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ELECTRONICS ILLUSTRATED

25c
MARCH

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What You Should Know About Electronics Inventions

Electronics In The Crime Lab

HOW TO CHANGE YOUR TV PICTURE TUBE

A Voice Actuated Switch

For the Ham and SWL: A Signal Splitter

National News Dial

Published periodically by the NATIONAL CO. INC., MALDEN 48, MASS.

FIRST ALL-NEW, LOW-PRICED SHORTWAVE RECEIVER IN OVER 10 YEARS!

New National NC-60 SPECIAL Breaks All Sales Records For Christmas

First reports from National Co. Distributors indicate that the new NC-60 SPECIAL is breaking all sales records for low-priced SWL receivers during the Christmas season. The manufacturer is scheduling overtime shifts to meet distributor orders. It's no wonder why you consider the smart, modern appearance and exclusive features which combine to make the NC-60 SPECIAL America's top value in standard broadcast/shortwave receivers.

The NC-60 SPECIAL covers .54 to 31 mc in 4 bands with full electrical bandspread on all frequencies. Features exceptional sensitivity with separate tuning coils for each band. Has separate general coverage and bandspread tuning capacitors, front panel phone jack and built-in speaker. Standard broadcast, civil defense, WWV, marine, aircraft, amateur and world wide shortwave frequencies are clearly marked on dial .110 volt AC/DC.

ONLY $5.95 DOWN Suggested price $59.95. Most National Co. Distributors offer budget terms.

NATIONAL CO. DISTRIBUTORS OFFER FREE $17.50 SPEAKER WITH NC-109 OR NC-188 RECEIVER!

NC-109 PLUS NTS-1 SPEAKER
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NOW ONLY $19.95 DOWN
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Regularly $177.45
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For a limited time only, most National Co. Distributors offer an opportunity to buy and save $17.50 on the purchase of either the NC-109 or NC-188 receivers. You get the receiver PLUS speaker . . . BOTH FOR THE PRICE OF THE RECEIVER ALONE! See your National Co. Distributor now and save.

NC-109 . . . Covers 540 kc to 40 mc in 4 bands. Calibrated bandspread for 10-80 meter bands. Exclusive "MICROTOME" filter provides 5 degrees of super-sharp selectivity. Sensitivity 1-2 microvolts with 10 db signal/noise ratio. Separate high frequency oscillator with temperature compensated ceramic coil forms reduces drift to .01% or less. Separate product detector for SSB makes the NC-109 America's lowest priced SSB receiver.

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New Organization To Stimulate Interest in Shortwave Radio

The NAAA is the NATIONAL ASSOCIATION OF ARMCHAIR ADVENTURERS—a grand group of bold, dare-do-wells devoted to effortless world-wide travel and adventure through the medium of shortwave radio listening. Membership in the exclusive, international organization is limited to those with courage to risk 50c for a colorful membership certificate and a copy of an exciting new book on Shortwave Listening. Tells when, where and how to listen. Provides log for listing each exciting shortwave adventure. Send 50c to NATIONAL CO., INC., MALDEN 48, MASS.

You Practice with Kits NRI Gives

People *look up to* and depend on the Technician more than ever before. New Electronic products are increasing the job opportunities for Radio-Television-Electronic Technicians. Right in your own home, during spare time, you can gain knowledge, develop skills needed to get good jobs in this vast industry. You learn by doing. You get NRI kits developed especially to give actual practice and experience. As part of your NRI training you can get all parts including picture tube to build the 17" Television receiver, multi-use vacuum tube Voltmeter, shown at left, use it to learn Radio-TV-Electronic circuits, make tests, experiments. All equipment is yours to keep.

NRI Trained These Men

Good Spare Time Earnings

"Am doing well in spare time Radio and TV. Sometimes have three TV jobs waiting"—G. F. SEAMAN, New York, N. Y.

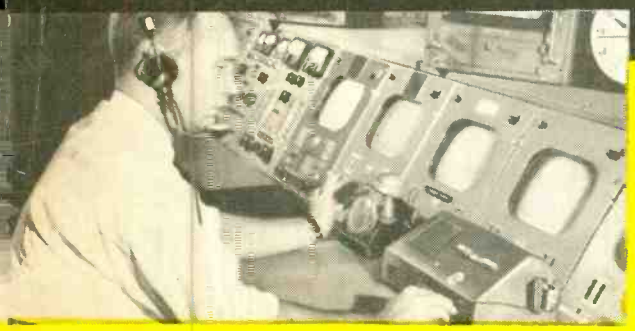
Has Own Radio-TV Business

"Have Appliance store with TV Servicing. In Army, NRI helped get me top rated job."—W. M. WEIDNER, Fairfax, S. D.

FOR GOOD PAY TO START AND A BRIGHT FUTURE

Learn Radio-TELEVISION-Electronics

AT HOME IN YOUR SPARE TIME



Broadcasting offers satisfying careers. Hundreds of Radio and Television stations on the air offer interesting jobs for Operators and Technicians. Police, Aviation, Two-Way Communications are expanding. Men with Radio-TV training are in demand.

A solid, proven field of opportunity for good pay is servicing the millions of Radio and TV sets now in use. Government, military, guided missile manufacturers, industry . . . all need Technicians. Color-TV, H-Fi are increasing the opportunities.

Start Soon to Earn $10—$15 a Week Extra in Spare Time

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

Benefit by NRI Experience—Oldest, Largest Home Study Radio-TV School

NRI's more than 40 years experience training men for success—the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, in small towns and big cities. Here is an investment that pays big profits soon. Each week, invest only a few hours spare time in yourself—preparing to be a Radio-TV-Electronics Technician. Invest in training to get ahead. NRI can provide the training you need.

NRI Is The Tested Way to Better Pay

Technical know-how brings better pay, fast advancement. Radio-TV-Electronic opportunities are great, and are increasing. NRI has developed over 40 years to developing simplified, practical training methods. Mailing the card at right can be one of the most important acts of your life. Do it now. Reasonable tuition, on low monthly payments available. Let us send you an actual Lesson and 64 page Catalog—BOTH FREE. Address NATIONAL RADIO INSTITUTE, Dept. 9CK, Washington 16, D. C.

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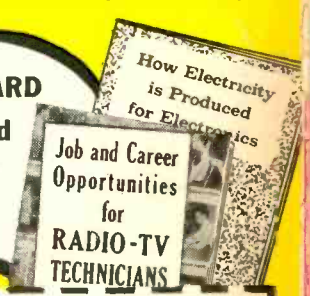

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Low bass frequencies from *both* stereo channels are properly phased through the XX3 STEREON Control Filter and channeled into your present full-range speaker to utilize its full-bass reproduction capabilities; the mid-bass, treble and very high tones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

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

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ELECTRONICS ILLUSTRATED

A Fawcett Publication

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Contents

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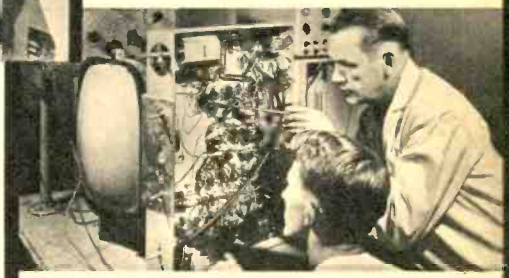

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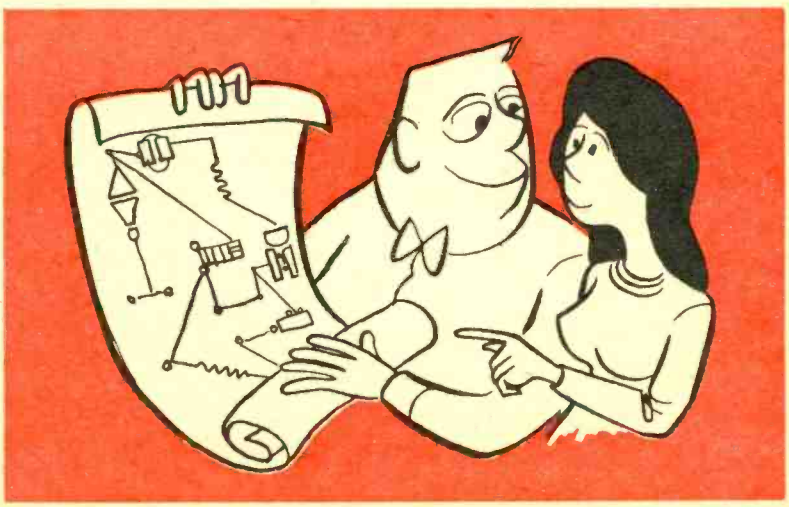
A Message From the Editor

I have just read a prediction that by 1967, eight years from now, we will be 20,000 engineers short if our schools continue to turn out engineers at their present rate. This prediction comes from the Science Manpower Project of Columbia University. At the rate that industry and government are using engineers, we'll probably need even more! What of the teenager who thinks he would like to be an engineer—how can he tell whether he is capable of successfully becoming one? According to the Project, a strong "interest in science and technology and *related hobbies* and participation in science competitions" is a good omen for future success in science. Among the related hobbies which are most helpful, educational and practical are amateur radio and electronic construction. In other words, if you, your brother or your son thinks he wants to be an electronic or electrical engineer a good way to get started toward such a career is to embrace electronics as a hobby. The Project also points out that such a hobby is also helpful for those who are interested in becoming technicians rather than engineers.

Some of the editors of *ELECTRONICS ILLUSTRATED* have become so interested in amateur radio (possibly inspired by some of the articles on amateur radio and shortwave listening that we have published) that we've decided to start a ham station right here in our lab. We are going through the paperwork stage now and if everything works out according to plan, many of you hams will soon hear our call. The station is not intended for our own amusement rather, we will use it for testing equipment, for becoming more familiar with many of our ham readers and, more important, for helping novices and would-be amateurs attain their general class ticket. Listen for us soon!

When RCA announced in the middle of last year that it was marketing a series of hi-fi stereo tape cartridges or magazines for use on an automatic tape recorder running at 3¾ inches per



How to interest your wife-girl in electronics, drawn by Kohler.

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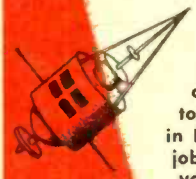
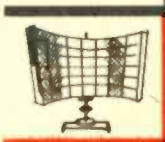


No Previous Technical Experience Or Advanced Education Needed!

Laborers and bookkeepers, store clerks, shop men, farmers, salesmen — men of nearly every calling — have taken the DeVry Tech program and today have good jobs or service shops of their own in Electronics. You don't have to quit your present job. If you are 17 to 55, see how you may get yourself ready for a future in the fast-growing Electronics field.

Whether you prepare at home or in our well-equipped Chicago or Toronto Laboratories, you get sound, basic training in both principles and practice. At home, you use educational movies. You build actual circuits and test equipment. You read simple directions, follow clear illustrations. When you finish, you are prepared to step into a good job in this excitingly different field. You may even start a service shop of your own. Mail coupon for free facts today.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second, the tape industry was taken by surprise. Many people who intended to buy tape recorders decided to wait to see what the new cartridge was like; dealers and manufacturers were skeptical that the new gadget would work and sound good at the slow speed. Rather than jump on the bandwagon of wild confusion, *EI* waited until we could get an RCA tape magazine and test play it. This we have done and our report on this new hi-fi development appears in this issue starting on page 38.

Among the other articles I would like to recommend to you in this issue is "All About Computers" which is the first of a series explaining the different types of electronic brains and how they are used; "How to Change Your TV Picture Tube," and "Inventions in Electronics."

Next month we have some very interesting features in store for you. I am sure that many of you construction hobbyists must constantly overcome a major handicap—your wife—when working to complete your projects. If you are not yet married it may be well for you to begin to learn how to cope with any woman who may become part of your life and your hobby. In our next issue, Carl Kohler, electronic wit and cartoonist will show you how to interest your wife in your electronic projects in how-to-do-it step-by-step style.

Great studies are being made in the laboratory toward harnessing the Sun's power for electronics. We'll bring you up to date on this vital topic next month.

Also in the next issue you will be shown how to build a hi-fi tester to check your present system or components that you intend to buy, also highly useful for kit builders. A novel experimenter's control center will also be described and in an interview, a highly respected veteran ham will tell you how to buy ham receivers and transmitters.

Of course there will be all our regular features and more, much more!!

Charles Tuttle

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HOW WILL YOUR I.C.S. SUCCESS STORY SOUND?

"I took my diploma from your school in Radio Operating in 1947. In 3 years I became chief engineer of WKOK in Sunbury, Pa. Then I came to California as Audio Engineer for ABC in Hollywood. I still hold this position. I will always be grateful for your help in getting me in the type of profession that has so much to look forward to." *William R. Dreese*

"I had been in the radio-repair business for 30 years, when I enrolled in the I.C.S. Television Servicing Course.

"Now I am able to approach a television job in a systematic manner, while others are still operating on the hit-or-miss level." *Kelsey G. Cobb*

"Up to the time I enrolled, my interest in electronics was purely a hobby, but before completing my course I was able to do a considerable amount of radio work. Now I have a good part-time business." *George A. Chase*

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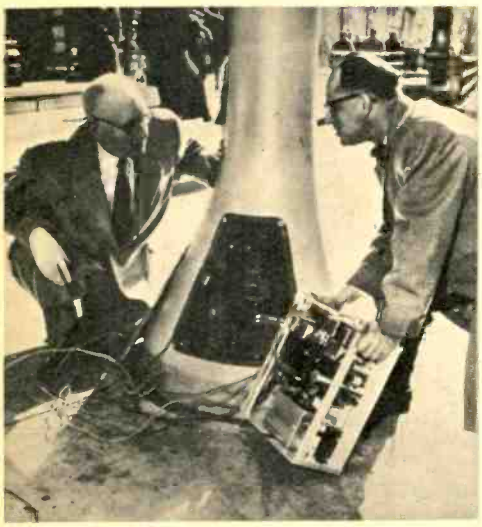
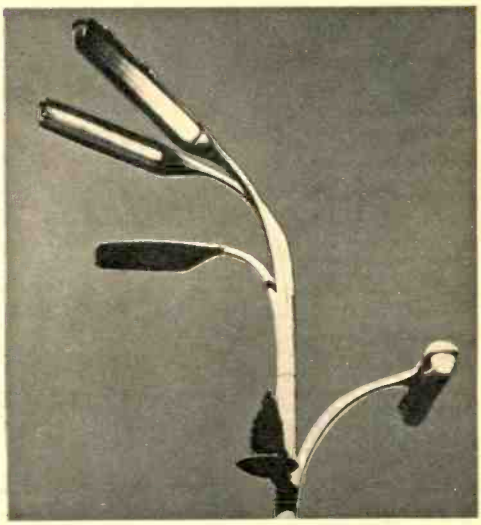
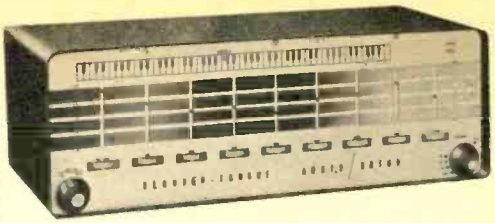
Electronics in the News





"The world's best lighted street," Chicago's State Street, now operates on electronics. General Electric is the maker of the radio control system that turns on the 280 street lights from one central station located in a nearby building. A 60 watt radio transmitter serves as the master signaling device for receivers located in the bases of 28 of the 70 light poles. Pulses from the transmitter turn the lights on and then off in accordance with an astronomically compensated timer. As the days grow shorter the lights are turned on sooner and vice versa, by the astronomic dials on the time switches.



Blonder-Tongue's new Audio Baton permits the user to boost or reduce groups of sounds up to 14 db within a range of nine octaves. Some forms of distortion, scratch, and rumble may be eliminated by varying the controls.

The unit is placed between the phono, tape recorder or tuner and the hi-fi main amplifier. A 3-position switch at the rear gives a choice of output levels. Net price is $119.50.

A miniature pocket-sized FM transmitter and an FM receiver for voice communications on the 25-54 and 144 to 174 mc bands were demonstrated by Motorola recently. Maximum range of these all-transistor units is ten miles. The receiver weighs about 12 ounces, the transmitter about 3 pounds, and can be fastened to a person's belt, replacing mobile type radios used heretofore on these bands. Each unit is capable of operating with any conventional VHF communications system.

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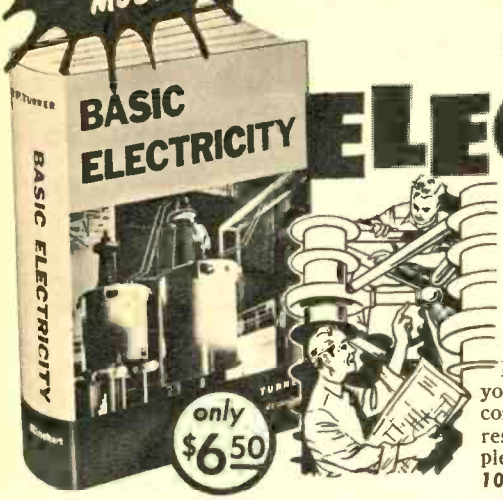

No matter what you want to do in ELECTRONICS, RADIO, COMMUNICATIONS or ELECTRICITY, this is the most important training of all!

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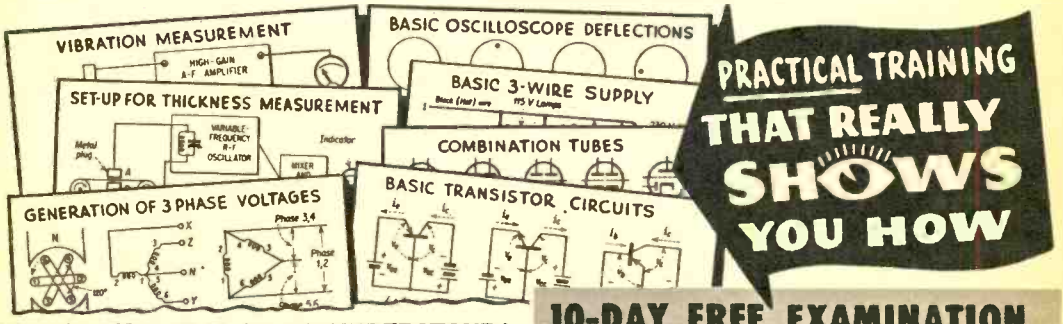

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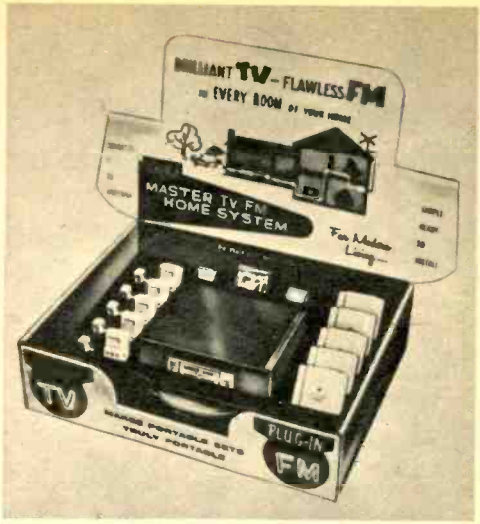

A master antenna system for the home providing up to 10 or more plug-in outlets for TV sets and/or FM receivers from one antenna is now being marketed by Jerrold Electronics Corp. This kit includes amplifier, antenna leads, hardware and plug-in outlets which can be distributed throughout the home. List price is $67.75.

—o—

New Booklets and Catalogs:

The Industrial Products Division of Herbach & Rademan, Inc. at 1204 Arch St., Philadelphia 7, Pa. has issued a 24-page catalog containing products and components for use in electronics, science, engineering, biology and astronomy. Free copies may be obtained by writing to the above address.

A 96-page Quality Control Catalog containing measuring magnifiers, microscopes, all types of optical items, illustrations and technical data may be obtained free of charge from Edmund Scientific Co., Barrington, N. J.

A wall chart listing the proper American receiving tube replacement for European manufactured types is available through the electron tube distributors of Sylvania Electronic Products.

—o—

The solar-powered radio in Vanguard I is still transmitting data back to earth, after travelling the distance equivalent to 195 round trips to the moon. It was put into orbit on March 17, 1958.

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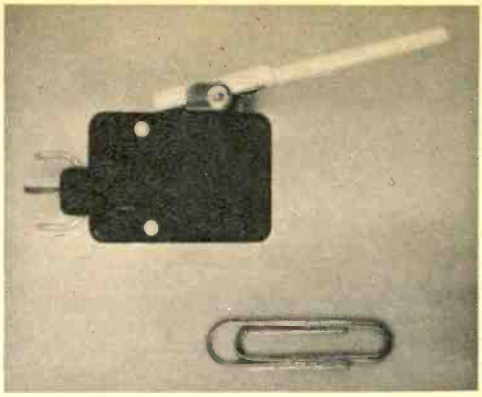
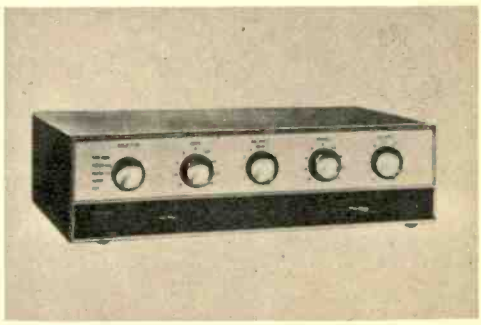


Robertshaw-Fulton Controls Co. has announced a new switch, not much bigger than a paper clip, which automatically shuts off a tape recorder when the tape runs out or breaks.

The main body of the switch is less than 1½" in length and is rated at 3 amperes, 250 volts AC.

If the tape breaks, pressure on the leaf over which the tape passes is released, shutting the recorder. $1.75 Net.

—o—



A new Stereo Preamp Control in kit form is now available from Knight Kits. The model, KN-700A has inputs for tape, AM-FM tuners, various phono cartridges and microphones. The preamp contains controls for master volume and separate bass and treble control for each channel. Net price is $89.95.

Knight Kit also has just made available a 30 watt per channel stereo power amplifier (model 83YU777) to complement the control unit. It features a separate balancing adjustment for each channel and 2 printed boards to simplify assembly. $84.50 Net. Both of the above are available from Allied Radio Co.

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Thrilling "Space Spanner" Receiver Kit

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Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short-wave, including foreign broadcasts, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Highly sensitive regenerative circuit. Built-in 4" PM speaker and beam power output for strong volume. Headphone jacks and switch to cut out speaker. Handsome cabinet, 7 x 10½ x 6". AC or DC operation. 7½ lbs.

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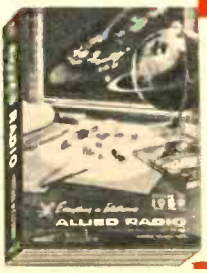

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—o—

Leaner bacon is the homey goal of an ultrasonic wave machine in England. A high-frequency sound wave is sent through the fat on the backs of live pigs. On reaching the boundary between fat and lean tissue it is reflected back to the surface. The time taken for the sound to make this journey is a measure of the fat thickness—and an indication of how good your future breakfasts may be.

—o—

The Aurora Science Tape Society is striving to increase its membership and would like to hear from people under 22, interested in science, and with access to a tape recorder. Write ASTS, Box 91, Sierra Madre, Cal. Membership and all facilities are free.

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The Grantham Communications Course does not include actual work with practical kits or other equipment. That is, for example, it does not teach you how to solder or how to remove a TV chassis from the cabinet, etc. It is not a repair course but, instead, is bona fide technical training which teaches you to understand electronic theory—which teaches you the *"why"* of electronics.

If you are a beginner in this field, the Grantham course will give you the kind of detailed training in radio-electronics theory and operating practices that will enable you to obtain your first class F.C.C. license quickly. Then, this license plus your knowledge of theory will qualify you for certain types of employment, and you can improve your practical ability while on the job earning a salary.

If you already have practical experience in radio-electronics, the Grantham course can add a knowledge of theory and an F.C.C. license to that practical experience. This should qualify you for higher pay and greater job security.

Train by Correspondence or in Resident Classes

RESIDENT CLASSES—The Grantham Communications Electronics Course is offered in both DAY and EVENING classes in Washington, Hollywood, and Seattle. The DAY course meets five days a week, from 9 a.m. until 1 p.m., and prepares you for a *first class* F.C.C. license in 12 weeks. The EVENING course meets two nights a week, from 6:30 p.m. until 10:30 p.m., and prepares you for a first class F.C.C. license in 30 weeks. All courses "begin at the beginning"—NO previous electronics training required or assumed.

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This course can prepare you *quickly* to pass F.C.C. examinations because it presents the necessary principles of electronics in a simple "easy-to-grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

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The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

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Serge G. Miller, 1315 W. 15th St., San Pedro, Calif.	1st	12
John A. Hayes, 1519 Madison Ave., Memphis, Tenn.	1st	14
Robert A. Morgan, 25 Barrow St., New York, N.Y.	1st	9
Hal Moon, Cook Hotel, 1334 Central, Kansas City, Mo.	2nd	5
W. R. Smith, 1335 E. 8th St., Long Beach, Calif.	1st	12
Erskin D. Davis, 4220 Clay St., NW, Washington, D.C.	1st	12
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Robert H. Moore, 807 Grace St., Baldwin, L.I., N.Y.	1st	12
Otis A. Towns, 3638 Bates St., St. Louis, Mo.	1st	12

THREE COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains three complete schools—one in Washington, D.C., one in Hollywood, Calif., and one in Seattle, Wash. All schools offer the same rapid courses in F.C.C. license preparation, either home study or resident classes.*

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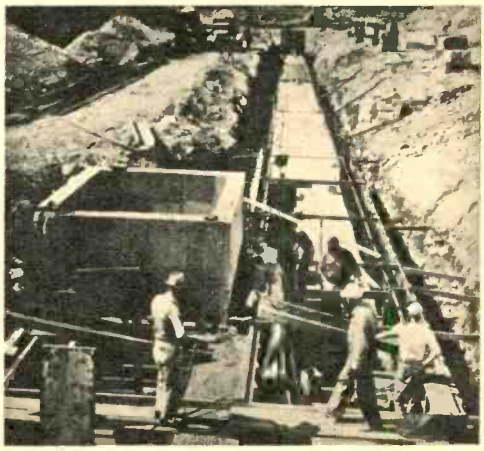
A new communications receiver featuring dual conversion, combination of slot and crystal filter, and automatic noise limiter was announced by Hammarlund Manufacturing Co., Inc. This receiver, the HQ-145, provides continuous tuning from 540 kc to 30 mc with electrical bandspread on all amateur radio bands. Dual conversion is provided from 10 to 30 mc, with the second conversion frequency crystal controlled.

The 60 db slot filter is adjustable ±5 kc over the passband. $269 Net.

—o—



Bell Telephone Labs is in the process of constructing a man-made ocean in Chester, New Jersey for testing cables under actual ocean conditions at 12,000 feet or 2 miles below the surface. The 315′ "ocean" lies 7′ underground, a level at which the earth's temperature is consistent. After "laying" the cable, it will be subjected to tests lasting 5-10 years.

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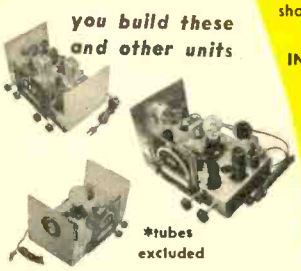
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build these and other units



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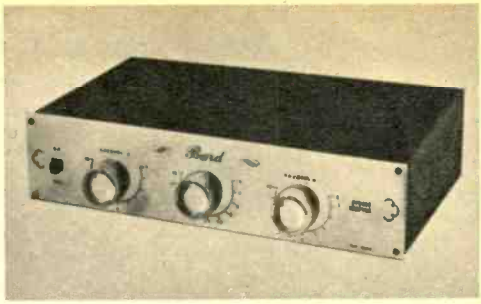


With Bard Record Company's Stereophonic Adapter any AM radio can be made to serve as the second channel for a stereo record playing system. The adapter contains a small transmitter which sends out the second channel to be picked up by the radio in the same room at an unused frequency on the band. The adapter itself is plugged into the phonograph and a stereo cartridge (included with the adapter) is installed in the pickup arm. About $29.95.

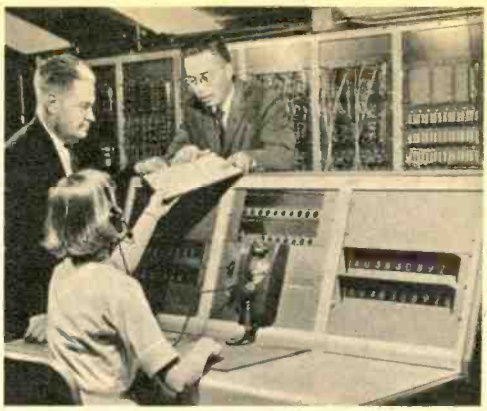
—o—

Intercontinental mail may someday be transmitted with the aid of a satellite repeater station thousands of miles above earth. As proposed by RCA engineers, letters would be converted to radio signals and "bounced" across the ocean by means of the satellite. The microwave signals or high speed facsimile can be converted into print.

—o—

Videotape is the "secret Weapon" the Minnesota Gophers used against the Iowa Hawkeyes for the first time in college football. The tape is played back during halftime permitting the coach and players to review the first half of the game and analyze their mistakes and the opposing team's weaknesses.

Amplex makes the playback machine.



Named for an oracle of ancient Greece, Bell Telephone Labs' "Sibyl" is a computer-like machine and laboratory, designed to predict the desires of future telephone customers. Sibyl can simulate and test a variety of communication devices, collecting data as she does so, without interrupting the privacy of the telephone user. The system is digital in operation and is composed mostly of electro-mechanical switching elements constructed in small modular units. Tone multiplex and DC signaling are used between the main machine and the remote terminal equipment. Readout of collected data is done by direct-writing recorders, magnetic tape recorders, paper tape punches, tabulating card punches, etc. Statistical analyses of punched cards are done by a high-speed electronic computer.

—o—

A Bulletin of Expired Patents is being offered by the N. Y. Research Bureau, 220 Cabrini Blvd., N. Y. 33, N. Y., at $12 for 12 issues. From the bulletin you can order any complete patent, with all information, exactly as filed by the inventor, for $3 each.

—o—

The Rochester N. Y. Transit System, moving with these electronic times, has equipped its fleet of nearly 300 buses with 2-way radios. The systems, developed by Stromberg-Carlson, should help eliminate traffic and tieup problems, and supply bus drivers with means of handling emergencies efficiently.

—o—

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

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You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, 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 $22.95. 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.

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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 closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

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Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, 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 16 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, 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 & Electronics Tester. The "Edu-Kit" also includes Code instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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- 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 troubles 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, 1834 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."

UNCONDITIONAL MONEY-BACK GUARANTEE

The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, schools and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

By popular demand, the Progressive Radio "Edu-Kit" is now available in Spanish as well as English.

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc., for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

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

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PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 509AE, Hewlett, N. Y.

Of interest to short-wave listeners, hams and satellite trackers, is this 12-inch Satellite Globe which contains an orbit ring for tracing the path of an earth satellite. One of 31 new Rand-McNally Space Age globes, this model, for $14.95, includes calibration of miles, degrees and hours for measuring air distances between any two points in the world.

Among the new toys from Science Electronics, Inc. is this Erec-Tronic Two Transistor Receiver and Broadcast Set. The T-175, retailing for $16.95, builds and rebuilds 10 sets progressing from simple demonstration circuits to powerfully performing transmitters and radios. No special tools or soldering are needed. A youngster can build a radio in 10 minutes.

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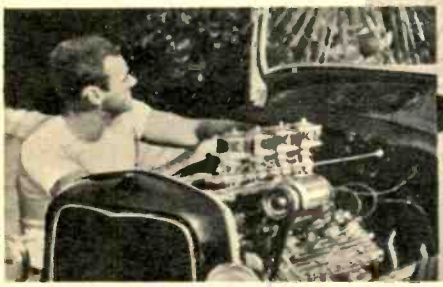

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what you should know about

Inventions In Electronics

By Harry Kursh

Do you have an invention idea? Here's a rundown on your chances of parlaying it into big money.

A VERY successful inventor was recently asked what he believed the future held for inventors in electronics. It was pointed out that TV, radio, tape recorders, etc., were all on the market and, after all, what was there left to invent?

"The future for the inventor in electronics is fabulous," he answered. "We have only begun. I once did a great deal of research into electronic patents. I saw so many that I almost gave up. I thought it was impossible to think up anything new.

"Now, I know just the opposite. There is always something better just waiting to be invented."

Defense industries, such as Lockheed Missile Systems, have need for items like tiny, rugged airborne tape recorder, held by Mark Siera, inventor.

NEW YORK TIMES, FRIDAY, NOVE

U. S. ISSUES A CALL FOR 82 INVENTIONS

Asks Public's Ideas to Solve Problems That Still Elude Pentagon's Scientists

WASHINGTON, Nov. 13 (AP) —The Government is issuing a new appeal to inventors to help the armed forces solve "impossible" problems.

The National Inventors Council, a clearing house for ideas that might help the military, will publish tomorrow an ex panded list of technical p lems that have baffled engineers and scienti entire country is invite a crack at them.

Ever since 1940 th has issued lists of in wanted by the armed forces. new list adds eighty-two prob-

have either been s passed.

One new without i nicate w be used so that

The to pro meteo sky. of ra Th s

new idea military also wants a man-made electric eel. This is the fish that can generate electricity in sea water. The armed

ower amplifiers ached to und o strengt ls.

Inventions S To Strengthe

By Special

WASHINGTON, Nov. 23. — Armed Forces are hunting electronic inventions to strengt United States military power.

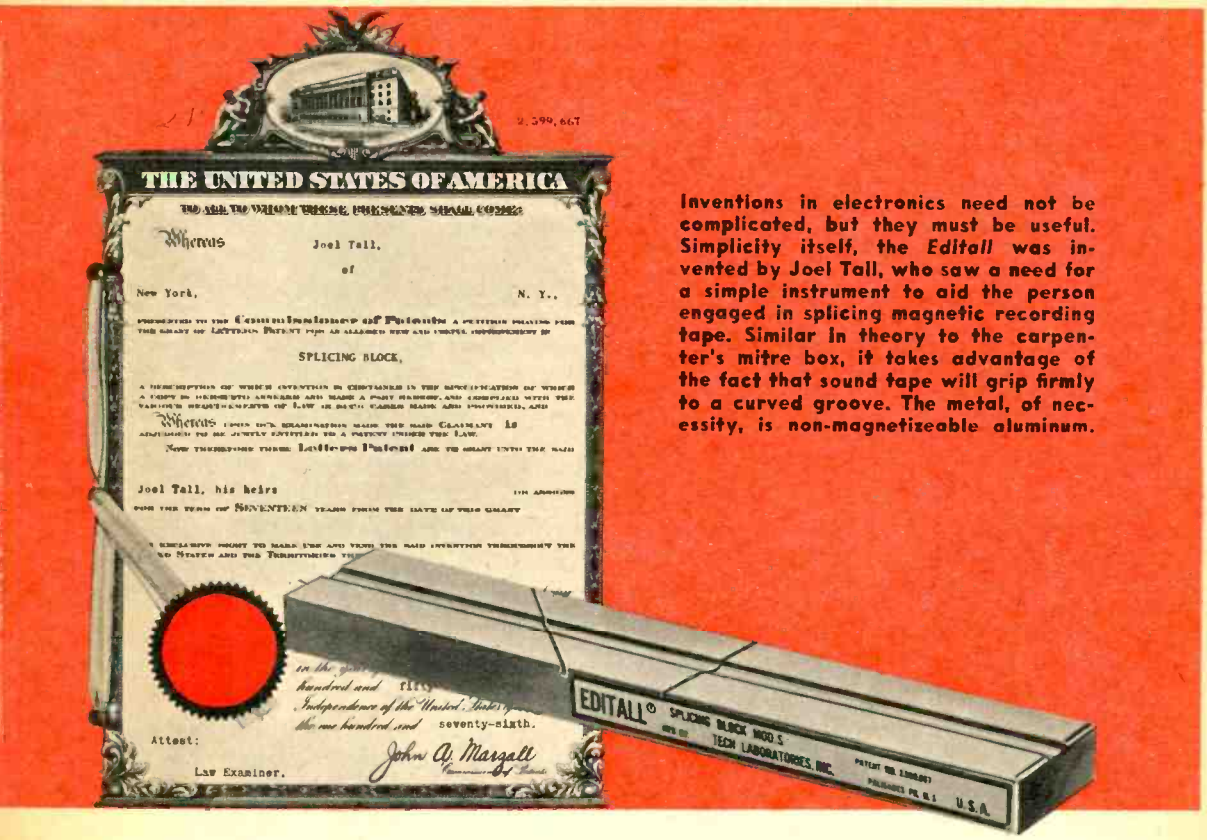
The National Inventors Coun appealing to industry, scien nd independent inventors to e ins unsolved problems of equip t and technique for defense advance new ideas and fresh

ng the most wanted items ultra-long range radar set an over-the-horizon capa- up to 2,000 miles — for ation penetration and

rate electronic distance system for geodetic dis- up to 1,500 miles is lso wanted are missile- ing TV systems with image quality near that of a photograph.

There is urgent need, the council says, for extremely sharp cut-off applicatic selective microwave filters; quick- upon bas heating cathodes capable of opera- foundati tion in less than primary transisto-

ch and nily ori



Inventions in electronics need not be complicated, but they must be useful. Simplicity itself, the *Editall* was invented by Joel Tall, who saw a need for a simple instrument to aid the person engaged in splicing magnetic recording tape. Similar in theory to the carpenter's mitre box, it takes advantage of the fact that sound tape will grip firmly to a curved groove. The metal, of necessity, is non-magnetizeable aluminum.

Madison Cawein wasn't giving a pompous pep talk, like the coach who's never been in the game. Since the time he first thought there was nothing left to invent in electronics, he has racked up some 65 electronics patents and is vice president in charge of research for Grimson Color, Inc., where he is still going strong. His most recent work has been on "Scanoscope," the wide screen television development that may revolutionize home TV.

Where do you stand? Do you have an electronics invention up your sleeve? Are you just marking time? Do you believe "there's nothing left to invent?"

The facts are these: Electronics is the fastest growing industry in history. The driving force behind all industrial growth is, and always has been invention. Electronics is no exception.

Today, the industry is pouring over $1 billion a year into research and development, which is just another way of saying invention. Approximately half the engineers employed in electronics are doing research and development exclusively. The electronics industry already holds more than 30,000 patents, an accomplishment exceeded only by the machinery and chemicals industries, which have been around generations longer.

True, the pattern of invention has changed considerably. The lone-wolf "Edison"—burning the midnight oil, walking on clouds, toying with crude tools, waiting for that sudden flash of genius that will make him rich overnight—has virtually vanished from the scene. Many inventions, particularly in electronics, are the products of high-salaried brains, operating as a team, enjoying the benefits of costly laboratories.

Does this mean that opportunities for the individual inventor have already become history? Not by a long shot. There are numerous solo inventors, many considered quite successful, even

though some have never gone beyond high school in their formal education.

For example, if you walked into the office of Henry O. Willier in Rockville, Md., you'd never guess he never went to college or technical school. Henry Willier got the idea that fame and fortune awaited the man who could find some economical means for recovering the silver particles that are ordinarily washed down the drain when used darkroom photo solutions are dumped.

Willier was told that trying to recover the particles of silver for profit would be like evaporating the Atlantic Ocean to get a pinch of salt. Others had tried and failed. But Willier, who had been tinkering with radio and electronics ever since he was a boy, was not one to be easily discouraged.

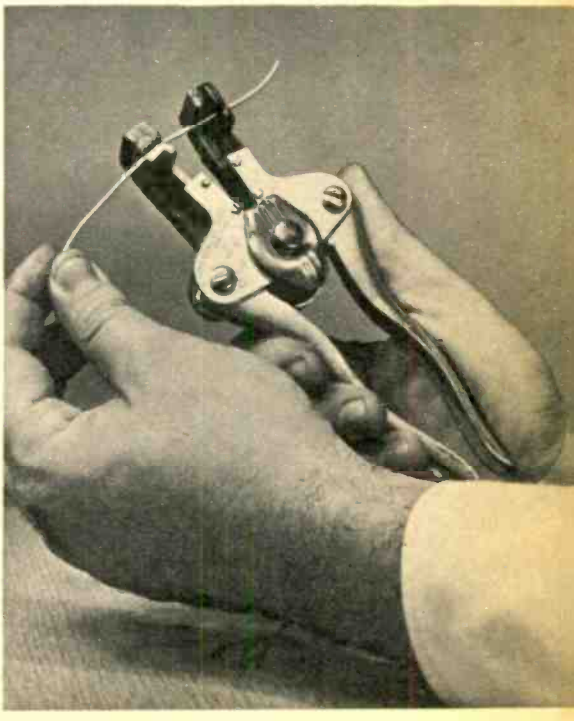
After several years of spare time experimentation, he came up with "an electrolytic device for continuous automatic silver recovery." About five years ago he started his own company, and now his customers number in the thousands, coast-to-coast and overseas. He either leases his device, and takes a share of the silver recovered by the customer, or he sells it outright.

In modern Takoma Park offices of the Rabinow Engineering Corporation on the outskirts of Washington, D. C., is another inventor, Jack Rabinow, a man considered by many to be one of America's true electronic wizards. Attesting to his talents are many citations (from the White House down), and inventions which are still kept under a top secret lid.

Almost all his life, Jack Rabinow had worked for the government, at the Department of Commerce's famed National Bureau of Standards. Scores of patents were issued in his name, but were assigned to Uncle Sam to be made available free of charge to any American company. An official once said that if Jack Rabinow had been able to license his inventions to private industry, he would have collected at least $10,000,000 in royalties alone!

Willier method of recovering silver from photographic hypo uses wire mesh electrode.

Speedex, patented wire stripper cuts insulation, separates it from wire in one operation.



Inventor Rabinow holds two models of several automatic headlight dimmers he developed.

Prototype mail sorter allows operator to send letter into one of only three mail groupings.

But Rabinow was content to serve Uncle Sam and get along with his comfortable five-figure salary as a division chief, until a few years ago when he decided to give up his government job and go it alone as an inventor. He used the basement of his home as a workshop and office. Today, he has a full time staff of 27 assistants, about one-third of whom are professional engineers. His former income has been multiplied by at least five, but it is only the beginning. Rabinow has been selected to develop an automatic electronic mail sorter for the Post Office Department (with a half-million-dollar contract to get started).

In between major chores, Rabinow has invented an inexpensive automatic headlight dimmer for autos and an automatic time adjuster for electric auto clocks. If your next new car happens to have a clock without a knob for adjusting the hands, you can be sure Jack Rabinow will be collecting a few pennies' royalty for it.

It would be foolish to leave the impression that the highway to fame and fortune in electronic inventions is paved with dollar bills and endless success, and customers waiting to make you rich as soon as you patent your brainstorms. As in any other industry, there are failures and obstacles and discouragements galore. It is something you have to go into with your eyes wide open, realizing the gamble is big—*but so is the payoff!*

Basic to all inventions, of course, is the patent issued by the United States Patent Office. An agency of the Department of Commerce, it gives you the exclusive right to own and control your invention for 17 years, during which time the patent is just like a piece of property: You can lease it, sell it outright, mortgage it, assign all or part of it, or pass it on to your heirs.

To know more about patents you need not go to law school. Just about all the information any inventor would need to know about patents can be had for 15 cents. It's a 35-page booklet called, *"General Information Concerning Patents,"* and may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

You do not need a lawyer to obtain a patent. With the help of the above mentioned booklet, you can apply for a patent yourself. But if you do, chances are you will be making a mistake you may regret the rest of your life.

It is one thing to get a patent, but

Advanced model features more address categories and permits greater ease in handling.

Expert Patent Office examiners carefully check your claims against all that have gone before.

it is an entirely different feat to obtain a patent which is so well prepared that it gives you the broadest possible protection and the greatest number of opportunities for striking it rich.

The heart of all patents is the claim. You may make all the claims you desire for your invention. These are listed specifically, point-by-point, and numbered in your patent application. After your application is received at the Patent Office, it goes through the hands of a specialist, a patent examiner, who may allow or disallow all or part of your claims. If only one claim sticks, you've got a patent. And on that your fortune rests.

But the art of writing up the claims is a highly complicated affair, calling for the talents of a skillful and experienced lawyer, usually one who specializes in patents. He who tries to write his own claims, as the saying goes, has a fool for a lawyer. This also implies that good legal patent work does not come cheap. Be wary of legal bargains. A patent lawyer has to take the time to understand your invention, and often you have to confer with him toward that end so that he can apply for every reasonable claim to give your invention the protection it deserves.

The United States Patent Office maintains a roster of lawyers who are registered to practice before the Patent Office, which means they must observe certain legal and ethical codes. Also, if you want to be referred to patent lawyers in or near your hometown, you may write to the American Patent Law Association, National Press Building, Washington, D. C.

So, now you're going to get a patent and you're on your way to riches. Whoa! Not so fast . . . Many patents aren't worth the paper they're written on, simply because the inventors never took the time to do some preliminary research to find out whether there was a *real need* for the invention.

Elton T. Barrett, a brilliant 43-year-old electronics company president who combines the skills of a chemist, engineer and patent attorney, puts it this way:

"What course is most likely to make money for the inventor? First of all, you ought to sit down by yourself, or with your friend, or with your attorney, and critically analyze the invention. Is it really and truly a better way of doing something? Can it be incorporated in apparatus which the public or some manufacturers will buy? Is it too expensive? Is it too complicated?

[*Continued on page* 108]

Special Project

how to change

Your TV Picture Tube

The most important factor for success in this project is SAFETY—as detailed in this article.

THE electronic hobbyist, experimenter, and kit builder quickly acquire a reputation among family and friends for being a "genius" for whom a TV set holds no secret. This article was designed to aid such a person in coping with a picture tube replacement without the need of extensive knowledge or equipment.

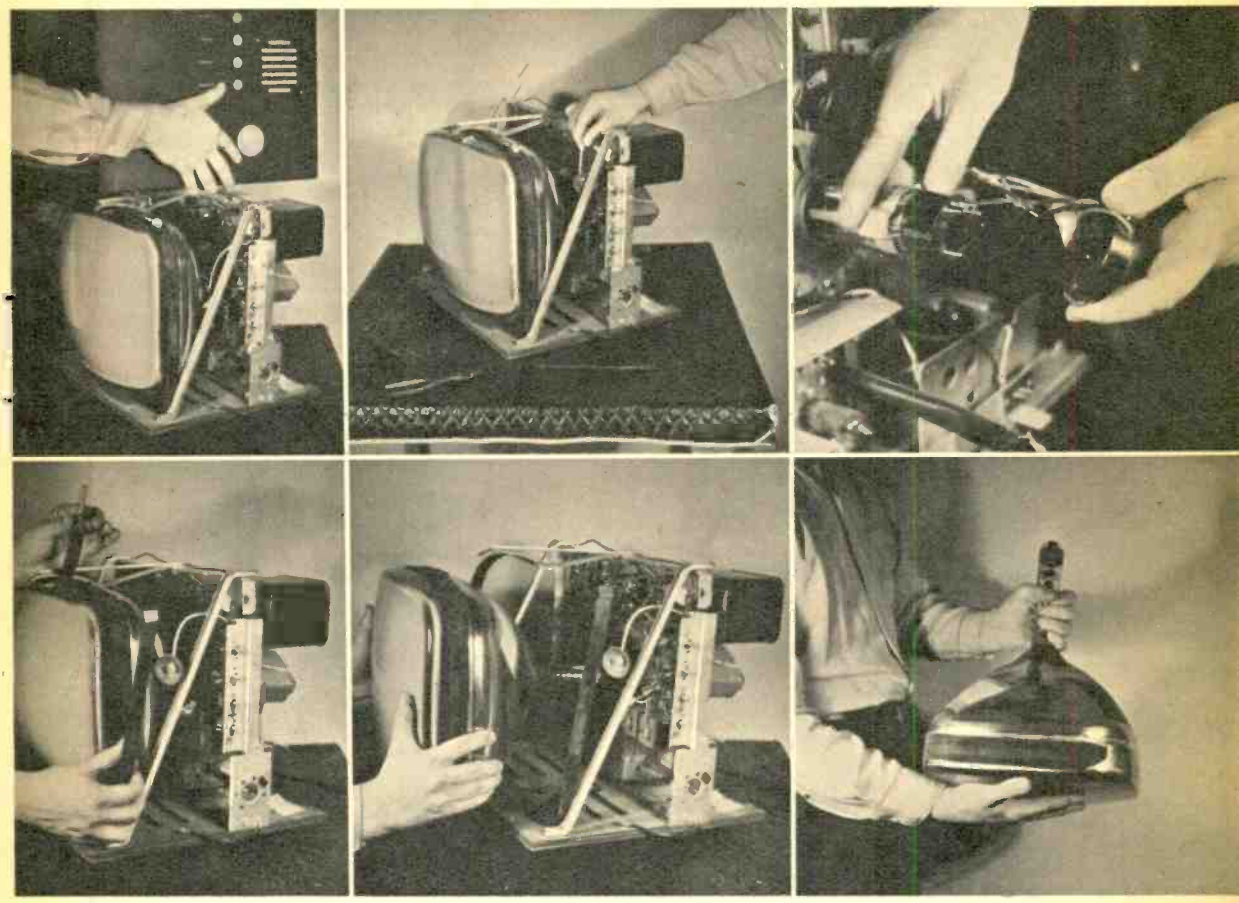
Changing the tube is certainly not a job for one whose only proficiency is fixing a broken antenna wire on the rear terminals of the set. But, if you've done some puttering and have the healthy respect demanded by any electronic equipment, go to it, you'll save money.

The owner's instruction book for this late model Zenith actually gives step-by-step disassembly information. On facing page are step-by-step photos for removing pic tube from vertical chassis sets; for horizontal type chassis, see the photos starting on page 34.

1. Cabinet on vertical set lifts after underside chassis bolts and knobs are removed.

2. Anode cap (see diagram) is pulled from side of tube and shorted against ground.

3. Picture tube socket is carefully pulled off and ion trap (other hand) removed.



4. Nut holding mounting strap near face of tube is unscrewed and strap is opened.

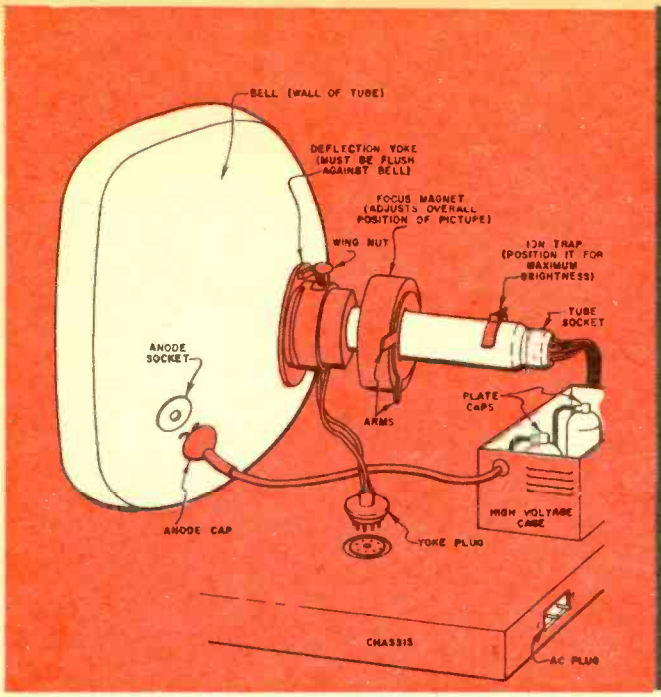
5. Slowly pull tube out. Keep it parallel to table and avoid any strain on neck of tube.

6. To carry tube; rest full weight on hand under face of tube. Other is for balance.

Before beginning this project it is certainly a good idea to determine if the picture tube *really* is at fault. Several small tubes could cause a loss in the high voltage that lights the screen. The *EI* Picture Chart in the Nov. 1958 issue covers this. These tubes include the horizontal oscillator, horizontal output, high voltage rectifier, damper, and AFC tube. Also, an ion trap (see illustration) that is slightly misadjusted will cut the white light on the screen—check it according to the instructions given later. Of course, if components under the chassis are malfunctioning, the circuits will be likewise affected.

Here are some reliable signs of a bad picture tube: A gradual dimming of the picture over a long period of time is one. This is due to the lowered emission of the filament. For a while this may be stemmed by a booster, but the tube will soon need replacement. If your brightness control has little effect and light remains on the screen though the control is turned down, shorted elements in the picture tube are probably the cause. This will also "wash out" the image on the screen.

One reason for a completely dark



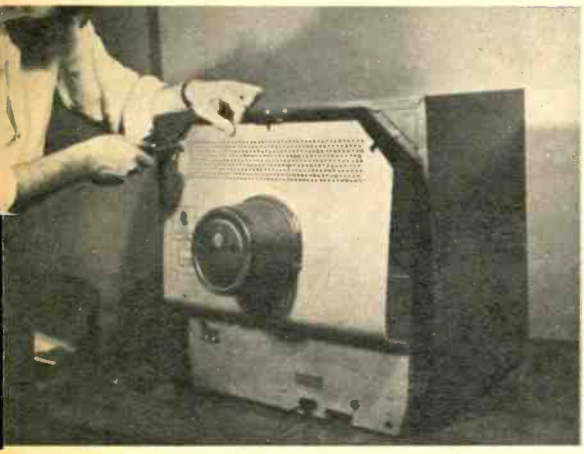
CAUTION!

All areas shown in white on this drawing have either residual high voltage or are fragile. Study this and the other drawings that are found on page 36.

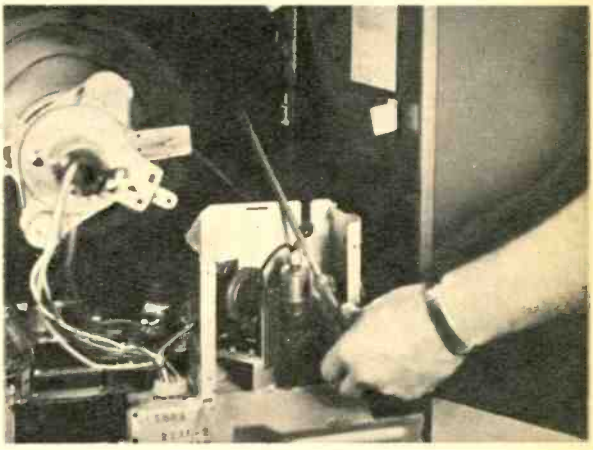
Anode socket and cap, and plate caps in high voltage cage, must be shorted to ground according to the text and other illustrations.

Picture tube bell and neck mustn't be struck, scratched or strained in any manner.

1. First step for horizontal chassis is to remove plug from wall and unscrew rear cover.

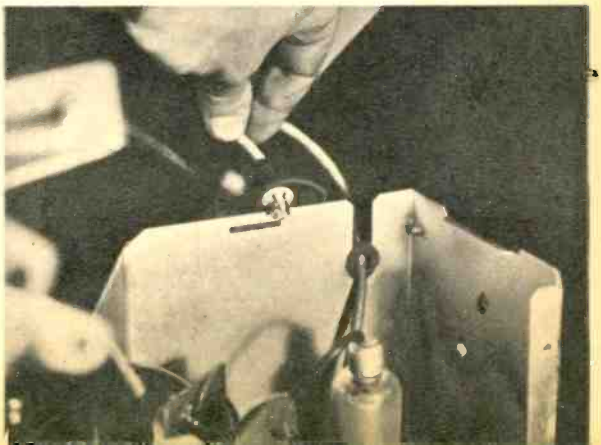


2. Open high voltage cage and short plate cap to ground several times with a screwdriver.



3. The anode lead emerges from the high voltage cage. Remove its cap from the side of tube.

4. Touch the metal plug of the anode cap to ground several times to discharge any voltage.



screen is a blown high voltage fuse. It is often located on the chassis, in or near the high voltage cage in a clip-in holder. Though it is designed to blow when a tube or circuit is defective, it can open up from "fatigue." Before opening the cage, remove the line cord. Then short out the plate caps as pictured.

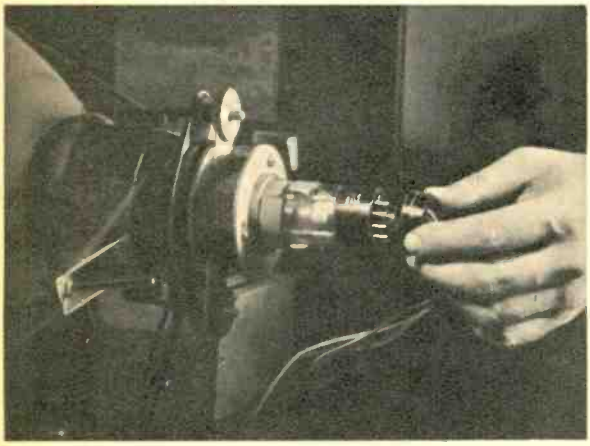
Just about the most positive way of pinpointing a bad picture tube is to check its filament for continuity. Examine the neck of the tube at the end toward the socket. Is there a dull red glow inside? If not, check for an open filament. Turn the set off and remove the socket from the neck of the tube. Pins 1 and 12 should be checked with an ohmmeter for continuity. These pins are located on either side of the "key" as shown in the drawings.

A successful tube change hinges on a single factor—*safety*. If you end up with a picture tilting on a 45-degree angle the remedy is quick and simple. Overlook the safety precautions and the result is no picture, no tube, and no money saved. Study the photos and drawings with care. Both horizontal and the newer vertically-mounted chassis are illustrated.

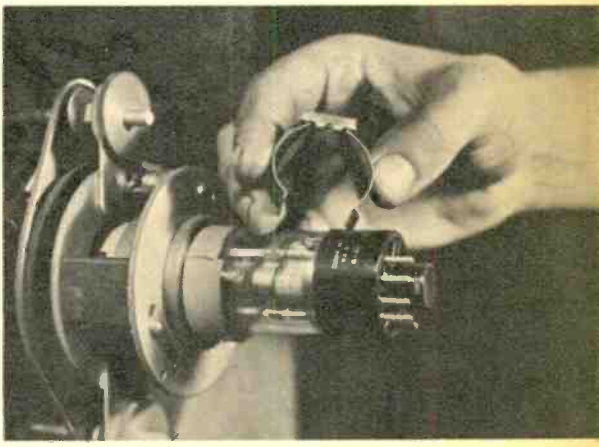
Your particular set might vary somewhat from these models. First, the yoke and focus magnet may be secured with a different type bracket. This is a mechanical arrangement that should be simple to figure out. On some sets the tube is mounted directly on the chassis, and they are removed together.

Other minor variations appear on the newer portables. Some have neither an

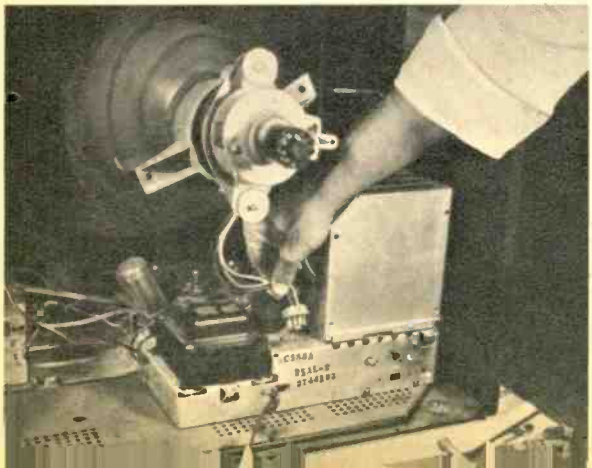
5. Remove tube socket gently. Bakelite base on an old tube might be loose and break off.



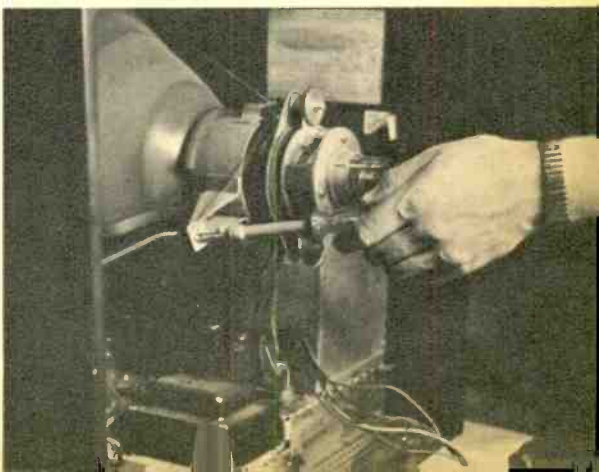
6. Ion trap should snap off. On some older types, a wing nut must be loosened first.



7. The deflection yoke plug (usually an octal) is removed from its socket on the chassis.



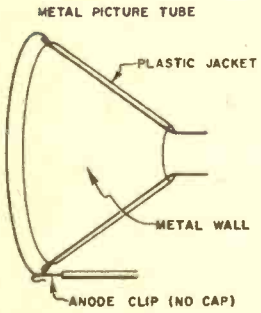
8. Next, yoke and focus magnet are removed. In this set two long rods held them in place.



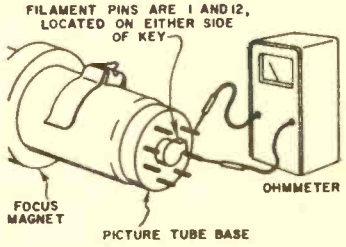
9. Pull off yoke and focus magnet. On some sets they dismount separately.

10. The nuts are removed from the 4 studs that secure the forward part of the tube.

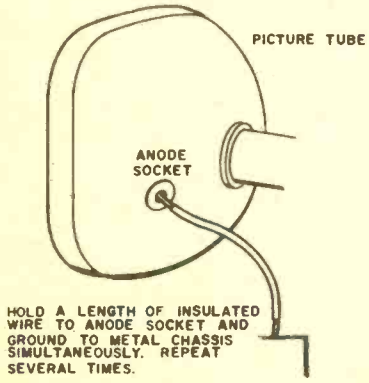
11. If tube is obstructed, chassis must be moved out of the way. Pull off knobs.



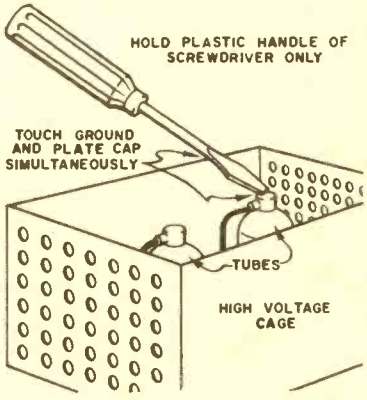
Wall of metal tube is sharted to ground before touching it. Note plastic jacket, anode clip.



When checking for an open filament, ohmmeter should read between 5 and 50 ohms.



Do this if screwdriver can't touch chassis and anode socket. On metal tubes short metal wall.



Detail for sharting plate caps in high voltage cage. One or two tubes may be faund there.

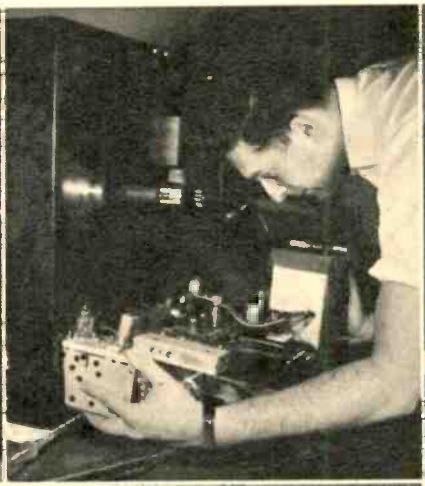
ion trap nor anode cap. However, if you understand the basic procedures, the job should go smoothly.

Since the air is evacuated from inside the picture tube, there is a great deal of atmospheric pressure bearing on it. Structurally, the glass is made to withstand it. Here is where safety and care really count. The tube must not be *struck, scratched,* or *strained.* If it is, the resulting *implosion* could cause the glass to fly in all directions with considerable force. When holding the tube don't permit any strain on its neck. Support the full weight on a flat hand under the face of the tube. The photos demonstrate this. One hand on the neck is for balance only.

What sort of tube replacement is recommended? Here you have two choices, new or rebuilt. In rebuilding, only the glass of a burned-out tube is re-used, the screen and electron gun are

[*Continued on page* 96]

12. Loosen and remove the chassis bolts, usually 3 or 4, at underside of cabinet.



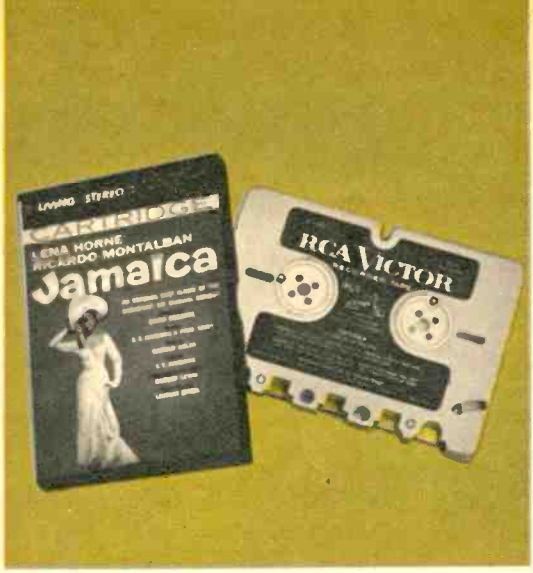
13. Before sliding chassis out, pull out any speaker or phono plugs connected to it.

14. Rest full tube weight on one hand. Other hand, on neck guides and balances it.

15. Withdraw tube with extreme care. Don't permit it to strike anything.

16. Place tube face down on a soft surface. Nut holding mounting strap is loosened.

17. Strap is placed on new tube. Include cork cushion to avoid scratching glass.



New RCA tape magazine features a four-track tape designed to play at 3¾ ips speed. It is enclosed in plastic with own threaded take-up reel.

All About Hi-Fi Tape Cartridges

By Norman Eisenberg

This newest advance may make stereo tapes as inexpensive as records—and as easy to play.

To play special four-track tape as it is (inside magazine) you need a special play-back instrument, not yet generally available. Here is RCA prototype.

A SPOOFING song about hi-fi has these lines:

"I've an opera here that you shan't escape

"On miles and miles of recording tape."*

On the face of it, RCA's announced "tape cartridge" seems an attempt to reduce those "miles and miles" (as well as the cost) of recorded tape. Yet, few things in hi-fi have aroused as much speculation, concern, and curiosity—with proportionately as little tangible to show for it all—as the recent news of this tape cartridge (or magazine).

The new item portended an upheaval in hi-fi. Existing tapes (which, for want of a better term, we shall call "regular" tapes) carry no more than two tracks of recorded material. Thus, monophonic (non stereo) tapes run first in one direction; then in the other. Stereo tapes play themselves out completely in the one direction. In either case, the full ¼ inch width of the tape is used for the required two channels of sound.

The new tape contains *four* tracks—two for stereo in each direction. Tracks 1 and 3 (counting down from the upper edge) represent channels A and B for stereo playback. When the end of the tape is reached, it reverses itself. Now, tracks 2 and 4 continue the playback to provide twice the amount of stereo programming.

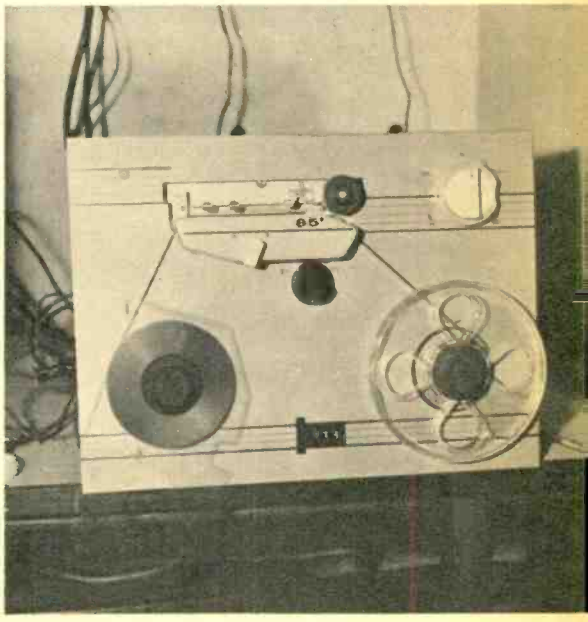
The speed of regular recorded tapes has been standardized at 7½ inches per second (ips). This speed, combined with the very narrow-gap tape heads that have been developed in recent years, have provided very acceptable sound. No one has denied that such tapes represent genuine high fidelity. But the new four-track tape is designed to play at half that speed, or 3¾ ips. And it requires tape heads with an even narrower gap, on the order of 1/10th mil (0.0001 inch).

Finally, and what is likely the thorniest point of all, the new package tapes simply cannot be played "as is" on existing tape equipment. Conventional home recording tapes come wound on reels, usually seven inches in diameter and with a center hub of about 2¼

* "The Song of Reproduction" from *At the Drop of a Hat* by Michael Flanders and Donald Swann (Angel 65042). Reprinted by permission.

For this fidelity test, plastic cartridge was opened to reveal 5" tape reel and take-up.

First step involved winding tape onto conventional reel using conventional tape deck.



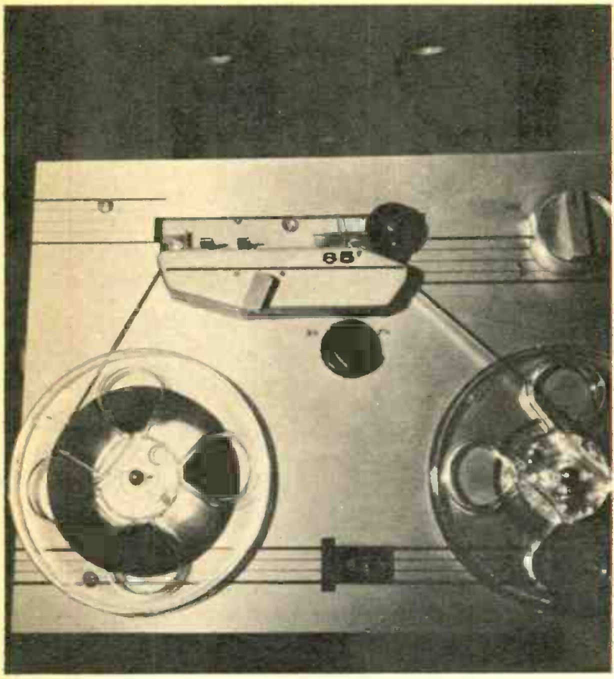
inches in diameter. To play them, tape recorders have been fitted with two spindles. The loaded reel is placed on one spindle and a small portion of the tape is threaded past the tape head assembly and onto the blank or "take-up" reel. As the one spindle plays out the tape, the other spindle winds it up. The "tape transport"—the mechanism that does this job—has been the costliest single element of any tape system.

The tape cartridge or "magazine" does not come as a single reel for use in the manner just described. It is a completely enclosed thin plastic case containing two hubs, one empty and the other wound with tape. This assembly can, in no way, be used on a regular tape machine. It must be set in place on a new type of tape player especially designed for it. And, this new tape machine cannot accept regular tapes.

A certain degree of "compatibility" is possible. The recorded tape inside the magazine can be unwound from its container, rewound onto a standard tape reel, and then played on a regular machine. That machine, however, must be equipped with the required quarter-track head assembly as well as the 3¾ ips speed. And indeed, new models of well-known recorders have begun appearing just so equipped. Among them are the high-priced Ampex, the middle-priced Tandberg, and the low-priced Viking. These new machines can, at least, handle the new tapes on a reel-to-reel basis—assuming the user goes through the chore of transferring the tape from magazine to reel.

But even then, is it worth the bother? Aside from the obvious advantage of longer playing time, how do the new tapes sound? Initial opinions were that the new four-track tapes are plainly not the equal in fidelity of the regular two-track, 7½ ips tapes. What's more, the new tapes appeared to have lower volume level and higher background noise. Still, they were judged "listenable"—perhaps as casual background or mood music as long as one does not expect of them the ultimate in hi-fi sound.

Whether or not the "lower fi" of the four-track, 3¾ ips tape can be corrected by subsequent improvements remains to be seen (or heard). More recent samples have sounded better. What is less doubtful are the economics of the situation. Regular stereo tape prices



With oxide-coated side out on reel (far left), tape is hardly in proper playing position. Therefore, it is flipped, and rewound.

Center photo is close-up of Viking's quarter-track head assembly. Note how tape is fed through and reversed onto empty reel.

Does 3¾ ips mean lower fidelity? Finally squared away now, rewound stereo tape is run like any other, except more slowly.

have run from about $8.95 to $18.95 per reel. The RCA cartridge has been announced with list prices from $4.95 to $8.95. Anything that halves the cost of a consumer item is bound to prove a show-stopper—and in the face of the double-headed threat of the low-cost tape cartridge and the new stereo discs, the regular recorded tape trade has taken a terrific beating. And consumers—even veteran tape fans—have assumed a policy of watchful waiting.

Without doubt, a good deal of the confusion has been caused by the apparent ghostliness of the new item. For some reason, it has been nothing that people could get their hands on, and there has been no burst of demonstrations, no extensive "home-testing" and few reports in the press of the tape cartridge. Having announced the thing, and the fact that it was "the result of four-and-a-half years of research and development," RCA then appeared to be in no great haste to put it on the market. The announced repertory of selections for the first batch of cartridges was impressive enough. But this series was originally scheduled for release in June 1958.

[*Continued on page* 110]

TWO RCA recorded tape magazines were received just before press time. To play the recorded tape inside this magazine, it had to be unspooled from its own hubs and rewound onto an empty standard tape reel. This reel, with another empty reel for take-up, was placed on the new Viking 85 ESQ tape transport, which is equipped with quarter-track heads and an adjustment for playing at 3¾ ips speed.*

The stereo effect was decidedly present, but the tonal range seemed somewhat limited as compared with what is available from good disc stereo and, of course, from standard recorded tapes played at 7½ inches per second on the same tape machine.

To accomplish the transfer of the tape from its cartridge holder to a standard reel took a little doing—winding, flipping and rewinding, as shown in photos. In initially handling the tape on its original hubs, it was necessary to keep it sandwiched between its two glassine coverlets or the tape would spill all over the place while it was being threaded.

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*KPS-3003, "The Band of the Coldstream Guards" and KPS-4002, "Jamaica" (original cast recording)

Who'll get there first? Claws akimbo, ice skating "mice" have "homed" onto loose puck. They race to gain possession with considerable fervor.

Electronic Mice On Ice

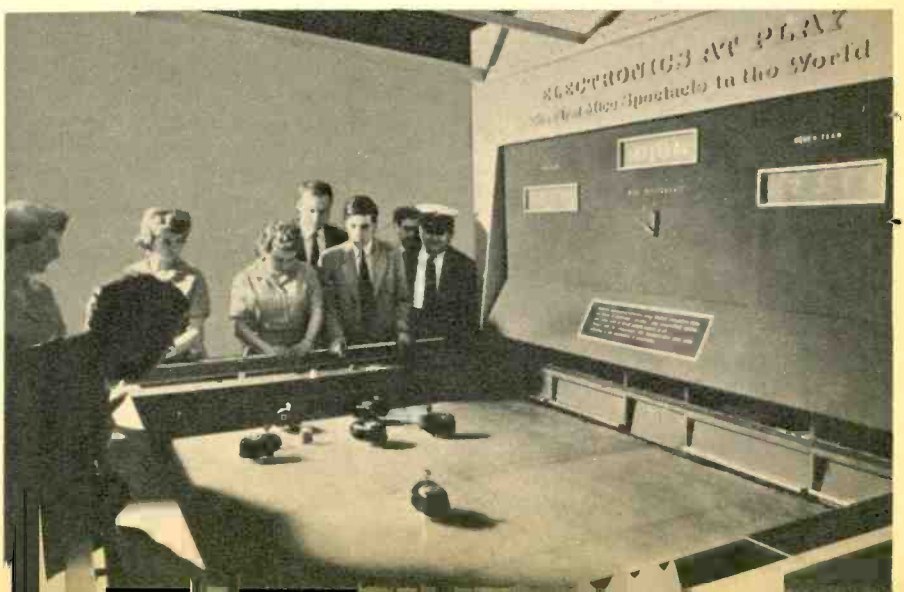
NOW mice are playing ice hockey—on real ice! These are not ordinary mice. With phototransistor "eyes," they have the unique ability (as no other mice have) of gaining possession of a puck, carrying it up-ice over magnetic lines of force, and then either passing to a teammate or shooting for a goal. This "mouse olympics" was held at Britain's recent radio show.

Actually, the puck is a source of modulated light. While the mouse's eye, mounted on a rotating neck, scans the entire rink, the mouse circles aimlessly. But when the eye picks up light from the puck, the resulting photo-current locks his steering mechanism so that he "homes" on the puck.

When the mouse's metal claws fasten around the puck, his steering mechanism is freed and he again begins to circle. Another scanner, in contact with the ice, takes over until its probes become coincident with one of the lines of force. A voltage potential is produced which re-locks the steering mechanism.

Each mouse is given either a positive or negative polarity so that he will always move toward the opponents' goal. But he had better get there in a hurry, for after a short interval, the puck is mechanically ejected from his claws, simulating a pass or shot at the goal. The interval is decided randomly and the mouse, in spite of his polarity, may be facing his own goal when the puck is released, making the outcome of the game unpredictable.

Talents of electronic mice depend on phototransistor scanner, lines of force. Rink and mice were built by Mullard, British electronics manufacturer.



A Signal Splitter

By Joe Doherty

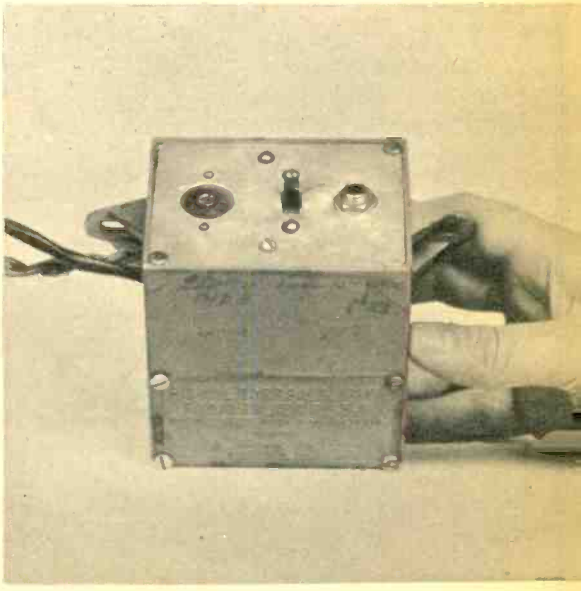
Separate crowded code stations with this sharp filter. Requires no wiring inside your receiver.

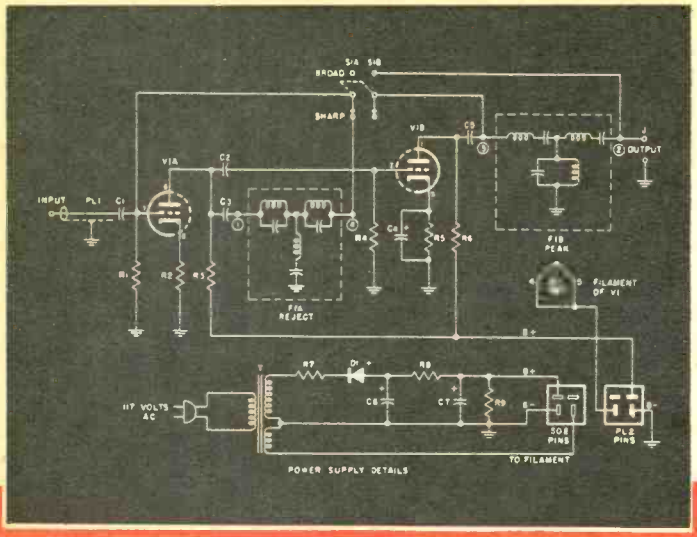
HAVE you had difficulty separating code stations on your short-wave receiver? Would you like to be able to slice out just the signal you started to copy when it suddenly became covered up with interference? Here is a Signal Splitter does the job for you with the flip of a switch. There's no digging into your complicated receiver circuits, no disturbing of your present wiring. Just plug it into your receiver 'phone jack, and plug your headset into the Signal Splitter output jack and you will be in business.

Selectivity, or the ability of a receiver to separate one frequency from another effectively, has long been a missing feature of many economically designed receivers. If yours lacks a good crystal filter, the addition of the Signal Splitter will be an outstanding contribution to your CW listening pleasure. Its operation depends upon the application of a readily available surplus CW filter together with a two-stage amplifier, the combination of which adds up to a kind of audio "Q" multiplier, tuned to a frequency of 1020 cycles. In practice, virtually the only signal you will hear in the output of the unit will be at 1020 cycles, the others will drop out of the picture. This means that you can

Headset plugs into unit, output jack goes to receiver. Note small power supply near unit.

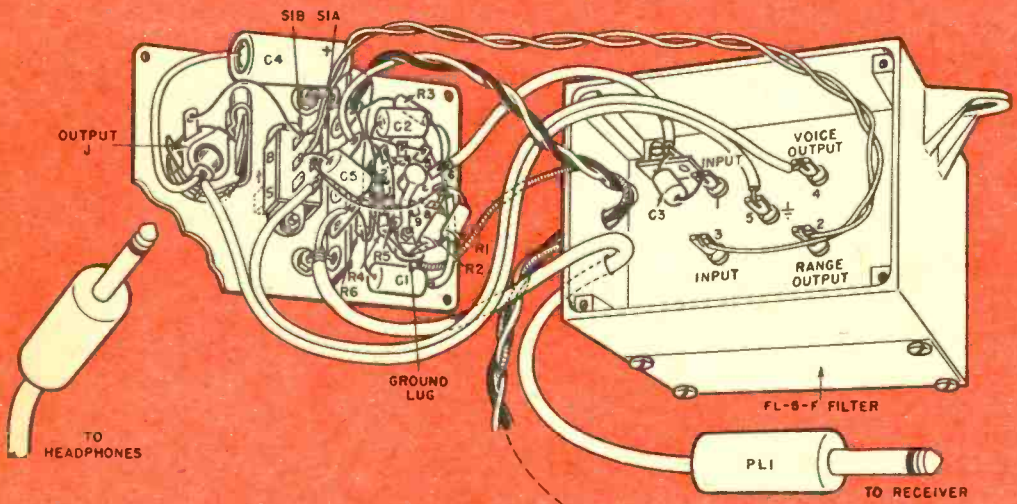
Cover of filter case is removed and drilled for (left to right) tube socket, S1, jack J.

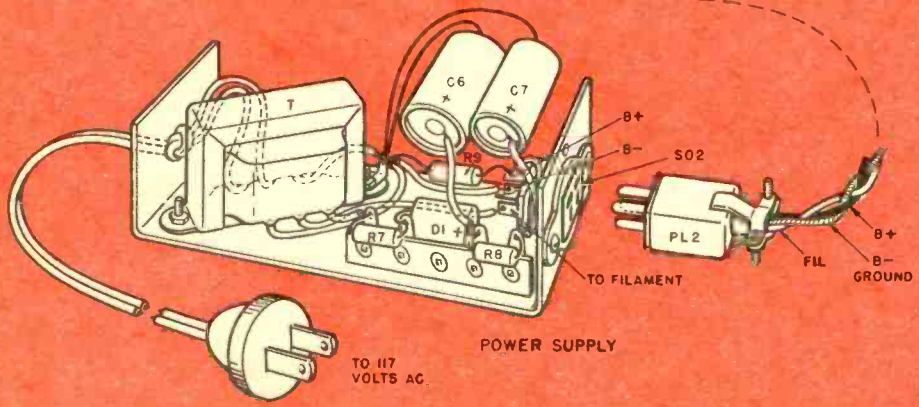


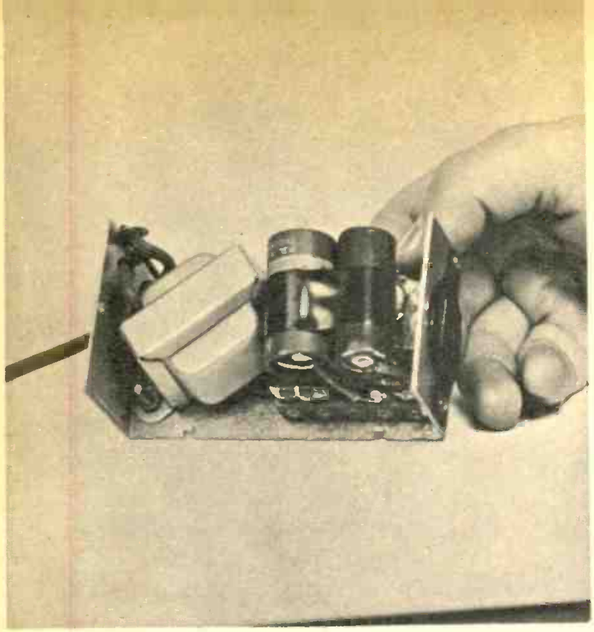


In the schematic, dotted lines represent surplus filter unit that is purchased (2-section). Case is ground.

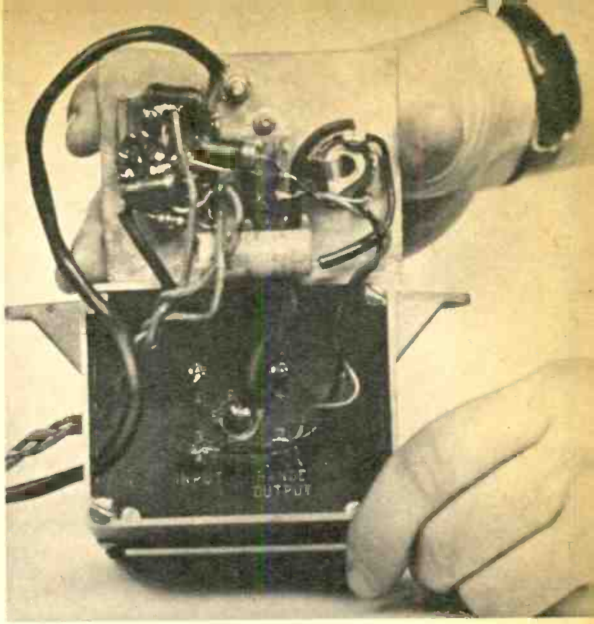
Wiring guide shows complete filter and its AC power supply. The terminal numbers recessed in FL-5-F case are at upper right.







Power supply chassis. Visible from left to right are 117 volt line cord, T, C6, C7, and SO2.



Various interconnections should have enough slack so cover of filter case may be removed.

actually select your desired signal and hear it on what becomes effectively a clear channel, free from interference from other CW or phone signals.

The surplus filter designated FL-5-F, has long been used for separating code signals. In its original state the filter introduces a loss in signal level which may be serious enough to cause the signal to become inaudible during deep fades. The incorporation of the amplifier, however, places the picture in a different light, and instead of encountering losses, we have a gain of up to +4 db at 1020 cps only, with an extremely sharp peak in the "sharp" position. In the BROAD position, used for 'phone reception, the overall gain is as much as + 19 db.

The filter, which is the heart of the Signal Splitter, is housed in a metal case measuring 3¾" wide by 2⅞" deep by 4" high. The top cover is taken off easily when four screws are removed, one from each corner. Follow this guide for drilling the mounting holes;

1) Drill ¾" hole to accommodate 12AU7 socket, approximately ¾" in from left side.
2) Drill ⅜" hole, ⅝" in from right side for 'phone jack J1.
3) At approximate center, drill hole to accommodate function switch S1, 5/16" for toggle switch, or ½" by ¼" for slide switch, whichever is preferred.

Another hole must be drilled to allow entry of power supply leads and the input audio lead from the receiver. This audio lead must, of course, be shielded to prevent hum pickup. The size of the hole is dictated by the combined wire sizes, and it should be drilled on the left side at a point about 1" from the top.

To operate the Signal Splitter, after the power supply has been connected and turned on, first turn the function switch to the BROAD position, connect

[*Continued on page 96*]

PARTS LIST

R1,R4—580,000 ohm ½ w resistor
R2—1000 ohm ½ w
R3,R6—33,000 ohm ½ w
R5—3300 ohm ½ w
C1,C2,C3,C5—.03 mfd 400 volt Aerovox Aerolite capacitors
C4—25 mfd electrolytic 25 volt
J—phone jack
PL1—phone plug
S1A,S1B—DPDT slide switch
F1A,F1B—Filter FL-5-F (available at most surplus dealers or Concord-Niagara, 47 Warren St., New York City)
V1A,B—12AU7 tube and socket

Power Supply Parts

R7—120 ohm ½ w
R8—820 ohm ½ w
R9—33,000 ohm
C6,C7—20 mfd 150 v
D1—Silicon diode rectifier (Sarkes-Tarzian M-150)
T—Power transformer (Stancor PS8415 or Triad R54X)
SO2—Chassis socket (Cinch-Jones S-304-AB)
PL2—Power Plug (Cinch-Jones P-304-AB)
Case—Aluminum box 4"x2⅛"x1-9/16"

Electron miscroscope helps Detective Ludwig Sabatino examine very minute clues in lab.

Narcotics sample, held between salt slabs, will be fitted to infrared spectrophotometer.

how they use electronics in

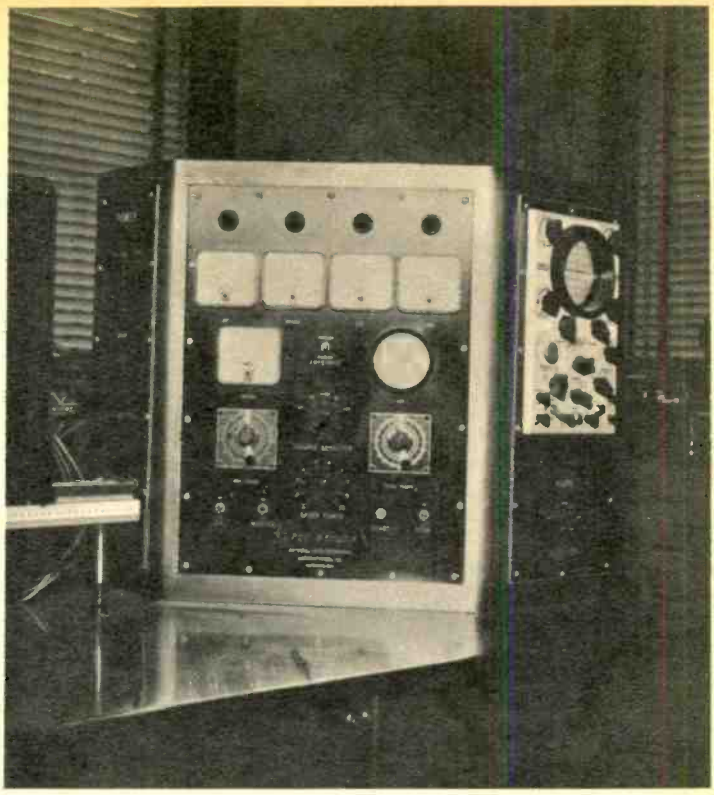
The Crime Lab

By Ed Nanas

Feature Editor

Bits of evidence that once defied classification can be identified through modern electronics.

A WOMAN had just been murdered in an Upper Manhattan robbery attempt. Evidently, she had been attacked from behind, an arm thrown across her face. The dragnet that followed the first police alarm brought in several suspects, and one in particular looked "good" to detectives. This man had what appeared to be a powder smudge on his jacket sleeve, just about at the spot that would have come in contact with the victim's face—*if* that arm had been locked around the victim's head. It was the only worthwhile lead available at the time.

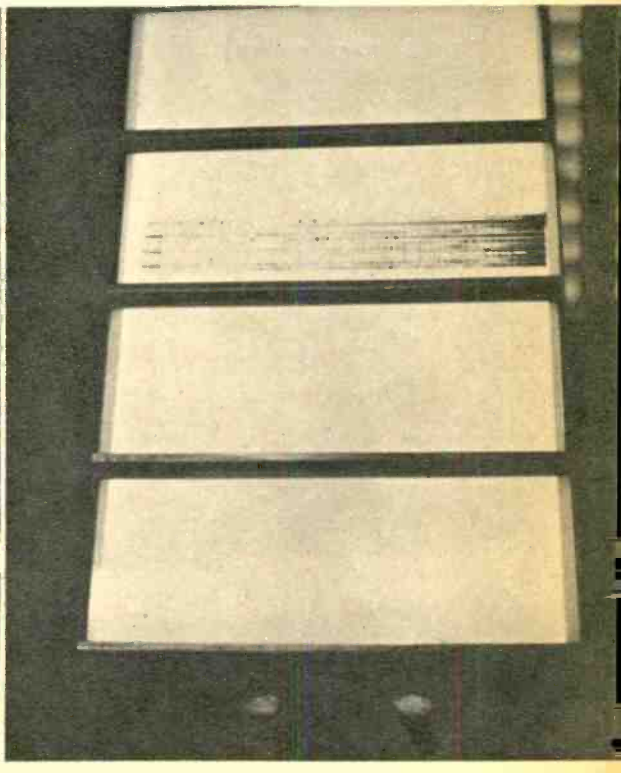


Control panel for spectrograph permits lab expert to select either AC, DC or spark to volatize sample. Burning can be monitored on built-in oscilloscope, seen at right.

Photos by Mike Bonvino

Dr. James Manning adjusts lens apparatus on spectrograph. At right is combustion chamber.

Film strip from spectrograph is like a "fingerprint" of material. Note series of fine lines.



Densitometer is used here to compare spectral lines of two samples. Spectral photo of known element is inserted at top of instrument where it is scanned electronically, then projected for comparison with photo of doubtful element.

Had some of her face powder rubbed off on the sleeve? The suspect denied any connection with the crime and claimed the smudge on his sleeve was indeed powder—his own aftershave brand. Leaving nothing to chance, the investigating officers sent the jacket to the New York City police crime laboratory at 72 Poplar Street, Brooklyn. Along with the jacket went a sample of the victim's face powder. Could a comparison be made?

Dr. James Manning, senior physicist and assistant director of the lab, was able to pick off a few grains of powder from the jacket, but it was too small a sample for chemical analysis. Electronic instruments in the lab might do the trick, however.

In a small room tucked away at the rear of the lab, the tiny sample was carefully prepared for examination under the electron microscope. This was done by placing the powder grains between the holes of a metallic screen so small that it appears more like a solid piece of metal than a screen. Mechanical and diffusion pumps were put to work evacuating the microscope housing. A 50,000 volt power source was turned on and the powder sample from the jacket sleeve was bombarded with a beam of electrons focused by a surrounding electrostatic field (an electron lens).

Visible on the microscope's small fluorescent screen was the powder's image, magnified 5,000 times. The image was simultaneously photographed on 35 mm film in the microscope housing. This was then enlarged six times, pro-

viding total magnification of 30,000 times the original sample.

The process was repeated with the victim's face powder and the two photographs carefully compared. Results were conclusive: The "good" suspect evidently was telling the truth. The powders did not match and an innocent man was released. Subsequent investigation later uncovered the actual killer.

Perhaps Dr. Manning's most frequently used electronic instrument is the spectrograph. Unknown or doubtful material found at the scene of a crime can be analyzed and identified in a very short time with results accurate to one part in one-million. The spectrograph, which is an impressive array of tabletop equipment taking up considerable room in the lab, is an instrument for taking a photograph of a spectrum produced by the controlled burning of a substance.

Here again the samples tested are exceedingly small. As Dr. Manning noted, criminals seldom leave much behind, unless it is a set of too-heavy-to-carry burglar tools or an empty burlap bag.

For instance, a detective may bring in a tire iron found near the scene of a homicide and ask lab experts to determine if a tiny metal shaving found imbedded in the victim's skull came from the tire iron. If so, the detectives know they have the murder weapon, and can then proceed to the often difficult task of linking it with the killer through fingerprints or witnesses.

Each batch of metal differs from every other batch in some small way. One may have a little more of a certain alloy, a little less of another. The small piece of evidence is placed in a graphite electrode, put into the combustion chamber, and the juice turned on. The charge which actually burns the sample must be carefully controlled to produce the best possible spectrum. The lab analyst can choose between AC or DC current or a spark with which to burn the sample. His choice is not a haphazard one, but is governed by the nature of the material, which must not

[*Continued on page* 102]

Right, Detective Kevin O'Brien adjusts cylindrical X-ray diffraction camera. Inside the non-optical camera is a confiscated sample of heroin hydrochloride. Film, left, shows concentric arcs formed by diffracted X-rays. Measurements can be made to classify sample, which is not destroyed.

EI reports on a new

Turntable Kit

You need only a screwdriver and drill to assemble this turntable, a real bargain for the hi-fi fan.

DEPENDING on what type of records you play, how you play them and how good your ear is, you may have decided to get a manual record player instead of an automatic changer type for your hi-fi system or stereo conversion. Perhaps you decided to get one, that is, but hesitate at the price. The new model K-33 Rondine turntable kit by Rek-O-Kut for $39.95 net may be just the thing for you. This is a belt driven turntable with a four-pole motor for 33⅓ rpm. ($49.95 for hysteresis model.)

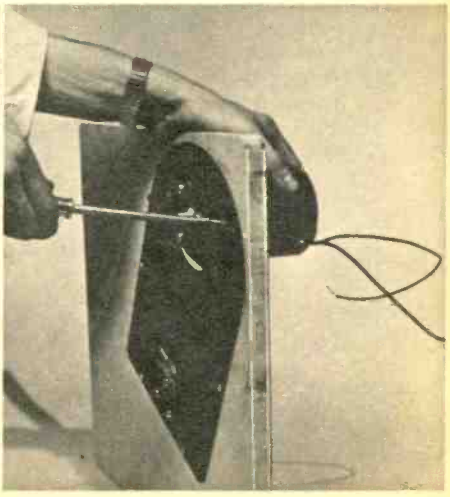
Total time for the complete assembly of this kit was 45 minutes by a non kit builder. The tools required were a screwdriver and drill (our constructor used a staple gun to tack down the line cord but this is not necessary). No soldering is required.

Instructions are clear, diagrams are furnished of all parts. It took two tries to assemble the belt tension adjustment but with patience the spring slipped in neatly. The turntable should not be turned over with the cover plate off after the belt is on, otherwise it will slip off—a minor inconvenience.

A small strobe disc is included for adjusting the turntable to its correct speed, as per the instructions.

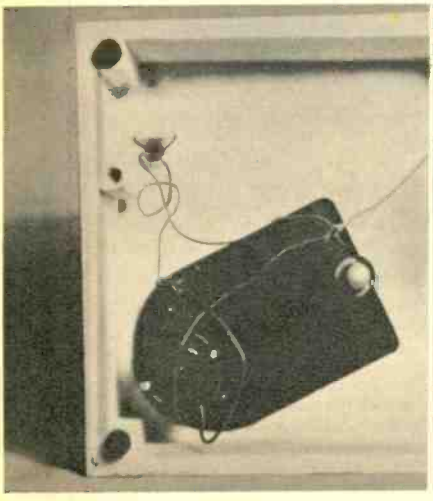
The completed turntable was tested with a stereo system; with the bass and volume controls full on, there was no appreciable hum nor rumble. In our opinion, the Rek-O-Kut turntable kit is a Good Buy.

First step is to lay out all the parts after removing them from the box and check them against the parts list. The motor is screwed to the mounting plate and this is then screwed to the mounting board which is furnished.



The finished turntable (base is extra) is shown as it underwent tests with Audax arm. The mounting plate will accept any arm, needs one drilled hole.

Wires from motor to switch and line cord are connected via solderless twist caps.



Motor plate is moved in slightly to slip belt from table onto motor spindle.

The line cord was stapled to base, prevents pull on cord opening connector.

A Voice Actuated Switch

By Harvey Pollack

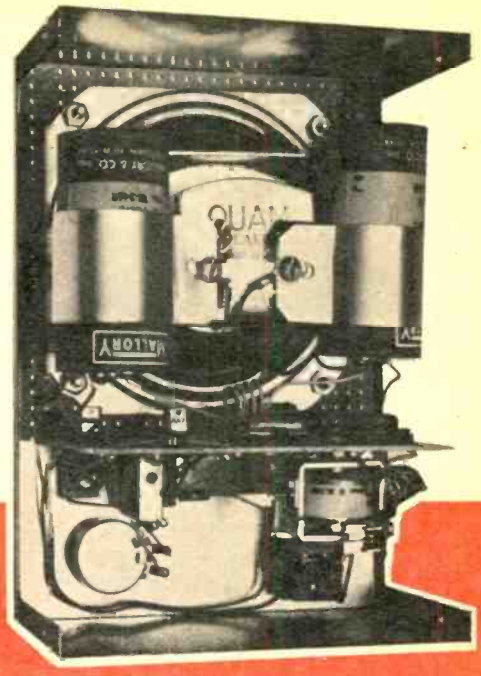
Control a variety of devices with an on-off switch that will respond to your voice or other sound.

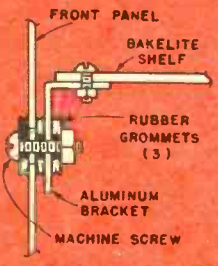
THERE are many applications for this sensitive sound actuated relay. Completely transistorized and fully portable, it can be coupled to the shutter of a camera and photoflash gun to make a bird take its own picture the instant it gives out with a single chirp! Its fully controllable sensitivity makes it ideal for opening garage doors or turning on floodlights at the sound of the automobile horn. You can couple it to an electrical door lock

Front panel shows perforated Bakelite used to protect the speaker behind it. In this circuit the speaker acts as a microphone.

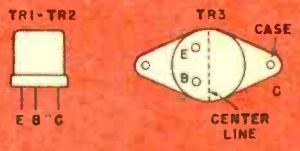
Dimensions for the two metal straps used in mounting the mercury batteries are in the text.

Note sub-chassis shock mounting detail at the upper left corner of the wiring guide.





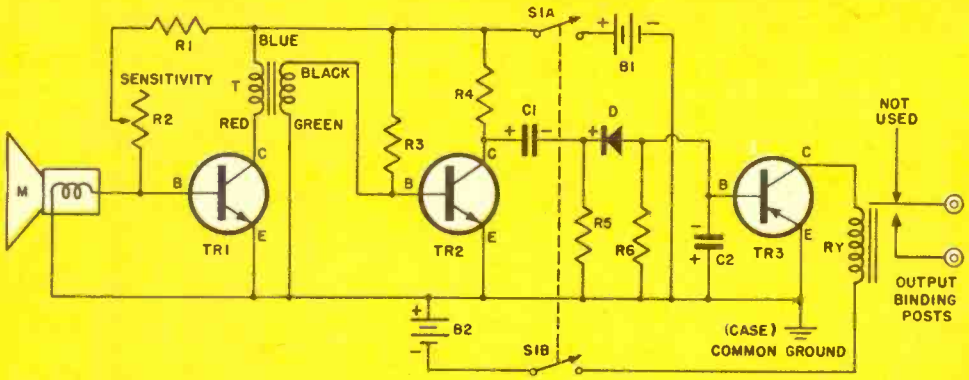
SUB-CHASSIS MOUNTING DETAIL



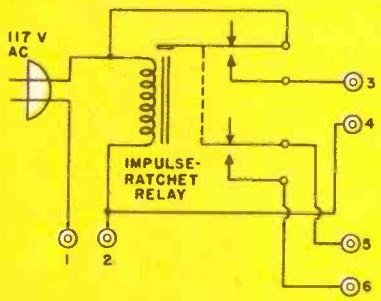
ACTUAL LOCATION OF SUB-CHASSIS

TO OUTPUT BINDING POSTS ON REAR OF CASE (NOT SHOWN)

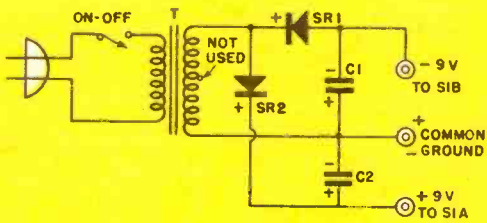
NOTE: SUB-CHASSIS SHOWN REMOVED FROM CASE



Schematic of the battery operated unit. Microphone (M) is a 45 ohm intercom type speaker.



Ratchet relay for on-off sequence. See text.



Suggested AC supply to eliminate batteries.

to be triggered by a single word, or "talk" your model electric trains in and out of operation. You can hook it up to the speaker of your television receiver or radio set to serve as a loudness "governor" for late-hour operation. In actual tests, the relay triggered positively at the sound of an ordinary sports whistle at a distance of 75 feet!

The unit uses three inexpensive transistors in a three-stage amplifier circuit. R2 is the sensitivity control. Its setting governs the bias current in the base circuit of TR1, thus establishing the triggering threshold. R2 is rotated to its zero resistance position for the most sensitive condition.

If a few simple precautions are followed during construction almost any layout of parts will do. In the model described here almost all of the parts are first secured to a small perforated Bakelite shelf equipped with a scrap aluminum bracket that holds the shelf to the front panel of the minibox. The components that are not placed on the shelf are: the speaker-microphone, the two 9 volt mercury batteries, R1, R2, and the double-pole, single-throw switch S1(A,B). You will find construction and wiring much simpler if you wire all the parts on the shelf before mounting in the minibox. Leave 6" wire leads for later connection to the panel mounted parts and the batteries; these leads are visible in the shelf photos as little coils formed by winding the wire around a pencil and then slipping it off. In this way, these leads do not flop around as wiring proceeds. Later, the coils are stretched out straight, cut to length, and soldered to their eventual terminals.

Due to the extremely high sensitivity of this circuit, there is a tendency for mechanical feedback to occur between the relay and the microphone. This is similar in effect to acoustic feedback in an audio amplifier when the volume is turned up too high. To avoid this, and

to make it possible to use full gain without feedback, it is advisable to secure the shelf to the front panel by means of a floating connection. The drawing shows how rubber grommets are used to do this. As an extra precaution, you might want to "float" the speaker in exactly the same manner, although this was not found necessary in the model being described here. It is perfectly possible to mount the speaker in a separate case remote from the electronic parts; in this case, no floating is necessary anywhere. While we are on the subject of mechanical feedback, it should be mentioned that when a completely closed case is used to house the entire unit, it may be necessary to cut a hole in the back of the box to allow pressure release for the compressional waves set up when the speaker vibrates. This is a requirement only if you desire to use the unit with full sensitivity. With the highest gain setting of R2, reflected sound waves inside the minibox tend to set up reverberations that lead to sustained speaker oscillation. Pressure release openings prevent this effect from triggering the relay at the wrong time.

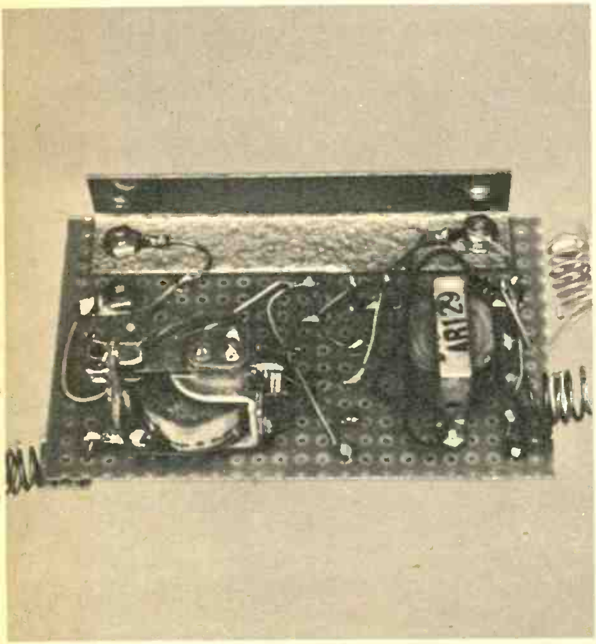
The customary wiring precautions you ought to observe are: be extremely careful of battery polarity because [*Continued on page* 106]

PARTS LIST

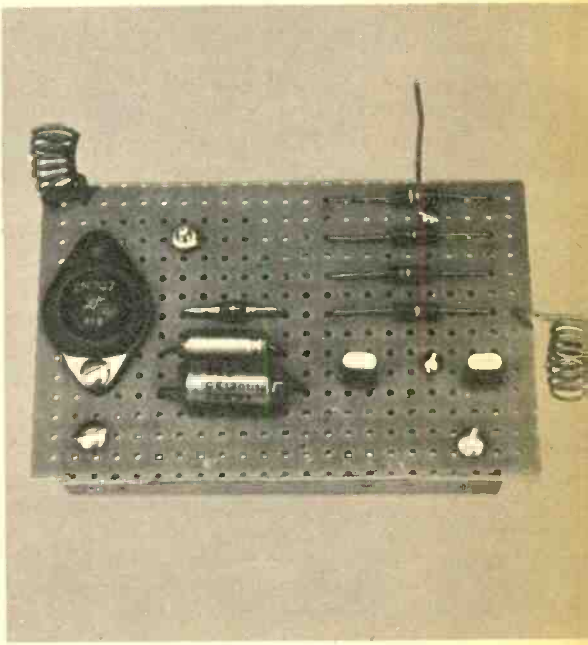
B1,B2—Battery, 9 volt mercury (Mallory TR-246R)
C1—5 mfd miniature electrolytic capacitor, 25 volts
C2—50 mfd miniature electrolytic, 25 volts
M—Microphone (PM speaker, 4" cone, 45 ohm voice coil. Quam 4A1Z45)
D—Germanium diode 1N34A
R1—1500 ohm ½ w resistor
R2—5000 ohm potentiometer, linear taper
R3,R5—10,000 ohm ½ w
R4—1000 ohm ½ w
R6—100,000 ohm ½ w
S1 (A,B)—DPST toggle switch
T—Interstage transistor transformer (Argonne AR-129)
TR1,TR2—Sylvania 2N233 transistors
TR3—Sylvania 2N307 transistor
RY—Relay, 6 volt DC coil, 25 ohms resistance (Advance MG/1C/6VD, SPDT)
Misc.—Perforated Bakelite board 7⅜"x6¾", aluminum case 7"x5"x3" Bud CU-2108, 2 binding posts with insulating washers

Parts for AC Power Supply (optional)

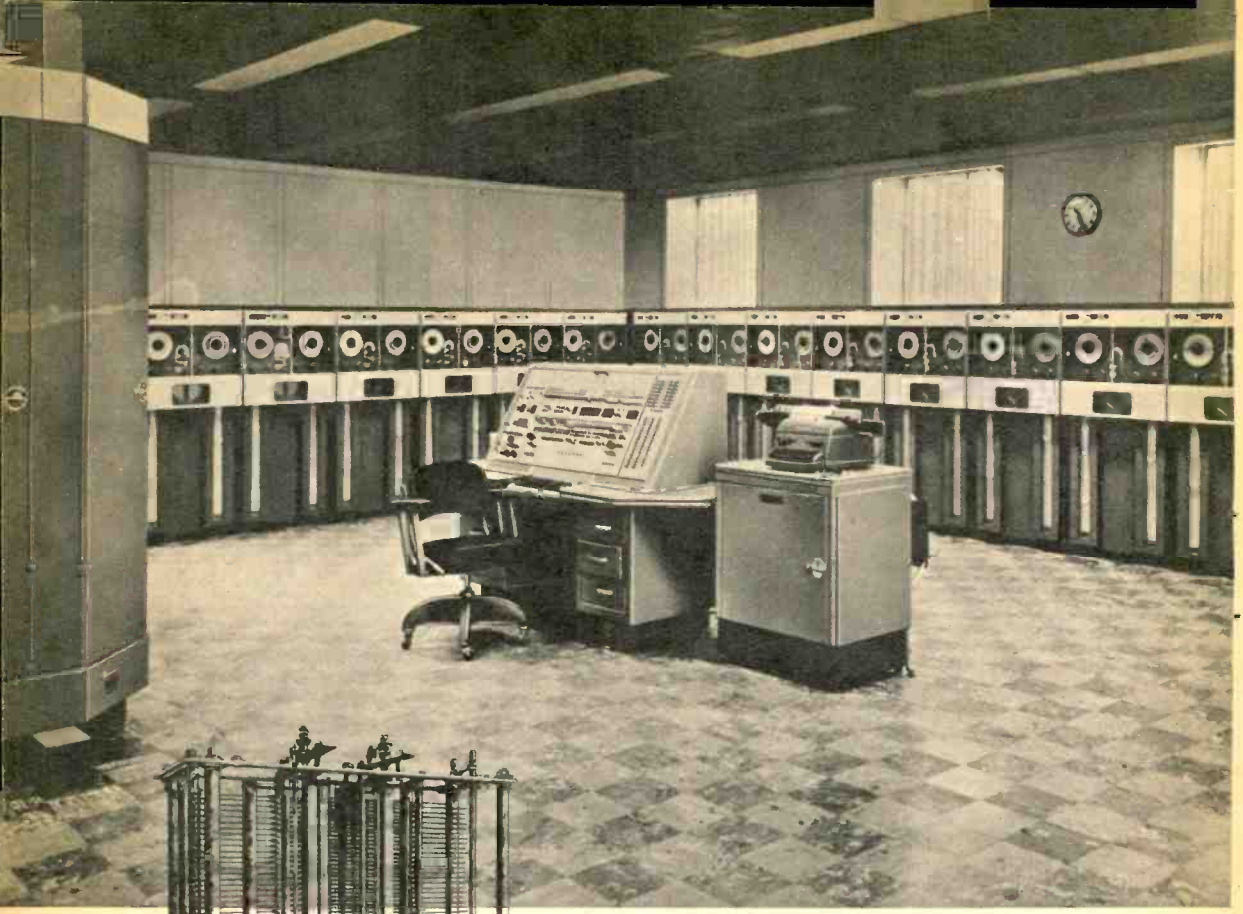
T—Transformer, 12.6 volt filament type, 2 amp. (Thordarson 26F67)
SR1,SR2—Selenium rectifiers 65 ma.
C1,C2—500 mfd, 25 volt electrolytic
Case—Aluminum 5"x4"x3" (Bud CU-3005)
Impulse-Ratchet Relay (if desired) Potter & Brumfield AP11A, DPDT, 117 volt coil
Case—5"x4"x3" (Bud CU-3005)



Underside view of Bakelite shelf. Visible are relay (left) and interstage transformer T.



Shelf topside. Lower mounting tab on TR3 (left) is scraped clean so screw contacts it.



Large scale Univac II digital computer installation, complete with numerous tape data feeds and complex control console, is a far cry from Charles Babbage's "difference engine," shown in drawing, left. Many Babbage principles hold good today.

All About Computers-1

By Richard W. Yates

Electronic brains are everywhere, advancing into fields never predicted for them. This series tells you what they are, how they work, what they can do.

FEW modern inventions have been quicker to excite the public imagination than the electronic computer, and few have been so little understood.

This combination of awe and ignorance is not surprising. The idea of a "giant brain" that can digest and solve a mathematical problem involving more than a million separate calculations in less than seven minutes; that can automatically process all the paperwork of a great corporation; that can guide a rocket through space; predict the outcome of a national election—all this is pretty deep stuff. It's no wonder that the average man may feel a

Military requirements speeded the development of computers. Here ancient abacus is examined alongside modern calculator's readout.

Shelves of paper records shrink to inches of tape which, when fed into RCA's Bizmac computer, result in rapid data processing.

IBM computer installation for SAGE (military's air defense system) is so extensive that huge console below is used only to check its many component parts.

little uneasy when he reads about it.

There is, of course, no cause for alarm. That same average man's personal brain, whatever its I.Q., is still vastly superior to anything science can invent. By human standards the most advanced computer in the world is an idiot: It is wholly dependent on instructions, and thus can't really "think" at all. But within that limitation it is a remarkable machine—the greatest tool yet developed for releasing human minds from drudgery and for increasing their ability to make use of available information.

A basic understanding of computers should begin with a smattering of history, for the principles on which they are based are centuries old. The abacus, a system of digital counting beads strung in a frame, was an aid to computation long before the Christian era, and is still widely used throughout much of the world. Seventeenth-century Europe produced the first true calculating machines, hand-operated gadgets that could do simple arithmetic. In 1812 an English mathematician named Charles Babbage designed what he called a "difference engine" to provide mechanical assistance in doing advanced calculations. His idea which involved a series of decimal counting wheels, never went into production. But its theory of operation was so far ahead of its time as to remain valid today. The logical organization of many modern electronic computers is remarkably similar to his pioneer scheme. The American development of mechanical punch-card tabulating systems, late in the 19th century, was another important step, for it introduced the concept of processing large amounts of data rapidly in sequence.

Electronics came into the picture as early as 1919, when the first volume of *Radio Review* carried an article by W. H. Eccles and F. W. Jordan describing perhaps the first electronic "trigger circuit" that could be used for automatic counting. But the Eccles-Jordan circuit, like the Babbage "difference engine," had to await further developments in technology.

It wasn't until World War II, under pressure of military needs, that the science of electronic computation came into its own. Government-sponsored research projects were established at a number of American universities, in-

[*Continued on page* 93]

Inputs to computers may vary from punch cards relating the price of tea in China to data from radar scope's picture of unknown plane.

Many offices are equipped with small computers such as this Burroughs E101 desk unit, which performs functions of the giant "brains."

SOME COMPUTER TERMS

Let's do a pencil-and-paper solution of a typical problem. You have to re-record music from a tape reel onto a phonograph disc. To make most effective use of the record's surface, you would select the number of grooves per inch on the basis of the total playing time of the tape. But to get that total you have to perform some addition:

Band One	*2:54*
Pause	*0:05*
Band Two	*3:12*
Pause	*0:05*
Band Three	*1:46*
Pause	*0:05*
Band Four	*2:18*
Your Total:	

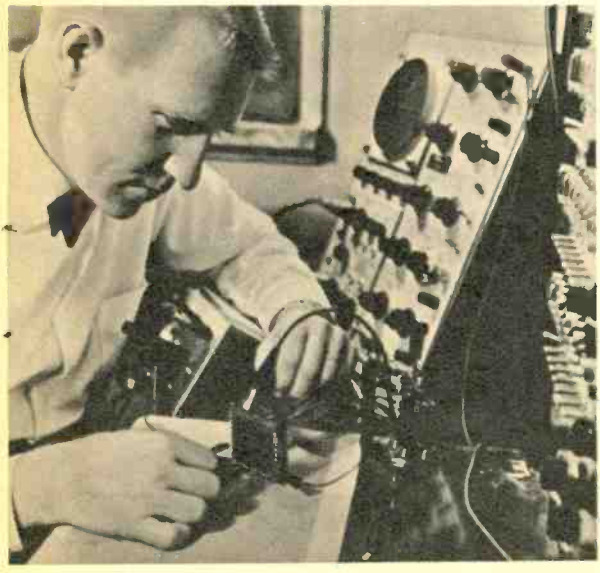
We see we are dealing with both seconds and minutes, which, like oranges and apples, must be added separately. This fact comes from your **memory,** *from the knowledge you have already absorbed concerning arithmetic.*

Again memory tells us that the column furthest to the right must be added first, and yields a total of 35. Memory again dictates: "Put down 5, and carry 3." The carried 3 is temporarily **stored** *at the top of the next column to the left. When added to the other numbers in the column, the total is 145 seconds. But since this is over a minute, it must be converted. Memory again says that there are 60 seconds in a minute. The 145 figure is thus a partial result or* **sub-total,** *which must be stored temporarily.*

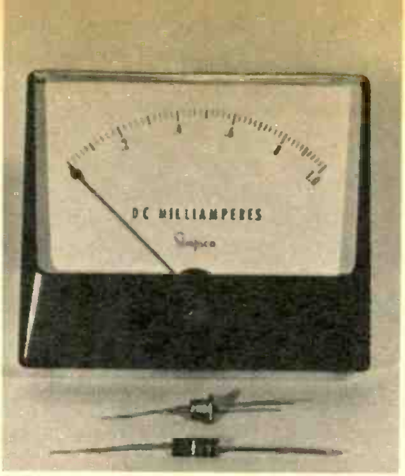
Using the same procedure we obtain 8 as the total from the minutes column. To convert 145 seconds into minutes, we divide by 60, again relying on memory. This gives 2 minutes, 25 seconds, which we add to our other sub-total of 8 to obtain the final total of 10:25.

This example spotlights several operational departments in a computer. Even the most complex mathematical operations are simply repetitions of simpler ones. Squaring, for example, is simply repeated multiplication, just as multiplication is repeated addition. Memory may be temporary or permanent, depending on the service it must perform. The planning and carrying out of the whole computation in proper sequence, which had to be done at the outset of our time problem, must still be done by a human mind. The computer must be told how and what to do, by a procedure known as **programming.**

National Cash Register engineer Donald Meier runs switching test with oscilloscope on his new rod-type computer "memory" assembly.



Some computers can produce answers so fast that they require very high-speed print-outs. This RCA unit handles 600 lines per minute.



The 1N536 silicon diode and 330 ohm resistor are the additional parts required. As described in the text, the resistor value varies according to the specific type of meter and is easily calculated.

Protect Your Meter

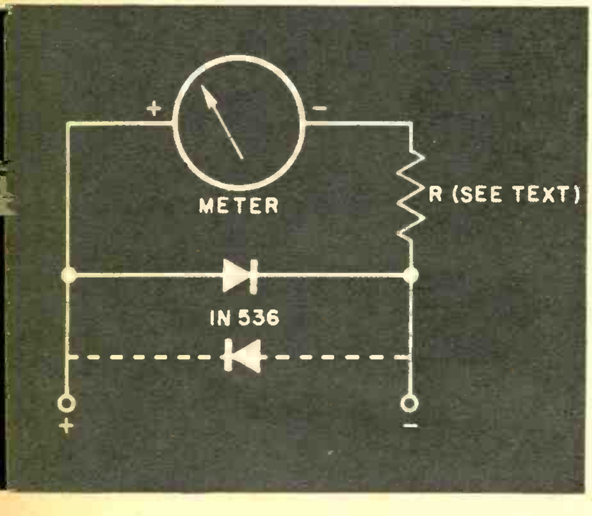
By R. L. Winklepleck

Don't accidentally burn out an expensive DC meter. A resistor and diode will reduce overload current.

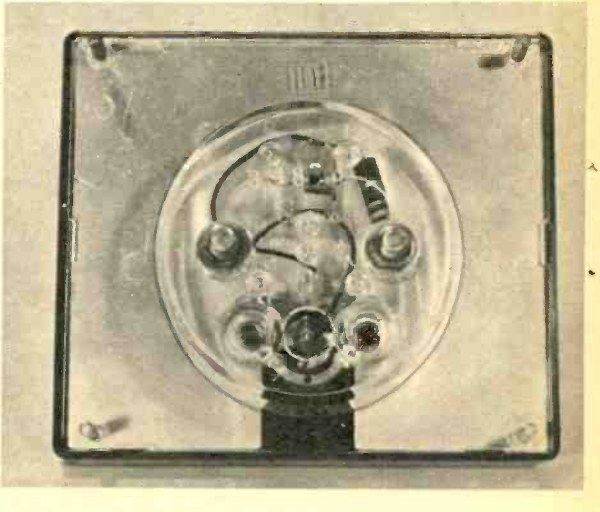
THIS addition to a meter gives the protection of a fuse without the need for replacement each time an overload occurs. The diode acts as a variable resistor that changes from a fraction of an ohm to several megohms, depending on the applied current. Working in conjunction with the fixed resistor, the diode sharply reduces overload current to the meter after the pin reaches full scale reading.

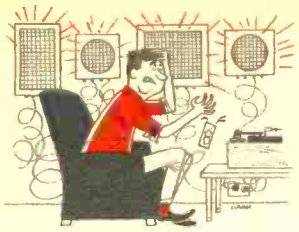
If the resistor is carefully selected, the error with this system is negligible. The formula is R=Vd/Im-Rm, where Vd is the forward voltage drop of the diode at maximum current (meter will read full scale), Im is [*Continued on page* 98]

Extra diode (dotted line) limits current if meter is overloaded in a backward direction.



If meter is not sealed, parts may be mounted inside case, or simply on the external studs.





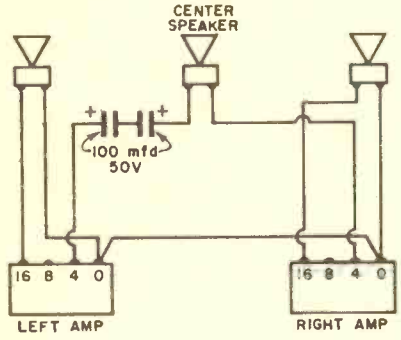
Hi-Fi Clinic

The clinic answers any questions on hi-fi; how to adjust, how to install, or how to repair. All queries are answered by mail.

Stereo Center Channel

I want to add an eight inch speaker as a center channel for my stereo system. My problem is finding a way to mix both channels to feed this center speaker. I would also like to cut off all frequencies below 200 cps. Can you help me?
E. W. Emond, South Weymouth, Mass.

The circuit below will serve your requirements. The exact value of the capacitor in series with the center speaker is not critical.



Tweeter Mounting

I recently bought a woofer and separate tweeter intending to mount them in a bass reflex cabinet. Now I've been told that tweeters are not supposed to be mounted in the same cabinets as woofers but should have separate baffles or be mounted coaxially in front of the woofer. On the other hand I notice that a number of commercial systems have the tweeter in the same box. Why the contradictions?

Sander Rickleen, Quebec, Canada

The apparent contradiction derives from the fact that there are a number of different ways of manufacturing a tweeter. Shown here are three tweeters; one is a horn type and the other two are cone type tweeters. One of the cone type tweeters you'll notice has a sealed back. If you were to mount the tweeter with the open back in a small sealed or bass reflex type baffle, the pressures built up inside the enclosure on low frequency notes would modulate the cone of the tweeter and, in effect, take away most of the effectiveness of the crossover. You can see how horn and sealed back tweeters would not have this problem.

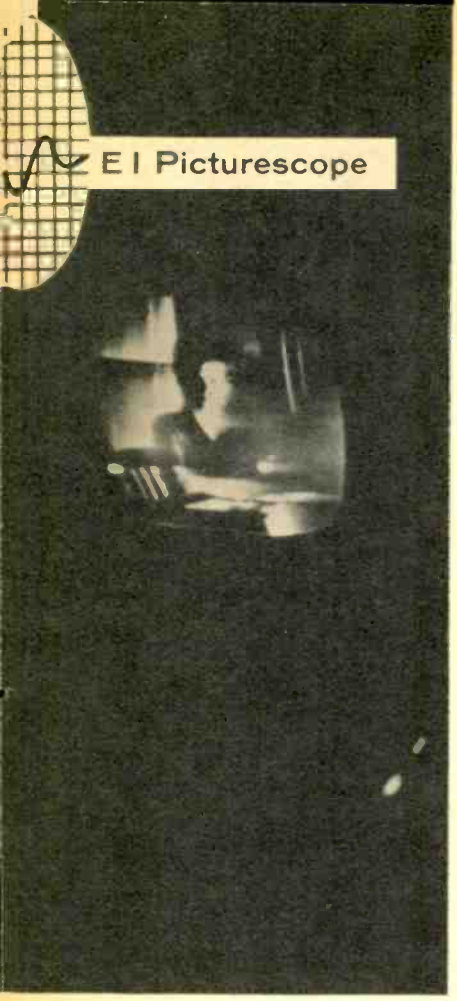
Consumer Testing Labs

I've been following the consumer report magazines for advice on hi-fi components. I've bought some of their "best buys" in equipment and was very satisfied. Now they've recommended a brand of speaker that I don't particularly like the sound of. What should I trust—my ears or their instruments?

Jason Sheckley, Chicago, Ill.

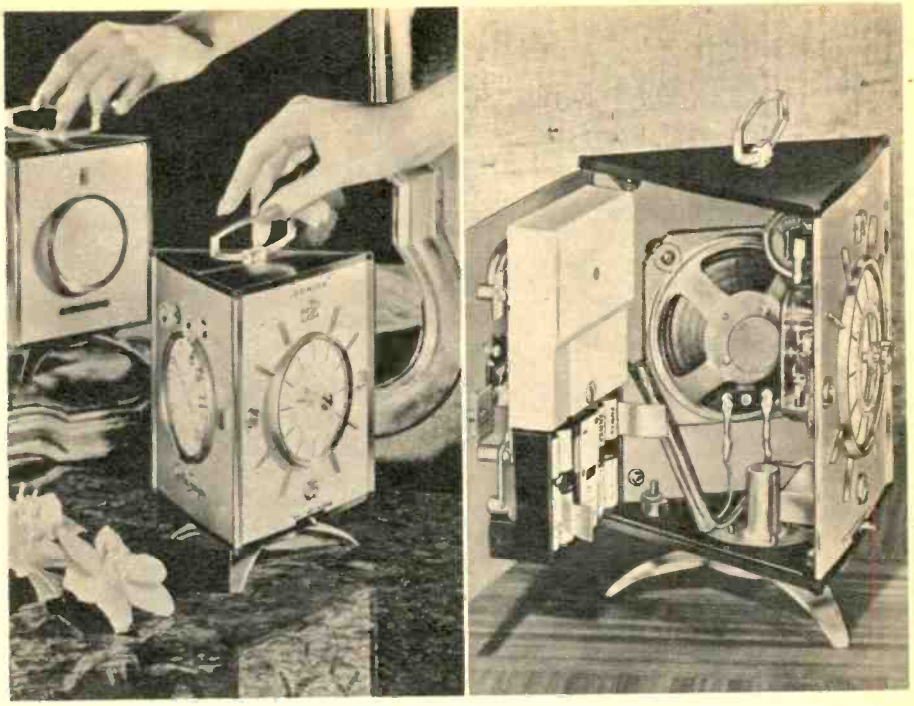
Most authorities, when discussing hi-fi loudspeakers, state that the human ear is the final judge of loudspeaker quality. Designers frequently find a speaker with a good curve and poor sound or vice versa. Instruments are helpful as guides in design and in testing one speaker against another.

In any case, it isn't your ears against the consumer reports' testing instruments, but your ears against the ears of their listening panel. Whether their panel is qualified to tell you the kind of sound you should like is a question which you will have to resolve by extended listening to a number of speakers. There is no "ideal" speaker in existence and every speaker, even the finest, contributes some type of distortion. The problem is to locate the type of speaker whose distortion is least objectionable to your particular ears.

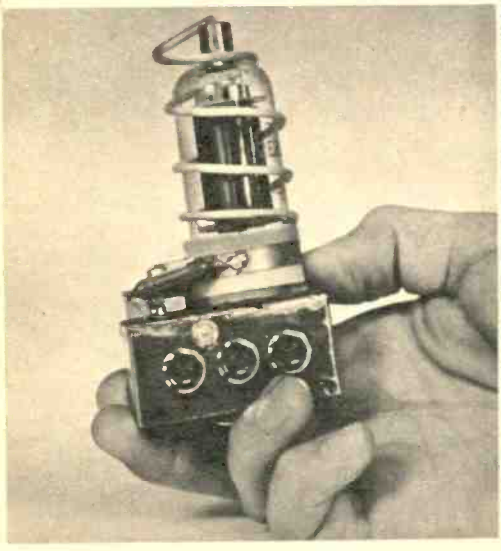


Unretouched photos above illustrate how new General Electric television camera can penetrate darkness better than the human eye. At right is picture under normal lighting. At left, with lights out, camera transmits a good picture utilizing only the glow from the girl's cigarette lighter.

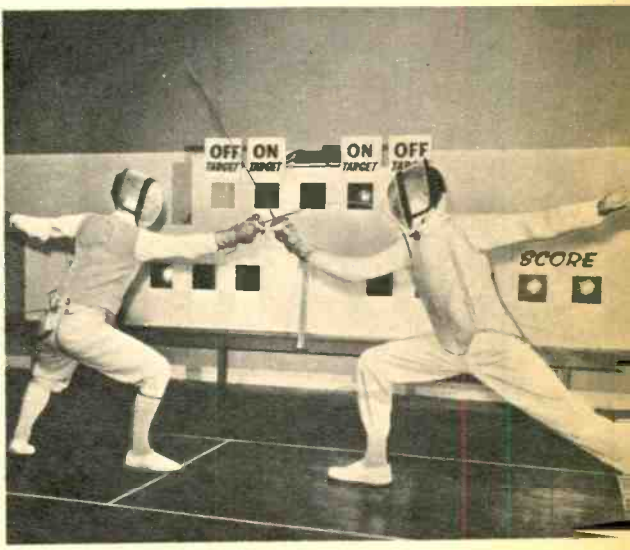
New piggy-back radar equipment which permits the foot soldier to see some distance ahead of him is presently undergoing tests at the Army's electronic proving grounds in Arizona. Developed primarily for nighttime use, it is completely portable. Image appears on hand-held scope.



Called the Golden Triangle by Zenith, this unique clock radio is cordless, completely transistorized. Swiss clock and AM radio are battery operated. The cabinet rotates at touch to reveal its three faces—clock, radio dial, and the radio's speaker grille.



Crystal stabilized transmitter (only 2½ ounces) can send 50-watt TV output 240,000 miles. It was designed by the Navy for eight pound scanning system to picture the moon.



Touche! Tallied electronically, "hits" are no longer a scoring problem at San Francisco School of Fencing. Wires are connected to fencers' foils, then linked to free-moving coil.

new fields for electronics

Electronic Age School

This school is wired for the latest in education. Tape recorded lessons permit great flexibility.

IN all ways but one, the students at St. Scholastica School in Covington, Louisiana, are typical of other students throughout the country. They are educated via electronics.

Since St. Scholastica is run by the Benedictine Sisters, only girls attend classes, which range from grammar grades through high school. But oddly enough, the girls seem to appreciate electronics as much as boys. The call of "take out your headsets" is as natural to their ears as "fill your inkwell" was to students a generation ago. Their desks come complete with built-in storage for the headset—but no inkwell.

The typical teacher's desk contains no wilting plant, no pile of books and no old globe. Rather, it is an advanced console, with four tape decks, about 100 controls—switches, lights, but-

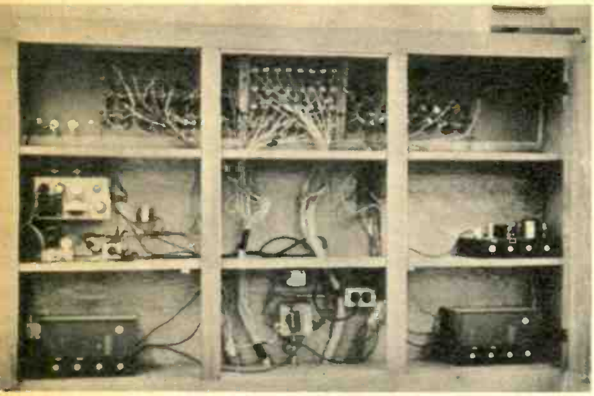
All wiring is under the floor at the new school, and each student's desk is provided with a convenient phone jack receptacle. Controls on Bogen K-10 amplifiers for each tape deck in teacher's console are pre-set. Individual gain, tone is governed by desk-top pre-amp.

Photos by Dennis J. Cipnic of Black Star

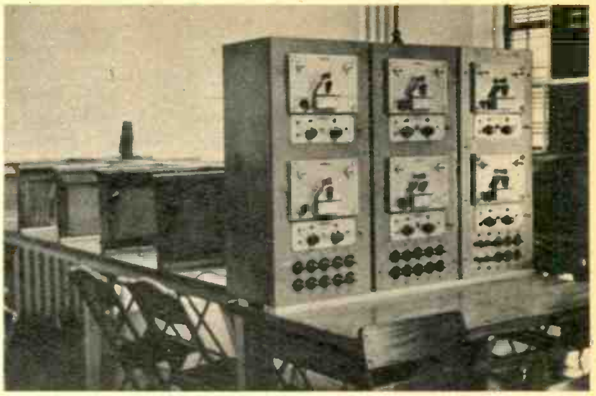
Above, certain students in eighth grade classroom are "on tape" while others receive a non-conflicting oral lesson from Sister Anthony, chief teacher and an electronics expert.

At right she cues in tapes to each one of her students. Her console is typical of those in every classroom. Headset and mike allow her to talk with students, answer their questions.

Student at work: Class is receiving an English lesson via tape, but this Spanish girl is on different channel learning to speak English from simultaneous lesson in Spanish language.



Rear view of master control console for the "isolation room" booths has 5-position cueing switches, Masco C-6, Bogen K-10 amplifiers.



Early attempt at tape education had students sit in booths, listen to one of six tapes. This was dropped in favor of classroom situation.

tons, etc. Every classroom is equipped in this manner.

At the beginning of the class period, the teacher can reach for one of 64 switches on her six-foot long console and send a tape recorded lesson to the desks of her students, who listen through earphones. The fact that the teacher has four tape decks at her fingertips permits enormous flexibility. The brighter students may receive an advanced lesson, the majority a normal lesson, and the slower students a basic presentation.

Teachers may channel special tapes to individual desks, and individually set the volume for each child. In addition, each child is provided with an inquiry line to the console. If she has a question, she pushes a button and a console light indicating her desk flashes. The teacher speaks to the student through her headset microphone.

This technique of private questioning has vastly increased the amount of student participation in all subjects. Youngsters reticent to ask "silly" questions in public now feel free to take advantage of electronic privacy for consultations.

This electronic school has been in operation for only two years and has already improved student abilities about 100 percent over nationally graded learning averages. St. Scholastica's students, even in lower grades, generally have no trouble discussing serious issues facing the world today. Straight "A" report cards are commonplace. In no small part, this ability is due to the fact that students are encouraged to make their own tapes, thus improving diction, vocabulary and the ability to stand up and speak well.

Electronically, the new school features under-the-floor wiring. Students plug into flush phono jacks. No tripping, no costly re-wiring of junction boxes. Of the four Viking-75 tape decks in each console, only one is equipped with a recording amplifier—the Viking RP61. Each playback has its own Bogen K-10 amplifier, housed under the desk with pre-set controls. Gain and tone can be controlled by the teacher with desk top pre-amps.

Each class has its own graded textbooks and each tape recorded lesson comes complete with worksheets. The real beauty of teaching via electronics is not that it lets the teacher sit back and play a tape recorder. Rather, the teacher is set free by tape to teach orally those who most need such instruction.

While the teacher gives an oral lesson to certain students, those on tape pay no heed to her, but bend to their texts and worksheets. Use of headsets eliminates confusion that might arise out of hearing two lessons at once.

Students, according to their grade level and ability, get tape recorded lessons from the world's leading uni-

[*Continued on page* 113]

Judging by smiles, Diane Anchel, KN2LLB, and Ed Davis, K2PHK, have made an important DX contact using their school's ham radio station, K2LAK.

Teenage girls seem to be in majority at this code practice session. They also study theory in preparation for their FCC novice class exams.

High School Hams

By Robert Hertzberg

Teenagers are taking to ham radio in a big way as school radio club trains them for FCC licenses.

BACK in the early days of ham radio there were radio clubs, sure enough. But their membership usually consisted of intense young men bent only on bringing in all the stations they could, no matter if the station was around the corner or a couple of hundred miles away. Seldom, if ever, did a female cross the threshold into the radio shack.

Now the story is slightly different. Take for example the radio club at South Side High School in Rockville Centre, a suburb of New York City: Of the 15 members who have obtained FCC licenses in its short two-year history, three girls have already made the grade. Several other young ladies are pounding the key, taking code practice and studying theory along with the boys. The age of the average club member is 16 years, which hardly qualifies him for the hamese designation "OM" (old man).

An up-to-date club station, K2LAK, gives both girls and boys the opportunity to observe or participate in actual on-the-air ham operation. The console was designed by the members under the direction of club advisor Miles R. Stireman, the school's industrial arts director, and himself K2KAT. It contains a National NC-300 receiver and a Johnson Valiant transmitter, which operate with a Matchbox antenna on the 10 through 80 meter bands.

How to Phase Speakers

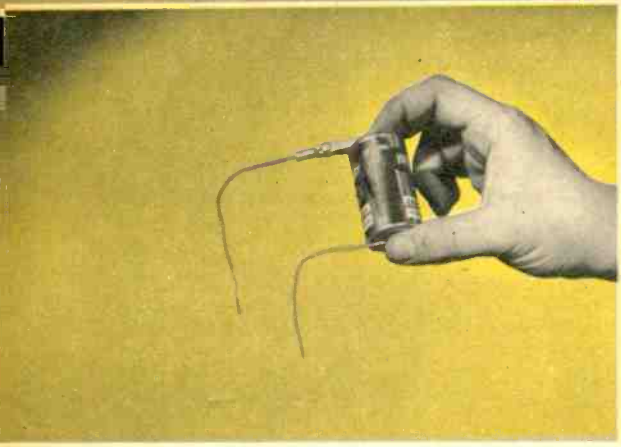
By Len Buckwalter
Associate Editor

Avoid dead spots and loss of volume when using more than one speaker in a hi-fi or PA system.

ANY time two or more speakers are used with little physical separation between them phasing difficulties can occur. It shows up, for example, as a reduction in volume when using a hi-fi extension speaker, or as dead spots in PA systems. As the speaker cones pump air, the resulting pressures can work against

1. An out of phase condition can exist between two speakers. At any given instant the left cone moves in as the right one moves out.

3. The first step is to connect a battery lead to a speaker terminal. Then touch the other lead to the other speaker terminal.



2. The only materials required to phase the speakers are a 1.5 volt flashlight battery and 2 leads. Alligator clip is not essential.

4. As both battery leads make contact with the speaker terminals observe the front of the cone. It will visibly move either in or out.

each other and cause cancellation of the sound energy.

The central idea behind the various steps illustrated here is to mark the speaker terminals so they may be handled according to your particular needs. The rule is that when two speakers are facing the same direction their like terminals are connected to the same leg of the amplifier. This is the parallel connection where, for example, two 8 ohm speakers are wired to the 4 ohm tap on the amplifier.

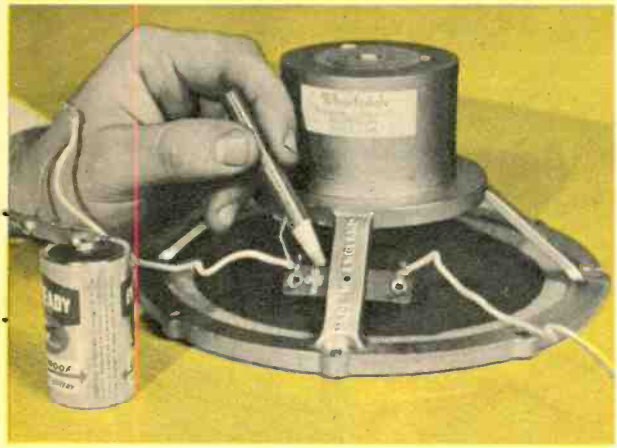
If you use a series connection (two 8 ohm speakers to a 16 ohm tap, for example) wire as shown in Step 7. Both diagrams show how to wire when the speakers face in the *same* direction.

If the speakers are quite distant from each other phasing is less important. However, if more than one speaker is used in the same enclosure the cones should all move in unison to achieve the best performance.

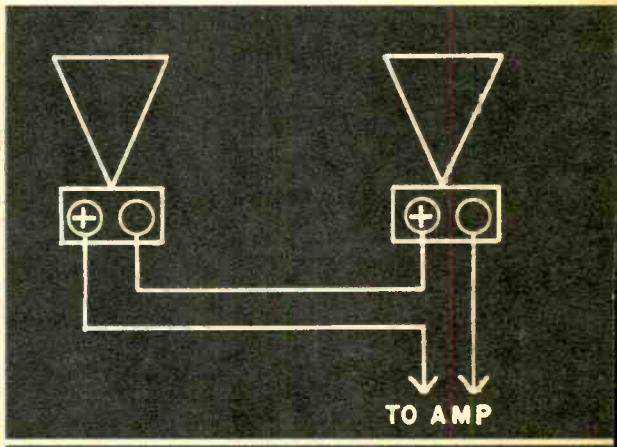
With PA systems where large areas are covered, unpredictable sound patterns and garbling may result. Here, some speakers may be purposely operated out of phase to minimize this difficulty.

5. With a grease pencil, or some red nail polish, mark the speaker terminal connected to the plus (or center) battery terminal.

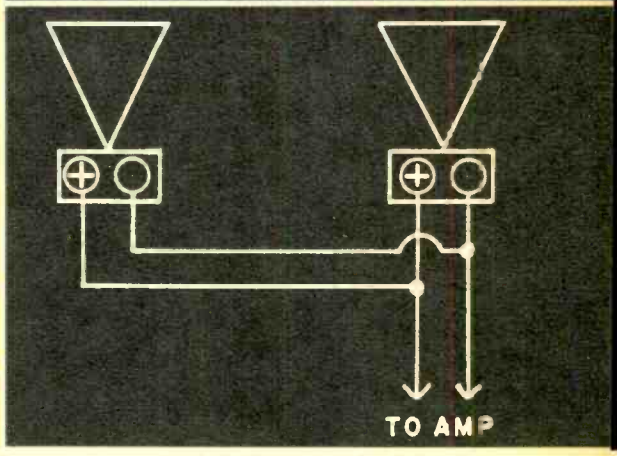
6. Connect battery leads to other speaker so cone moves in the SAME direction as the first one. Mark terminal with + as before.



7. Diagram for wiring two speakers in series to one amplifier. Both speaker cones will be in phase and move in the same direction.



8. Wiring diagram for phasing two speakers when they are connected in parallel. See text for other details on both arrangements.



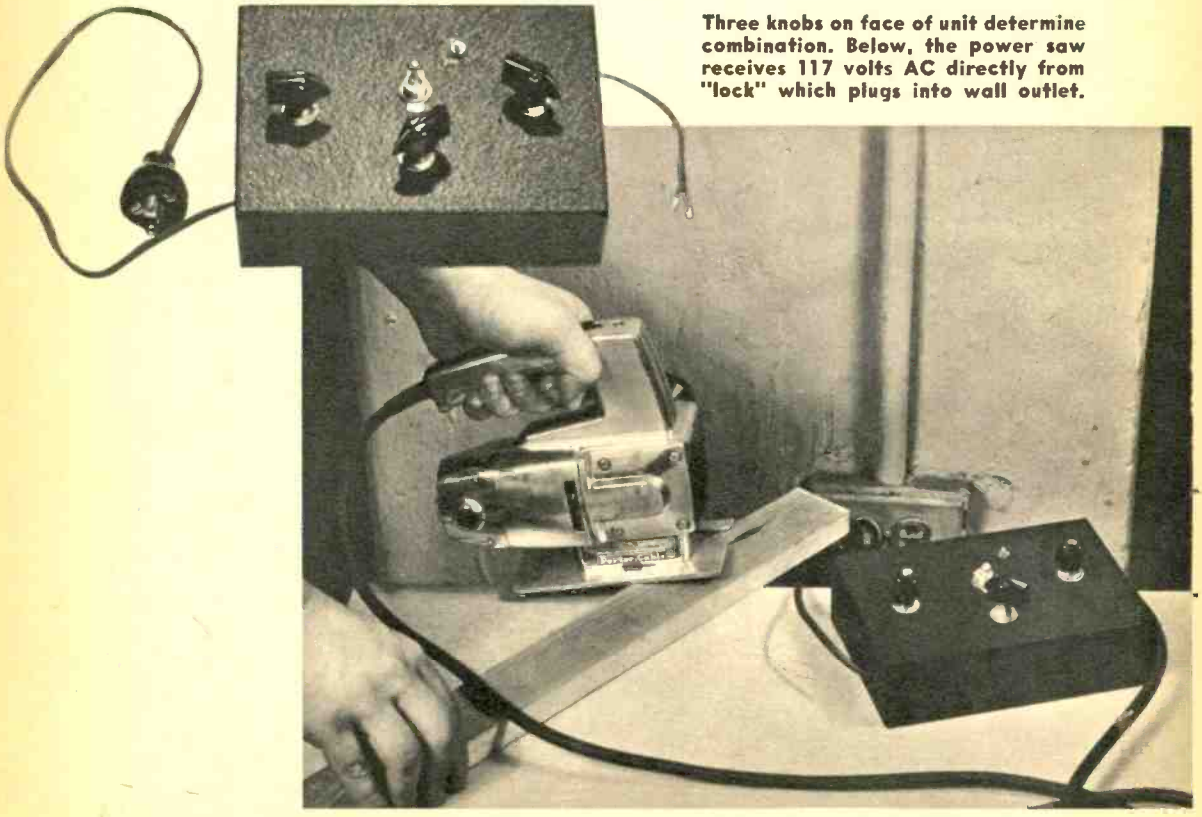
Electronic Combination Lock

By Ronald Wilensky

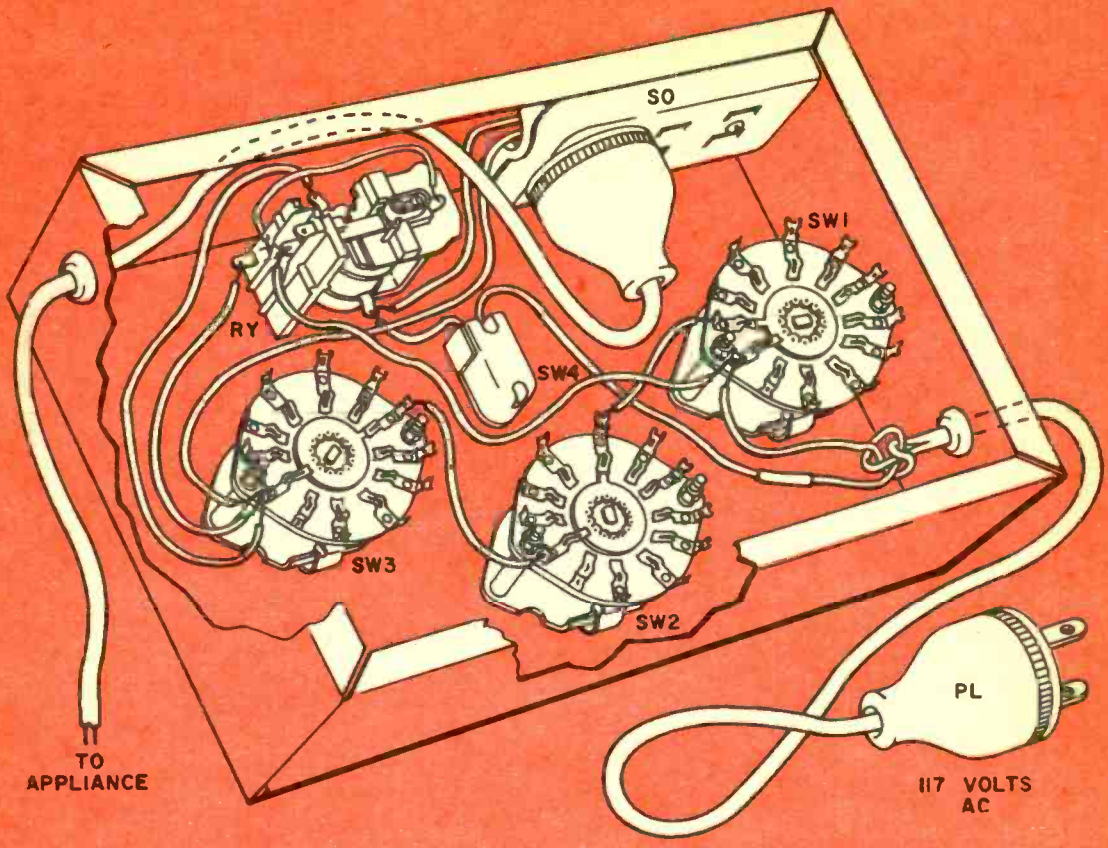
Use this to prevent children and others from turning on your power tools or dangerous appliances.

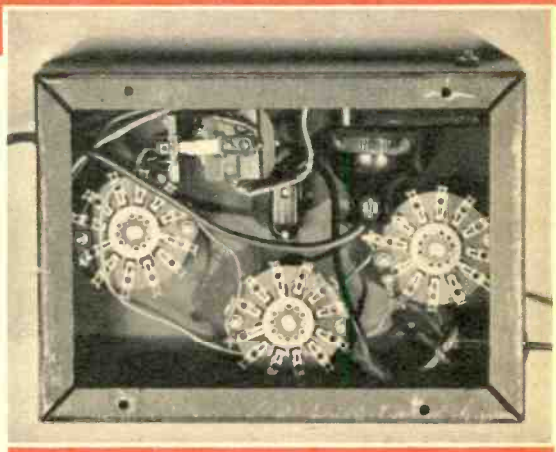
MANY times it is desirable to keep power tools and other electrical devices from being turned on by unauthorized people. Of course this is especially true with children and power tools—a potentially dangerous situation. Other cases where a lock comes in handy is on amateur radio transmitting gear and similar equipment. The common key type lock is one solution, but does not offer the advantages of the combination type where there are no keys to lose. The Electronic Combination lock described here offers several novel features.

With the three 11-position switches there are about 1000 possible combinations. It was tested with twelve people—and not one of them even came close to the correct positions. Notice that



Three knobs on face of unit determine combination. Below, the power saw receives 117 volts AC directly from "lock" which plugs into wall outlet.

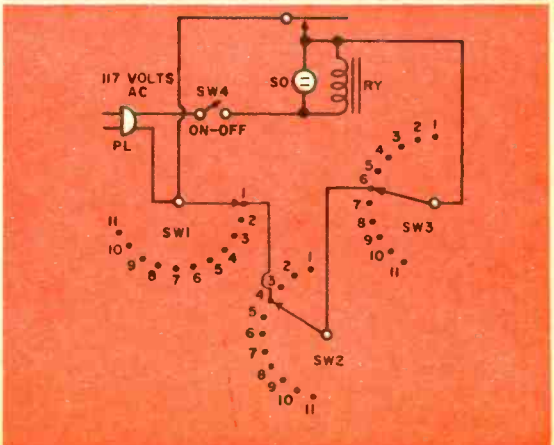




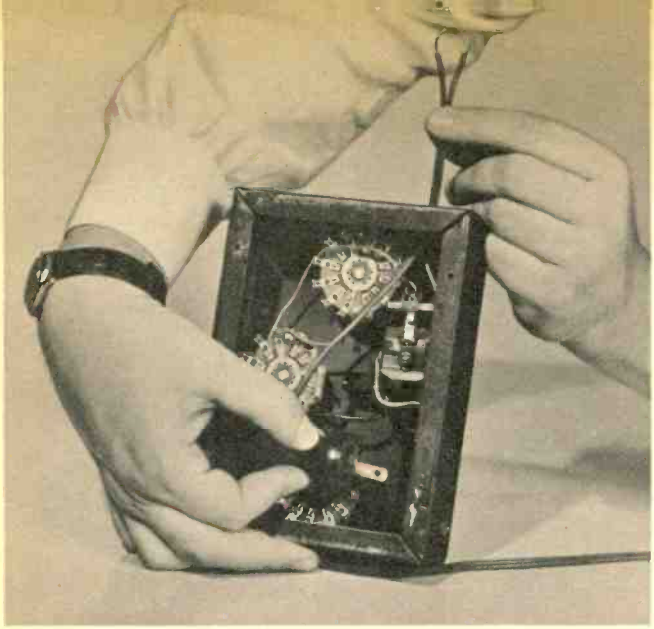
Guide above shows position and wiring of components. Note that there are no wires connected to the chassis.

Underside of chassis, bottom plate removed. Any combination may be selected on the switch terminals.

In schematic, terminal numbers on SW1, SW2, and SW3 indicate that the combination is set for 1-4-6.



March, 1959



Don't remove wire from appliance. Take off its plug, slip wire in hole and reconnect.

number decals were left off the panel to increase the secrecy of the device. The user simply counts the correct number of clicks on each knob to close the circuit.

The relay was included for an important reason. After the combination is arrived at, the switches are placed in any random position and the power remains on. Thus, if any person attempts to learn the combination by observing the pointers of the three knobs, he is effectively foiled. After the appliance is used, the on-off switch is thrown to Off and the power is cut.

In the unit pictured here, the appliance receptacle within the unit has three sockets. However, a single receptacle may be used if you only intend to operate one appliance.

Construction of the unit is simple. It may conveniently be built into an aluminum chassis of the dimensions given. Be sure to buy the bottom plate in order to prevent any prying fingers from touching the 117 volts AC.

No wires are grounded to the metal chassis, you simply follow a point-to-point route from one component to the next as shown in the wiring guide. Be certain that no bare wire touches the chassis at any point.

The combination of the lock may be changed at any time with little difficulty. The leads on each of the three switches may be shifted to a different lug since there is a choice of eleven on each. Don't change the "common" wire. Usually, the manufacturer identifies this lug with a dab of green color. In any case, it is the lug going to the wiper or armature of the switch.

Here is the way to connect the desired appliance or power tool to the lock. First the plug is removed from the line cord. This will permit you to insert the cord into the hole drilled for it in the metal chassis. Once this is done the plug is reconnected and then inserted into the socket (SO in the lock). With this arrangement there is no chance that the appliance plug will be pulled out of the lock and inserted directly into the AC wall outlet. If you plan to use several line cords, the hole must be widened accordingly. The use of rubber grommets will prevent chafing of the AC cord and the possibility of future short circuits.

The contacts on the relay specified in the parts list are rated at 5 amperes. Accordingly, appliances using up to 550 watts may be used with the lock.

PARTS LIST

SW1,SW2,SW3—Rotary switch, single-pole 11-position non-shorting (Centralab #1403 or equiv.)
SW4—SPST toggle switch
RY—SPDT relay, 117 volt AC coil (Potter & Brumfield KA5A)
SO—Female AC receptacle
PL—AC plug
Case—5"x7"x2" chassis with bottom plate
Misc.—two rubber grommets, AC line cord, hookup wire

Car Headlight Delay Switch

By Paul Hertzberg

After you leave your car, this switch will keep the headlights on to light your path for 30 seconds.

DON'T be left in the dark, light your way with the delayed action safety switch known as the "Pathfinder."

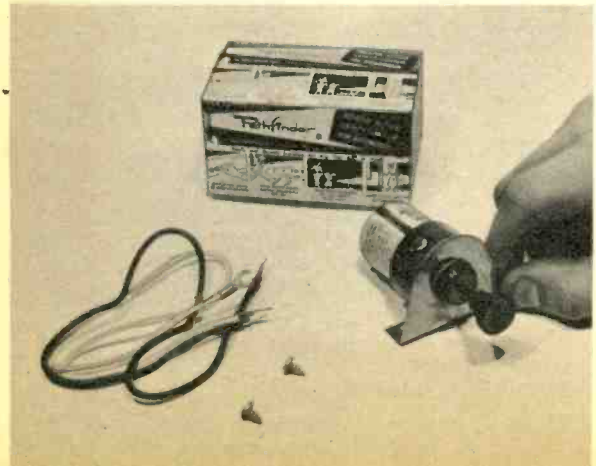
To install, fasten the switch panel to the bottom edge of the dash board near the light switch. Use two self tapping screws. One lead of the switch is connected to the "hot" side of the battery and the other is connected to what ever light circuit you want to operate, headlights, taillights, and spotlights.

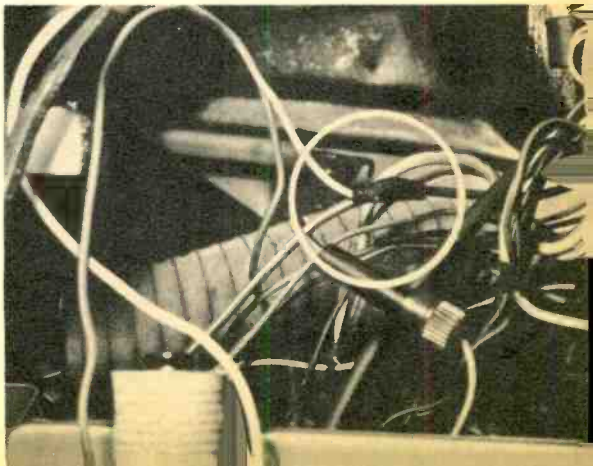
To operate, turn off the regular light switches and push the "Pathfinder" switch in. Since your lights will remain on for approximately thirty seconds you may leave your car and enter your house with ease and safety.

Depress the switch once and the delayed action begins. Two holes are drilled under the dash for the mounting bracket.

At lower left are the parts. Plunger compresses air in a cylinder which forces it back in 30 seconds to open switch.

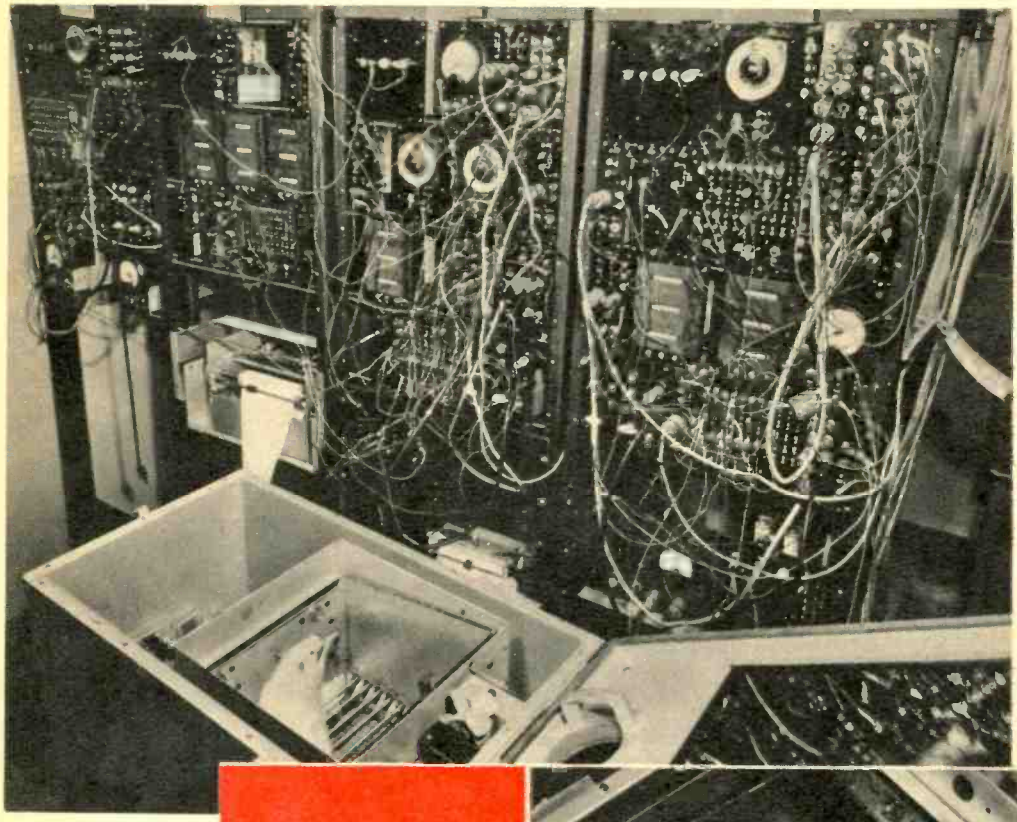
One switch lead is spliced to headlight wire (circle), while the other goes to a "hot" battery terminal (6 or 12 volts).



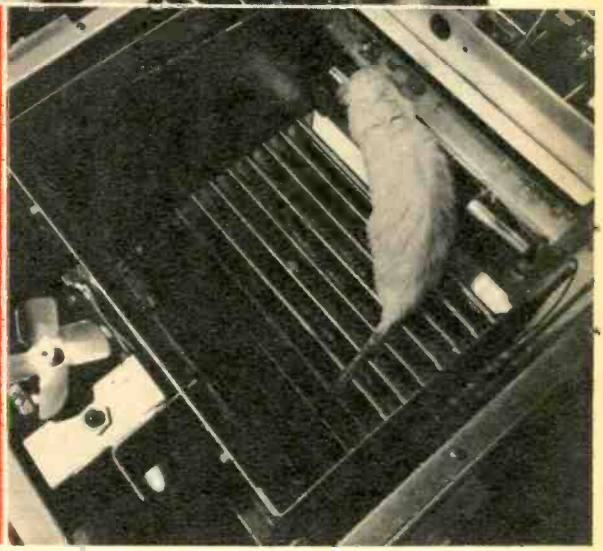


automation calls the tune for the . . .

Rat In Electronic Cage



Elaborate electronic apparatus controls light, sound, temperature and sets up program which rat must carry out in order to get food or water. Rat's reactions are recorded on graph.



AS science moves closer to sending man into outer space, we are beginning to examine elements of our behavior here on earth under scientific conditions. How do we get what we need to stay alive? How do we react when our normal environment is changed? Why do we become mentally ill?

To answer these and other questions, laboratory animals in electronically controlled environments are studied. The way a mammal such as a white rat reacts to electronically automated changes in his environment may provide the clues which will enable man to more fully understand the ways in which he deals with his own environment, whether it be here on earth or in unknown outer space. This research is known as the study of "operant behavior."

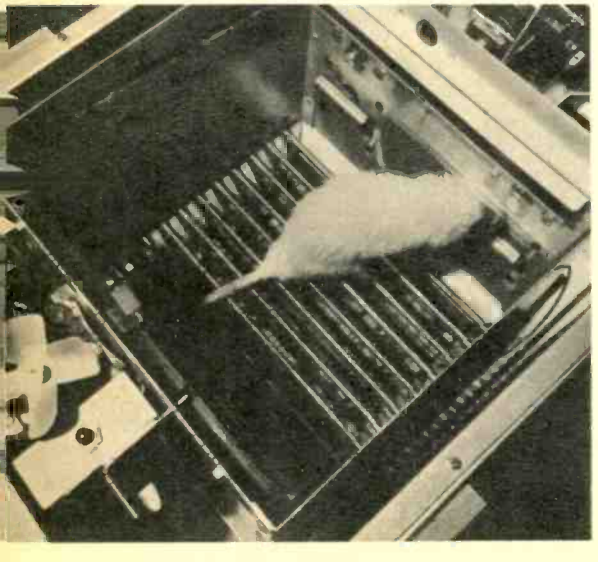
At the Squibb Institute for Medical Research in New Brunswick, N. J., extensive switching circuits, stepping switches, electric timers, loudspeakers for sound stimuli, and recording devices provide a precisely controlled environment and a record of how the rat reacts in that environment. The thirsty, hungry animal must perform a certain sequence of responses in proper behavioral pattern in order to be rewarded with a small amount of water or food.

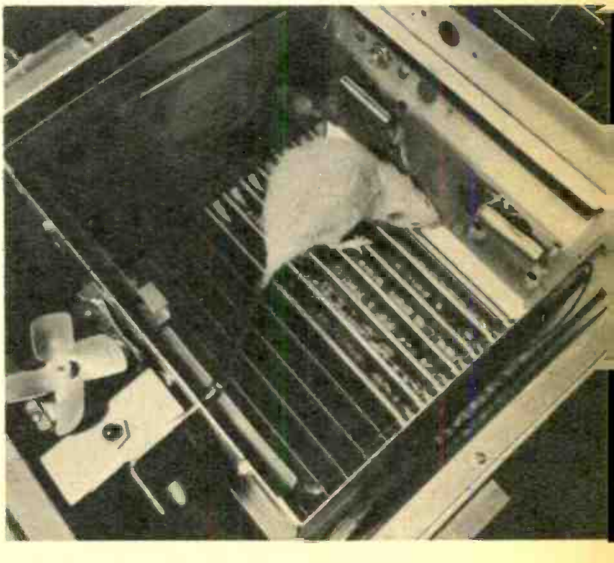
In order to arrive at a "normal" pattern, hundreds of experiments are required before a rat's training is complete. To vary the training program and record the results by hand is impossible; but it is an easy task for electronic automation, in which tapes and film "program" the environment and dish out the rewards. When the white rat has learned a set of responses, it is then possible to study how he reacts to changes after receiving, for example, a tranquilizing drug or barbiturate.

This is how it's done: The rat is placed in a box whose light, sound and temperature are rigorously controlled. The box is actually a system of intricate relays which automatically program what the rat must do in order to be rewarded and records his responses on graph paper or tape. The program may require the rat to press one lever 25 times, another 50 times before he gets the payoff. Or the rat may have to press a lever every three minutes to get his reward. Under these latter conditions, the rat may actually learn to "tell

[*Continued on page* 113]

Rat, in photo at far left, tries to get reward by tapping left lever on control box. In center photo, he taps right lever. After tapping in sequence on each lever the required number of times, he receives his reward as food is delivered by cam device into area between levers.





The ABC's of Electronics-9

By Donald Hoefler

This part describes resonance, an important principle used for radio and audio frequencies.

THERE are three devices for retarding the flow of current in AC circuits: resistance, inductance and capacitance. Let's see what happens when we use them all in a single circuit. In Fig. 1 we see combined one of each element in series with an RF generator, which is putting out 2 volts at a frequency of 2.5 megacycles.

Under these conditions the inductive reactance of the coil is about 8,000 ohms, and the capacitive reactance of the capacitor is also about 8,000 ohms (formulas given last month). With only 2 volts of signal, it would seem that the current in this case should be exceedingly small. But when we measure it, we find the current to be 0.39 milliamperes, or simply the value of E/R. Obviously the reactances in the circuit have had no effect whatsoever!

The reason for this is that the two reactances oppose one

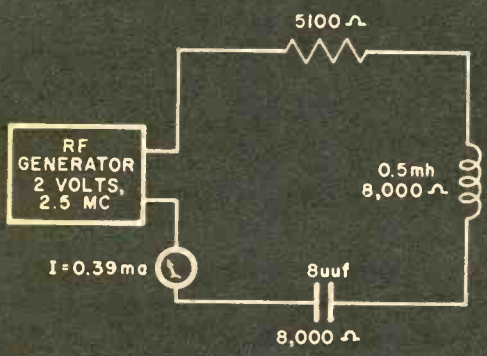


Fig. 1. The basic elements of a resonant circuit are coil, capacitor, and resistor. Actually the resistance here is "lumped" for purposes of illustration. It is usually distributed over the wiring.

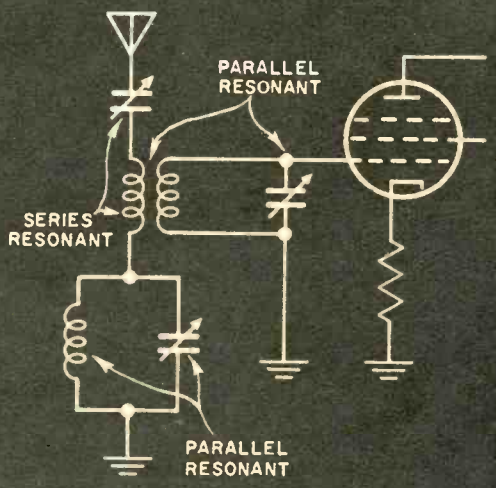
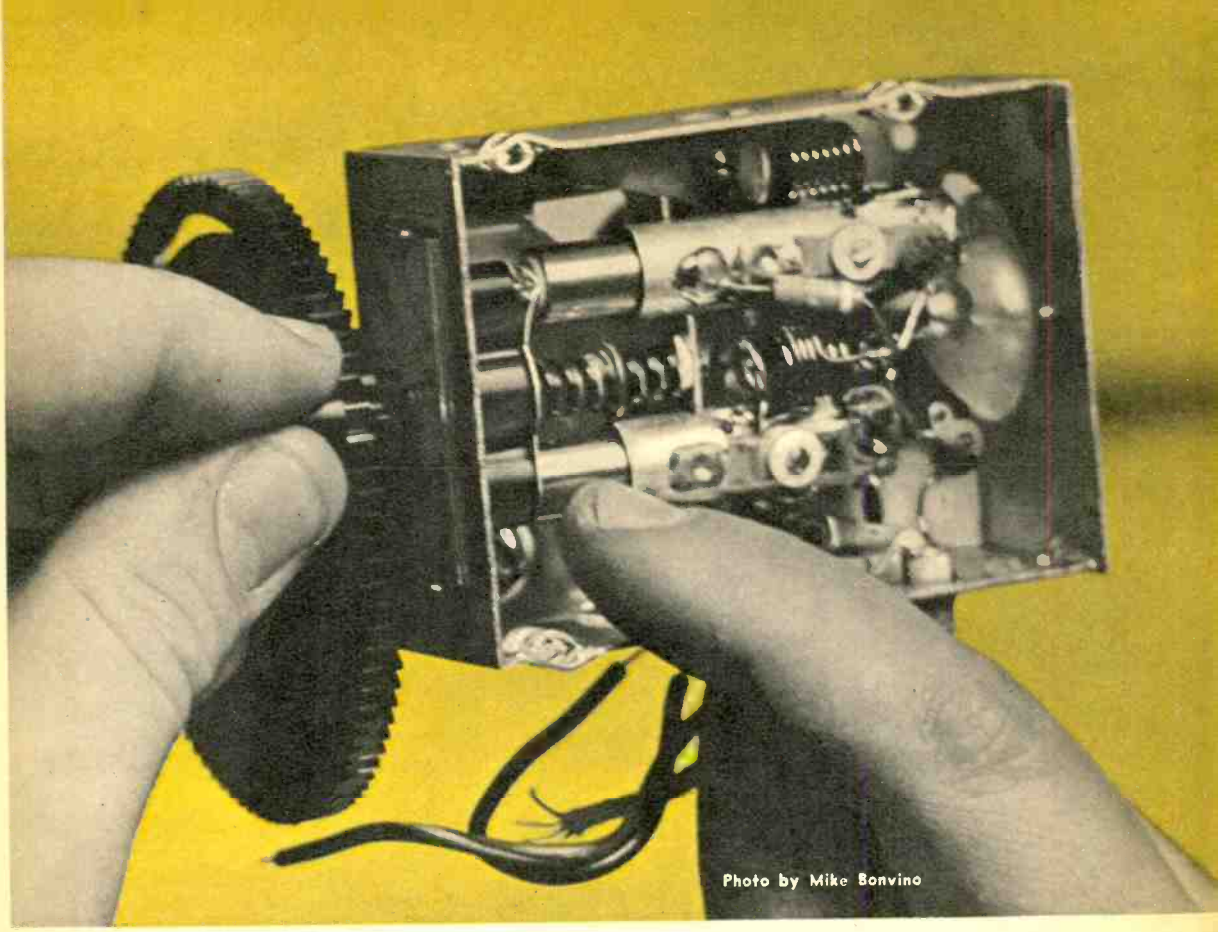


Fig. 2. Parallel and series resonant circuits described in text. Considering the tube as a receiver RF amplifier, the various tuned circuits select desired signal and reject the spurious ones.



Granco FM "front end" has 2 coaxial tuning capacitors in resonant circuits. (See tuning slug).

another. They are 180° out of phase and will tend to cancel each other out. Complete cancellation, however, will occur only under a special condition known as *resonance*, which in turn occurs only at one specific frequency known as the *resonant frequency*.

We can understand just what this means simply by shifting the frequency of our generator in Fig. 1. Suppose we drop it down to 2.0 megacycles. Then the reactance of the capacitor will increase to 10,000 ohms while the inductive reactance drops to 6,400 ohms. The reactances no longer completely cancel, for now there is a net reactance of (10,000 —6,400), or 3,600 ohms.

To find the total impedance to current flow, we cannot simply add this net reactance to the circuit resistance. As we have noted, the effects of the two reactances are completely opposite, or 180 degrees out of phase. But more than that, the effects of each of them are at right angles, or 90°, with respect to the resistance.

This concept of *phase angle* is a little too involved for us to treat here, but its practical effect is a simple matter. It means that the effective impedance is found by adding the resistance and net reactance geometrically, rather than arithmetically, using this simple formula:

$$Z=\sqrt{R^2+X^2}$$

where Z=impedance in ohms
R=resistance in ohms
X=net reactance (difference between X_L and X_C, regardless of which is larger) in ohms

To apply this to the circuit of Fig. 1 when F=2.0 mc, we substitute as follows:

$$Z=\sqrt{(5{,}100)^2+(3{,}600)^2}$$
$$=\sqrt{38{,}970{,}000}$$
$$=6{,}244 \text{ ohms (approx.)}$$

Here we see that the actual impedance is less than the simple arithmetic sum of the resistance and reactance. If the signal frequency should be increased, say to 3.0 mc, the inductive reactance increases to 9,600 ohms and the capacitive reactance drops to 6,600 ohms. Then X_C must be subtracted from X_L to obtain the net reactance for the impedance formula. Now we have 3,000 ohms of reactance in series with 5,100 ohms of resistance, which works out to a resultant impedance of 5,916 ohms, once again less than the simple sum of resistance and reactance.

Resonant circuits are used in radio and TV receivers, both for the selection of the desired signal and for the rejection of unwanted signals. The relative ability of a receiver to perform these functions is called its *selectivity*. In transmitters, the entire process of generation and amplification of RF energy is dependent upon tuned circuits. Wherever RF is to be found, in fact, in signal generators, oscillators, frequency meters, radar, sonar, radio telescopes, there also will be found many tuned circuits.

Not all tuned circuits are series resonant. Another type of circuit, called parallel resonant, is encountered even more frequently. A practical application of both types is shown in Fig. 2. This shows the input to a receiver, where the primary of the antenna transformer is tuned to series resonance, while the secondary is made parallel resonant. There is also a parallel resonant trap circuit in the ground leg of the antenna circuit. Each circuit is tunable to resonance by means of a variable capacitor.

The tuning of both windings of the antenna transformer is for the same purpose, to develop maximum voltage from the desired signal frequency. The primary might have been made parallel resonant as well, but in this case the series circuit will include the important inductive effect of the antenna also, while this would not have been a part of the resonant circuit if the tuning capacitor had merely been connected across the primary winding.

In the case of the secondary, the objective is to develop as much voltage as possible between grid and ground, and this the parallel resonant circuit does very well. The other parallel resonant circuit, between the antenna and ground, is used quite differently, however. This is a *wave trap*, tuned to some strong nearby signal which might otherwise cause interference. It presents a maximum impedance to the undesired signal, and thus permits only a minimum of the interfering signal current to flow in the antenna coil. This is quite different from the series resonant circuit, whose impedance at resonance ideally drops to zero. To understand why this is so, we must analyze just what happens in the parallel resonant circuit. [*Continued on page* 98]

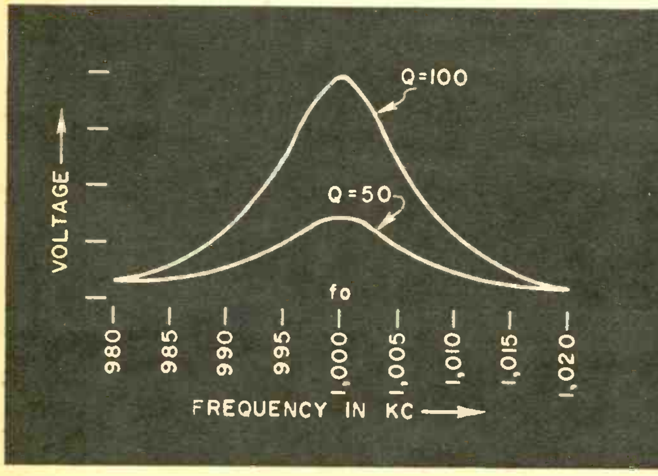
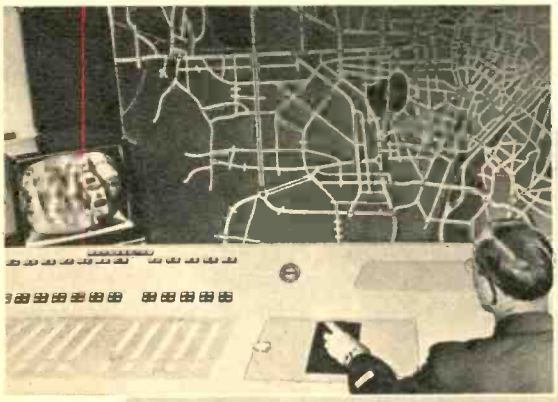


Fig. 3. Q or "quality" of a resonant circuit affects the sharpness and amplitude of the response curve as shown here. One way to increase Q is to lower the resistance in the circuit.

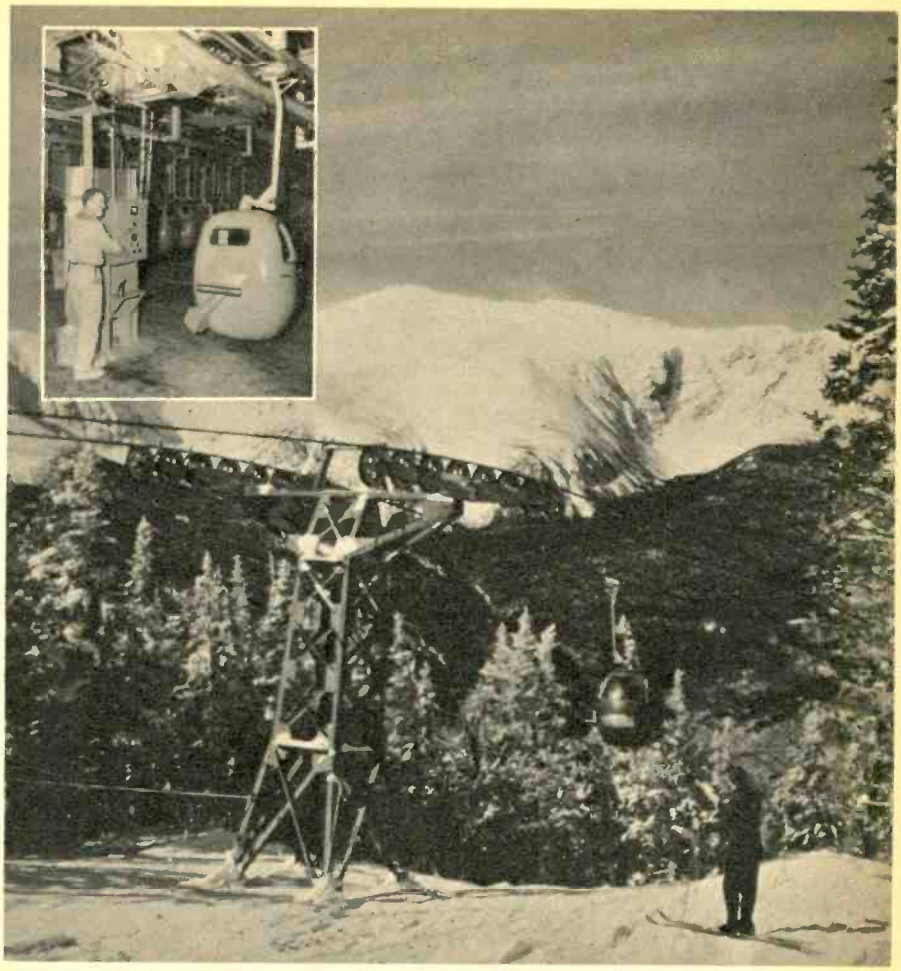
TV in a tower

Eye On Traffic

STREETCARS, autos, bicycles and pedestrians tend to jam downtown traffic in most major European cities. Munich, the world's beer capital, is no exception. But the once-hapless corner constable no longer must face the onslaught of traffic at the busiest intersection, the "Stachus." Atop a 52-foot high mast is a TV camera which can be rotated and tilted by a constable at headquarters several blocks away. From his console he can point the camera simply by moving a joystick and his bird's eye view of traffic on a monitor enables him quickly to determine what signal devices are appropriate. Controls for the traffic signals and the camera's optics are also located in the console. A thermostat in the camera housing keeps the delicate components at constant temperature for all-weather operation.



High above city, TV camera flashes traffic pictures to headquarters. Left, officer rotates camera with joystick. He can also change signals from console.



Electronic computer at base station automatically keeps tabs on number of cars on each side of cable, prevents overloading cable.

Tramway trail on Wildcat Mt. runs through virgin timber. Gondola is clamped to Swedish cable supported by 22 Swiss towers.

electronics aids the skier . . .

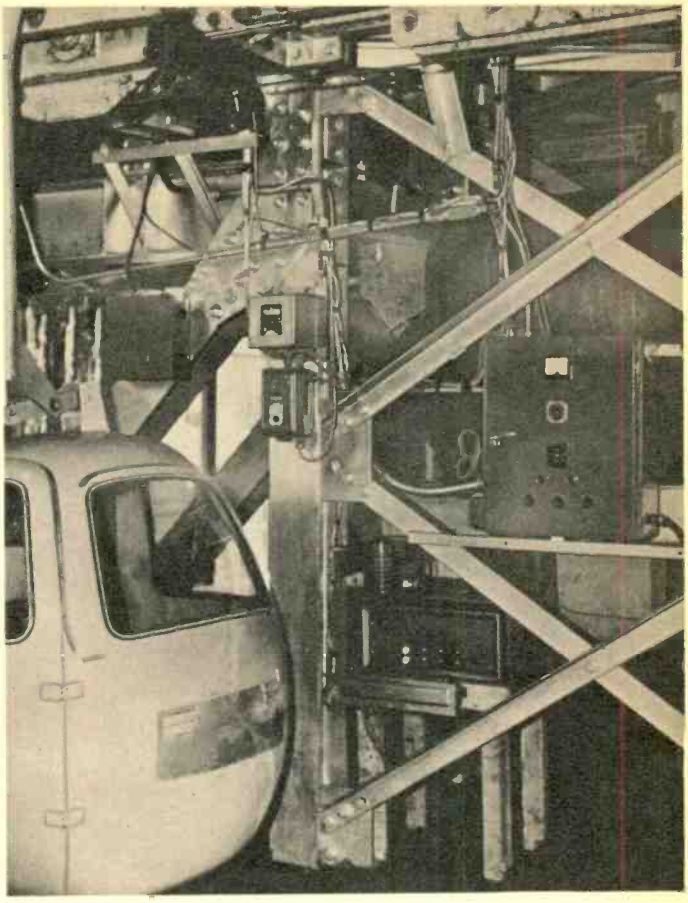
Gondola Up A Mountain

THERE was a time when only the hale and hearty dared undertake the sport of skiing. Only those long of wind could navigate the steep, winding mountain trails. But now even the girl whose major exercise consists of pounding a typewriter can swoop down snow-covered slopes thanks to the invention of the ski lift.

Man's latest refinement on open, shaky ski lifts is the Wildcat Mountain Tramway near Gorham, N. H., in the heart of the White Mountains. Wildcat has a half-dozen runs suited to both novice and professional skier. Wildcat's unique tramway system features two-man gondolas designed to haul skiers up the 6,800 foot mountain with the utmost speed and safety. The enclosed gondolas also afford complete protection against adverse weather.

The tramway runs along a cable two-and-a-half miles long, and is supported by 22 towers. The tear-shaped gondolas—91 in

Safety-plus factor lies in electronic safety devices and cut off switches which give fail-safe protection against weight imbalance.



all—come from Italy, but the electronic safety controls are American designed.

The gondolas, only ones of their kind in this country, are clamped to the cable, ride up one side and down the other. When a car reaches the terminal at either top or bottom, it is detached automatically from the main cable and shunted to a side rail where it stops to allow safe loading and unloading. When loaded, the car is speeded along a steel rail by a launching motor. When it reaches the velocity of the main cable, it is again clamped to the steel wire with a pressure of seven tons.

The system has a "backstop" arrangement which permits the cable to operate in one direction only, eliminating any tendency for it to reverse direction due to power failure. As further precaution an electronic car counter, the most important safety device of all, maintains a balance between the loads on the ascending and descending sides of the cable. An electronic computer adds the weight of each car as it is launched, and subtracts when each car is removed.

Any excessive weight imbalance between sides is flashed to the operators by a system of warning lights, and corrective measures are taken. If, through some error, too many cars are loaded on one side, power automatically is cut off.

The Wildcat Mountain tramway is used during the summer for sightseers and can carry up to 600 passengers an hour at seven mph. It's main drive is a 400 horsepower diesel engine at the summit.

Photo by Grayson Tewksbury

Fail-Proof Fire Alarm

By Harvey Pollack

It's fast acting, protects up to eight rooms, and will not fail when the house current shorts out.

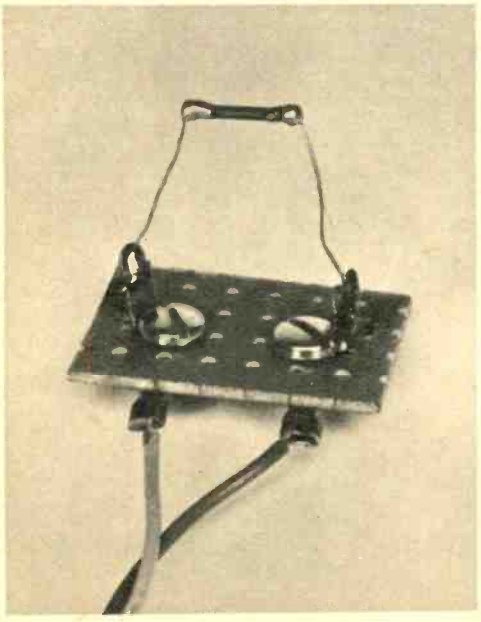
NO ONE needs to be told how important fire protection is, but it will probably come as a surprise that many commercial fire-alarm installations have dangerous disadvantages. Any system that depends solely upon the 120 volt power lines represents a form of false security because the AC voltage supplied to the home is likely to be one of the first things to go when a fire begins. Unfortunately, there is still a lot of illegal wiring in small homes to which many fires may be traced. Another shortcoming is the constant large battery drain that occurs during standby operation. This is particularly true of the solder-link or fuse-link series system which depends upon fire to melt an easily fused metal and break a series circuit. Such installations have a serious time lag

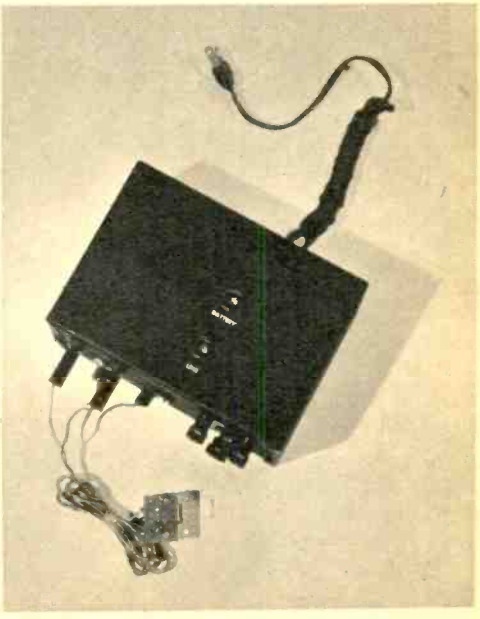
Photo on facing page shows fire triggering the alarm bell. Though flame may waver and brush past the detector, the unit will lock in and keep on ringing.

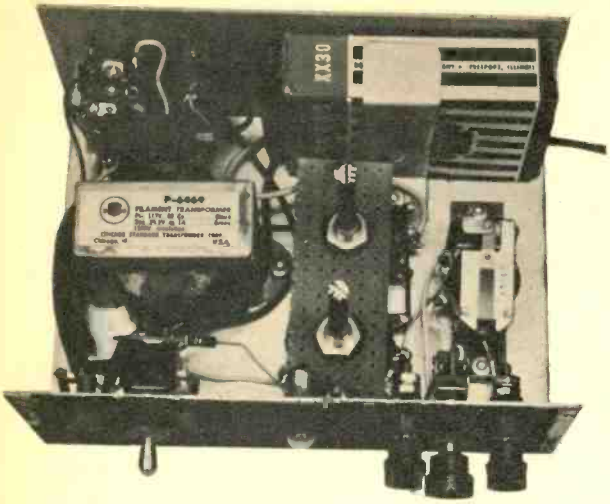
Complete unit is shown below. Thermistors are connected to INPUT, with bell and battery wired to RELAY terminals. RESET permits checking of operation.

Sensitive thermistor, the fire detecting element is shown below left. Solder lugs and bakelite board provide convenient mounting for wiring the thermistor.

Lower right shows BATTERY and LINE adjustments atop case. Once calibration with a screwdriver is done, battery takes over if the house current fails.



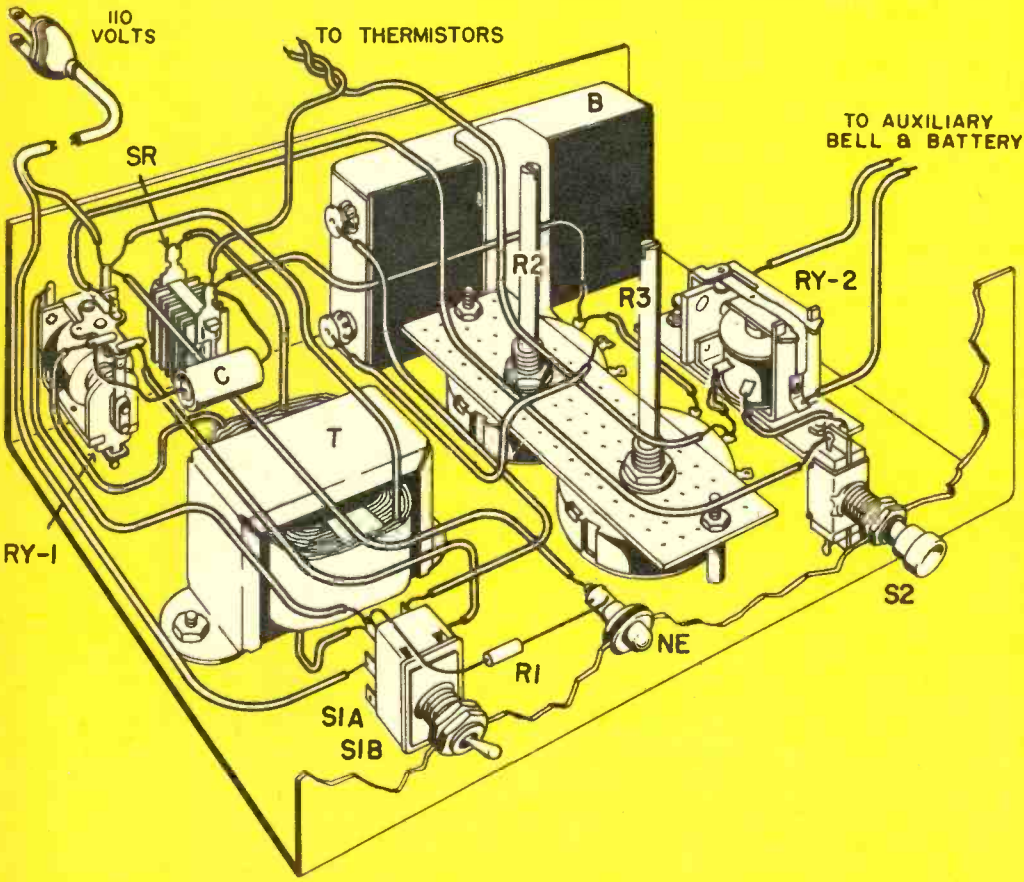




Complete unit with cover off showing placement of parts. Note pan-type construction.

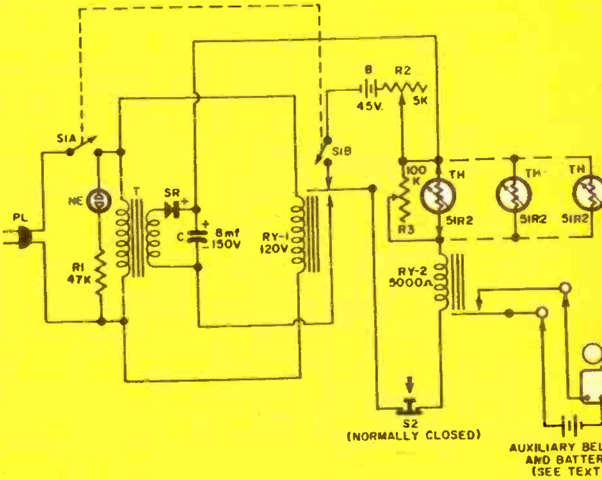
Facing page shows schematic with 3 thermistors wired in. If necessary, 8 may be used.

Wiring guide appears below. Use indicated values though parts layout isn't critical.



PARTS LIST

B—45 volt battery (Burgess XX-30)
C—8 mfd., 150v electrolytic capacitor
NE—Neon bulb, NE-51 or NE-2
R1—47,000 ohms, ½ watt
R2—5,000 ohm wirewound potentiometer, linear taper
R3—100,000 ohm wirewound potentiometer, linear taper
RY1—Relay, 120 volts AC, single pole double throw (Advance MG-1C-115VA)
RY2—Relay, 5000 ohm, single pole double throw (Potter and Brumfield LB-5, 5000)
S1A, S1B—Switch, toggle, double-pole single-throw
S2—Pushbutton switch, normally closed
SR—Selenium rectifier, 130v, 75 ma
T—Transformer, primary 117 volts AC, secondary 25.2v, 1 amp. (Stancor P-6469)
TH—Thermistor Veco type 51R2 (100,000 ohms at 25°C)
Case—7"x5"x3" aluminum (Bud Minibox CU-3008)
Terminals—2 banana jacks and plugs, 2 binding posts
Misc.—Perforated Bakelite sheet, 1½"x4" to hold R2 and R3. Two ¾" brass spacers to clear controls. Two 1¼" 6/32 screws. Bracket to hold battery, cut from scrap



between the instant the fire reaches the link and the moment the fusible metal melts.

The thermistor alarm described here has these significant advantages; (1) an extremely fast response time—less than two seconds after a flame brushes one of the thermistors; (2) reliable operation whether the line voltage is present or absent; (3) no battery drain when electrical conditions are normal; and (4) from *one to eight* different locations can be protected simultaneously. The installation may be set up with only one thermistor to start, others being added as the occasion demands *without any changes in the equipment.* One of its most important features is its automatic lock-in action. Once the alarm relay pulls in due to high temperature around any one of the thermistors, it stays in even though the flame may waver away.

A thermistor is a tiny resistance element with a high negative temperature coefficient. This merely means that its resistance drops sharply with increasing temperature. If we connect a source of DC voltage in series with the thermistor, a control potentiometer, and a relay, a rise in temperature due to a flame will cause the resistance of the thermistor to drop enough so that relay pull-in current flows. Should the power now fail, RY-1 immediately drops out causing battery B to replace the selenium rectifier power supply. Note that no battery current flows at all except during periods of line failure. These occur so infrequently that the battery may be expected to provide several years of service without replacement.

A reset button (S2) is included to permit periodic tests without making it necessary to readjust the potentiometers each time a check is performed. A tiny neon lamp (NE) serves as a perpetual indicator of the "power-on" condition. The neon lamp and the AC relay together consume less than 2 watts at a cost of a few cents per year, surely the most precious investment you can make for the protection of your home and family! The selection of the alarm bell and batteries must be left to you because each installation is bound to be different. We strongly suggest the use of three #6 dry cells and a raucously loud 4½ volt bell mounted where it is sure to attract attention in case of fire. Since the alarm relay contacts will

[*Continued on page* 92]

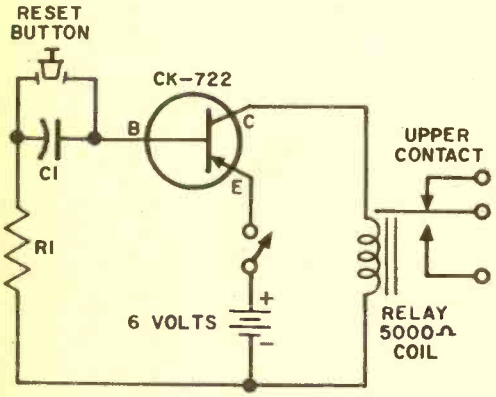
The Electronic Brain

Send in any questions on electronics. All queries will be answered either in this column or by mail.

Electronic Timer

How can I make an electronic timer that will close a relay at the end of a set time interval? Can such a timer produce a time delay up to fifteen minutes?

Ronald Hooper, Clifton, New Jersey



Simple electronic timers can be constructed using either vacuum tubes or transistors connected properly in a relay circuit. The fundamental arrangement of a circuit using a transistor is shown. It will provide time delays up to about ½ minute or slightly longer, depending on the value of R1 and C1. In most cases, the battery is replaced by a rectifier-filter power supply of the appropriate voltage and current rating for the device being used. *EI* has published in the January, 1959 issue a photo-timer circuit using a unijunction transistor; this circuit is very stable and reliable. Vacuum tube circuits of more elaborate design may be found in reference books such as "Handbook of Industrial Electronics Circuits" by Markus and Zeluff (McGraw-Hill) if you should wish to construct one. An excellent discussion of timing principles and a good example of a versatile timer are represented in the booklet called "R-C and R-L Time Constants" published by John F. Rider.

Time delay intervals as long as 15 minutes are best handled by mechanical timers such as small electric motors utilized in washing machines and dishwashers. Although this long a delay can be accomplished by electronic means, the expense and unreliability generally do not warrant the effort.

Gassy Picture Tube

Can you help me diagnose this TV receiver trouble? The white portions of my picture have a bluish appearance and are not bright enough. When I try to bring up the brightness with the panel control, the dark parts of the picture fade into gray.

H. Brassington, Saskatchewan, Canada

From your description of your picture difficulties, we would say that you have a gassy or "silvery" picture tube as the servicemen term it. When air leaks into a tube it ionizes and causes unwanted effects.

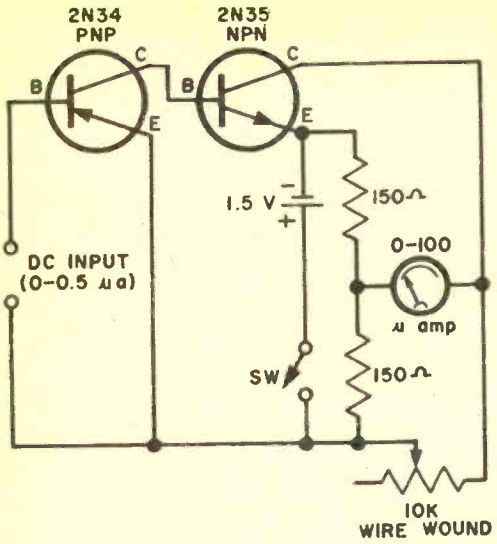
In the case of a picture tube, gas results in a blue or silvery raster when the brightness control is set at a reasonably low point. As the brightness is brought up, the contrast of the picture decreases so that the black portions turn gray.

Before replacing the picture tube, however, it is always a good idea to try a new high voltage rectifier tube. In most receivers, this is a 1B3GT or a 1X2GT. Sometimes a defective rectifier may give the illusion of a gassy picture tube by causing blooming of the picture as the viewer attempts to get more brightness. Also, see the picture tube article elsewhere in this issue.

Sensitive Meter

Can you provide me with information for the construction of a sensitive galvanometer made from an ordinary meter and one or more transistors?

Philip B. Powell, Los Altos, Calif.



An extremely sensitive galvanometer can be constructed using a pair of transistors, a 0-100 DC microammeter, a few inexpensive resistors, and a 1.5 volt battery.

The transistors are connected in complementary-cascade for high gain; the 2N34 is a PNP type while the 2N35 is an NPN transistor. The 10K wirewound resistor forms part of a bridge circuit which permits you to zero the meter when the DC input to the terminals is also zero.

This instrument will provide full scale deflection for only *0.5 microamperes input!* This means that you can measure down to approximately 0.01 microamperes with reliable precision.

Metal Locators

Can you tell me how the portable mine detectors used by the Army operate? Does a mine detector differentiate between different metals?

Wayne Lee, Pullman, Washington

Portable mine detectors are metal locators based upon the beat-frequency oscillator principle. A completely shielded oscillator inside the case produces a radio frequency signal, usually of the order of 2 mc. A second RF oscillator whose tuning inductance is the search coil that is swept back and forth close to the ground is adjusted to oscillate close to the first frequency. The heterodyne, or beat-frequency, obtained by mixing both these signals is then fed to an audio detector such as a pair of headphones or a meter.

When the search coil approaches any metal, the inductance changes, detuning the associated oscillator and causing the beat-note to alter in pitch. The closer the approach to the metal, the greater the change in pitch.

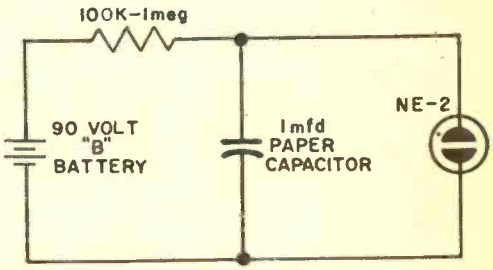
Ferrous metals (iron, steel, cobalt, nickel) cause the inductance to rise; non-ferrous metals produce a decrease of inductance. Hence, it is possible to distinguish between metals to this extent at least. A mine detector cannot, however, provide specific information concerning the nature of the metal.

Mine detector circuits used in World War II may be obtained by writing to the Government Printing Office in Washington, D. C.

Neon Bulb Oscillator

I have heard that capacitors can cause lights to blink. What kinds of lights are used and how are they connected?

David Smith, Columbus, Ohio



Small neon lamps are generally used with capacitors to get a blinking-light effect. The simplest way to experiment with this phenomenon is to obtain a 90-volt radio "B" battery, a few resistors of the ½ watt variety ranging from 100,000 ohms up to 1 megohm, and a 1.0 mfd paper capacitor.

Connect one of these resistors to the battery, capacitor, and neon lamp as illustrated in the drawing. As you change resistors you will find that the blinking rate rises as the resistor is made smaller; the same effect would occur if you were to reduce the size of the capacitor. A good neon lamp to use in this circuit is the NE-2.

YOUR FUTURE MAY REST BETWEEN THIS PAGE AND THE NEXT!

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ECPD Accredited Technical Institute Curricula • Est. 1927

Dept. 173-F, 3224 16th St., N.W., Washington 10, D. C.

Fail-Proof Fire Alarm

Continued from page 85

handle up to five amperes, you can feel safe in purchasing a large bell.

You will need a metal bracket to hold the 45 volt battery securely to the side of the case. The author made his from a piece of scrap aluminum.

The neon indicator is at the geometric center of the panel. No socket is used for the neon lamp. A ½ inch hole is drilled in the correct spot and a rubber grommet (½" o.d.) is inserted. The NE-51 lamp is an excellent friction fit for the inside hole of this grommet, connections being brought to it by soldering directly to its sleeve and bottom contact. You may use an NE-2 neon lamp if you prefer. This is somewhat easier for soldering but it has a pointed rather than rounded glass end.

Before wiring, bend the relay (RY2) tail spring so the armature pulls in at *approximately* five milliamperes. To do this, remove the little tail spring screw (don't lose it!) and bend the spring *down* very slightly. A milliammeter is not necessary for testing the adjustment if you have a 22½ volt battery. The relay should just pull in with 22½ volts applied across its coil. If you haven't the equipment, don't worry about it. Assemble the fire alarm completely and perform the tests described later. Should the relay fail to operate on line voltage, the tail spring can be bent in successive small steps until reliable pull-in is realized.

When the wiring is finished, don't be in a hurry to plug it in. First be sure that all the connections are correct and there are no short circuits. Connect one thermistor across the input terminals and some indicating device such as a battery and light in series across the RELAY contact terminals. Rotate both potentiometers fully counterclockwise and plug in. When the power switch is turned on, the neon light should glow and RY-1 should instantly pull in. The battery need not be in the circuit for this initial test.

Now *slowly* advance R3 (the 100K potentiometer) clockwise until RY-2 pulls in and sounds the alarm bell. Pressing the reset button S2 at this point should release RY-2 but it should instantly pull back in when the button is allowed to spring back. Now back off R3 (counterclockwise) a *tiny, tiny amount*. Press the reset button, hold it in for a second or two, then release it. If RY-2 pulls in again, back off R3 again very slightly. Repeat this process until operation of the reset button releases the armature of RY-2 permanently. Now hold a lighted match for just a second under the thermistor; RY-2 will then pull in and *remain that way*. After the thermistor cools, the reset button should again cause RY-2 to drop out and stay out. The line-voltage adjustment is now complete.

Install and connect the battery, then remove the line plug from the wall. Observe that RY-1 is de-energized when you do this but RY-2 will not pull in if you have rotated R2 (5K pot) fully counterclockwise. Now slowly advance R2 just as you did with R3 previously, following exactly the same sequence of steps. Adjust until the indicator comes on, then back it off until pressing the reset button will cause it to stay out. Repeat match test for battery operation.

Additional thermistors are connected in *parallel* with the original one as shown in the diagram. Each time a new thermistor is added it is essential that the adjustment of R3 and R2 be repeated. You will find that additional thermistors make it necessary to increase the resistance of R3 to compensate for the new element in parallel. It is not really necessary to re-adjust R2 at all, but you may want to go through the procedure merely as a security check.

It does not matter how far apart the thermistor units are placed since the resistance of the wires used to string them out is inconsequential in this system. Ordinary intercom wire or lamp cord may be used for joining one thermistor to the other. Some suggested locations for up to 8 thermistors are: (1) In the basement near the oil burner and above the fuse box; (2) One each in the kitchen and living room (3) In the upper hallway if you have a two-story house, in the master bedroom and in the children's room (4) Finally, one in the attic if you still have not used a maximum of eight.

All About Computers

Continued from page 58

volving some of the leading mathematicians and engineers. The technological race was on—an event that was soon to grow into a new industry—and open new frontiers in man's ability to deal with facts.

Most of the immediate wartime requirements were for analog (as opposed to digital) computers. But in certain cases the contracts called for machines capable of providing answers to equations faster and with greater precision than was possible on analog machines; and it was the effort to fulfill these specifications that led to the development of digital computers.

The distinction between analog and digital systems is an important one, for all present-day computers fall into one or the other of those categories. Both types employ electronic circuitry to activate the give-and-take of mathematical values, and both can be made capable of performing series of computations in sequence, on the basis of operating instructions "stored" in their "memories." But they serve different purposes and work in wholly different ways.

The basic difference can be grasped by considering the two ways for a man to describe the length of a fish: He can indicate its length by showing you the space between his two outstretched hands—this is analog measurement—or he can tell you it is 12 inches long (digital measurement).

Another example: The slide rule, on which mathematical values are expressed and computed in terms of spatial relationships, is an analog device; the abacus, whose beads are assumed to represent actual numbers, is digital.

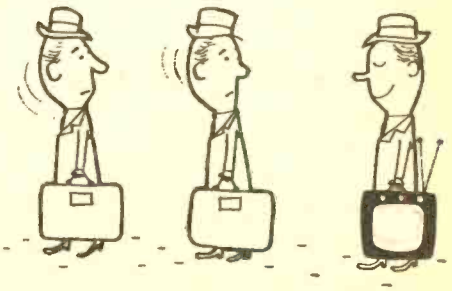
Analog computers, then, work from varying physical magnitudes—light intensities, voltages, the speeds of rotating shafts, and so on—which they interpret and use as mathematical factors. Many of present-day devices used for navigation, artillery fire control and missile-guiding are analog computers; so are certain more complicated machines such as may be used by aeronautical engineers to test the characteristics of aircraft designs under theoretical conditions of supersonic flight—without going to the expense of actually building a working prototype.

But in general, when we speak of "giant brains," we're talking about digital computers—machines that work from pulses representing actual numbers and the actual alphabetical symbols of language. Obviously, electronic registers are not articulate. No vacuum tube, transistor or magnetic core is able to say "1959" or "Hello"; the only statement it can make is to say whether it is conducting or isn't conducting, "on" or "off."

But long before computers were invented, there existed a language called the binary digit code—a way of expressing an infinite variety of numbers and letters through the use of only two symbols, "1" and "0." When we consider that "1" can be taken to mean "on" and "0" to mean "off"—and that the code is fed to hundreds of thousands of electronic registers within the computer, each of which can go on or off at speeds measured in millionths of a second—we may begin to see how automatic computation in digital and alphabetical terms is possible.

All computers can be described as "accurate" in the sense that they don't lie, but only digital computers can be said to be precise—can be relied on to deliver fast, exact answers to literally any problem that can logically be broken down into a series of mathematical steps. That covers a lot of territory—from processing a company payroll to forecasting a presidential election or tracking a satellite.

How both types of computers work, and what they can accomplish, will be discussed in subsequent articles.



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• No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers • No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement • Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale • 41 phosphor bronze beryllium tube sockets never need replacement • 7-pin and 9-pin straighteners mounted on panel • Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out • Special scale on meter for low current tubes • Compensation for line voltage variation • 12 filament positions • Separate gas and short jewel indicators • Line isolated — no shock hazards • Long lasting etched aluminum panel.

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OUTSTANDING FEATURES

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T.V. Picture Tube

Continued from page 37

replaced. Thus, the quality is comparable to a new tube and the 1-year guarantee is the same. Rebuilt tubes were especially attractive several years ago when new tube prices were approximately double the rebuilt cost. When purchasing the replacement get the correct number (etched on the neck of the tube) and turn the old one in for the "glass allowance," few dollars.

Returning to the matter of safety, discharge the various points on the set indicated (with line cord removed). Be certain to discharge the anode socket on the picture tube itself. The tube acts as a capacitor and retains some voltage on its internal surface though all connections have been removed. Discharge this point to ground with a screwdriver.

The re-installation of the tube is the reverse procedure of removal. Here are various adjustments that are required. Check the illustration for the identification of the various parts. The deflection yoke must be flush against the bell of the tube—otherwise, the picture will not fill the screen completely. The adjustment of the ion trap must be made with the power on. Here, a "cheater cord" (available at an electronics parts store) is used to operate the set with the rear cover removed. Close the high voltage cage to prevent high-voltage contact.

Turn the set on with the brightness control full up. As you twist (very slowly) the ion trap (around, and back and forth) on the neck of the tube, observe the screen. A mirror in front of the set is helpful. White light will appear when the ion trap is in its proper position. Actually there are two points that will produce light. Use the one giving maximum brightness, which is the point nearer the socket of the tube. If you cannot get brightness in a minute or two, turn the set off and check if the various plugs (yoke, anode cap, tube socket, etc.) are in place.

Assuming that the new tube is functioning properly, check if the picture fills out the screen completely. If any shadow is present, be sure the deflection yoke is as far forward as it can go on the neck of the tube. If the shadow is not eliminated, the next step is to adjust the focus magnet, which affects the centering of the picture. It has either wing nuts or adjustment arms for this purpose. There will be some interaction of the focus magnet with the ion trap. The rule is to always adjust the ion trap last and not to use it to get rid of shadow. If picture is tilted, loosen wingnut on deflection yoke, rotate till image is correct.

Remember that care is essential while servicing the inside of any TV set, especially in regard to picture tube breakage and accidental contact with the residual voltage on the tube or other exposed points. Follow the precautions carefully and the result will be a bright, contrasty picture.

A Signal Splitter

Continued from page 45

the audio input lead to the headphone jack on your receiver, then plug your headset into the output jack on the top of the signal splitter. You should be able to hear all the signals you would normally hear, but at greatly increased sound level due to the amplification within the unit. Reduce your receiver audio to a comfortable listening level.

Now, turn the function switch to SHARP and operate your receiver BFO in the normal manner. You will notice immediately that the signals will not be as loud as when in BROAD position and that 'phone signals will no longer be intelligible. This is normal, due to the extremely sharp tuning characteristics of the filters. However, you will also notice that as you tune across your receiver dial with the BFO on, that one particular note (1020 cycles) will appear to be particularly loud, and that almost invariably you will hear only one signal at a time. To prove this to yourself, pick a crowded portion of any CW band with the switch in the BROAD position, then switch to SHARP—the results will be most gratifying. Tuning will be much more critical than before because the jumble of signals you heard then will now be dissected microscopically as each signal is reduced to a 1020 cycle note, passed individually through the filter rather than all at once, giving you effective clear channel copy.

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The ABC's of Electronics

Continued from page 78

The current flowing around in the closed "tank" circuit may be many times greater than that in the external circuit to which it is connected. Just as in the case of the series resonant circuit, the impedance of the *internal* circuit is minimum. But the inductive current and the capacitive current are just 180° out of phase with each other, and so they tend to cancel each other out. Only a small residual in-phase current will flow in the external circuit, and this is due to the small inherent resistance in the wiring, components and connections. And so we can generalize and say that in resonant circuits, impedance is minimum at series resonance, and maximum at parallel resonance.

Referring back to Fig. 1, we saw that at resonance all of the 2 volt supply signal was dropped across the resistor. But there are also voltages appearing across the coil and condenser, which because they are equal and opposite, cancel out. But they are not imaginary. They do exist and can be measured.

Since at resonance $X_L = X_C$, we can say that each of these voltages is simply I x X, or 0.00039 x 8,000=3.12 volts. So not only are these voltages present in addition to the source, but each of them is even greater than the source. Now if the resistance were lowered, the current would increase and the reactive voltages would be still greater.

Thus the reactive voltages appearing in any tuned circuit will be determined not only by the values of the reactances themselves, but also by the amount of resistance in the circuit. Since a minimum of resistance is usually desirable, the ratio of reactance to resistance (X_L/R or X_C/R) is called the figure of merit, magnification factor, or quality factor of a tuned circuit or component reactance. From this latter term is derived *Q*, its standard symbol. The Q of the tuned circuit of Fig. 1 is 8,000/5,100, or only 1.56. This is due to the large amount of resistance, but in practice a Q of many times this figure is not uncommon.

A couple of interesting points concerning the behavior of resonant circuits are illustrated by Fig. 3. The vertical axis of the graph can be taken to represent either current in a series circuit or the voltage appearing across a parallel circuit. In either case, note that there is a pronounced maximum at resonance, which tapers off either side of the resonant frequency. But note also that both the value and the sharpness of the peak are affected considerably by the Q. Simply cutting the Q in half squashes the sharp peak of the upper curve down to the little mound of the lower one.

There are times, of course, where resonance effects are undesirable and a low Q is deliberately designed into the circuit. In wide band systems, such as video or hi-fi audio amplifiers, peaks are definitely to be avoided. But this too would be impossible without some knowledge of resonance and Q.

Protect Your Meter

Continued from page 60

the full scale meter current in amperes, and Rm is internal meter resistance.

Let's take an example to see how it works. The internal resistance of the one milliampere meter shown is 46 ohms. The manufacturer will supply this information. We'll permit the diode to introduce a maximum full scale error of only 1 percent. In other words, we'll permit only 1% of 1 ma or .01 ma to flow through the diode at full meter deflection. With the 1N536 diode .01 ma flows through the diode when there is a voltage drop of about .37 volts. This is the Vd in the formula. Im is .001 amperes (1 ma) and Rm is 46 ohms. Thus, R=.37/.001-46 or R=324 ohms. A few ohms plus or minus isn't serious but, in this instance, a 330 ohm resistor from the junk box measured 324 ohms.

The one disadvantage of this circuit is easily overcome. There's no protection if the meter is overloaded backwards. Identical reverse protection is provided by adding a second diode, paralleling the first, but connected in reverse.

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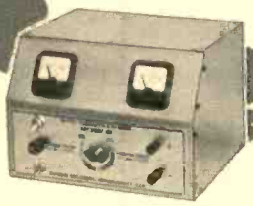

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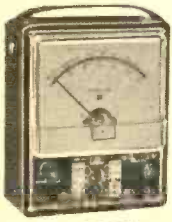

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Electronics In the Crime Lab

Continued from page 49

burn too fast nor too slowly. A bit of paint, for example, would burn much faster than a broken key, therefore the burning of the paint must be slowed down to permit an adequate photograph to be taken of its spectrum.

How does the spectrum come about? Light given off by the burning sample passes through a dispersive instrument, such as a prism. A lens focuses the image on a strip of photographic film which, when processed, gives the appearance of several series of lines. Each line represents a wavelength of light. The spectrum photo is like a fingerprint of an element. Each alloy when burned, radiates the electromagnetic waves of the elements of which it is composed. The spectrum of these radiations is photographed, wavelengths measured, and the sample identified. To aid in this identification a densitometer is used. This electronic unit compares the density of the spectral lines in the sample with those of a known quantity of the elements making up the sample, and both a qualitative and quantitative analysis is possible—the greater density of a line, the more prevalent that element is in the sample.

The spectrograph has not only been used to match evidence, but has also resulted in the saving of a life. New York police officers found a man apparently dying on the street. He had all the symptoms of having been poisoned, but what poison? What antidote?

There wasn't much to go on. The only thing that might prove of value were two drops of the victim's waste fluid, and these two drops were rushed to the crime lab. There wasn't time for a chemical analysis, and besides, the sample was too small. It was decided to volatize the drops in the spectrograph. The results were quickly available. The fluid was found to contain the unusual element thallium, which is similar in structure to lead, and definitely poisonous to humans. This information was telephoned to the hospital and the victim received the proper antidote in time to save his life.

The spectrographic analysis continued to be of service to the officers working on the case. They had determined that the victim had eaten stew at the restaurant in which he worked. Earlier that day he had had an argument with a fellow employe, and investigation revealed that same employe had recently purchased a box of rat poison, ostensibly to use around the restaurant.

Instead he had put a goodly portion in the victim's stew. Recovery of the box of poison before the culprit had a chance to get rid of it and subsequent analysis of the rat poison showed that it contained a large quantity of a thallium compound. The police now had a solid case for the district attorney's office to act upon in court.

Spectral analysis is carried a step further in an adjoining room at the lab which houses an infrared spectrophotometer. This electronic instrument is designed to compare photometrically the brightness of two spectra, wavelength by wavelength in the infrared range, which extends just above the visible. It is particularly useful in comparing unknown organic materials such as waxes, greases, and liquids.

The infrared spectrophotometer is an

Keeler polygraph, often called the "lie detector," is demonstrated by Texas Department of Public Safety experts. The instrument records physiological changes in suspect during planned questioning period.

invaluable aid in the fight against narcotics. New York City police realize that 20,000 officers could be assigned to round up narcotics violators and many arrests would be made, but the flow of illegal drugs into the city would not cease. The flow must be stopped at its source.

Most narcotics come from the poppy plant, which grows all over the world. There are 26 organic alkaloids in the poppy, including codein, morphine, etc. But the chemical makeup of a poppy grown in Mexico, for example, is different from one grown in China—but this is too small a difference to measure accurately by chemistry. You may ask why are the poppies different? Amount of rainfall may vary from country to country, as does the mineral content of the soil, intensity of the sunshine, etc.

In order to determine where a confiscated narcotics sample came from, it is carefully prepared by forming it into a tiny crystal under 20,000 p.s.i. of pressure. It is then mounted between two discs of rock salt, which exclude moisture and form the optics of the system. Instead of a photographic reading, all 26 organic compounds are simultaneously charted on a graph.

The graph is then interpreted by checking the registered percentage of each element against graphs of previously tested samples from all over the world. Once the country of origin has been determined, the findings are presented to the proper U. N. agencies, who then bring pressure to bear in the United Nations.

Often a bit of evidence must not be destroyed in analysis, yet it is necessary to identify it and keep a record for future use in court. This can be accomplished with crystalline substances, such as the narcotic heroin, by employing apparatus that takes advantage of X-ray diffraction.

Again, preparation of the sample for the diffraction equipment is a difficult process. The granules of evidence must be loaded into a special glass capillary about as thick as a toothbrush bristle and twice as long. This glass is imported from West Germany and contains no elements that have diffraction properties of their own. Therefore, if the fragile capillary is broken in the loading process, it can be ground right to the crystals and loaded into another.

The prepared evidence is placed in the center of a cylindrical, shielded container which, in effect, is a camera without optics. Completely encircling the inside of the container is a strip of film. With the appropriate X-ray tube in place (usually a copper or iron element tube) the power is turned on and X-rays are directed into the crystalline sample, where they are diffracted to form a pattern on the film.

When developed, concentric circles of varying density appear on the film and tell the men at the crime lab just about every necessary detail concerning the nature of the sample—exactly what it contains and how it differs from other samples on record.

The men at the detective bureau have their polygraphs (lie detectors), and the precinct officers have their two-way radio communications—both highly useful electronic instruments. The little known laboratory branch of the police department also has its electronic tools to aid in the fight on crime.

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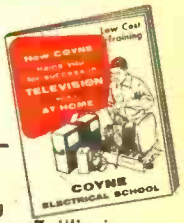

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A Voice Actuated Switch

Continued from page 55

reversal may cost you one or more transistors; the two capacitors are electrolytics for which correct polarity is very important; the case may be used as a "common ground," if desired, but if it is so used you must be certain that all grounded connections are really "common" and secure; be sure that both output binding posts are insulated from the case. These posts, connected to external circuits, provide momentary contact closure as the armature of the relay pulls down under the stimulus of a sound. This action can be used to trip a camera shutter, fire a flash gun, activate a gong, etc.

A rather novel battery mount is utilized. Two strips of metal each measuring approximately 1¼" x 5" are cut from the side of a coffee can and folded around the mercury batteries. These strips are then slitted or drilled to take 8/32 machine screws. The speaker bracket at the rear is already drilled and tapped for the machine screws.

For certain types of applications, such as "command" operation of model trains, it is desirable to have the momentary closure action of the relay result in alternate sustained ON and OFF conditions. That is, a spoken word must turn a circuit on and leave it that way until the next command comes along to turn it off. An impulse-ratchet relay is the most direct answer to this problem. The drawing illustrates one representative arrangement in which such a relay is wired to control either a 117 volt AC device (such as a train transformer primary) or merely establish closed or open circuit conditions alternately for some external equipment. Terminals 1 and 2 are connected directly to the output binding posts of the unit. As the relay RY closes momentarily, an impulse is passed on to the coil of the ratchet relay causing it to pull in. This latches the armatures down so that both circuits are closed; that is, terminals 3 and 4 now provide 117 volts AC to an external device, while 5 and 6 merely present closed circuit conditions for some other external apparatus equipped with its own power source. The arrival of a second impulse disengages the armatures, leaving them off.

A very simple but reliable AC power supply that may be used in place of the batteries is shown near the schematic. A 12.6 volt filament transformer, two inexpensive selenium rectifiers, and two capacitors provide approximately 9 volts plus and minus with respect to a common terminal as required by the instrument. You will note when you study the main schematic diagram that the batteries are really in series, with the junction between them serving as the common ground in the circuit. The wiring diagram of the little power supply indicates clearly the connections that must be made to replace the batteries. Again, in the construction of the power supply, it is extremely important to observe the polarities of the rectifiers and filter capacitors because a simple error in this regard might very well cost you three transistors in addition to ruining the filter capacitors. As a last precaution, be certain that neither one of the 117 volt AC wires becomes grounded or comes in contact with any of the secondary leads.

BEFORE CLOSING THE SWITCH FOR THE FIRST TIME;

(1) With the batteries removed or the AC supply disconnected, connect an ohmmeter between S1(A) and S1(B) to make sure that there are no B+ to B— short circuits. Repeat from each point on each switch to common ground.

(2) See that all transistors are well in place. The two 2N233's mount in transistor sockets while the 2N307 is held to the Bakelite shelf by means of a machine screw through one of the holes in its case. The paint should be scraped off where the machine screw passes through to assure good contact with the case (collector).

(3) Rotate R2 to full sensitivity, fully clockwise.

(4) Turn the switch on. At full sensitivity, the merest whisper into the microphone should trigger the relay momentarily. At minimum sensitivity, it should be necessary to shout into the microphone to get any response from the relay.

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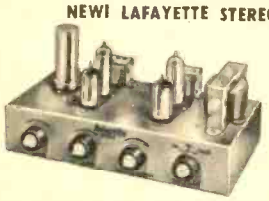

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CUT OUT AND PASTE ON POSTCARD

Inventions In Electronics

Continued from page 31

As a matter of fact, Barrett, who is president of CGS Laboratories, Inc., has put a great deal of valuable advice into an essay which is distinguished by its hard-hitting plain talk about inventions in electronics. He'll send you a free copy if you write to CGS Laboratories, Inc., P.O. Box 146, Ridgefield, Conn., and ask for "Preparing for Patenthood."

"But wait a minute—talk about my invention? Ridiculous! It'll be stolen."

No doubt you have heard this remark before. Yet one of the least known facts about invention is that you can protect yourself long before you get a patent. Most people think you do this by detailing your ideas in a letter which is sealed, registered and sent to yourself. This fallacy has cost many an inventor the loss of his brainchild. Registered letters rarely stand up in court.

Most successful inventors have a self protection system. Here is a popular one: Always put down in writing everything you do. In other words, keep a diary of your work. Secondly, make a full disclosure of your ideas before two witnesses, even to the extent of using sketches. Then ask your witnesses to sign a dated statement to the effect that they have read and understood your disclosures. Place one copy of this witnessed statement in your files, and send the other to your attorney for safekeeping.

In the event you want to claim that you got there first with an invention, the date on that witnessed statement may spell the difference between legal victory and defeat, fortune or loss.

Now, what to invent? What are the most-needed inventions in electronics? Such a list would not be difficult to compile. The only trouble is that as a source of profitable ideas it would be next to useless. Most inventions that are known to be needed have either been invented, are too complicated and costly for one man to handle, or show little evidence of being profitable.

The National Inventor's Council, another unit of the Department of Commerce, puts a list of most-wanted inventions, many of which are in electronics. This list should serve as an ample source of inspiration. It did for one electronics fan, a repairman, during World War II, when he came up with the electrical mine detector idea, for which he received over $50,000.

The most-wanted inventions list is free. You get it by writing to National Inventors Council, Department of Commerce, Washington 25, D. C.

Most successful inventors agree that real fortunes in inventions are not made by large, complicated devices, nor by solving world-shaking problems. Often a little thing that will help an existing product perform better, or more cheaply, make life a little easier, save time, effort and money—these are the things that usually go over big and make inventors rich.

We asked Jack Rabinow, who already has close to 100 patents to his credit, "How do you dream up an electronics invention?"

"Most of my ideas," he said, "come when I recognize a problem or a need for something that can be solved electronically. These things are all about us everyday, around our homes, shops, offices—everywhere! Give me a category, anything, and we'll try to dream up an invention in a hurry."

"Fine," we said. "How about the outside of the house? The lawn—hate cutting grass, can't stand the gasoline smell or the noise of a power mower."

"Good," said Rabinow. "But what about an electric lawn mower?"

"Tried it, but always manage to cut the power line."

"There's your problem," Rabinow beamed. "How to prevent the electric mower from cutting the power line. Why not an automatic cutoff, to shut the power if the line gets too close to the blades? Every electric cord has a field around it. Perhaps some transistor device which is affected by this field can be installed to work an automatic cutoff. Invent it, and you may touch off a boom in electric lawn mowers and make yourself a fortune."

Well, no one can say *Electronics Illustrated* hasn't given its readers at least one idea for an invention. In any event, if you don't get rich you'll still have fun.

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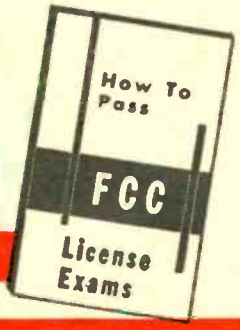

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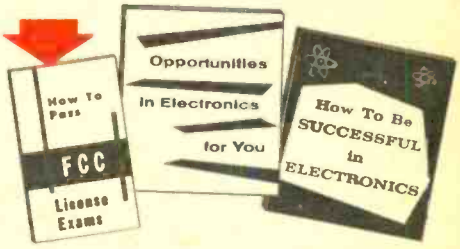

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EI-6

Hi-Fi Tape Cartridges

Continued from page 41

Since then, through many delays, the release date has been put off to some time this year.

If the cartridge has proven a sketchy item to track down, the machine for playing it is even more elusive. To begin with, announced prices for this special piece of equipment ran from $295 to $450. Here again is a choice piece of incongruity. We are faced with the apparent contradiction of a cartridge priced at half of what regular tapes sell for, but which can be played only on a machine that is not similarly scaled down in price.

At those prices, it would seem more prudent for the average consumer to buy a low-cost tape deck equipped (or which could be later equipped) with both twin-track and quarter-track heads, and two speeds (7½ and 3¾ ips). The increasing number of component tape manufacturers who are turning out this type of unit would indicate at least one sane path out of the wilderness as well as revived hopes for the recorded tape business—which still offers the best in recorded music.

Besides RCA Victor, a few other manufacturers such as Pentron, Motorola, and Philco have been reportedly tooling up to produce a magazine tape player.

Another assuring sign is news of a tape magazine by Armour Research which can be used on standard tape recorders. Leaving fidelity and acoustical quality out of it for a moment, this newest development would provide all the convenience of RCA's cartridge with none of the threat of obsolescence of existing tape recorders.

Obviously, a final verdict on the cartridge player must await its appearance. For something that isn't here yet, it has created a terrific stir, perhaps out of proportion to its ultimate importance. At best, it represents a system for tape playback (and recording) that eliminates the difficulty of threading the machine and reduces the danger of tape spillage and breakage.

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Electronic Age School

Continued from page 66

versities, scholars, the Federal Government, scientific foundations, their own faculty, foreign nations, and from commercial tape suppliers. Concentration on lessons and student discipline are much better at St. Scholastica than in conventional schools. Occasionally, the teacher hooks herself into an individual desk and tells the young lady to sit up, pay attention, stop whispering, and such. Students never get bawled out in front of their classmates.

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This unique school may well reflect the future in education. The remarkable aspect is that it is in use *today!*

Rat In an Electronic Cage

Continued from page 75

time." In learning a proper sequence of taps on the lever or the proper time interval, the rat is bound to make mistakes. These mistakes are recorded.

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