .79 | ___ | 6BG6 | 1.66 | ___ | 6S4 | .48 | ___ | 12AV5 | .97 | ___ | 12EL6 | .50 | ___ | 25CD6 | 1.44 |
| ___ | 1W4 | .57 | ___ | 5CG8 | .76 | ___ | 6BH6 | .65 | ___ | 6SA7GT | .76 | ___ | 12AV6 | .41 | ___ | 12EG6 | .54 | ___ | 25CU6 | 1.11 |
| ___ | 1U5 | .50 | ___ | 5CL8 | .76 | ___ | 6BH8 | .87 | ___ | 6SK7 | .74 | ___ | 12AV7 | .75 | ___ | 12EZ6 | .53 | ___ | 25DN6 | 1.42 |
| ___ | 1X2B | .82 | ___ | 5EA8 | .80 | ___ | 6BJ6 | .62 | ___ | 6SL7 | .80 | ___ | 12AX4 | .67 | ___ | 12F5 | .66 | ___ | 25EH5 | .55 |
| ___ | 2AF4 | .96 | ___ | 5EU8 | .80 | ___ | 6BK? | .85 | ___ | 6SN7 | .65 | ___ | 12AX7 | .63 | ___ | 12F8 | .66 | ___ | 25L6 | .57 |
| | | | | 5J6 | .68 | ___ | 6BL7 | 1.80 | ___ | 6SQ7 | .73 | ___ | 12AZ7 | .86 | ___ | 12FM6 | .45 | ___ | 25W4 | .68 |
| ___ | 3AL5 | .42 | ___ | 5T8 | .81 | ___ | 6BN4 | .57 | ___ | 6T4 | .99 | ___ | 12B4 | .63 | ___ | 12K5 | .65 | ___ | 25Z6 | .66 |
| ___ | 3AU6 | .51 | ___ | 5U4 | .60 | ___ | 6BN6 | .74 | ___ | 6U8 | .78 | ___ | 12BA6 | .50 | ___ | 12SA7M | .86 | ___ | 35C5 | .51 |
| ___ | 3AV6 | .41 | ___ | 5U8 | .81 | ___ | 6BQ5 | .65 | ___ | 6V6GT | .54 | ___ | 12BD6 | .50 | ___ | 12SK7GT | .74 | ___ | 35L6 | .57 |
| ___ | 3BA6 | .51 | ___ | 5V6 | .56 | ___ | 6BQ6GT | 1.05 | ___ | 6W4 | .57 | ___ | 12BE6 | .53 | ___ | 12SN7 | .67 | ___ | 35W4 | .52 |
| ___ | 3BC5 | .54 | ___ | 5X8 | .78 | ___ | 6BQ? | .95 | ___ | 6W6 | .69 | ___ | 12BF6 | .44 | ___ | 12SQ7M | .73 | ___ | 35Z5GT | .60 |
| ___ | 3BE6 | .52 | ___ | 5Y3 | .46 | ___ | 6BR8 | .78 | ___ | 6X4 | .39 | ___ | 12BH7 | .73 | ___ | 12U7 | .62 | ___ | 50B5 | .60 |
| ___ | 3BN6 | .76 | ___ | 6AB4 | .46 | ___ | 6BU8 | .70 | ___ | 6X5GT | .53 | ___ | 12BL6 | .56 | ___ | 12V6GT | .53 | ___ | 50C5 | .53 |
| ___ | 3BU8 | .78 | ___ | 6AC? | .96 | ___ | 6BY6 | .54 | ___ | 6X8 | .77 | ___ | 12BQ6 | 1.06 | ___ | 12W6 | .69 | ___ | 50DC4 | .37 |
| ___ | 3BY6 | .55 | ___ | 6AF? | .73 | ___ | 6BZE | .54 | ___ | 7AU7 | .61 | ___ | 12BY7 | .74 | ___ | 12X4 | .36 | ___ | 50EH5 | .55 |
| ___ | 3BZ6 | .55 | ___ | 6AF4 | .97 | ___ | 6BZ? | .97 | ___ | 7A8 | .68 | ___ | 12BZ7 | .75 | ___ | 17AX4 | .67 | ___ | 50L6 | .61 |
| ___ | 3CB6 | .54 | ___ | 6AG5 | .65 | ___ | 6C4 | .43 | ___ | 7B6 | .69 | ___ | 12C5 | .56 | ___ | 17BQ6 | 1.09 | ___ | 117Z3 | .61 |
| ___ | 3CF6 | .60 | ___ | 6AH6 | .99 | ___ | 6CB6 | .54 | ___ | 7Y4 | .69 | ___ | 12CA5 | .59 | ___ | 17C5 | .58 | | | |
| ___ | 3CS6 | .52 | ___ | 6AK5 | .95 | ___ | 6CD6 | 1.42 | ___ | 8AU8 | .83 | ___ | 12CN5 | .56 | ___ | 17CA5 | .62 | | | |
| ___ | 3CY5 | .71 | ___ | 6AL5 | .47 | ___ | 6CF6 | .64 | ___ | 8AW8 | .93 | | | | | | | | | |
| ___ | 30K6 | .60 | ___ | 6AM8 | .78 | ___ | 6CG? | .60 | ___ | 8BQ5 | .60 | | | | | | | | | |
| ___ | 30T6 | .50 | ___ | 6AN4 | .95 | ___ | 6CG8 | .77 | ___ | 8CG7 | .62 | | | | | | | | | |
| ___ | 3Q5 | .80 | ___ | 6AN8 | .85 | ___ | 6CM? | .66 | ___ | 8CM7 | .68 | | | | | | | | | |
| ___ | 3S4 | .61 | ___ | 6AQ5 | .58 | ___ | 6CN? | .65 | ___ | 8CN7 | .97 | | | | | | | | | |
| ___ | 3V4 | .58 | ___ | 6AR5 | .55 | ___ | 6CR8 | .51 | ___ | 8CX8 | .93 | | | | | | | | | |
| ___ | 4BC5 | .56 | ___ | 6AS5 | .60 | ___ | 6CS6 | .57 | ___ | 8EB8 | .94 | | | | | | | | | |
| ___ | 4BC8 | .96 | ___ | 6AT6 | .43 | ___ | 6CU5 | .58 | ___ | 10DA7 | .71 | | | | | | | | | |
| ___ | 4BN6 | .75 | ___ | 6AT8 | .79 | ___ | 6CU6 | 1.08 | ___ | 11CY7 | .75 | | | | | | | | | |
| ___ | 4BQ7 | .96 | ___ | 6AU4 | .82 | ___ | 6CY5 | .70 | ___ | 12A4 | .60 | | | | | | | | | |
| ___ | 4BS8 | .98 | ___ | 6AU6 | .50 | ___ | 6CY7 | .71 | ___ | 12AB5 | .55 | | | | | | | | | |
| ___ | 4BU8 | .71 | ___ | 6AU? | .61 | ___ | 6DA4 | .68 | ___ | 12AC6 | .49 | | | | | | | | | |
| ___ | 4BZ6 | .58 | ___ | 6AU8 | .87 | ___ | 6DB5 | .69 | ___ | 12AD6 | .57 | | | | | | | | | |

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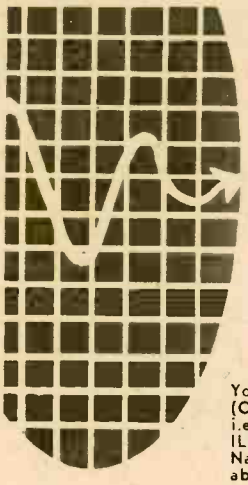

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## Radio Telescope

*Continued from page 47*

the most sympathetic study. It seems quite probable that what he has produced are the first-ever radio pictures of their kind. . . ."

The usual radio-astronomical practice is to select a frequency, and measure the intensity of radiation received from a portion of the sky or a definite "source," which may be a single astral object, or a nebula, or even a "space-cloud" that is dark as far as visible light is concerned. The measuring instrument is a radio receiver, and its output is graphed. From the graphs are made "radio contour charts" of the sky, or a portion of the sky, or a single object.

Mr. Stevens goes beyond that. He translates his receiver output readings to a scale of white spots of graduated size according to the intensity of the radiation received. His sky charts are not made of "radio contour lines," or lines of equal received intensity, but are *pictures* of the distribution of radio energy in the sky or originating from an object.

He takes them by scanning the sky, "line by line," much in the way a television picture is scanned on a camera tube's matrix, only slower. He does this, of course, by swinging the antenna on its bearings. The antenna is equatorially mounted, like the usual optical telescope, so that its main axis of rotation is parallel to the Earth's axis. Thus it can swing east and west. It tilts north and south on a secondary axis.

He hopes to be able to demonstrate the recording of his pictures directly on film and also eventually to record multi-frequency pictures, the radio equivalent of color.

The present telescope is only large enough to permit the development of the technique. For detailed pictures it is necessary to apply the principle to larger instruments having a much higher resolving power. The bigger the parabolic reflector, the narrower the antenna pattern, or the sharper the "beam." This permits better scanning. Stevens thinks direct-recorded pictures using the great radio telescopes of the world would show greater detail than those processed from contour charts, where much detail has been lost.

Although a member of the Derby Amateur Radio Society, Mr. Stevens has never found time to become a licensed operator. His friend, Fred Ward, G2CVV, secretary of the society, lives nearby and helps out with the radio end of the operation.

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