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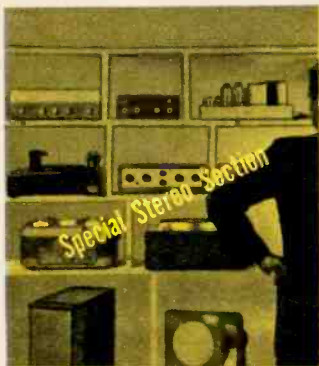
ELECTRONICS ILLUSTRATED

A Fawcett Publication

Nov. 1958

Vol. 1 No. 5

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The new stereo hi-fi products on our cover are, from left to right and from top to bottom: Bogen DB212 preamp amplifier, McIntosh C85 preamp control, Leak Stereo 50 amplifier, Garrard RC88 record changer, Eico HF81 preamp-amplifier, Scott 330C AM-FM tuner, Norelco Stereo Continental tape recorder, Rek-O-Kut 8-12GH turntable, Electro-Voice Stereon speaker and enclosure and Jensen DA-3 Director speakers.

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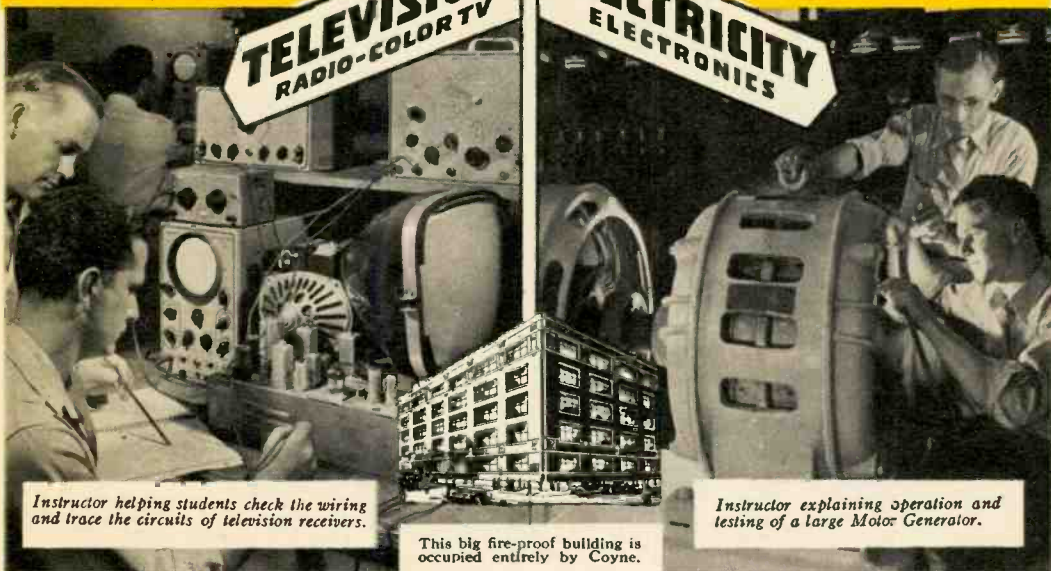
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A Message From the Editor

This is the first issue of **ELECTRONICS ILLUSTRATED** which contains a special section devoted to one subject—Stereo Hi-Fi. You'll be reading more and more in magazines and newspapers about this new way of enjoying recorded music at home. We're bringing our report to you now because this is the time when manufacturers and retailers of hi-fi components announce and display their new wares. Stereo components will be in the place of honor and you may want to keep our special report to use as a buying guide.

Last month we brought you a report on eleven pickup cartridges designed to play stereo records. This month you'll learn all about the special tuners, preamps, amplifiers, converters and speakers that you'll need to complete a component stereo system.

Be sure to read the article on FM multiplex. You will be hearing more about this new method of free, off-the-air stereo broadcasts fairly soon, and will want to use it.

This issue winds up the series on "How To Build A Safe Model Missile." In the future we will have information with our unique wiring guides on how to add electronic speed and height indicators and telemetering equipment to small rockets for further experiments. Many amateur rocketeers have become alarmed over the tendency of towns and cities to prohibit the firing of small rockets. Realizing the importance of this amateur activity to the production of future rocket scientists, the Department of Defense is now trying to interest many localities in building safe rocket launching facilities for the use of amateur rocketeers. Additional information on this can be obtained by writing to the Army Headquarters for your area, or to the Department of Defense in Washington, D. C.

Commander William R. Anderson, Captain of the atomic-powered submarine *Nautilus*, recently accomplished a feat that



Norm Eisenberg, author of *Stereo Survey* on page 28, is right at home in evaluating and describing hi-fi products. After working for an audio manufacturer he raised his banner for the consumer and joined a highly respected testing agency. Your Editor took a hand in the testing, and found stereo exciting.

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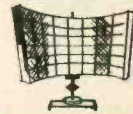
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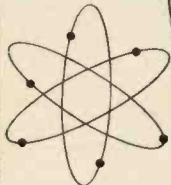
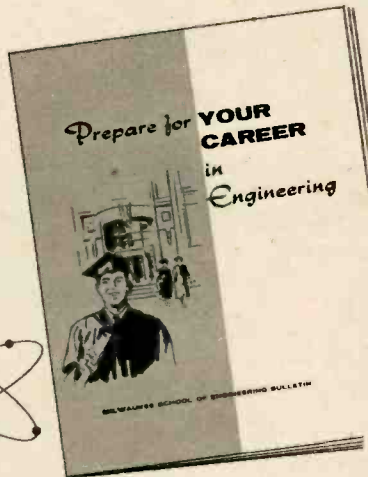
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Cmdr. Anderson and Lt. Jenks of the Nautilus
were interviewed by EI. Read it next month.

won world-wide admiration for himself and his crew. Many newspaper stories and magazine articles have been written on the Nautilus' trip under the North pole. But, we think we have the most complete story on how the Nautilus really did it. We interviewed Cdr. Anderson and his navigator, Lieutenant "Shep" Jenks, aboard the Nautilus, and were amazed at the complexity and the accuracy of the electronic equipment aboard. Modern submarines are truly up-to-date electronic laboratories of the most advanced type. If you really want to know how this little self-contained universe was able to navigate through the eerily isolated world beneath the ice packs, read our next issue.

We'll also have a step-by-step explanation on how to add sound to your home movies, and ten ways to get more out of your tape recorder. For the build-it-yourself fans we have a child's radio phone which will make a much appreciated and original gift for your child around Christmastime.

As a special dividend we've gotten Jack Gould, widely quoted and authoritative Radio and TV editor of the New York Times—and an active short wave listener—to write a series for us on the pleasures and romance of tuning into the world. Jack will give you practical hints on how and where to tune. Tying in with this, is an article on how to convert a common AC-DC table model radio to short wave reception, for the beginner.

In addition, we'll have the Electronic Brain and Hi-Fi Clinic, a small portable radio that is sun-powered, and much, much more.

Charles Tupper

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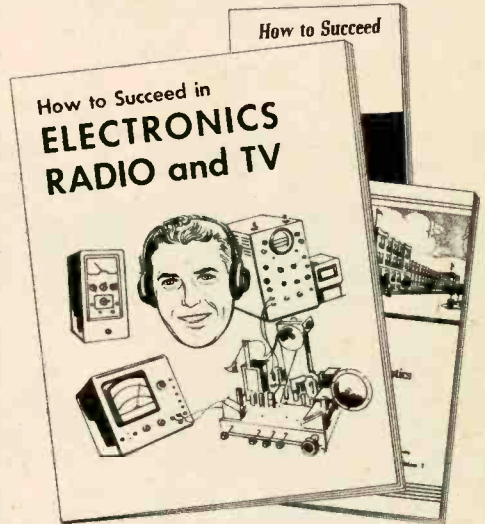
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Electronics in the News



Electronics makes its stage debut at the University of Buffalo Opera Theatre. Though the orchestra is in the balcony, the maestro, left, is televised onto receivers directly in front of the stage. A TV monitor backstage, right, gives entrance cues, alerts technicians to lighting changes.



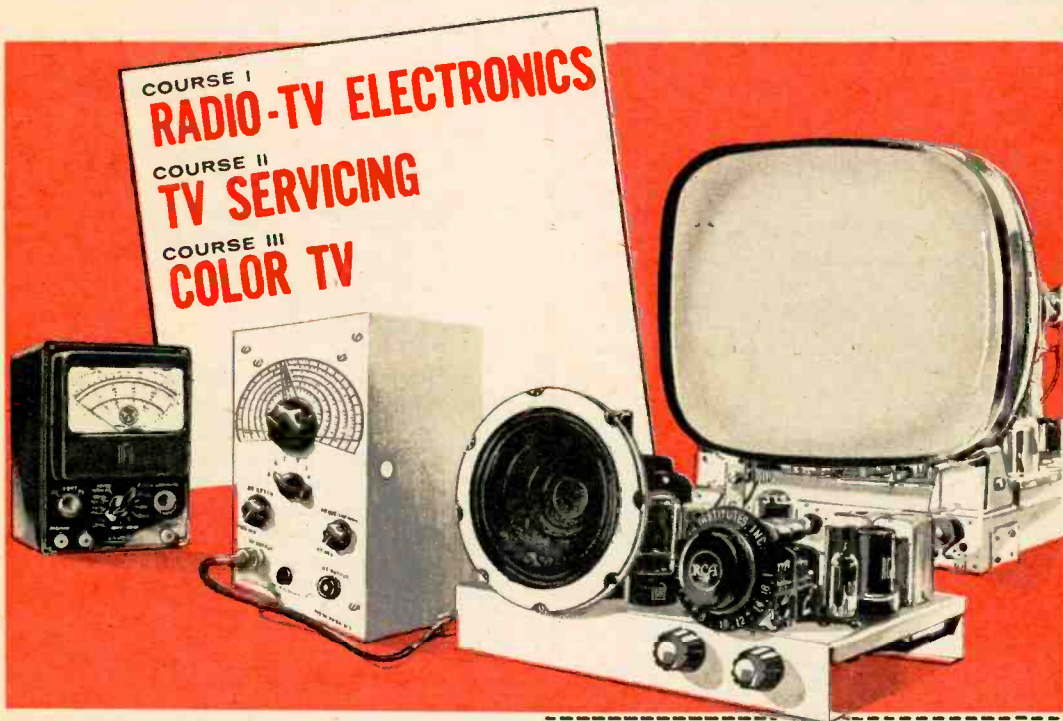
Movie-makers have brought electronics into the act also, with a closed circuit TV system for composing background music for sound tracks. Composer Raymond Scott sits at a "Videola", which includes a Blonder-Tongue Monitor TV receiver. A tape recorder at his left records his music; the TV monitor shows film for which it is intended; and at his right are push buttons for indicating film footage, volume meters, and selector buttons for watching the film and/or listening to the dialogue.



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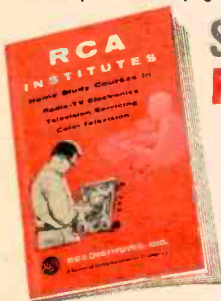


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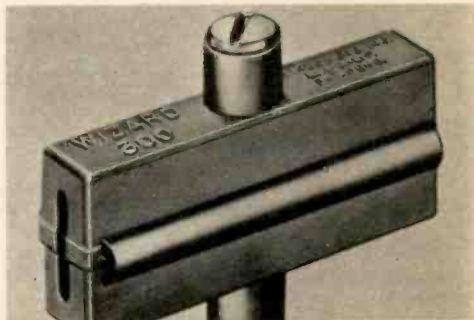
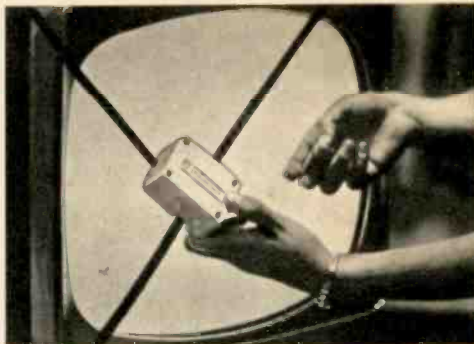
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Operation of over 20 TV or FM sets from one antenna is claimed for the new Wizard 300 coupler from Charles Engineering, Inc., Los Angeles, Calif. This unit, requiring no power, is designed for apartment houses, motels and other multi-set applications. The coupler simply slides onto the antenna line and requires no cutting or soldering for installation. The principle of operation is electro-magnetic coupling without the use of separate coil or capacitor elements. Two models are available; the Wizard 300 for 300 ohm flat line (\$1.95 list), and the 450 for open lines with spacing of one inch or more between conductors.

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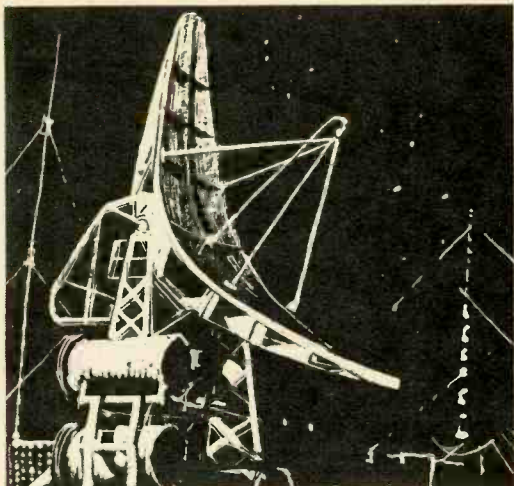
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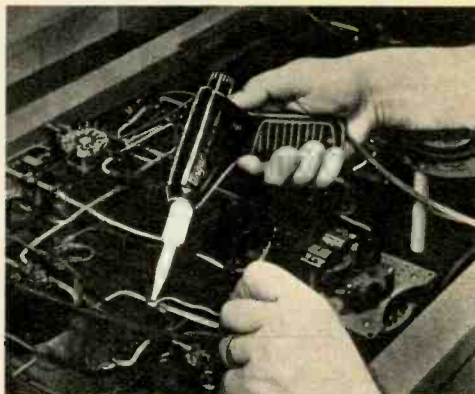
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Ungar Electric Tools, Inc., has introduced the No. 260 Soldering Pistol featuring a comfortable hand fitted grip, light weight and perfect balance. Adjustment knob permits 180° turn of 2½" Tellurium copper chisel tip. \$4.50.



A series of "beeps" coming from your radio may mean a tornado is on its way, if you own one of the Sferics, Inc. severe weather warning devices. Designed as part of a standard radio, this unit operates on the electrical discharge principle, not as a barometric unit. It can indicate a tornado within 40 miles of the set, and shows the storm's progress on an alarm meter. List price \$84.50.



An invisible electromagnetic shield for our first supersonic bomber, the Air Force's B-58 Hustler, has been tested by Sylvania. Protecting against electronically guided weapons, it is the first automatic defense system specifically designed to suit one particular type of plane.



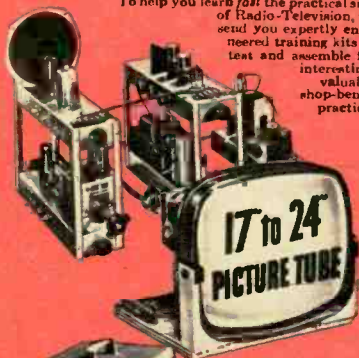
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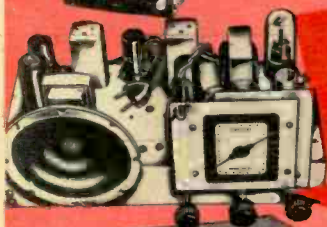
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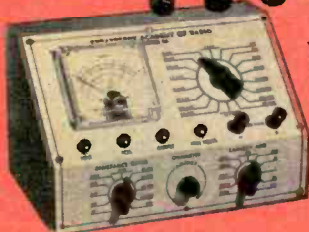
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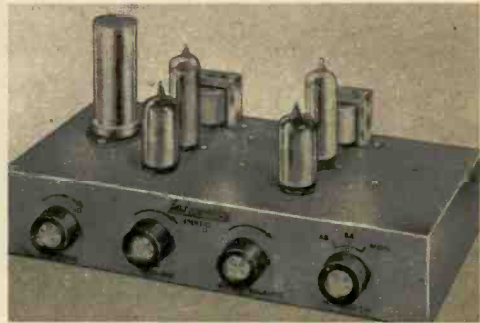
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An electronic "eye" which can see in near darkness may provide the key to observation of previously unseen details of planets and nebulae. The device is RCA's new camera tube based on television principles and known as the Intensifier Orthicon. The extreme sensitivity of the tube is achieved by two "intensifier" stages built into the tube between the light-sensitivity pickup surface at the front and the signal output assembly at the rear. Electrons emitted into the tube from a sensitive surface do not go directly to the target

but to these intensifier screens. When two such screens are used, approximately 300 electrons are produced for every one released originally by the image on the sensitive surface.



A small, economy stereo amplifier in kit form, is the KT 126 from Lafayette Radio. This compact unit has an output of 2 watts per channel or 4 watts when monaurally operated, with separate volume controls for each channel, ganged tone control, stereo-monaural and phasing switch. \$17.95.

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 - ★ EXCELLENT BACKGROUND FOR TV
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YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner, how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but are 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 capacitors, 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 connections. 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 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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- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS ● ALIGNMENT TOOL
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- HIGH FIDELITY DISCOUNT CARD
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- TESTER INSTRUCTION MANUAL
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- MEMBERSHIP IN RADIO-TV CLUB
- CONSULTATION SERVICE ● FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of 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. Statistis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself, I was ready to spend \$240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

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

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

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 with 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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Electronics goes back to school, with an ingenious network combining a public address system, fire detection equipment, telephone-intercoms, clocks, signals and closed circuit TV. Built by DuKane Corp., the MCS (Multi-Purpose Communication and Signaling) includes a Thermodyne fire-protection system, which is a tiny sensing unit in the ceiling that detects any change in temperature and triggers a fire alarm. Flood detection and tripping of burglars can also be adapted to this system.

A new transistor characteristics and interchangeability guide is available from Sylvania Electric Products, 1100 Main St., Buffalo, N. Y., at no cost.

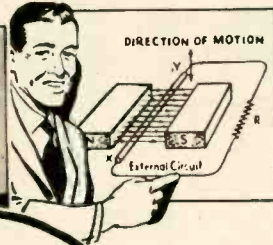
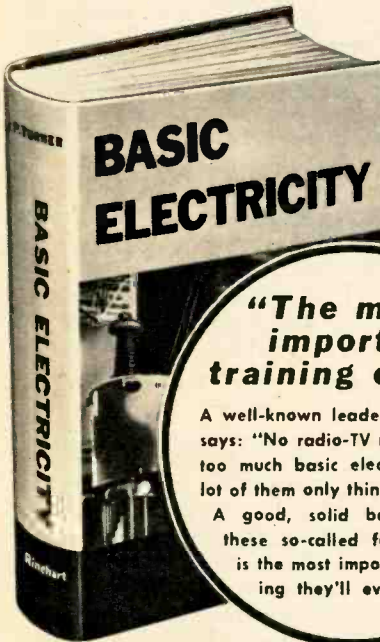
A major step toward safer and more reliable electronic equipment for the control of large nuclear reactors has been taken by Bendix Aviation Corp. with the development of a "cut-off" switch. The system, comprising more than 100 transistors, detects and warns of any abnormal condition in the reactor, and automatically shuts it down if safety requires it.

The Civil Aeronautics Administration operating a network of weather navigation stations on the 200-400 kc. band gives complete weather summaries and special aviation information. Write: U. S. Coast & Geodetic Survey, Washington 25, D. C., for charts of CAA stations and marine beacons.

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A well-known leader in electronics says: "No radio-TV men ever knew too much basic electricity—and a lot of them only think they know it. A good, solid background in these so-called fundamentals is the most important training they'll ever get."

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That's why this big, new 396-page BASIC ELECTRICITY manual brings you the most important training of all. It is a complete course in basic electrical subjects, including basic electronics. For the beginner, it is as necessary as oars are to rowing a boat. For the more experienced serviceman, amateur, experimenter or hi-fi enthusiast it paves the way to new and better understanding of almost any problem, circuit, component or piece of equipment.

COMPLETE ELECTRICAL "KNOW HOW" (Including Basic Electronics) in one big, easily understood home training guide

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No involved mathematics—just plain, common technical sense!

From basic circuits and currents to electro-magnetism . . . from capacitance to resistance . . . from polyphase systems to 'phone principles . . . from instruments to the whys and wherefores of electrical tests . . . from amplifiers to oscillators . . . from vacuum tubes to transistors and dozens of other subjects, this big book explains things from the beginning.

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power factor—often neglected by ordinary books—are fully, and clearly taught in a way you can hardly fail to understand.

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Following is a partial list of subjects:

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Naval officers make an inspection tour, via closed circuit TV, of Lockheed's P2V Neptune. Engineer with pocket-size TV camera and microphone inside plane at right, provides a look at the extensive electronic installations for inspectors seated before TV monitors outside.

Electronic Earmuffs, which create artificial quiet by adding more noise, have been developed by Army and RCA engineers. A miniature microphone in the special earpiece creates a noise, just as loud as the external one but opposite in phase. When the two sound waves meet in the earcup they use up most of their energy fighting each other, thus reducing a loud roar to a whisper. The earmuffs could be used to muffle combat noise, as well as having commercial applications for factories and mills.

A fully transistorized portable color TV system which uses 75 watts less power than the sealed-beam headlights of an automobile, is in the experimental labs of RCA. The system is designed for closed circuit use in industry, defense, education and research, where compactness, portability and operating economy are essential.

An index to manuals of radio and TV schematic diagrams and tube layouts, listed according to make of set and year is now available to readers of *EI* from Supreme Publications, 1760 Balsam Road, Highland Park, Illinois, for only 5c in stamps. Usual price is 25c.

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Yes, this great course costs far less than any training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

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This 35 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, 36 such shops are NOW IN BUSINESS AND PROSPERING. We are signing contracts with ambitious men to become future owners and operators of these shops in all areas.



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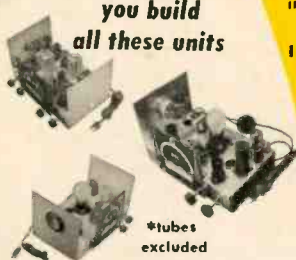
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When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops **WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED** plus an inventory of parts and supplies. In other words we will stake you... **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

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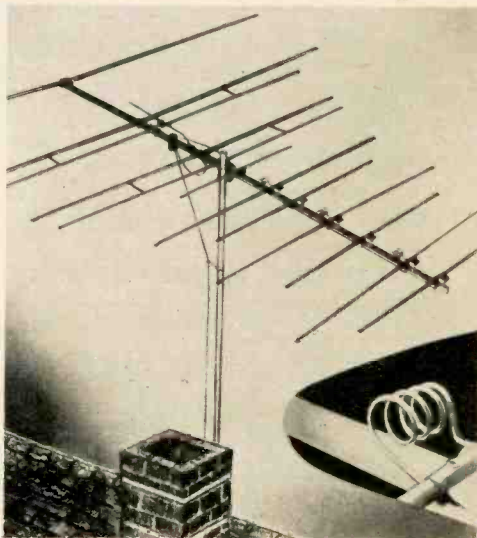
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Insomniacs take heart—electronics has come to the rescue with the Sleepatron. Developed by Gardiner Electronics Co., the device simulates the sound of falling rain and completely shuts out extraneous noises. Its aluminum box contains 4 flashlight batteries and 7 transistors, and is entirely portable. \$125.



The Sky Blazer, Channel Master's Model 334, an all-channel VHF antenna with impedance compensating inductance coils provides a uniform, flat response pattern on all channels. Special elements give an extra gain boost on channels 7-13. List price \$21.53.

Light bill savings and fewer-bulb replacements are aims of a Bendix G-15 computer used in an effort to put longer, more uniform life into light bulbs.

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Two stereo hi-fi amplifiers are now available from General Electric; the MS-4000 40-watt model with two integrated 20-watt channels at \$169.95, and the MS-2000 28-watt model, pictured, with two integrated 14-watt channels at \$129.95. Each has two power amplifiers and two preamp control units on a single chassis. The balance control on both allows the listener to adjust the sound volume from both speakers for the stereo perspective he wishes. Other controls for volume, bass, treble and contour are integrated dual types for simultaneous adjustment of both stereo channels.

A spectacular stereo demonstration by RCA will take place October 21 with a radio and color TV simulcast of the George Gobel show. The music and special effects will demonstrate the dramatic aspects of stereo, which home listeners can receive by placing an AM radio about 8 feet to the right of the TV set.

Five kits for converting present hi-fi equipment to stereo have come from RCA Victor. Model CK-2, consisting of a complete stereophonic record changer including cartridge, at \$49.95, also permits playing of stereo discs monaurally. Model SA-2 has a single speaker and a second amplifier unit in a mahogany table cabinet, for \$54.95. When combined with model CK-2 this completes conversion to stereo with separate amplifiers and speakers for each of the two channels. Model SH-3 has a second amplifier and a 3-speaker sound system in a console cabinet for \$79.95. SK-2 is a modification parts kit with the RCA Victor stereo cartridge, at \$19.95. Model AK-1 is an AC-DC dual channel amplifier, \$29.95.

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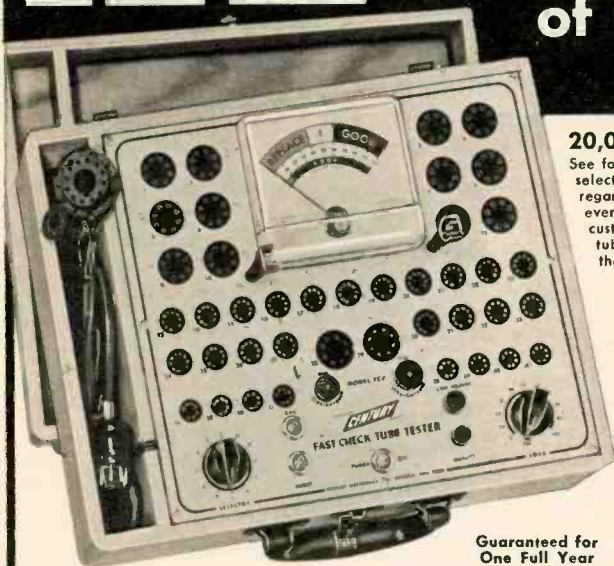
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Circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.
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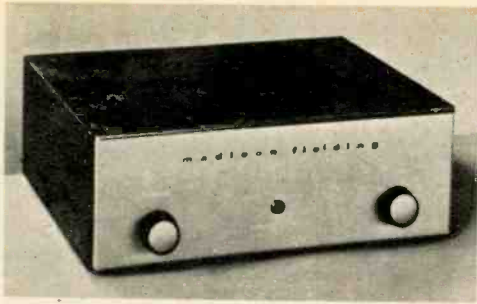
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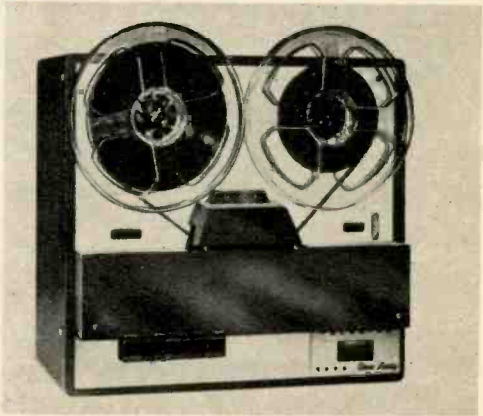
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Home audiences will be able to receive the new stereophonic FM broadcasts with Madison-Fielding's Multiplex Converter Model MX-100. Manufactured under license from Murray Crosby, the unit need only be plugged into the Multiplex output on most FM tuners, to achieve stereo. The "Dimension" control enables the user to choose the degree of aural separation desired, regardless of speaker placement. Completely self-powered, the converter connects to FM tuners and amplifiers by means of standard phono-tip cables. Retail price, \$49.95.

The Telectro Tape Transport, Series 900, from Telectrosonic Corp., can record and play back stereo at 3 speeds: 1 7/8 ips, 3 3/4 ips and 7 1/2 ips. The deck is equipped with a 4-track head that accommodates 2 and 4 channel stereo as well as dual track monaural tapes. A unique braking system and re-wind method prevent tape spill or breakage. Prices from \$89.95 to \$114.95.



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TEXT PREPARED BY MIT SPECIALIST

Dr. Claude Shannon, known to the readers of Electronics Illustrated for his invention of the electronic mouse, that runs a maze, learning as it goes, formerly a research mathematician for Bell Telephone Laboratories is now a research associate at MIT. His books include publications on Communication theory and the recent volume "Automat Studies" on the theory of robot construction. He has prepared a paper entitled "A Symbolic Analysis of Relay and Switching Circuits" which is available to purchasers of the GENIAC. Covering the basic theory necessary for advanced circuit design it vastly extends the range of our kit.

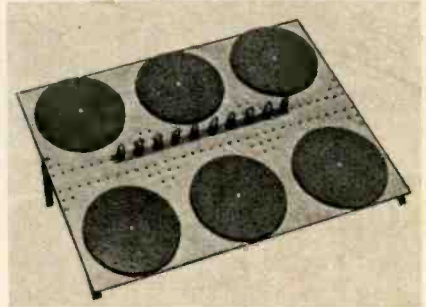
The complete design of the kit and the manual as well as the special book DESIGN-O-Mat® was created by Oliver Garfield, author of "Minds and Machines," editor of the "Gifted Child Magazine" and the "Review of Technical Publications."

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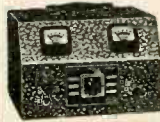
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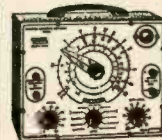
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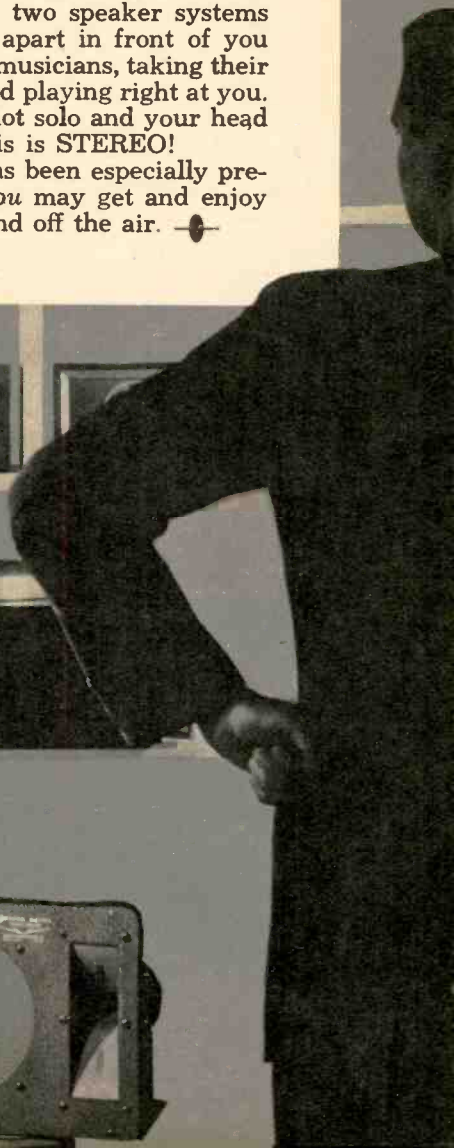
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This 27 page section has been especially prepared to tell you how *you* may get and enjoy STEREO from records and off the air. 



Stereo Survey

By Norman Eisenberg

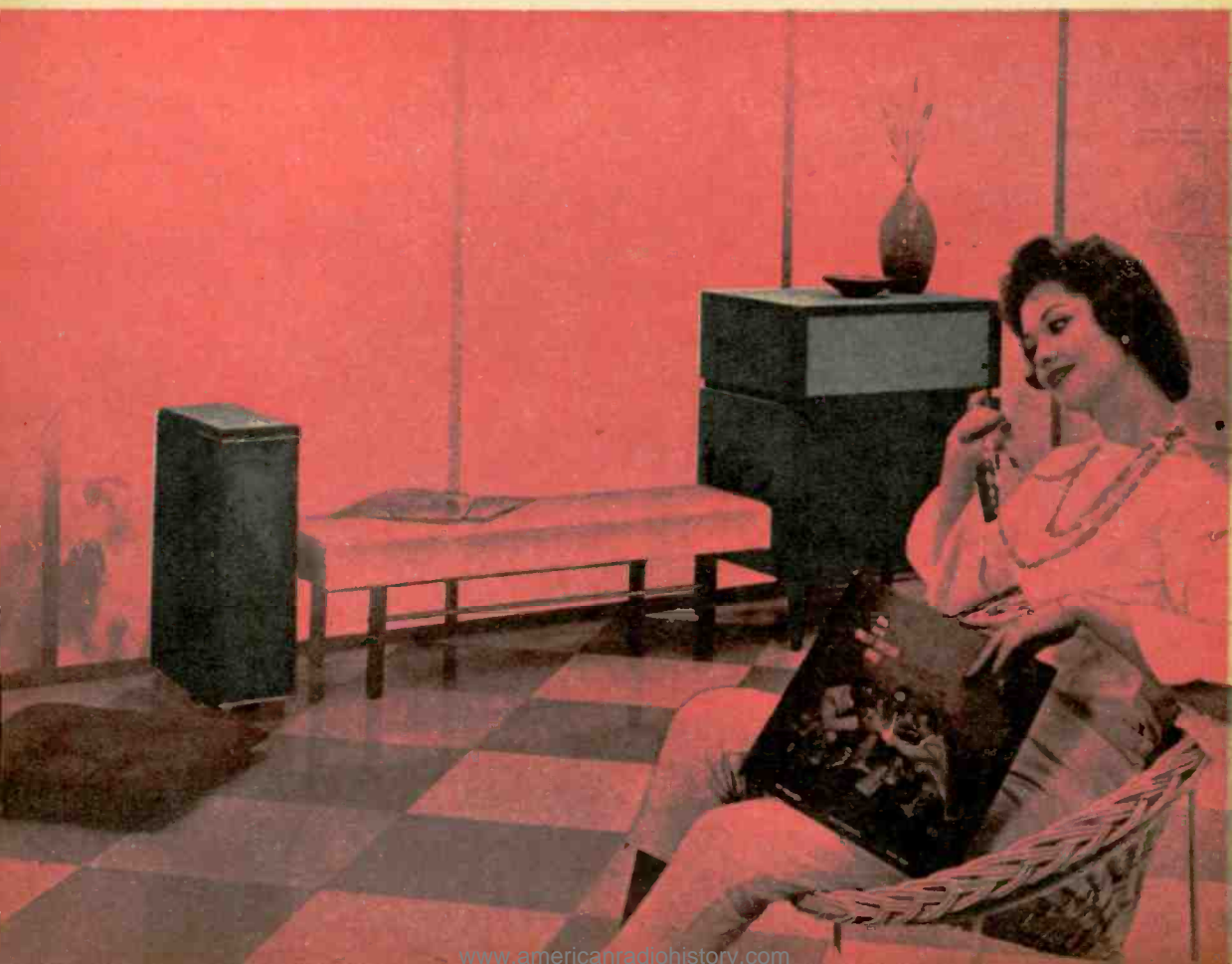
You can convert to stereo or buy an all new stereo system—either way, here is what you will need.

STEREO, because of its realism and naturalness, promises to convert more people to quality audio in the home than monaural hi-fi ever did. As a matter of fact, stereo has become synonymous with hi-fi.

If you are interested in stereo hi-fi you will need some special equipment. But before you buy, you would probably like answers to the following questions: How does stereo equipment differ from monaural equipment? Should I buy stereo now, or wait? Should I buy stereo at all? Is the stereo component actually better for two channel listening than two monaural units? What's the purpose of all the new controls?

The rest of this article answers these questions.

Two full-range speaker systems are not needed for stereo, says Electro-Voice. The second speaker can be like their Stereon, a small mid- and high-range unit.





The above is not a typical stereo setup. The author is shown with but a portion of the components he tested for this article.



Stereo components need not take up much room. At the right is shown a complete stereo preamp-amplifier and record player which replace only twenty books on a shelf. Two speakers are elsewhere.



The complete tuner and tape system shown below right, uses two dissimilar preamps and amplifiers which may be balanced by using a stereo adapter like the one just above the author's hand in the top photo.



H. H. Scott Type 330C



Fisher Model 101-R



Harman Kardon TP-200



Lafayette KT-500



Heathkit PT-1

Stereo tuners with individual AM and FM. Two stations can be tuned in simultaneously.

Stereo Tuners

A stereo AM-FM tuner is, essentially, two tuners in one. AM and FM sections are built on the same chassis and use the same power supply, but they function independently. With such a tuner you can listen to AM only, FM only, or both at once. The both-at-once function permits tuning in stereo AM-FM broadcasts. Available in some areas, those broadcasts provide stereo of sorts.

The "of sorts" qualifies the set-up, of course. Listeners to broadcast stereo point out that the channel separation is nothing like what is available from good tapes and discs played at home. This appears to be true, using a stereo tuner or using an FM-only tuner and a self-contained AM receiver. Obviously, the tuner itself, good as it is, cannot furnish more than is sent to it by the broadcasters. And even the best AM lacks the wide-range, interference-free characteristics of average FM.

What with FM multiplexing coming in as a superior broadcast stereo medium (see story on page 44 of this issue), one may well speculate on how important a stereo AM-FM tuner is at all. The simple answer is that this type of unit—whether you use it on stereo or not—still furnishes you with two basic program sources, and if you feel you need them, then the stereo tuner is no less valid than the nonstereo AM-FM tuner.

At this writing, there are less than a dozen different makes of stereo tuners. As with any carefully designed AM tuner, the AM half of the stereo unit pulls in AM broadcasts with clarity and apparently wide response. However, in some circuit designs, AM sensitivity tends to be lowered if wideband response is sought; this fact often calls for a healthy length of outside antenna.

All of which means that the stereo AM-FM tuner is a two-in-one affair that

will allow you to tune in the limited AM-FM type stereo broadcast with extra convenience. The important question when judging one, is how good is it as an FM tuner, and as an AM tuner.

Proven performers include the \$199.95 Scott 330-C; the Madison Fielding 330 at \$149.95; the Lafayette KT-500, a kit for \$74.50, or the LT-50, the same unit wired and tested for \$114.50. More recent models worthy of serious consideration are the \$229.50 Fisher 101-R and the Harman Kardon TP-200 which at \$189.95 includes a built-in stereo preamp. A new stereo tuner kit by Heath, the PT-1 for \$89.95 is worth noting and Knight (Allied Radio) promises one soon. The lowest priced model is the ST-11, a kit by Arkay, at about \$50 it offers an interesting, if minimal, circuit.

Stereo Amplifiers

The stereo tuner may not be the answer to everyone's crying need, but the stereo amplifier is virtually a must for

correct, convenient, and ultimately satisfying stereo operation. Many listeners (the author included) have concluded by now that using two monaural amplifiers for stereo discs or tapes (yes, and broadcasts too) omits a lot.

For one thing, there is the matter of stereo balance. Level controls on each channel are, of course, needed, but they're not enough; a master control for regulating overall level is handy, as is a control that can be used to favor one channel over the other. Differences in the two speaker systems as well as differences in the acoustical characteristics of various parts of the same room can be settled with a balance control.

There are other areas for variation in stereo. Differences in recording techniques as well as in listening tastes being what they are, a convenient means of reversing the relative positions in the room of channels 1 and 2, i.e., changing one channel from the left speaker to the right one and vice versa, is a definite

Combined stereo preamp-amplifiers. These can all be used in a conventional monaural system.



Eico HF 81



Bell Pacemaker Model 2221



Pilot SM-244



Sargent-Raymont Model SR-17-17



Harman Kardon Model A-250



H. H. Scott Type 299

advantage. A switch on the control panel saves you the job of changing the connections to your loudspeakers. Yet another chore is eliminated by a phase reversal switch. When connecting two speakers to stereo outputs, you have a fifty-fifty chance of connecting them in phase, so that they work together instead of against each other. A phase reversal switch enables you to correct the mistakes from the amplifier control panel instead of crawling behind the speakers again.

Aside from control convenience there are other points on which the stereo amplifier scores over two separate monaural amplifiers. Connecting the output from a stereo magnetic phono pickup

to two distinct chassis increases the likelihood of a hum loop, or even a shock hazard. Then too, stereo amplifiers can do tricks. The better stereo preamps have provision for blending part of channel 1 and 2, without interfering with them, and combining the mixture for a third channel—for monaural listening in another room, or for 3-channel stereo. Also, some stereo amplifiers have provision for operating their power output sections in "cascade"; a dual 10-watt unit, for example, can be switched for use as a monaural 20-watt amplifier. This is of value to the owner who has not yet bought a second speaker.

We have been using the term ampli-

Typical stereo preamp control units with such unfamiliar controls as "balance" and "phase".



H. H. Scott Type-130



Eico HF-85



Leak Point One Stereo



Arkay SA25



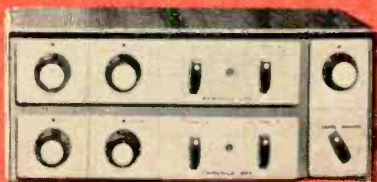
Madison Fielding Series 340



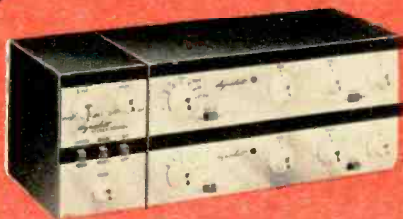
Knight Model KN-700



Lafayette remote stereo control



Fairchild stereo converter with preamps



Dynakit stereo control DSC-1 with preamps

If two individual preamps are used it is convenient to use an "adapter" to balance them.

fier in its most general sense, implying all the while, of course, preamplifier and power amplifier. In terms of specific models available, the greater number produced to date are "integrated amplifiers" (also described as "all-in-one" or "single-chassis" or "complete" or "control" amplifiers). In such a unit the preamp and its controls as well as the power amplifier (for both channels) are all on the same chassis.

Alternately, the separate preamp-power amplifier approach is represented by a number of top-quality stereo preamp-only units which may be connected to two separate power amplifiers or two power amplifiers on one chassis. Yet another variation, unique to stereo, is the unit that contains a stereo preamp with one built-on power amplifier. This type needs an additional power amplifier for stereo.

All-in-one Stereo Amplifiers. Many of the first crop of lower-priced stereo all-in-one amplifiers, produced apparently in response to a big demand for low cost equipment that would enable people to play the new stereo discs immediately, provide most of the extras mentioned earlier, but omit some of the staples associated with hi-fi amplifiers. It is perhaps too early in the game to

generalize; changes in design, specifications, and price are going on even as this is being written.

Many of the all-in-one units do not furnish, for example, separate treble and bass controls on each channel. The use of a common or "tandem" control is, to be sure, convenient; it is also, obviously, an economy. But it assumes you will never want to compensate one channel a little differently than the other. As things stand now, there is good reason for using separate controls on each channel—because of dissimilarity of speaker characteristics. There is something quite frustrating about trying, for example, to bring up the treble on channel 1 only to find it causes channel 2 to become screechy.

Among the all-in-one stereo amplifiers, a few offer more controls and facilities than others. The Madison Fielding 320, for example, and the Scott 299 both provide separate tone controls on each channel. Additionally, the 320 features a novel channel balancing system and a very logical panel layout. The 299, on the other hand, includes channel and phase reversal, rumble and scratch filters, and phono pickup selectors. Less features are offered by such amplifiers as the Harman Kardon "Epic" A-250



Jensen DS-100 speaker system has two woofers pointed down two mid- and high-range units that can be rotated toward the listener.



Electro-Voice Stereon speaker system contains only mid- and high-frequency horns, supplies directive range of hi-fi sound.



and the Pilot SM-244, both of which provide for channel reversal, but use tone controls common to both channels. The Pilot's tone controls are calibrated for phono equalization; obviously once you set them for a particular playback curve they no longer function fully to compensate for speaker characteristics or room acoustics.

In another vein, the buyer should check to see that the mechanical layout is not so tight that the amplifier will eventually heat up excessively and cause premature breakdown. The Sargent-Rayment SR-17-17, for example, an integrated stereo amplifier with controls and 17 watts output on each channel, stands 5½ inches high. This unit shows evidence of careful conservative design, with plenty of room for its parts.

Stereo Preamplifiers. It is in the area of the separate preamp and power amplifiers that one finds an all-out, no-holds-barred approach to stereo. As might be expected, one finds higher prices too, but the extra cost buys you all the imaginable conveniences and extras of stereo control.

The roster of stereo preamps is impressive and appears to be growing weekly. The Pilot SP-215 at \$189.50,

the \$169.95 Scott 130, the Altec Lansing 445A at \$189 and the Fisher 400C at \$169.50 were among the first of the stereo preamp leaders. More recent is the model 340 by Madison Fielding. Each of these provides full stereo facilities and each has unique features for individual appeal; the Scott with its thorough flexibility and third-channel provisions; the Pilot with its two front-panel meters for monitoring stereo recordings; the Altec Lansing with its extensive use of low-noise transistors; the Madison Fielding with its third-channel provision and two-channel mixing facilities for home recording; the Fisher with its simplified push-button control arrangement. The most expensive stereo preamp is the \$239.50 Fairchild 248; this consists, basically, of two monaural preamps and a stereo adaptor packaged as one big unit. A low priced stereo preamp, aside from kits, is the Grommes 208. At \$124.50 it offers most but not all of the features found in the others. The Leak stereo preamp appears to be well designed and solidly built but is usable only with Leak power preamplifiers.

Among kits, Eico, Arkay, Heath, Al-
[Continued on page 96]

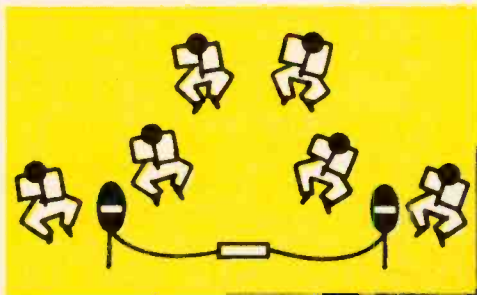
Stereo Records: An Appraisal

**How good is the sound on the new stereo records?
Much depends on the recording session techniques.**

STEREO recording, like a new tool, works fine if it is used properly. From a purely mechanical point of view, the problem of packing two or more audio channels into a single record groove has been solved. But the acoustics of stereo recording are still largely unexplored and record makers must learn how to use them to best advantage.

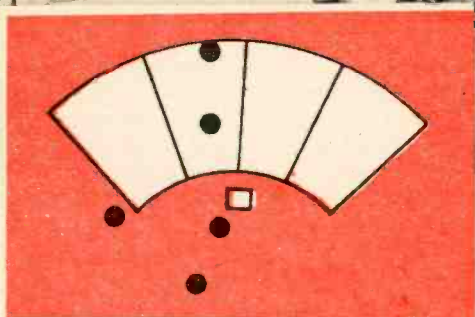
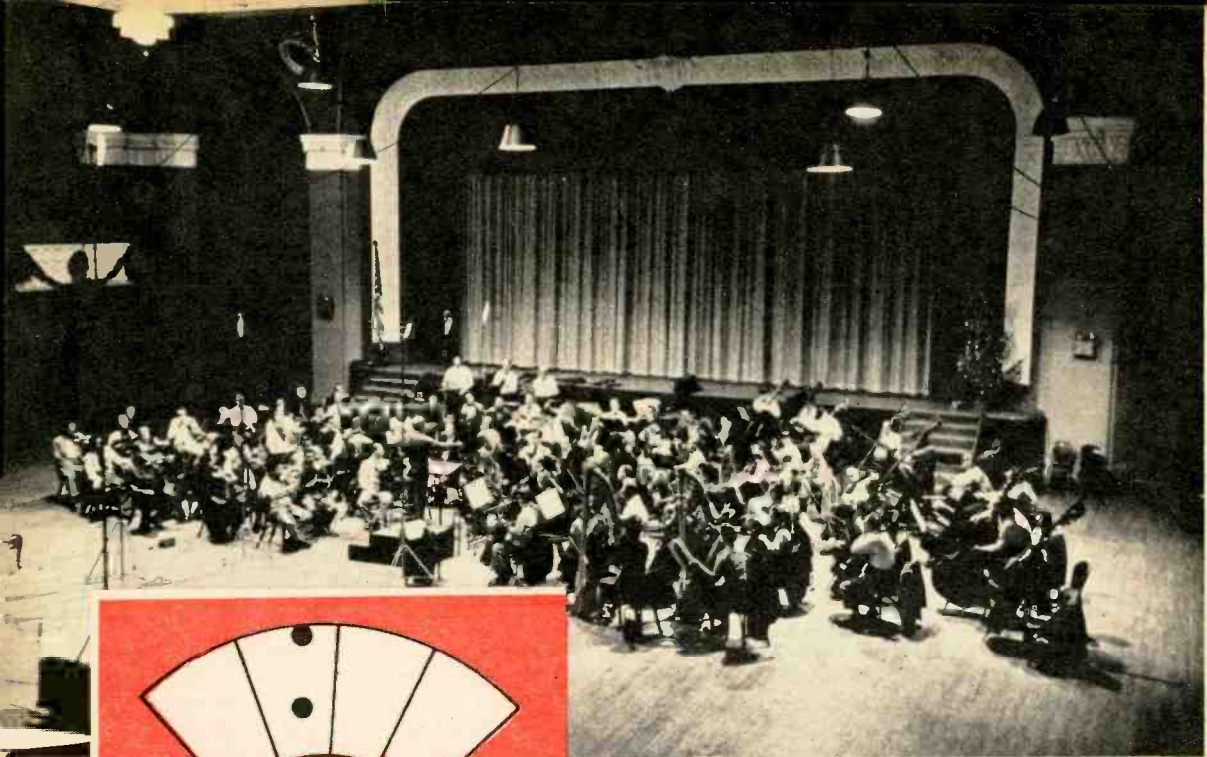
At present, recording engineers are experimenting with various microphone setups and the results vary all the way from superb to just plain awful. Eventually, standards will be adopted for stereo recording, but before this is done it will be necessary to reconcile different ideas on just what makes good stereo sound.

The usual way of making stereo recordings is to space out two microphones in front of the orchestra, one on the left side, the



Lateral (A-B) mike placement "lines up" musicians, separates instruments. Suitable for recording small groups, it's used below with jazz unit of Columbia's "Seven Lively Arts."





Symphonic recording often strives for three-dimensional tonal perspective in depth. Here Columbia has placed mikes behind conductor and through rows of Philadelphia Orchestra all the way to percussion section at rear.

other on the right. This is called "A-B" recording, since the two microphones are usually designated by those letters.

The spacing of the microphones is critical and no general rules have been formulated as yet. The size of the orchestra, the type and instrumental texture of the music, and the acoustics of the recording studio or auditorium figure strongly. If the mikes are too close, the stereo effect is diminished and the various instruments are not clearly localized in space. If the distance between the microphones is too great, the left-right directionality is exaggerated and, instead of giving the feeling of solid sound spreading evenly between the two speakers, the music jumps back and forth between the speakers like a ping-pong ball, with nothing in the middle.

The "hole in the middle" tends to rob the sound of the sonority and "body" that we might rightfully expect as one of the advantages of stereo.

Some record companies have recently found ways to plug up that sonic "hole

in the middle" between the two stereo speakers. They put a third microphone, called a "fill mike" midway between the spaced-out "A" and "B" microphones in front of the orchestra. The output from this centrally located mike is then fed as a weak addition into both stereo channels.

Some recording companies seem to sidestep musical fidelity and concentrate on achieving acoustic sensation. Left/right separation is exaggerated for its dramatic effect.

Sidney Frey, president of Audio Fidelity Records, makes no bones about it: "It's going to take more than just music—even good music beautifully reproduced—to sell stereo. The old ping-pong ball and the choo-choo demonstration record—'Listen, you'll hear it crash along from one side of the room to the other'—are going to clinch more stereo sales than the best symphonic recordings.

"Why? The customer is paying for two amplifiers and two speakers—not to

mention a special cartridge and needle. He wants to be able to hear what these two channels can do.

Goddard Liberson, president of Columbia Records, came out clearly on the side of "truthful" music: "We pay an orchestra to play together," he said, "and we won't let our engineers pull it apart."

As a basic rule in buying stereo recordings, remember that the best stereo sounds very much like the best monaural, except that it has more depth and spaciousness. Don't be taken in by dramatic effects of the ping-pong technique.

Some critics of current stereo discs point out that A-B mike placement, even with the fill mike, emphasizes directionality at the expense of depth. They consider this musically incorrect. It is not necessary, they say, to localize the instruments because nobody really cares

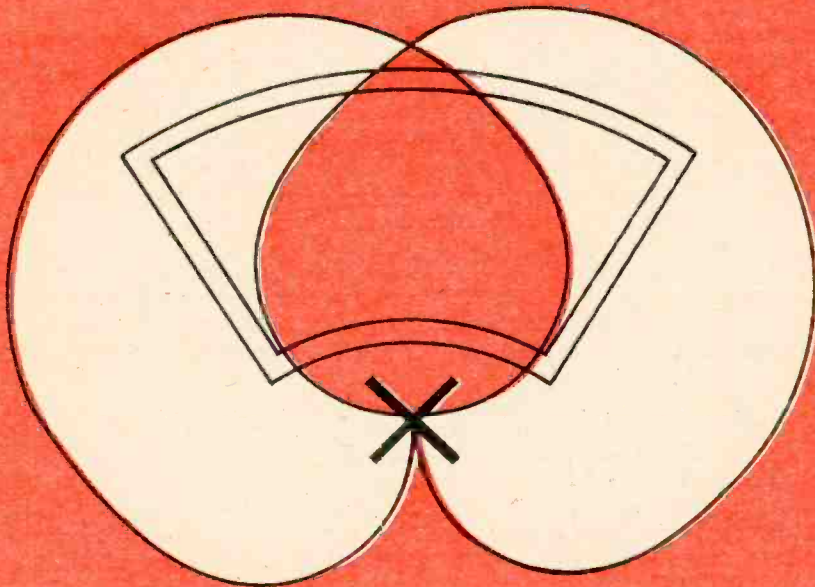
just where the players sit. What should exist is a three-dimensional sense of tonal perspective that puts the woodwinds behind the strings, the brass behind the winds, and percussion behind the brass.

These ideas have prompted some European companies to experiment with so-called M/S stereo system in which microphones and speakers are oriented in depth rather than from side to side. But here the shoe is on the other foot because depth is gained at the expense of directionality and we still do not have full dimensional sound.

A compromise solution is a stereo technique now favored by several other European recording companies, notably E.M.I., which appears as Angel and Capitol in the American market. In this system, two microphones (called the

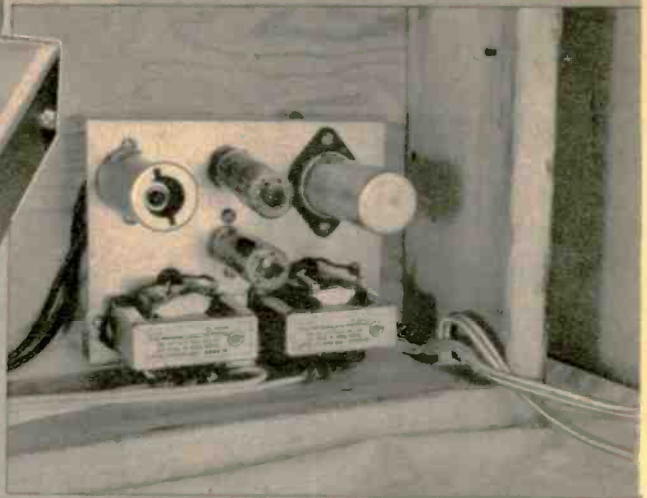
[Continued on page 94]

New M-49 stereo mike (Internal view at right) is actually two mikes in one. Set above center of orchestra, heart-shaped pickup pattern of each element is aimed at different far corner of symphonic group, achieving compromise between depth and directionality. Shaded area is where patterns overlap.





The stereo player described last month is seen above. The two-channel amplifier added now and shown at right will work with any phono having a crystal pickup.



Stereo on a Shoestring-2

By Ernest Wayland

Convert the simple stereo amplifier described last month from headphone to loudspeaker operation.

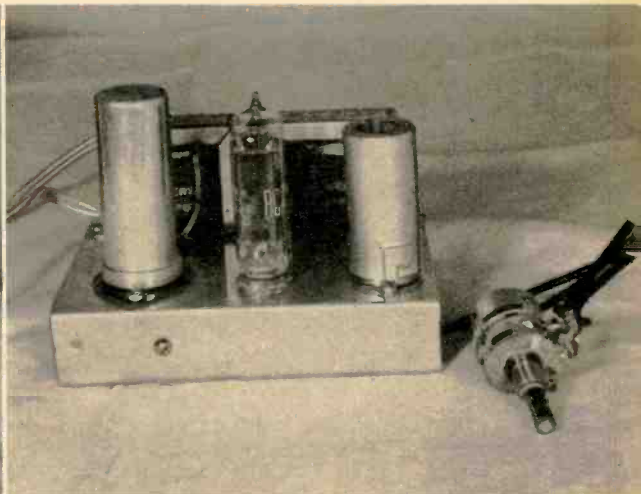
LAST month we described a two-channel stereo amplifier and record player to use with headphones. In this article the amplifier is expanded for operating two loudspeakers, the basic player mechanism remaining unchanged. All that needs to be added are two power output circuits and two speakers. The instructions given here are detailed enough so the amplifier may be built to use with an existing phono without referring to the previous article.

The stereo power amplifier is designed for operation with the Electro-Voice Model 66 stereo cartridge and two inexpensive speaker systems. The stereo speaker designed for *EI*'s first issue (May, 1958) worked out extremely well as one of the two speaker channels. Any of the small full-range systems will serve equally well in the other channel.

The new stereo loudspeaker amplifier is built on the same chassis used for the headphone version presented in our October issue. None of the expensive components are scrapped and additional parts should run about \$10.

The original dual triode circuit serves as the voltage amplifier to drive the new output stages. The output transformers fit comfortably on the chassis side by side if you followed the original layout.

Start the conversion by removing the 750 ohm resistor (R10). The ventilation holes which were drilled directly above it now



The additional parts visible on top of the amplifier chassis are two output transformers at left and the 50C5 output tubes, center. Right photo shows the dual control R11 and R12. On the chassis left to right are C3, V2, and V1.

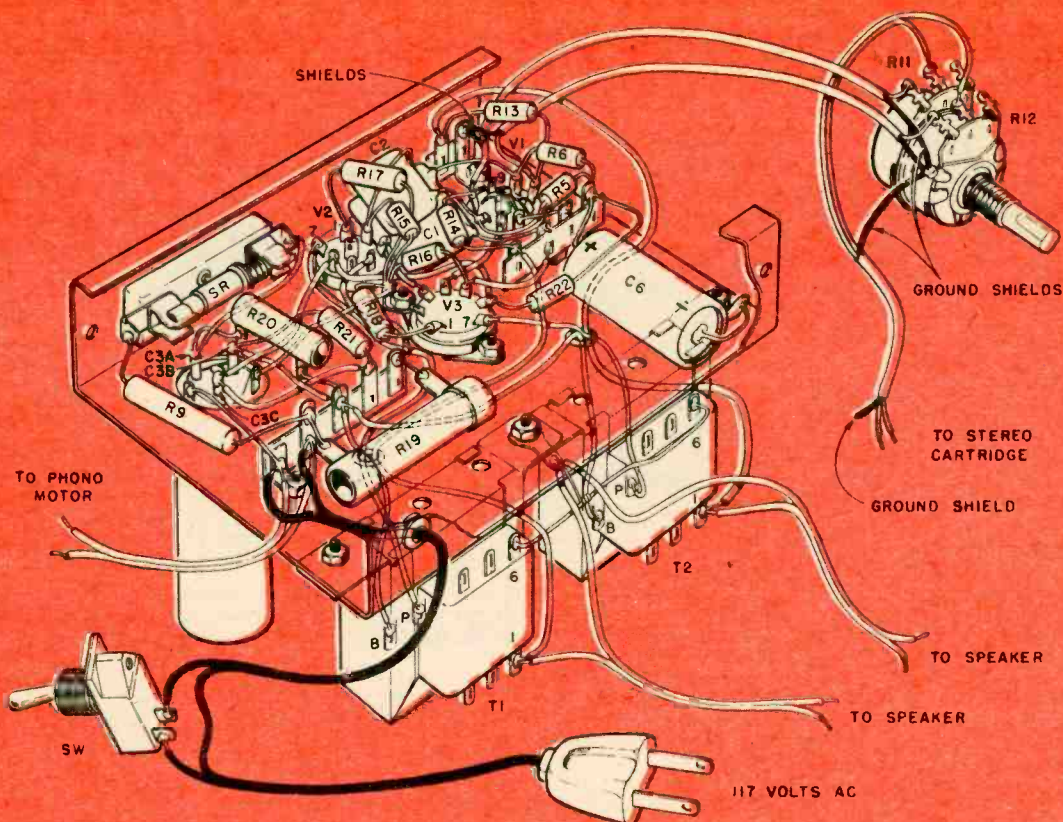
serve for transformer mounting. Notice that only three bolts are used, the middle bolt holds one tab of each transformer and a ground lug.

Before mounting the transformers, the tube socket holes are drilled and positioned on the chassis as shown. Two extra chassis holes are drilled on the plate lead side of the transformers to accommodate the B plate and feedback leads. It is good construction practice to insulate each chassis feed hole with a rubber grommet.

In addition to the removal of the filament dropping resistor, certain other wiring changes must be made and several components added. The filament of the 12AT7 is now wired in series with the 50C5's and the new 75 ohm 10 watt dropping resistor serves as a filament ballast. It's important that the filament ground return be made at the 12AT7 end of the series string as shown in the schematic.

Power supply redesign was necessary both to reduce the hum level of the amplifier for use with speakers having a good bass response and to supply the extra current for the output tubes. The wattage ratings specified for the new power supply resistors were determined experimentally. All of them will heat up during use but they are operating within their ratings. The original triple-section can type capacitor and an additional 20 mfd. tubular are used for filtering. The 3-section pi-filter network keeps the hum down to the point where it is inaudible more than two feet away from the speaker cabinets.

The input stage of each channel was redesigned for best possible performance with the remainder of the circuit. The 4.7 megohm feedback loop and grid return resistors were all removed, as were the headphone leads and jack. The two 5.6 megohm feedback resistors are critical and 5 or 10% tolerance components should be used. These resistors serve a triple function; (1) They are the cartridge load resistors; (2) The



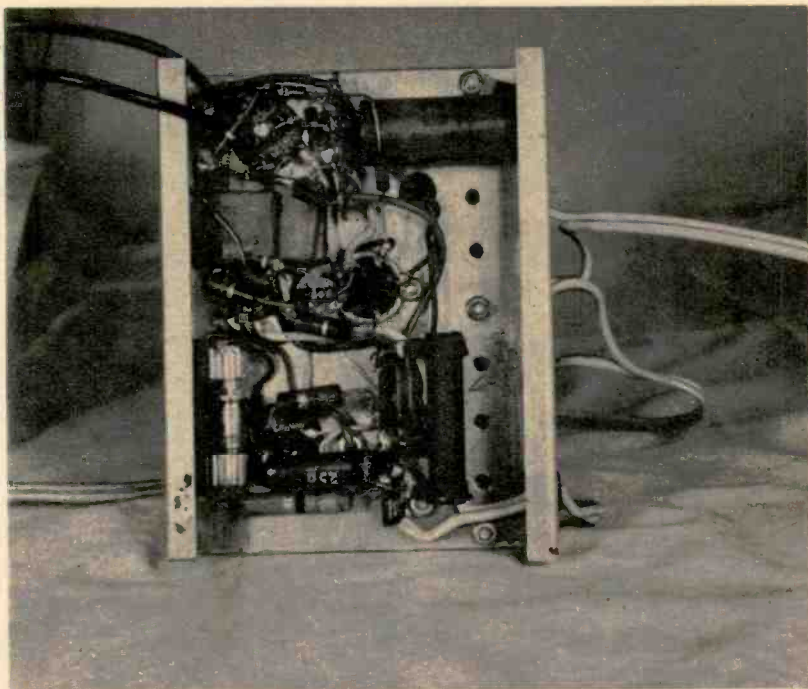
This guide will enable you to mount and wire in the new parts or to build the amplifier completely.

12AT7 grid bias resistors; and (3) provide the negative feedback from the secondary winding of the output transformer.

Make sure that the feedback loop is connected correctly. Note that on each transformer, one side of the secondary winding is ground and the other is connected to the feedback loop. If the phasing of the hookup is incorrect, one or both channels may squeal. In that case reverse the connections to the transformer secondary so that the lug that previously was grounded is now the feedback point. In the author's model, lug No. 6 on both transformers is grounded and lug 1 is the feedback connection. The speaker leads connect to the same terminals. Note that one side of both speaker lines is connected to the

chassis. Since the amplifier is AC-DC operated and may have a hot chassis, it is important to polarize the line plug to prevent chance of shock. See *EI* article "Play It Safe" (July, 1958) for the proper precautions.

A number of features available on the more expensive commercial stereo amplifiers have been omitted in this stripped down model. A volume control was considered necessary (it wasn't with the headphone model) and a 3 megohm unit was wired as shown in the schematic. The unconventional hookup used achieves a type of loudness compensation. That is, as the volume is turned down, bass boost is applied to achieve pleasant listening at low volume levels. The control itself may be two separate controls, ganged.



Underside view of the modified amplifier. Filter condenser C6, seen at upper right, and filament dropping resistor R19 lower right, are both new components.

Both the schematic and parts list indicate old and new parts. On the schematic, all additional components are designated by figures printed in heavy type.

PARTS LIST

Old Parts

- R5, R6—100,000 ohm, 1/2 w.
- R9—33 ohm, 1 w.
- C1, C2—1 mfd., 200 v.
- C3A, B, C—3-section electrolytic, all 40 mfd., 150 v.
- V1—12AX7 or 12AT7

Nine pin miniature tube socket

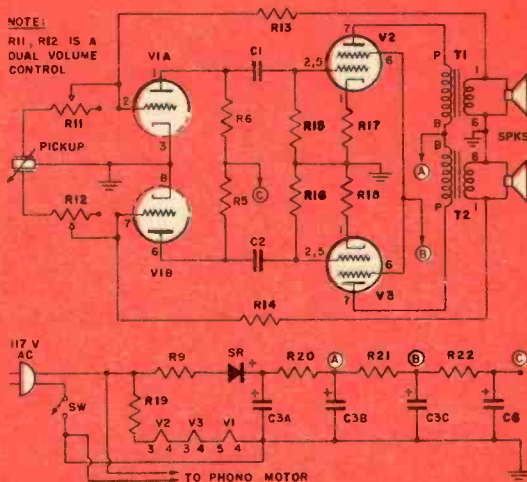
Aluminum chassis—1"x4"x5"

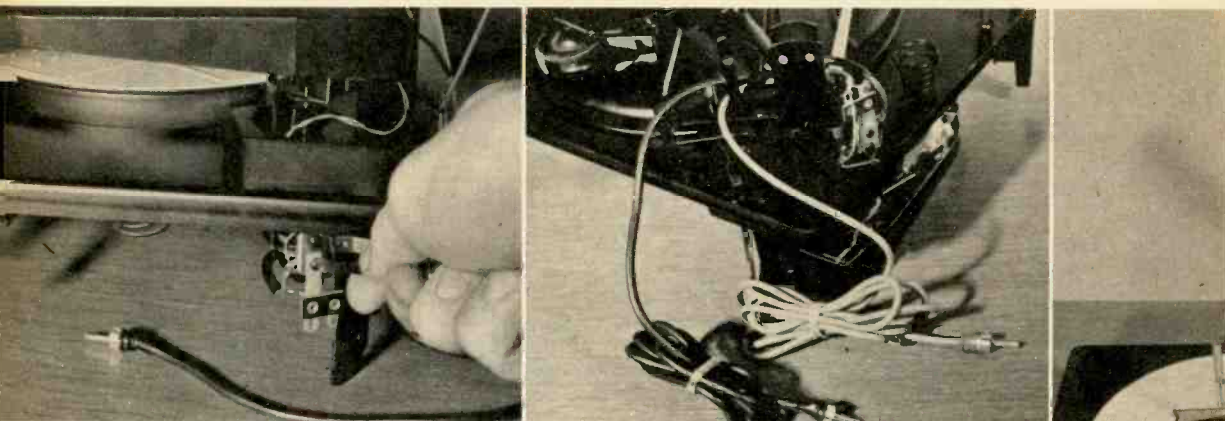
Switch—single pole single throw

SR—Silicon diode rectifier (Audio Devices A750)

New Parts

- R11, R12—3 megohm dual potentiometer
- R13, R14—5.6 megohm, 1/2 w.
- R15, R16—470,000 ohm, 1/2 w.
- R17, R18—150 ohm, 1 w.
- R19—75 ohm, 10 w.
- R20—250 ohm, 5 w.
- R21—1500 ohm, 2 w.
- R22—4700 ohm, 1/2 w.
- C6—20 mfd., 150 v.
- V2, V3—50C5 tubes
- 2—seven pin miniature tube sockets
- T1, T2—Output transformers (Stancor A-3849)





First mount a two-terminal strip (one lug grounded) below the changer deck near where pickup leads emerge. Then solder inner conductor of a second audio cord to the insulated lug and its shield to the ground lug. A #30 lead from pickup's third terminal is twisted through arm onto insulated lug. Materials shown here come in conversion kits for the Glaser Steers changer.

Convert Your Record Player to Stereo

By Sid Norinsky

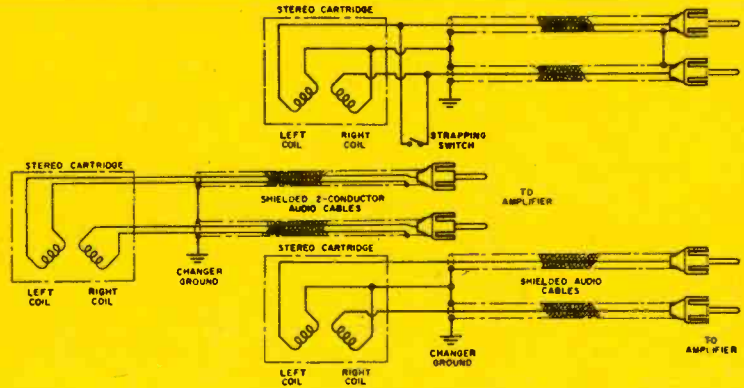
IF YOU are converting an existing monaural system to stereo, your present record playing equipment can continue to serve you by means of a few simple modifications. These consist in the main of rewiring the tone arm for a stereo cartridge. Your record player, manual or automatic, should meet certain standards, however, if it is to deliver clean stereo sound. Later we'll describe a simple test you'll be able to run to determine its suitability.

Assuming for now that your record changer is suitable, you can go ahead and convert in about half an hour. Most manufacturers of record players and changers make conversion kits available. Some are shown here. Complete instructions accompany these kits.

If you use a three terminal stereo pickup you will use a three wire setup; for a four terminal pickup you may use either three or four wires. Three-wire stereo operation is satisfactory where the cartridge feeds a one-chassis stereo preamplifier. The common amplifier ground for both channels makes its susceptibility to hum pickup about the same as it is for ordinary monaural reproduction.

A four-wire hookup is the best approach where separate-chassis amplifiers are to be used. In the four wire connection, hum-inducing ground currents circulate only in the shields of the audio cords, and do not contribute to cartridge output by circulating in a common third wire.

For a four-wire hookup, double-conductor audio cable is required, and a four-lug (all insulated) terminal strip. One of the



If the stereo pickup cartridge you use has three prongs, the prong marked R is connected to the inner lead of one audio cord, that marked L to the inner lead of the other cord and the third prong goes to the ground shields. A 4-prong cartridge is wired as shown in center. On top is rumble test setup.

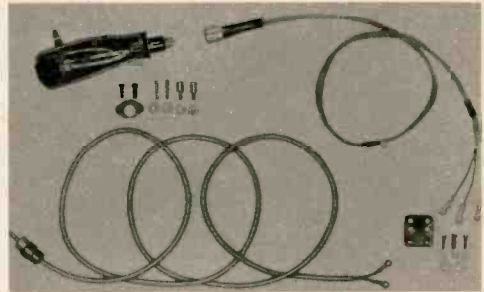
inner conductors in each cable is soldered to the shield at the phono plug end, where the cord plugs into the amplifier. Only the shields are soldered to a ground lug connected to the metal frame of the record changer.

Now comes the question that really takes precedence over the relatively easy matter of the conversion itself. Is your record changer suitable for stereo?

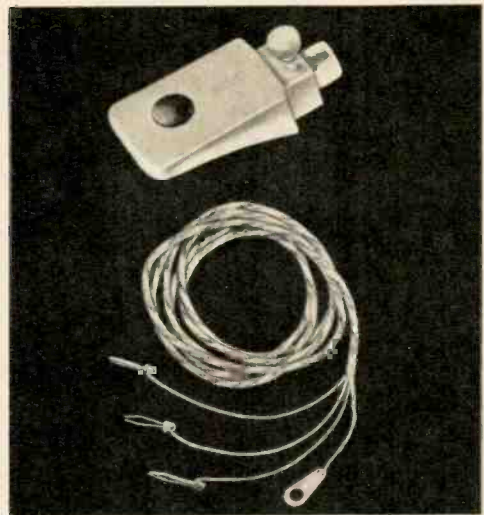
The first step in finding out is to obtain a stereo cartridge. You'll need it to carry out the simple test described below. Install the cartridge in your present record changer, make the stereo conversion, and plug the audio cables into your stereo amplifier-speaker system. You'll also need an LP "silent-groove" test record, which contains unmodulated grooves. Theoretically such grooves should produce perfect silence out of your loudspeakers. Components Corporation, D&R, Cook, and others offer such test records.

The basis of the record changer test is to determine how much rumble the turntable produces. Excessive rumble is due to worn motor bearings or cheap motor construction. Rumble is a serious cause of distortion with stereo records, because it contains a vertical motion component to which the stereo cartridge responds, just as it responds to the vertical components of the 45x45 groove modulations.

[Continued on page 100]



This kit converts Garrard players to stereo.



Audax tone arms may be converted to stereo by using kit consisting of new cable and shell.



The Bogen Multiplex receiver is currently being used in commercial background music. It includes a single-frequency FM tuner and multiplex adaptor.

All About FM Multiplex

By Len Buckwalter

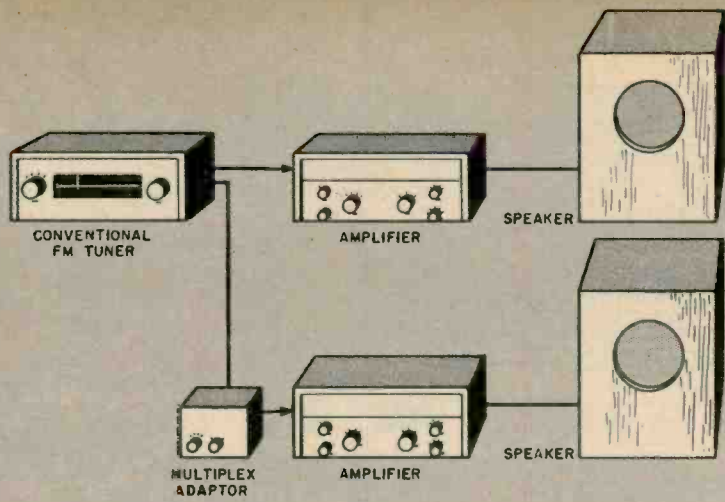
Associate Editor

The newest source of stereo sound, 2-channel FM, uses your present tuner with a plug-in adaptor.

JUST three years ago, in 1955, the Federal Communications Commission quietly triggered a chain of events now reverberating throughout the broadcast industry. Multiplex, a completely new concept in FM radio, is providing the answer to the problem of transmitting stereophonic sound to the home. Within a surprisingly short time this new medium will bring the audio enthusiast the depth and realism of stereo with a minimum of expense and equipment. Multiplex is now rising to the status of the stereo disc and tape recorder, with an extra bonus or two.

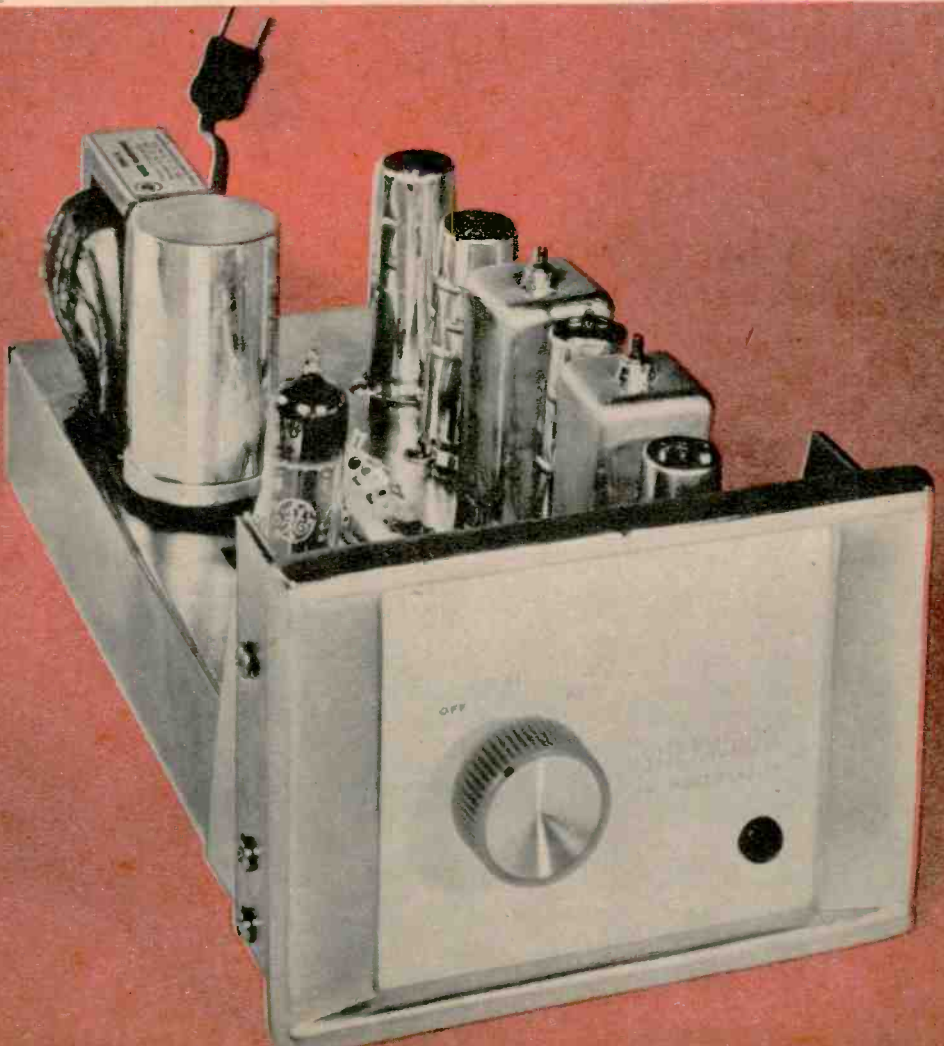
The April broadcasters' convention in Los Angeles devoted considerable emphasis to multiplex. Engineering papers and demonstrations proved conclusively that it is now ready for general use. The initial doubts expressed by many were dispelled when several Los Angeles stations transmitted high quality sound on the new system. As the number of FM stations acquiring these facilities increases, a fresh look at the origin and future of multiplex appears to be in order.

The birth of multiplex was sparked by a problem . . . a dilemma pervading all branches of radio today, namely a shortage of frequencies. There are simply too many services competing for



A typical set-up, in the home, for receiving multiplex programs. The FM tuner feeds amplifier in the usual way, while multiplex adaptor operates only on the sub-channel.

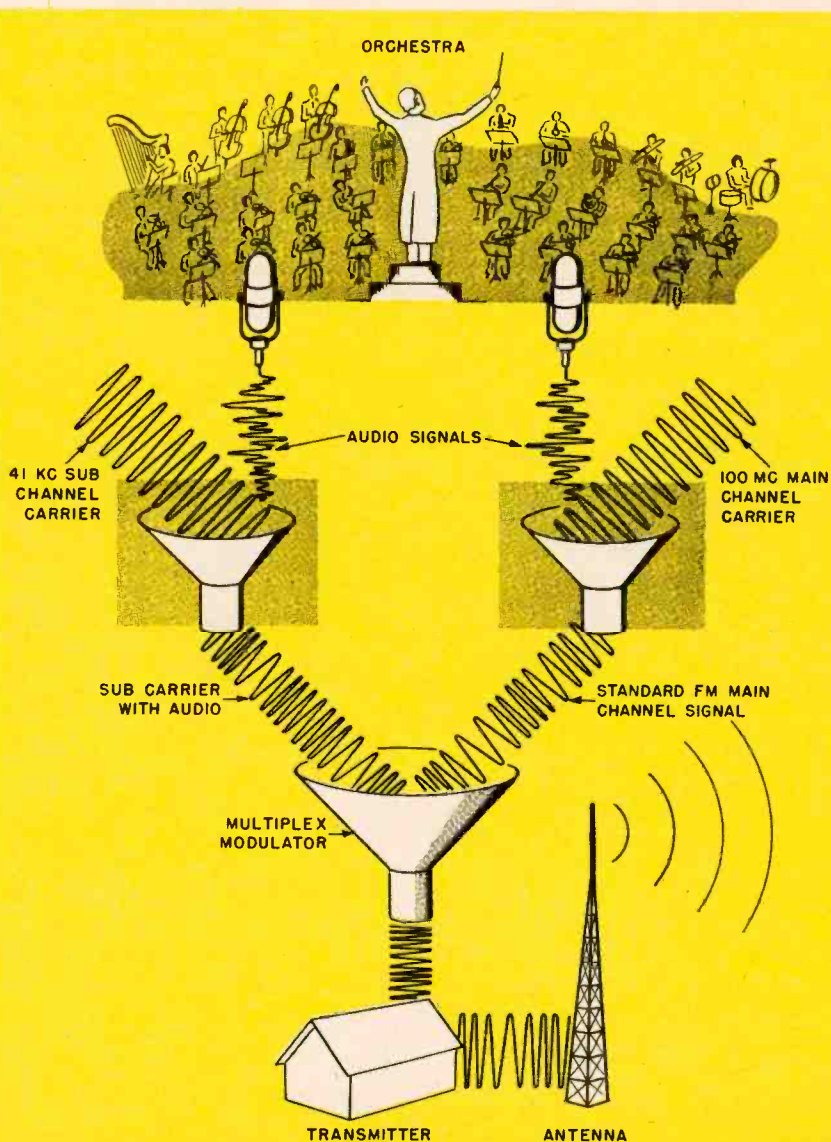
A prototype of the Sherwood multiplex adaptor with selectable sub-channels (41 and 67 kc). FM tuners are designed with room for an adaptor on the same chassis.





Multiplex jack is provided on the rear apron of most present day FM tuners (left jack of the pair at center). The adaptor picks off sub-channel signal at this point.

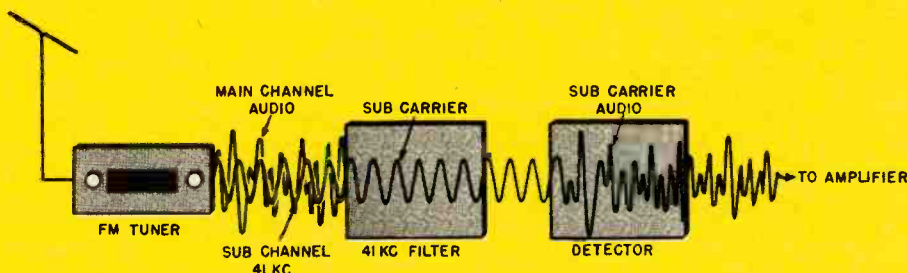
Creating the multiplex signal is mostly a process of superimposing one frequency upon another so they may be separated later on without undesirable "crosstalk."



MULTIPLEXED
FM SIGNAL



The multiplex adaptor is represented by the 2 blocks following the FM tuner. Its 41 kc filter will not accept the main channel audio which is fed conventionally to its amplifier and speaker for one half of stereo presentation.



too few allocations. For example, mobile radio now "splits" channels, TV ventures into the UHF region, and ham operators turn toward single side band. Each of these approaches serves to exploit the limited radio spectrum since the growth of communications during the post-war period has been phenomenal.

Multiplex, the word literally meaning "to interweave many" fits perfectly into this crowded pattern.

If it were possible for FM stations to send out two separate programs on their single assigned frequency, the complete FM band could effectively be doubled in width. You would then hear twenty stations where only ten existed before. Not only would the original band remain the same, but each program would be a separate entity causing no interference to another. This is the electronic miracle of multiplex—a contribution pioneered by Major Edwin H. Armstrong and only recently updated to commercial reality.

The key to understanding how multiplex works is a rudimentary grasp of FM. The customary FM transmitter produces a carrier wave changing in step with the audio program source. The music and voice frequencies from 15 to 15,000 CPS are recovered from the carrier at the home receiver. In multiplex, the second program is interwoven within this framework.

First, a carrier is supplied for it; one

that does not interfere with the normal channel. This new frequency is generated at 41,000 CPS. It is an *ultrasonic* tone appearing on the main carrier much in the same manner as the lower tones of voice or music, with one important difference—it cannot be heard. Even if the human ear could perceive such a tone, the FM receiver would de-emphasize it anyway. In the parlance of multiplex, a "sub-channel" has been created that is completely compatible with existing systems. At this moment you may be listening to an FM station unaware of sub-channel transmission.

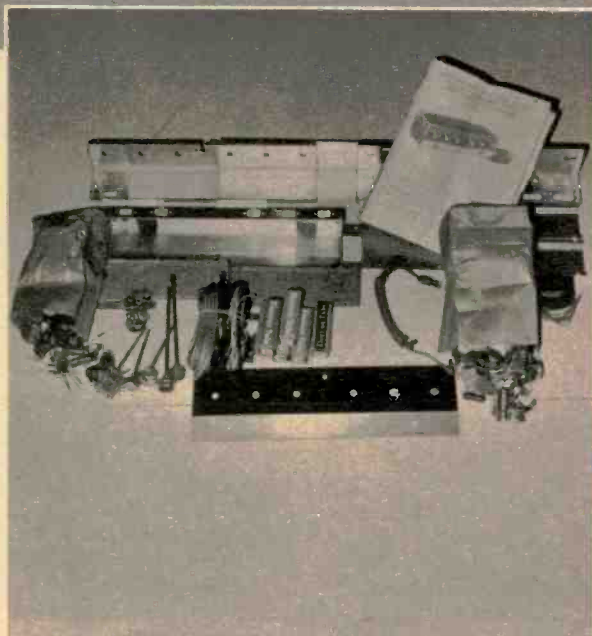
It is upon the new carrier that the second program, perhaps the second channel of a stereophonic broadcast, is impressed. The audio tones are not heard in the home receiver since they occur only as small frequency changes of the 41,000 CPS. They can be recovered only by a special receiver or adaptor added to the set.

Next in the multiplex chain is the receiver. It is actually two receivers in one, to detect the main and sub-channels. The first portion is quite similar to a conventional FM set. At the detector stage appear the main and sub-channel with audio and ultrasonic tone. Here a separation occurs; main channel audio goes to an amplifier and speaker, the sub-channel goes to the *multiplex adaptor*.

This adaptor, due to a filtering
[Continued on page 90]

EI assembles a
Stereo Preamplifier Kit

The Heath 3-chassis SP-2 preamp has many advanced features. We built it for this special report.



Both preamps are adjusted at the front panel by concentric knobs that may be adjusted individually, or work in unison.

The major parts furnished with kit are shown here. Construction time by the author, about 23 hours. Cost of kit \$56.95.

THE introduction of the single groove stereophonic disc caused an uproar of activity among the high fidelity component manufacturers. New stereo models of everything from cartridges to speakers were rushed from the drawing board to the production line in an effort to be "firstest with the latest." And often the performance and features of the new stop-gap stereo products reflected the haste in design.

Amidst this stereo uproar, what are the hi-fi kit manufacturers doing? Do kit stereo units measure up to the factory wired products? That's the big question **ELECTRONICS ILLUSTRATED** set out to answer for you.

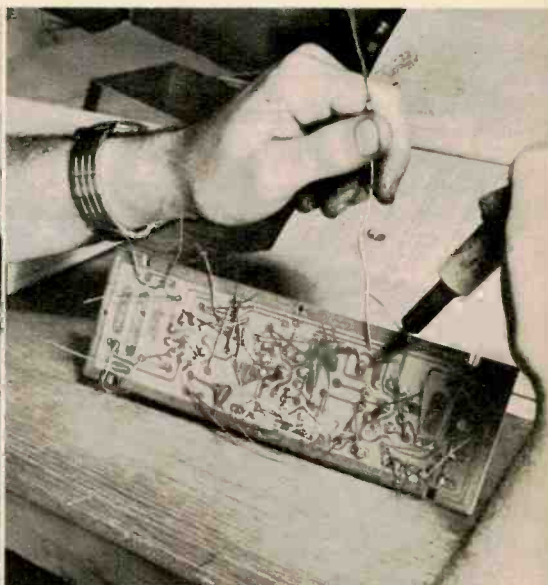
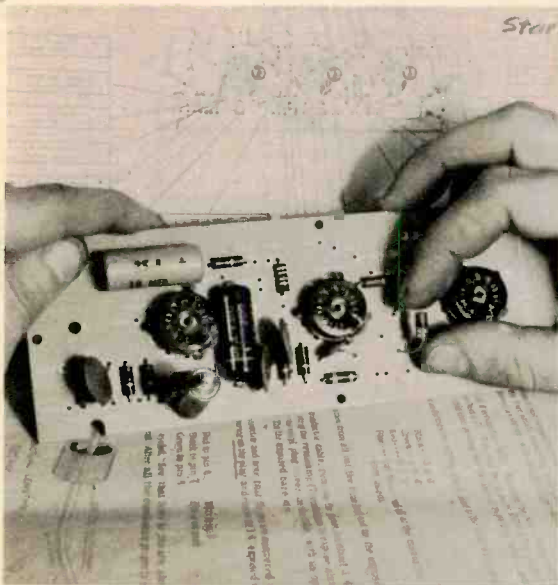
We checked with a number of manufacturers and came up with a pre-production sample of the Heath stereo-preamp kit SP-2. Unpacking the stereo kit is a startling experience. Heath seems to be playing double-or-nothing with the components. Bags of resistors, boxes of switches and bunches of wire overflow out of the carton.

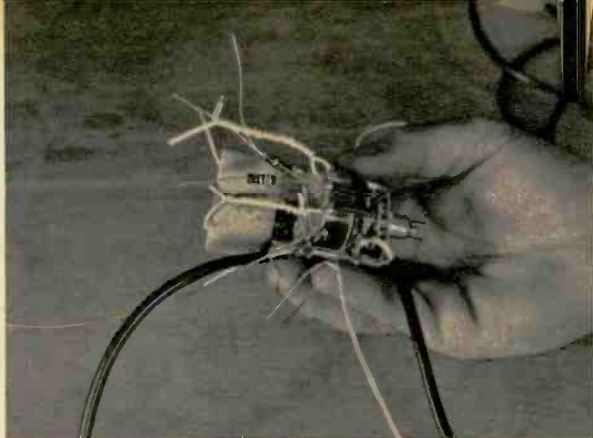
The 27 separate controls (6 switches, 21 potentiometers), 41 capacitors and 60 resistors are justified by the two *complete* preamps with special stereo switching and a built-in power supply that make up the SP-20.

The construction manual is a model of clarity, all 72 pages of it. In the usual comprehensive Heath manner, distortion and response curves are given for all functions, outputs and controls. Two pages are devoted to soldering instructions and old hands at the kit construction game may want to skip them. Don't—those two pages are as valuable a primer of soldering technique as you can find anywhere.

Total construction time is reduced considerably through use of printed circuit boards. Lower left shows resistor inserted into holes before soldering.

At the underside of printed board, lower right, component wires are soldered to the foil. Iron is applied quickly since excess heat causes foil to peel.



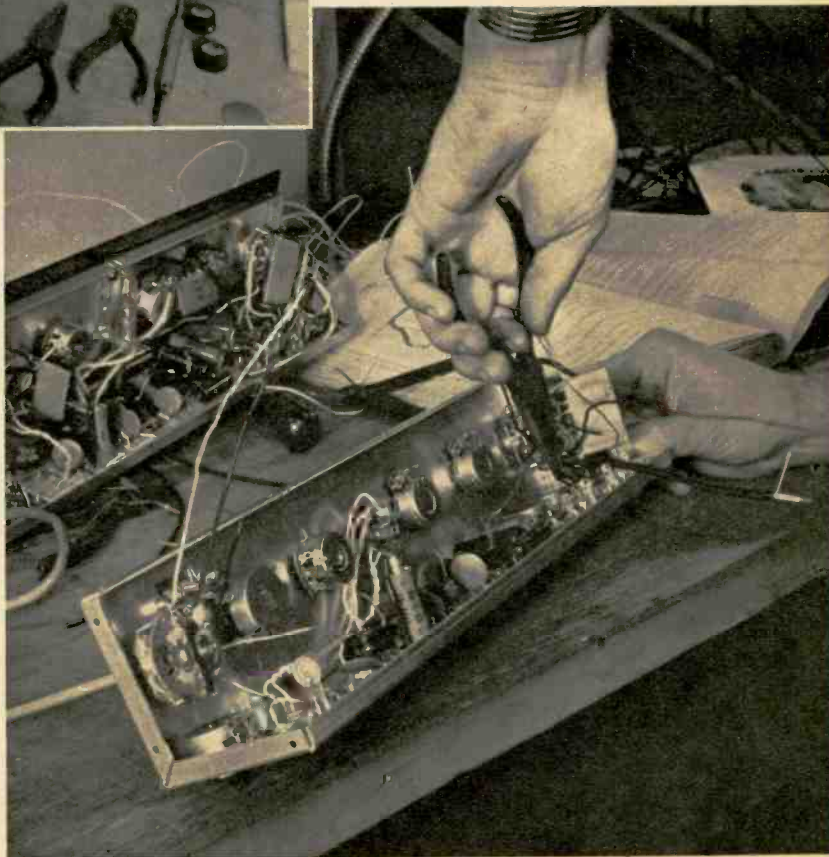


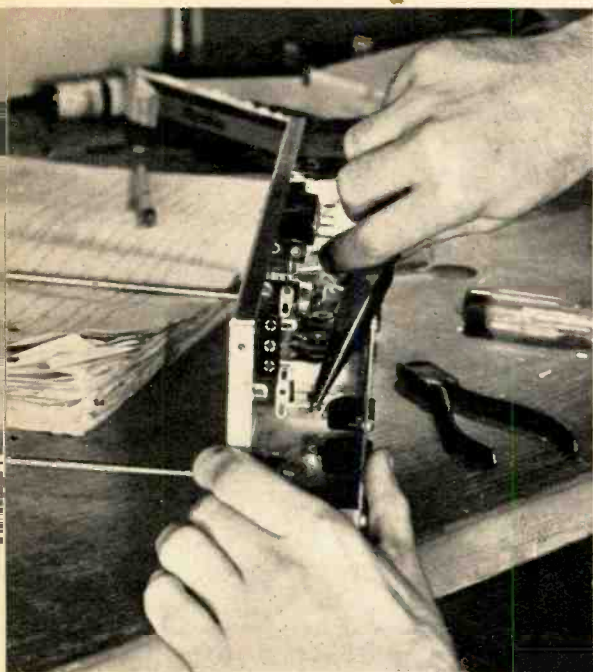
To avoid wiring in tight corners of the chassis, components are soldered on function switches before mounting.



During early stages of construction, controls and tube sockets are mounted on rear of front panel and chassis.

The second preamp, seen in front of the first, nears completion. The two units have almost identical circuits.



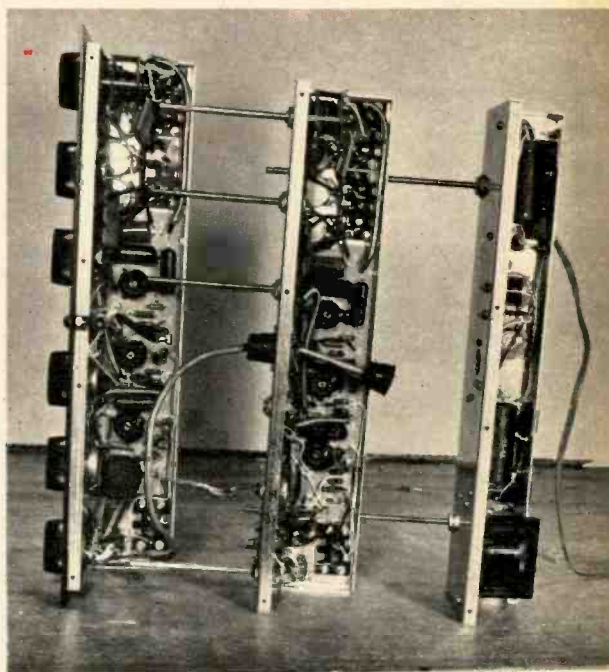


The power supply is the final section to be wired. It is assembled on a separate chassis.

Heath makes the point that the best way to solder printed wiring boards is "touch and go." It was found best to have a small blob of solder on the tip of the iron when applying it to any printed board connection. This insures rapid heat transfer. The iron, by the way, should be one of the high heat pencil types. The closeness of the connections on the printed circuit board make a small tip necessary.

Exercise extra care when soldering any lug or terminal with three or more wires connected to it. These multi-wire solder points are a favorite spot for rosin joints to crop up.

The construction book your reviewer used was still in page proof form and, not surprisingly, errors and misprints were found. These have been referred back to Heath for correction and will not appear in your copy of the manual. Construction is divided into several steps. There are five or six connections to be made in small corners but in general only minor wiring difficulties were experienced.



The two preamps and power supply. All the long shafts terminate in front panel knobs.

The two preamp sections are similar, but not identical, in construction and wiring. The printed circuit boards, however, do have the same component layout and it would probably save time and minimize error to assemble the components on both boards simultaneously.

Wiring time for the first preamp section ran about 10 hours, the second preamp—8 hours. The two hour difference was due both to the experience gained on the first unit and the slightly simpler hookup of the second.

The third unit to be wired deserves special mention. Heath calls it a Remote Stereo-Balance Control. It's a neatly packaged control at the end of a twenty-foot cable that plugs into the rear of the preamp. Its use is optional, but if desired, your stereo channels can now be balanced from almost anywhere in your listening room. This feature, to the best of your reviewer's knowledge, is exclusive with Heath.

The fourth and last unit to be wired is the power supply that serves both

[Continued on page 92]

Shelves for Your Hi-Fi

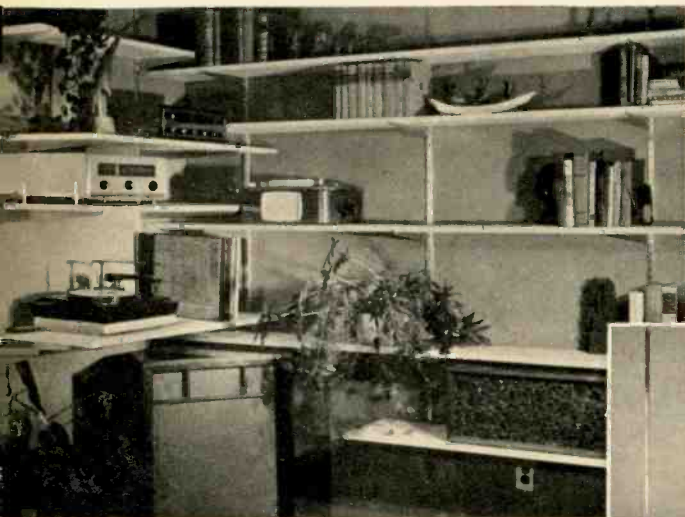
Good sound and good styling are not incompatible. Here's a hi-fi setup pleasing to both eye and ear.

VERY small amounts of time and money are all you need for building a practical place for hi-fi components, which will also be an attractive addition to any room.

The shelves pictured here began with metal standards and brackets, available at any hardware store. These aluminum finish standards cost 20 cents a foot, 10-inch brackets 50 cents each. Other finishes are available at higher prices. Brackets come in varying sizes from 8 to 18 inches. For components it's best to use the narrowest possible consistent with the dimensions of the unit, since wider brackets have a greater moment of force and a greater tendency to break.

The first step in hanging your shelves is to locate the studs in your wall. On an outside wall they should be exactly 16 inches apart; up to 20 inches apart on an inside wall. A stud finder is recommended for this job. This is a compass needle which swings around to point to metal and will indicate where the nails, and thus the stud, are located. The standards are then fastened to the wall by screwing them into the studs, next the brackets are fastened to the standards, as pictured.

For the shelves themselves common pine, costing about 20 cents a square foot is a good economical choice, if you can find pieces without too many knots. Select lumber runs about twice that. Stain or finish the boards to blend with your room and enjoy good looks along with good listening. —●—



Components are installed on the finished shelves with heavier units at the bottom.

Where heavy loads are to be supported standards should be no more than one stud apart. For lighter loads a two-stud separation will do. You can be sure the standards will hang straight if you fasten the top screws in first. With standards secure you can install the brackets (below right) at any level you desire. These can be easily altered at a later date if you wish to change the arrangement or even add more shelves.



For Stereophiles Only

ANYONE going in for stereo in a really big way of course wants to know everything there is to know about it. And, just as naturally, the manufacturers of stereo equipment are most anxious to oblige, by providing information on stereo in general, and their equipment in particular. Listed here is the literature available to you, our readers, at little or no cost. For your convenience we have divided this descriptive material into two categories: booklets about stereo in general, how it works and how it can work best for you; and catalogs describing specific equipment available from individual manufacturers.

BOOKLETS

STEREO FACT BULLETIN

4 page booklet explaining the fundamental principles of stereo sound reproduction. No charge.
Allied Radio Corp., Dep't. EI
180 N. Western Ave., Chicago 80, Ill.

UNDERSTANDING HIGH FIDELITY— STEREO EDITION

A detailed, thorough explanation of stereophonic sound, complete with diagrams. 25 cents.
David Bogen Company, Dep't. EI
P. O. Box 500, Paramus, N. J.

HOW TO CHOOSE & PLACE STEREO EQUIPMENT FOR THE HOME

An illustrated brochure of stereo set-ups to suit individual rooms, plus general rules on arranging stereo equipment. 50 cents.
Electro-Voice, Inc., Dep't. EI
Buchanan, Mich.

STEREO—THE EASY WAY. BOOKLET K

A simplified explanation of the basic facts of stereophonic sound. No charge.
Fairchild Recording Equipment Co., Dep't. EI
10-40 45th Ave., Long Island City 1, N. Y.

HOW TO ASSEMBLE A STEREO SYSTEM

8 page booklet on how to convert a monaural system to stereo, and how to set up a complete stereo system with the company's equipment. No charge.
H. H. Scott, Dep't. EI
111 Powdermill Road, Maynard, Mass.

IT TAKES TWO TO STEREO

12 page illustrated brochure describing how stereo records are recorded and reproduced, and how to convert a monaural system. No charge.
Pickering and Company, Dep't. SB
Sunnyside Boulevard, Plainview, N. Y.

STEREO FIDELITY FOR YOUR HOME

A booklet about the fundamentals of stereo, and how to achieve stereo hi-fidelity. No charge.
Pilot Radio Corp., Dep't. EI
37-06 26th St., Long Island City 1, N. Y.

CATALOGS

STEREO EQUIPMENT FROM AMPEX

Individual brochures, illustrated in color, on all stereo components available.
Ampex Audio Inc., Dep't. EI
1020 Kifer Road, Sunnyvale, Calif.

CERAMIC STEREO CARTRIDGES

Technical data sheets, including diagrams, describing available cartridges.
Astatic Corp., Dep't. EI
Conneau, Ohio

BELL HAS IT

Illustrated booklet describing available stereo equipment.
Bell Sound Systems, Inc., Dep't. EI
Columbus 7, Ohio

STEREO EQUIPMENT

Illustrated flyers on the Gyro/Jewel stereo cartridge and the Gyro/Balance arm.
Electro-Sonic Labs, Inc., Dep't. EI
35-54 36th St., Long Island City 6, N. Y.

THE FISHER STEREOPHONIC—1959

Brochure of equipment, illustrated in color.
Fisher Radio Corp., Dep't. EI
21-21 44th Drive, Long Island City 1, N. Y.

STEREO FROM HARMAN-KARDON

Descriptive material on stereo tuners, amplifiers and multiplex adaptors.
Harman-Kardon, Dep't. EI
520 Main St., Westbury, N. Y.

[Continued on page 109]



Hi-Fi Clinic

Send in your questions on hi-fi. The clinic will answer any query on how to repair, how to install, or how to listen.

Pickup Distortion

My hi-fi system does not reproduce music at the upper end of the scale clearly. On records where the brass section is prominent, a "tinny" sound is produced along with the normal tones. It sounds similar to listening to a radio that is tuned slightly off the station. Also, I notice that adjustment of the treble control influences this sound to a large degree. Please advise me on this matter.

W. Krapcho, Chatham, N. J.

Although almost any component in your system might be the cause, the most common source is the cartridge or stylus. First, be certain that the stylus is centered properly in the cartridge. Also check for wear and correct pressure.



Eliminating Hum

I have tried to put an extension cord on the microphone used with my tape recorder. When the plug is inserted into the jack on the recorder, a loud hum is heard. Could you tell me the reason for this?

Richard Armenteros, Downey, Calif.

Hum of this kind is usually caused by an improper or open shield on the microphone cable, especially for high impedance types such as crystal. Check if the shield on the microphone cable joins the shield of the extension cord.

Long leads on crystal microphones are susceptible to hum pickup and high frequency loss. However, for runs of up to 20 or 30 feet, no particular difficulty should be encountered if good shielding is used.



Transistor Schematics

I have a portable tape recorder and would like to use a small, simple transistor amplifier with it. It should be able to operate a 2½-inch speaker. Can you supply a diagram for it?

Mike Lambert, Arlington Heights, Ill.

At present, ELECTRONICS ILLUSTRATED does not maintain a diagram service. However, construction articles on transistorized amplifiers will appear in future issues. Booklets on transistor application are available from Raytheon, Sylvania, RCA, GE, Motorola, and other large producers with a number of schematics that would fulfill your immediate requirements.

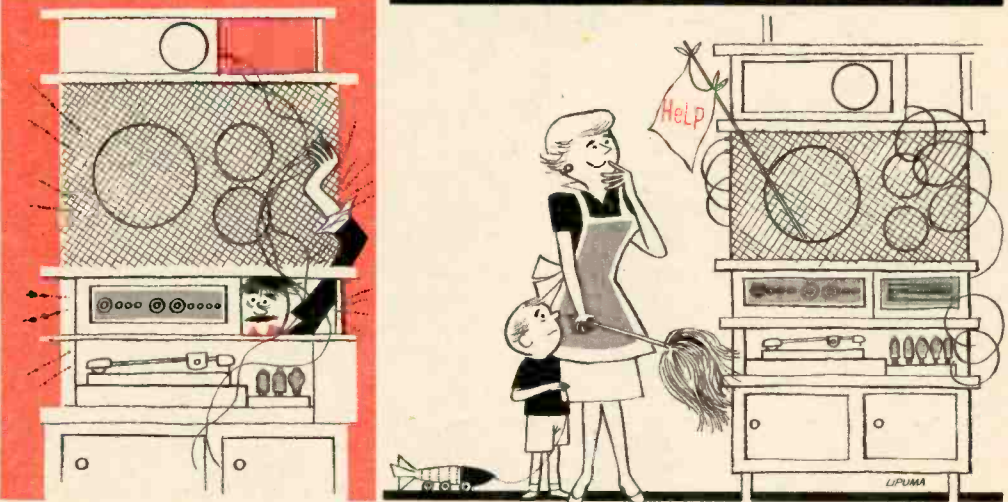
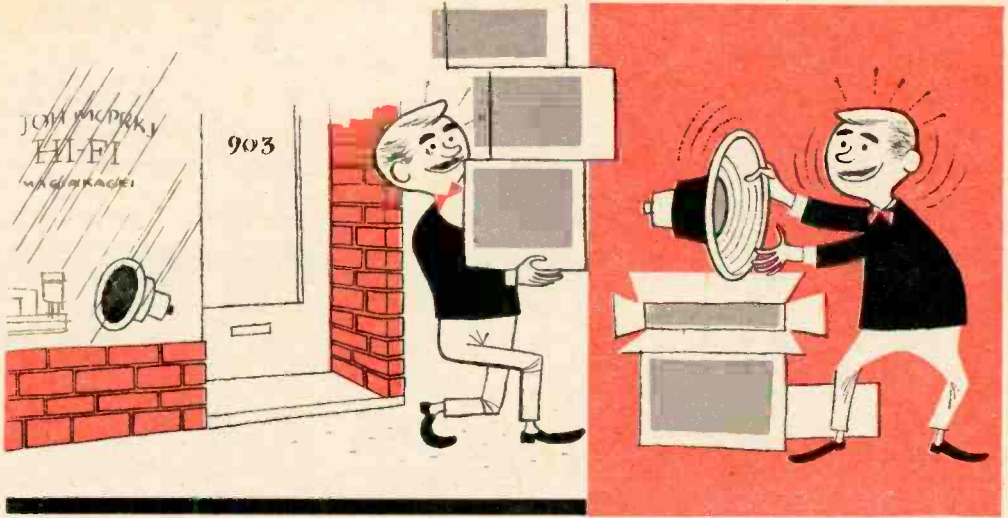


Feedback

I recently set up my hi-fi rig after moving to a new location and something very odd is occurring with the new arrangement. I can't turn the volume control of the amplifier beyond a certain point without the speaker sort of "roaring" at me. This only happens when I'm playing the phonograph, not the tuner. What's your guess as to what's wrong?

Tom Bell, Atlanta, Ga.

What you're experiencing is probably a bad case of acoustic feedback from your phono cartridge to the speaker. Vibrations from the speaker cabinet in this set-up are transmitted directly back to the stylus. Either the speaker is physically too close to the turntable, or your turntable is mounted on something that is resonating to the louder passages reproduced by the speaker. The cure is to reposition your speaker and turntable so the same acoustic path no longer exists.



Shooting For The Moon

By John L. Springer

America's lunar probes gather data essential for space travel, and here is how it's done—

THE big four-stage Thor-Able I blasts off from its flame-filled launching pad at Cape Canaveral. Almost hesitantly at first it rises, a stream of flame and smoke spewing from its tail. It pierces the sky with growing fury at speeds up to 20,000 miles per hour. Minutes later it is through the clouds and beyond sight.

Now we wait. Two days and 14½ hours after the tense moment on the launching platform, the rocket's teardrop-shaped instrument package reaches its destination, the moon's gravitational field—the first step of our amazing conquest of a body in outer space.

Unlike Columbus and other adventurers, modern-day explorers are not human, but electronic marvels of breathtaking daring and ingenuity. For "shooting the moon," like man's earlier successes in rocketry and satellites, would be impossible without the knowledge and practical application of the electronics scientist. Hundreds of amazing electronic devices are needed to make this feat possible. Most are in the top secret category and many were mere dreams of their designers only months ago.

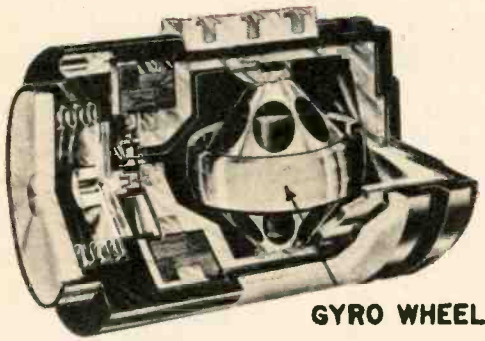
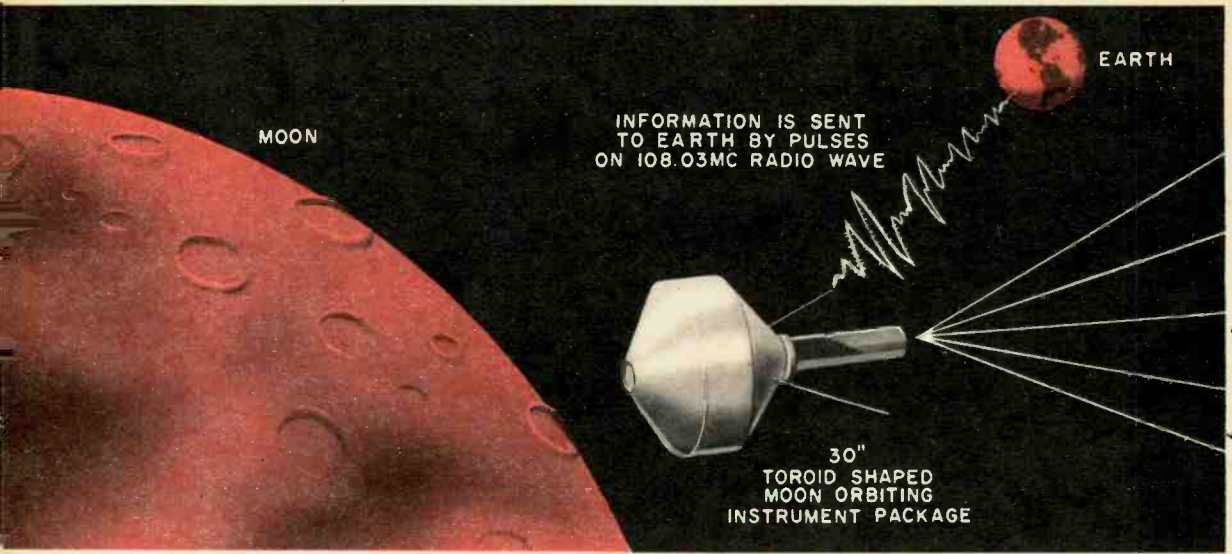




Thor-Able I, the Air Force's lunar probe, stands ready (right) to deliver its 85 lb. instrument package to moon's vicinity. At left, 60 feet of spider web-like antenna for automatic telemetry tracking, towers over man on 7-story tall base.

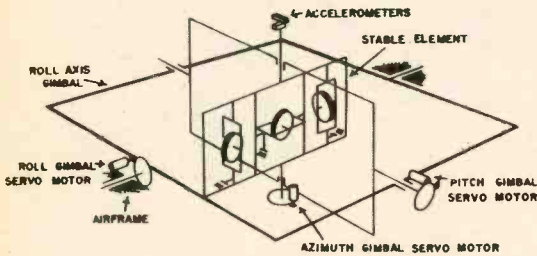
Complex telemetry racks for rocket firing, guidance and data gathering get serviced and modified almost constantly to avoid hitches when the chips are down.





GYRO WHEEL

Honeywell



Aviation Week

Heart of inertial guidance is spinning gyro, a stable reference regardless of conditions and in all planes, as shown in diagram. Gyro pictured in cutaway is only 2.7", 1/2 lb. System using gyro, computer, accelerometers, helps rocket remember starting point, destination.

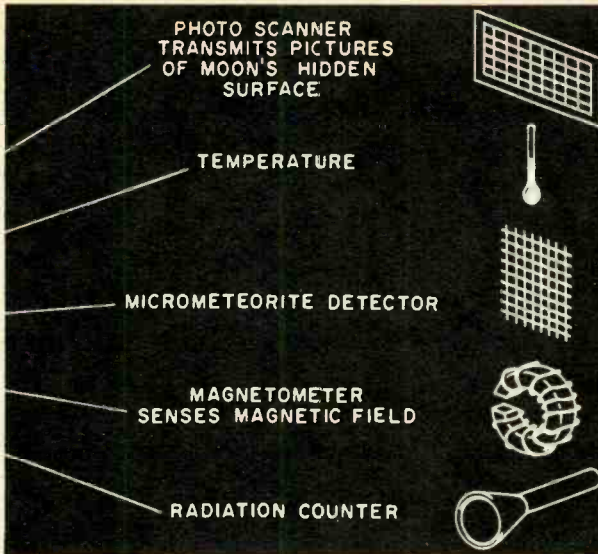
The lunar probe vehicle itself stands 88 feet high. The first stage, the standard USAF Thor, weighs over 100,000 pounds and delivers an initial thrust of 150,000 pounds. The "Able" addition adds eight spin rockets.

The earth, being itself a body in space orbiting around the sun and spinning on its own axis, is a rather unstable platform for shooting the moon, but the only platform we have. Sending the moon rocket off in the right direction is of the utmost importance, just as important as keeping it on course in outer space. Therefore the moon rocket requires two guidance systems—one to direct it out of the earth's atmosphere and gravitational pull, and one to guide it across outer space.

The first is an inertial guidance system like that of our ICBMs. Using this system the rocket directs its own course. The second guidance control method involves navigating the rocket electronically from the earth.

The inertial guidance system, once a highly hush-hush item, employs some of the most complex instrument packages that have yet come out of the the electronics lab. It is an electro-electronic-mechanical arrangement designed with the utmost precision.

Inertial guidance, as applied to rockets and missiles, is invulnerable to enemy jamming, independent of ground



Telemetering the moon shot enables earth-bound scientists to receive and interpret new and important data that will eventually permit interplanetary travel by humans. Conditions in outer space and the moon's gravitational field such as temperature, cosmic radiation, magnetic fields are encoded into one radio signal which is transmitted back to earth at 108.03 mc. Widely scattered receiving stations record the signal, then decipher it by measuring frequency, spacing and length of pulses much as a detector in your television set separates audio and visual signals, horizontal and vertical pulses, etc. A separate transmitter for each of the satellite's telemetering instruments is therefore not required.

facilities and does not emit radiation which can be detected by an enemy. It is designed to operate in all temperatures, through shock and vibration.

Such a system employs accelerometers that instantly sense and measure any change of direction or speed and warn the remainder of the system when the rocket veers off course even slightly. But the heart of every known inertial guidance system is the gyro. The gyro maintains a stable platform for the accelerometers while an electronic computer calculates positions in 1,000th of a second and immediately signals other mechanisms that must make certain adjustments to keep the rocket on course.

The second guidance control for the moon-bound rocket involves the use of radio. Telemetering equipment in the rocket beeps its data into space and these radio signals are picked up here on earth, fed into a control center computer which calculates the rocket's exact speed and relationship to the moon. Signals are then transmitted from earth to direct the rocket.

On the way toward the moon's gravitational field, the rocket's most urgent job is the measuring and recording of cosmic rays in outer space beyond the orbits of present earth satellites. The first United States and Russian satellites found that intense radiation about 500 miles up literally choked the Geiger

counters sent along to check it.

Other devices in the rocket's 30 pound moon-orbiting instrument package are designed to measure temperatures, solar rays, gases, the impact of micrometeorites and the strength of magnetic fields in interplanetary space. Most of the instruments are geared to run on batteries recharged by the sun and the data gathered will be broadcast back to earth at 108.03 mc. The toroid-shaped moon satellite resembles a 30-inch angular mushroom.

Widely scattered stations have been set up to track the lunar probes. They are located at: USAF Missile Test Center in Florida; Millstone Mountain, New Hampshire, operated by MIT's Lincoln Laboratories; Manchester, England, site of the world's largest radio telescope; Singapore on the Malay Peninsula; and Hilo, Hawaii. Information gathered at these locations is recorded on magnetic tape and relayed to the Air Research and Development data reduction center in Inglewood, Calif.

Scientists have always wondered what's on the side of the moon that always faces away from the earth and has never been seen by man. The moon's hidden side, roughly 40 percent of its total surface, may be explored by a TV-like scanning device using infrared light. When the strange vehicle con-

[Continued on page 104]

how to build a safe rocket—part 4

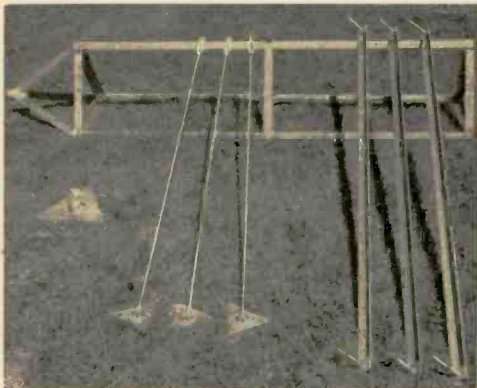
A Launching Pad

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

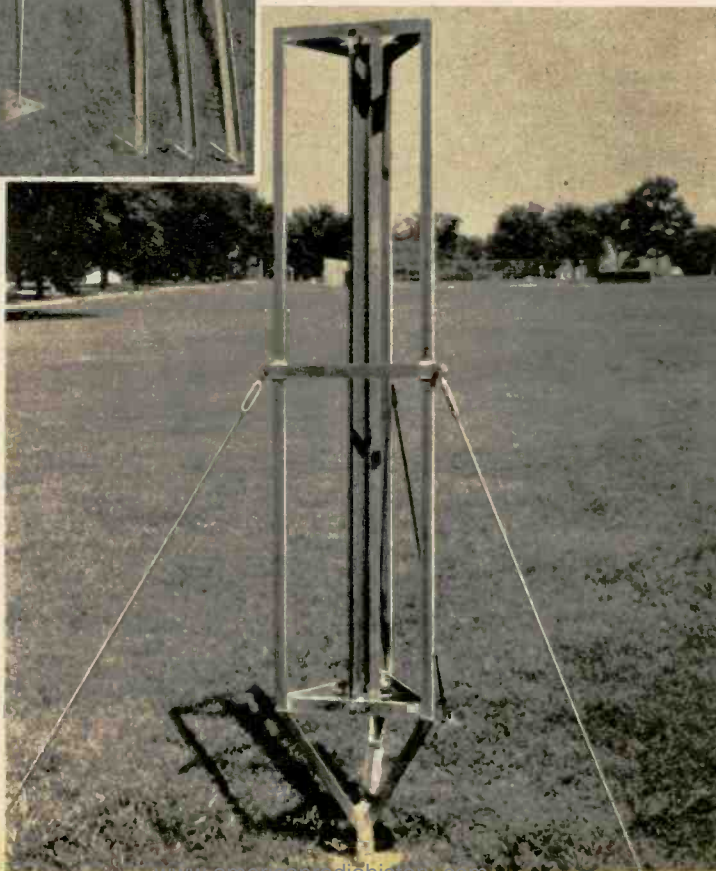
Corps of Engineers, U.S. Army
Chairman of the Advisory Committee for Missile & Rocket Amateurs
National Capital Section, American Rocket Society

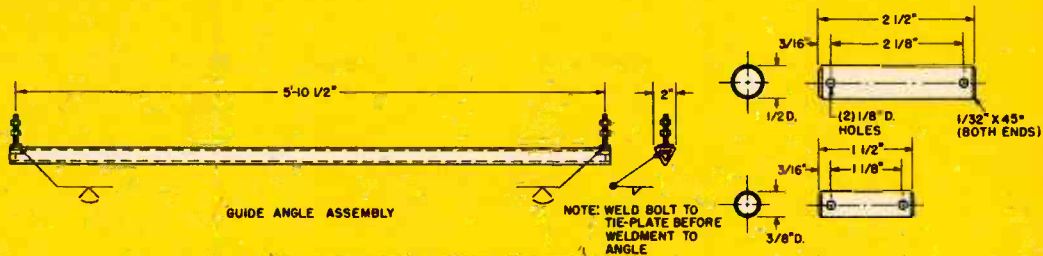
IN THE July issue we discussed the safety rules and plans for a safe model rocket, in September it was how to fuel your model rocket, in the October issue it was how to test your rocket, and now we shall discuss the launching pad for your rocket.

If you haven't already, it is imperative that you now look up the rules and laws of your community regarding the firing of rockets and **OBEY THEM**. Check with the Chief of Police, the Fire Marshal, the local Civil Aeronautical Authority and the

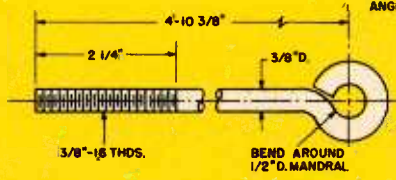


At left are major parts of the launching pad. Below, the pad is erected, ready to receive rocket. Local officials, civic or military, should be consulted before the actual firing of rocket. On facing page are detailed plans for building launcher.

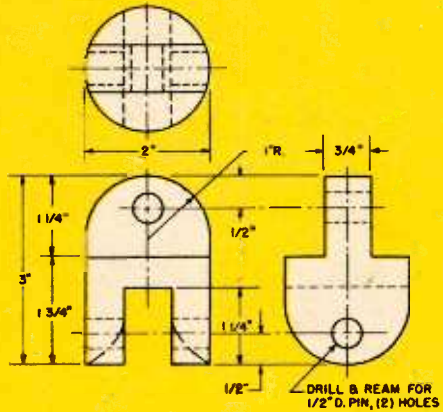




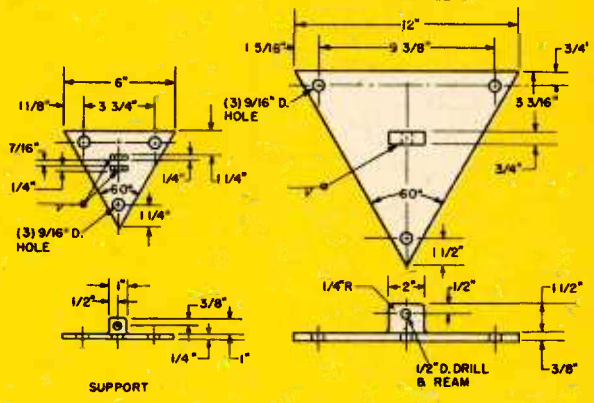
GUIDE ANGLE ASSEMBLY



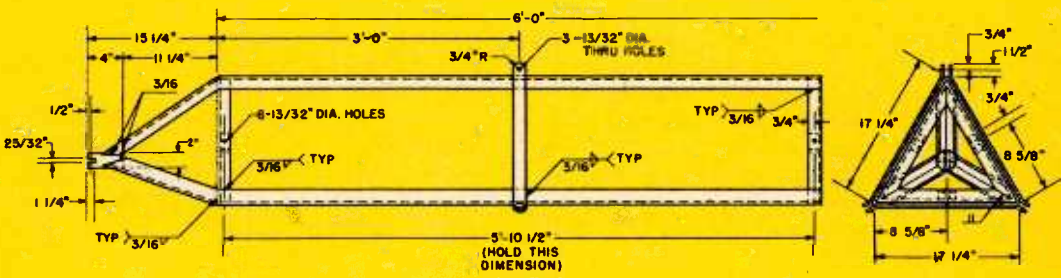
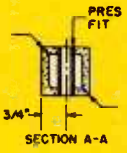
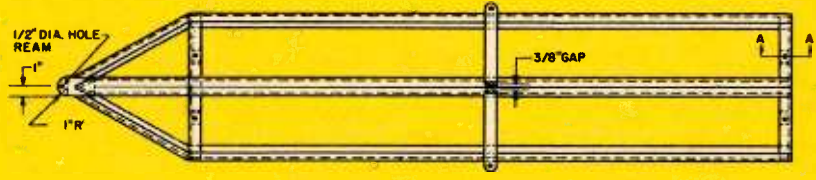
SUPPORT ADJUSTING ROD STEEL



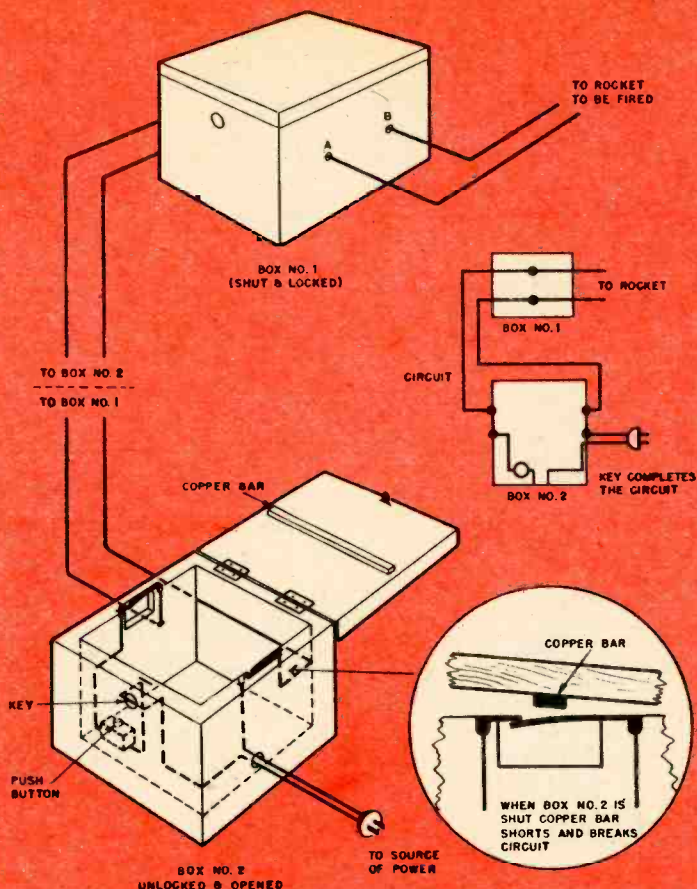
CLEVIS ALUM. ALLOY



BASE



The Firing Circuit shown here is the most important piece of safety equipment and must be built according to diagram and instructions.



agency that your local authorities have asked to coordinate the local amateur rocket clubs, groups or societies.

Nine times out of ten you will find that once you have checked in with the authorities mentioned above that the answer is NO, you can't fire your rocket in this community or surrounding area.

The question that confronts you now is what to do. Let us stop for a minute or two and look at this problem from a few different angles. Depending on your ability and knowledge, your rocket, once launched, might travel as high as 2000 feet and that far again from your launcher. Remember, 2000 feet is four times as high as the Washington Monument. Then again, your rocket might explode and burn on the launcher or explode just after launching.

But let us assume that your rocket leaves the launcher with a great deal of thrust. What control do you have over

the rocket? Why, none. What direction will it travel? You hope in the direction that it was pointed but you can't be sure. What will happen if the rocket is still burning when it lands? Depending upon the remaining thrust the rocket will scoot about on the ground obeying Newton's second law of motion. Where will it land? Even the experts couldn't tell you. What happens if your rocket lands in a hay stack or in a large vacant lot overgrown with grass that is now dry? A blazing inferno is the answer.

We advise that you:

1. Join a recognized and qualified rocket club.
2. Have representatives of all qualified clubs in the same area get together.
3. Write to the Department of Defense, Washington, D. C., and request a copy of directive DOD 5410.9.

[Continued on page 110]

Your set's model and serial number are on rear cover. Tube layout sheet is inside cabinet.



Fix Your TV Set

By Lawrence Herrick

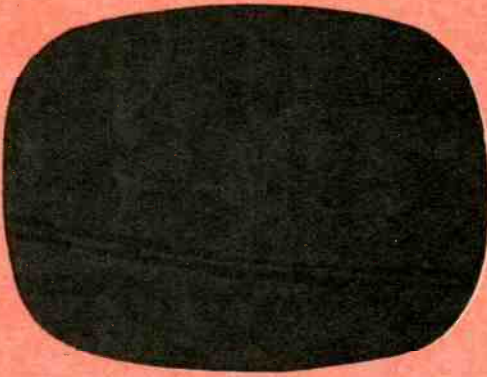
**Find faulty TV tubes with the EI Picture Chart—
a key to localizing most of your TV set trouble.**

ONE of the first rules for rapid repair of any electronic equipment is to localize the trouble. This procedure is simplified in the case of TV receivers since most of the time the symptom will appear on the picture tube. Then, with the aid of the chart accompanying this article, the defective tube may be located and replaced.

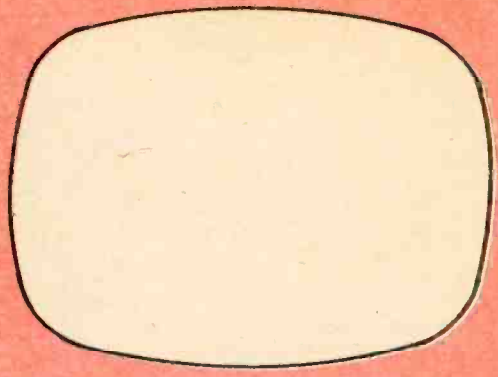
Some symptoms are perfectly obvious—for instance, a loss of height, width, or both; dark screen, etc. Other symptoms are more subtle and can best be detected when a test pattern is on the screen. If the symptoms fall into this category, that is, if an inspection of the picture doesn't permit you to determine just what is wrong, postpone operations until you have a little spare time some morning to check reception with a test pattern coming in.

Tubes are listed in the chart according to function, not tube type. Before you can make the substitutions indicated in the chart, you must know which tubes in your set are performing the functions listed in the chart. To determine the function of any tube in your receiver, do the following;

[Continued on page 102]



DARK SCREEN, NO SOUND; low voltage rectifier. If series set, any open filament. If sound OK, hi-v. rect., damper, horiz. output, oscillator.



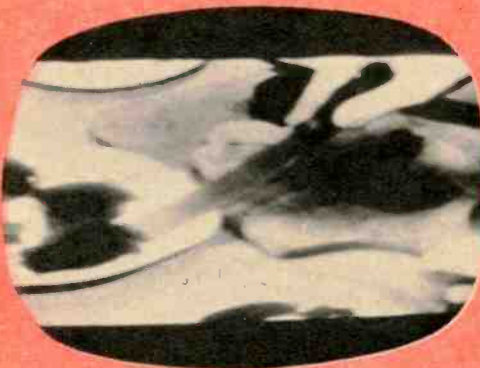
NO PICTURE, NO SOUND, RASTER OK; RF amp., HF osc., mixer, video IF, amp., or detector. If sound normal, check video amp., video detector.



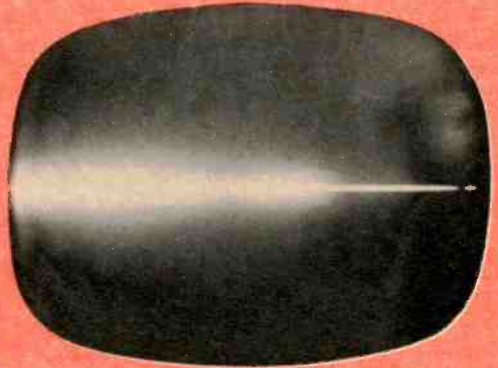
WEAK PICTURE WITH SNOW; RF amp., AGC. If picture is weak with no snow, check HF oscillator, mixer, video IF, video detector, video amp.



INSUFFICIENT WIDTH; horizontal output, damper, low voltage rectifier, horizontal oscillator.



INSUFFICIENT HEIGHT; vertical output or osc.



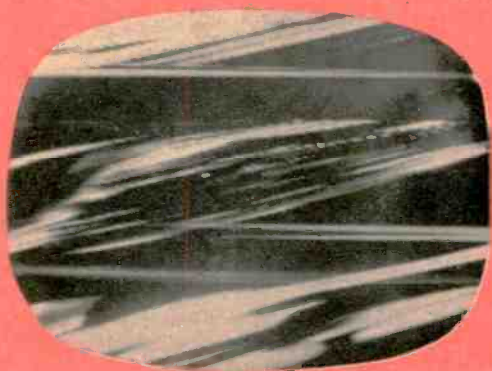
HORIZONTAL LINE, NO RASTER; vertical output, vertical oscillator.



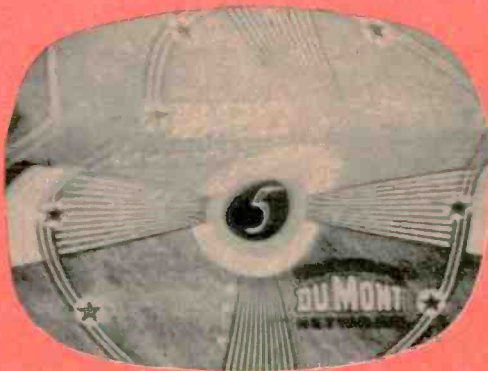
SMALL PICTURE, INSUFFICIENT HEIGHT AND WIDTH; Low voltage rect., damper, horiz. output.



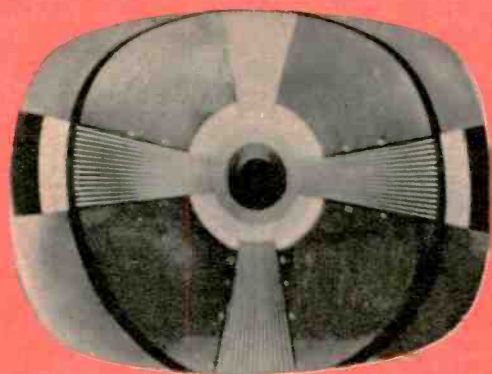
LOSS OF VERTICAL SYNCH; vertical oscillator.



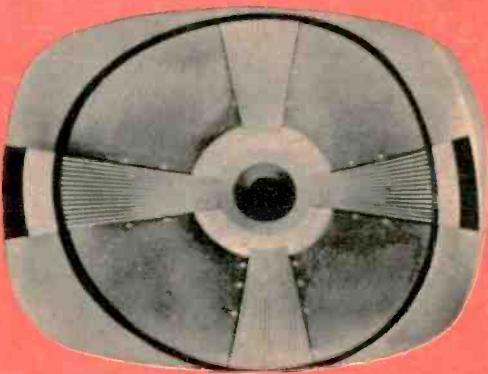
LOSS OF HORIZONTAL SYNCH; horiz. osc., AFC.



HORIZONTAL PULLING; RF amp., video IF amp., video detector, video amp., horizontal osc., AFC, synch separator, synch amp.



VERTICAL NON-LINEARITY, TOP WEDGE SHORTENED; vertical output, vertical oscillator.



HORIZONTAL NON-LINEARITY, RIGHT WEDGE SHORTENED; horizontal output, damper, or horizontal oscillator.

we try for a

Radio Controlled Model Airplane Record

By William Winter

Dawn-to-dusk in the air is the ambitious goal of these R/C modelers, but their problems are many.

WITH radio control of model planes, boats, cars and even decoy ducks a routine matter, the hobbyist wants new worlds to conquer. Miniature boats and airplanes have been guided across the Catalina and English Channels. A six-foot long plane remained aloft for 5½ hours—a model glider more than seven. But here's the story of a really king-sized project—a dawn-to-dusk flight of a model airplane!

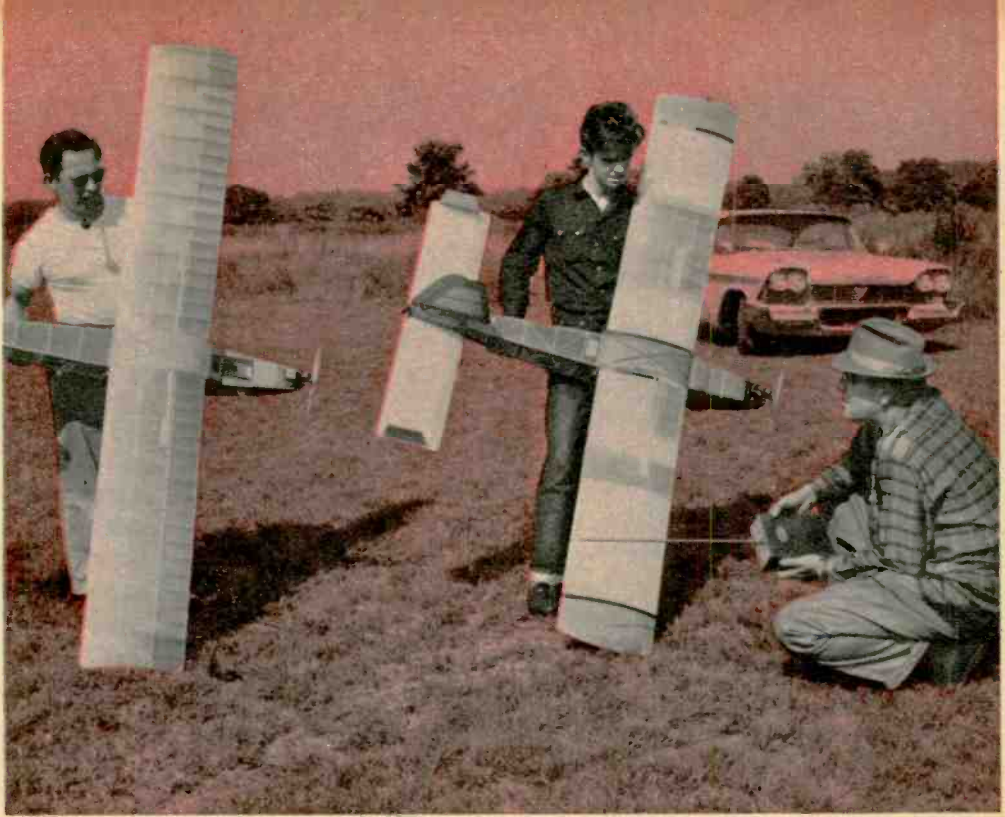
Federation Aeronautique Internationale, with headquarters in Paris, has strict rules governing record flight attempts. The model plane must take off from the ground and may not exceed a gross weight of 11 lbs.

Electronic equipment must be light and reliable and a power plant with the lowest rate of fuel consumption is essential. Trying to strike a practical weight balance between the electronic gear, engine and fuel, then trying to build a plane around them is

Shown alongside familiar dry batteries, two VO-500s (left) and four LRO5s (center foreground) were excellent in-plane power packs.

Essco receiver (at rear with tiny meter) is operated by on-off carrier. All-transistorized CG (cover removed) uses modulated tone.

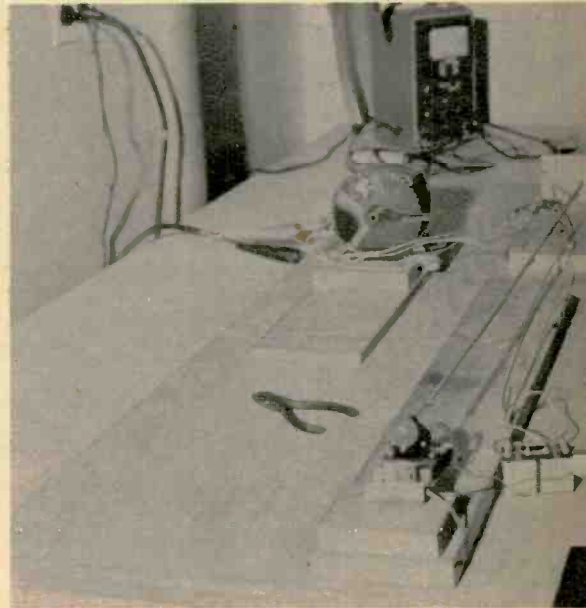
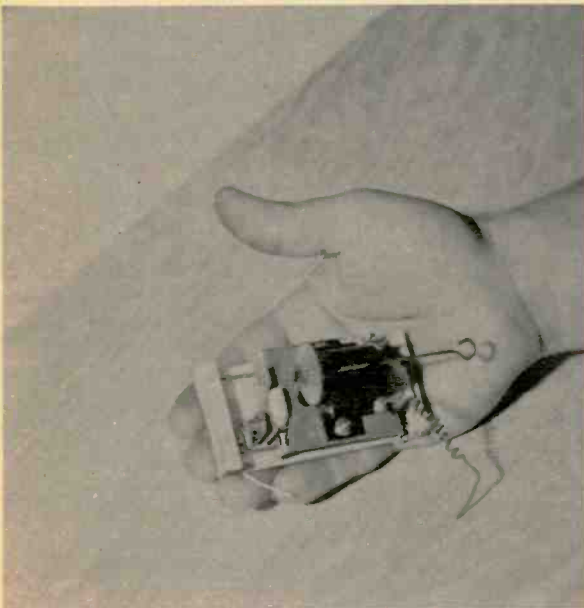




Author (with R/C transmitter, right) inspects two 13-hour capability test models in field.

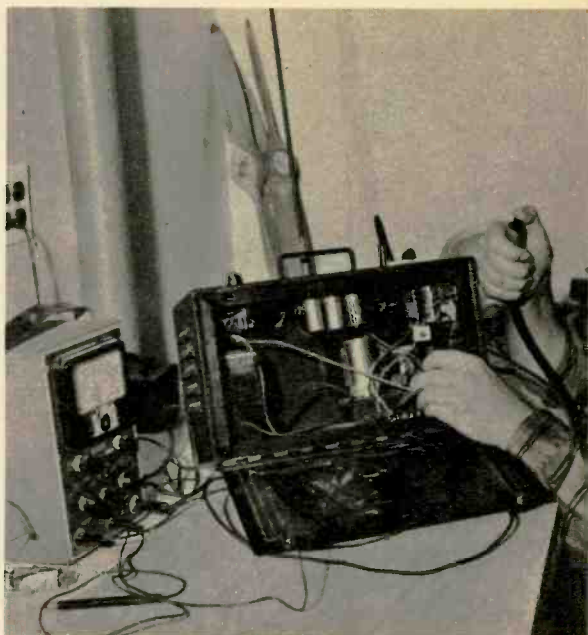
This small motor is mounted on wire runners and winds rubber escapements. It is turned on and off by varying tension in escapement.

Tests run continuously. Below, keying disc on slow speed motor at rear triggers rubber escapement which is hooked to winding motor.





Bramco tone xmtr works CG rcvr. Keying lead with phone jack allows placement on car roof.



In carrier wave operation, Essco with 2v wet cell and built-in charger, vibrator was used.

nothing short of a designing nightmare.

Six months of testing, automatic keying devices triggering trial equipment on a 24-hour basis, setting up and then changing the positions of system components, dozens of flying sessions, and lots of worry were what faced the builders of this radio controlled 13-hour capability "test" airplane.

Selecting fuel and engine was the first step. After three months of engine testing, P.G.F. Chinn, British authority on miniature engines, came up with a .09 Diesel engine that burned about three ounces of fuel per hour. At this rate the fuel tank would have to hold about 48 ounces to sustain a dawn-to-dusk flight. So heavy a fuel tank would have to be placed at the plane's center of gravity to achieve proper balance. But such a move puts the fuel too far from the engine. The answer: Pressure fuel feed using a float chamber to supply fuel to the engine on demand.

Engine requirements met, the next knotty problem was making some provision for bringing the model down from excessively high altitudes which inevitably would be reached many times

during a long flight. Engine-throttle control was not practical because varying throttle adjustments on such a small engine might lead to engine failure. Elevator control was undesirable because of speed build-ups in dives which might overload the structure or cause engine stoppage due to over-revving. Violent aerobatics due to "spinning down" the machine were taboo for the same reasons.

The answer was the "spoiler"—a small appendage extending vertically from the upper surface of the wing. This tends to reduce lift and permits a shallow dive. For steering, rudder-only control is adequate.

These simple controls required a compound actuator to be worked by a simple single-channel receiver. Limited to products readily obtainable in any hobby shop, the designers used a compound type escapement to mechanically power the rudder and spoiler. (Bonner and Babcock motor servos subsequently were used in two test ships.) The compound escapement is rubber-strand driven. One long pulse gives one rudder
 [Continued on page 106]

another EI sun-powered project

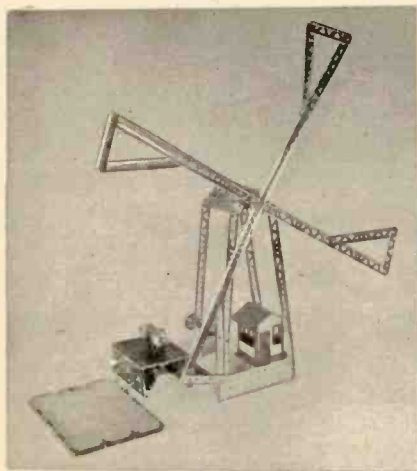
Fun With a Sun-Powered Motor

By Lou Garner

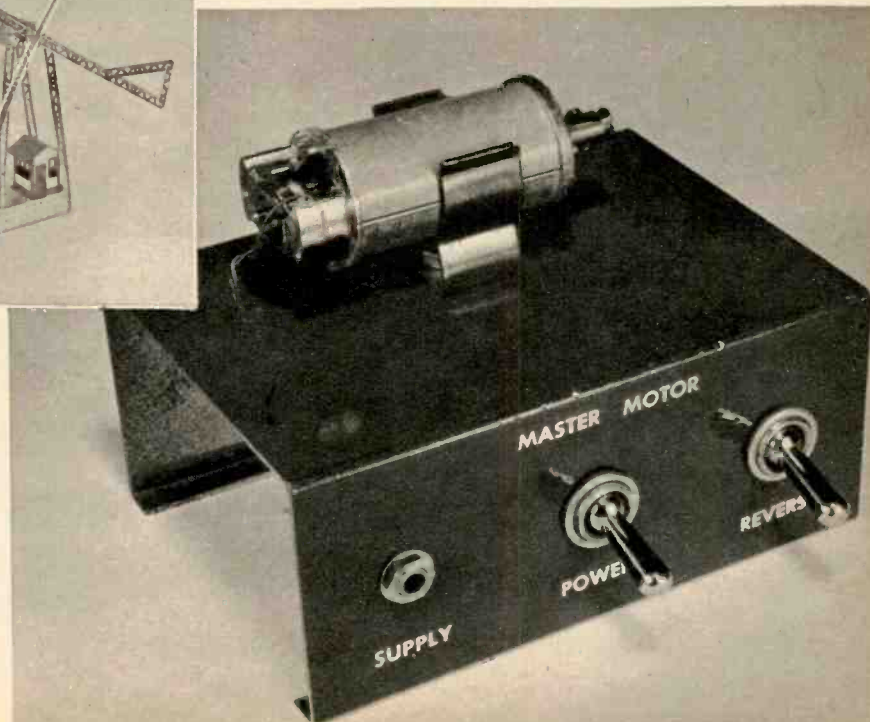
A miniature power plant to operate toys, models, or window displays, is recharged by solar energy.

SMALL, low-power battery-operated motors have dozens of useful applications. You can use them to operate scale models, toys, small fans and stirrers, and in similar projects around the home. Industry uses them in small instruments and to operate scientific and educational displays. Department stores and merchants use them to operate eye-catching store window and showroom displays.

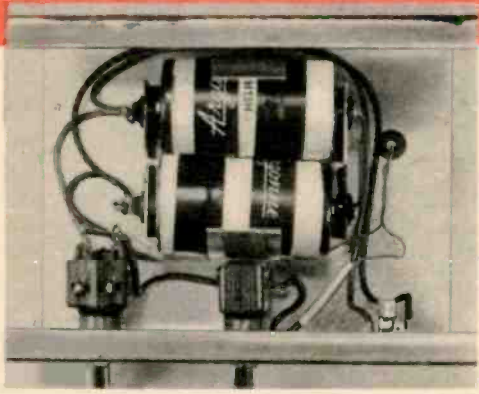
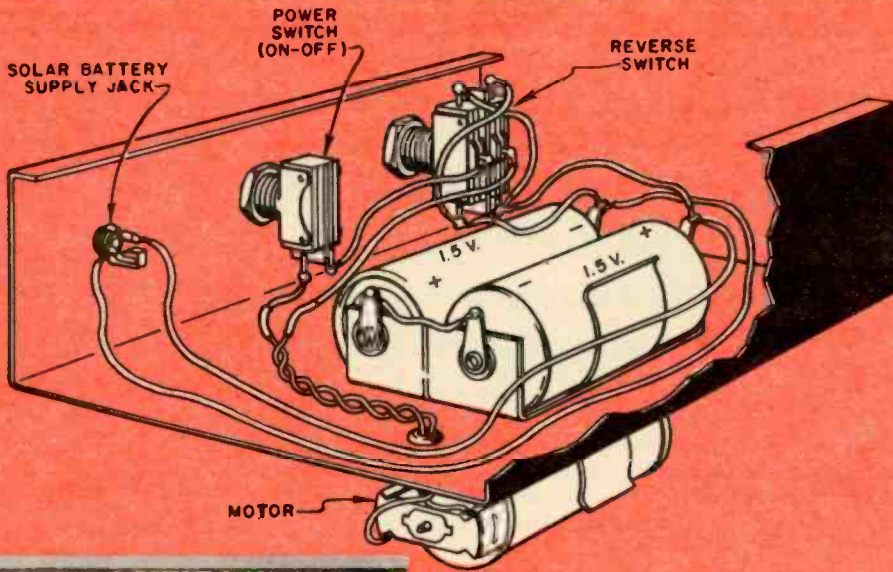
An important limitation on the use of these motors is their relatively high cost of operation. While these motors, in general, are powered by standard flashlight cells, their current require-



At left the motor assembly powers a toy windmill. The large flat plate is the Sun Battery that recharges the cells in the unit. Seen below are motor and chassis. The motor may be conveniently mounted by snapping it into a 60 ampere fuse clip.



November, 1958



Underchassis view of the 3 volt assembly. Add two more cells in series for 6 volt operation.

The motor shaft is shown being wound with electrical tape to fit oversized gear or pulley.



Follow the wiring guide above. However, the exact placement of the parts is not critical.

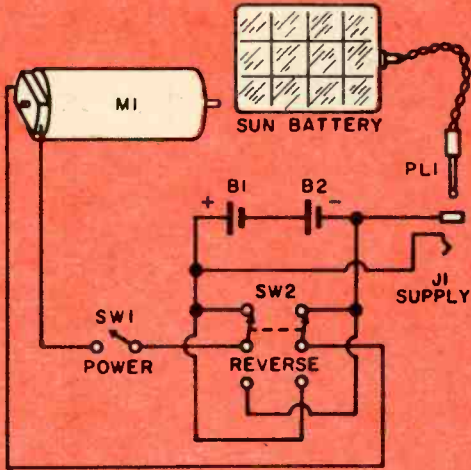
PARTS LIST

- SW1—SPST Toggle switch.
- SW2—DPDT Toggle switch.
- J1—Miniature jack.
- PL1—Plug, to fit J1.
- B1, B2—1½ volt rechargeable flashlight cells (Lafayette No. BA-10).
- M1—Low drain battery motor (Lafayette No. F-285).
- Sun Battery—6 volt Solar Battery (Lafayette No. F-380).
- Chassis—Aluminum, approx. 3¼" x 4½" x 2".
- Battery holder—For (2) Size "C" cells.
- Large fuse clip—for motor mounting (Union type 31-60A).

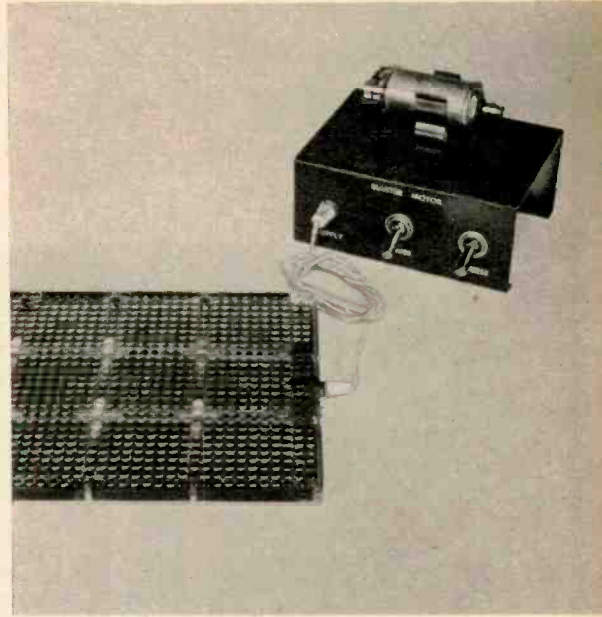
ments are such that a typical cell lasts a comparatively short time.

However, with the recent introduction of a high-efficiency motor and the commercial availability of a high-output Sun Battery and moderately priced rechargeable flashlight cells, you can now put together a useful motor assembly which derives its ultimate power from the Sun . . . an unlimited source of "free" energy.

The very small motor specified in the PARTS LIST will operate with from 3.0 to 6.0 volts. The higher the operating voltage applied to the unit, the greater the torque the motor can de-



After charging cells, Sun Battery may be disconnected. Motor uses energy stored in cells.



Don't put the glass-topped Sun Battery too near a light bulb. Excess heat will damage it.

velop and the higher its no-load speed. If you intend to use the completed assembly for light-duty applications only, you can plan on a three-volt power supply (as was used in the model).

For a three-volt power source, use a single dual-battery holder, wiring the two sections in series. To use the motor to operate a model, toy, or display, you'll need to mount a small pulley or gear adaptor on this shaft. If you have difficulty finding a pulley or gear which matches the motor's shaft *exactly*, obtain a unit with a slightly larger hole and bush out the motor's shaft to provide a snug fit, applying one or more layers of Scotch electrical tape. Stretch tape slightly as you apply to insure good adhesion and a smooth, round surface.

The Sun Battery used to recharge the motor's built-in batteries is supplied with a flexible connection cord equipped with two subminiature plugs. One of these fits the battery's own "output" jack. The other should be replaced with a plug to match the motor assembly's power SUPPLY jack (J1). Be sure to observe correct polarity, checking the Sun Battery's output with a voltmeter if necessary.

To use the motor, simply couple it to the toy, display, or other item you wish to operate, using an appropriate drive belt or gear train. In general, the use of small pulleys and a drive belt is preferred, for this arrangement permits a certain amount of "slippage" and makes it easier for the motor to start under load. A small rubber band makes an excellent drive belt if only light loads are to be driven by the motor.

To recharge the built-in battery power supply (B1, B2), insert the Sun Battery's output plug (PL1) into Supply jack (J1). Full sunlight is best, but an acceptable charging rate may be maintained if the unit is exposed to a fairly strong artificial light.

The Sun Battery is a multi-cell unit having a nominal output rating of six volts, and, therefore, can be used to recharge up to four cells in series. Don't worry about damaging your rechargeable cells if you've used a three-volt (two cell) power pack, however, as a greater load is placed on the Sun Battery, its output voltage drops. In actual practice, its no-load (open circuit) output voltage may reach as high as seven volts in full sunlight. ●



The unit, placed under lamp base near window, responds to the amount of light outdoors. It is insensitive to auto headlights or lightning.

On the rear panel from left to right; on-off switch, R2 sensitivity control, 1-inch photocell window, and AC receptacle for lamp plug.



The Skywatcher

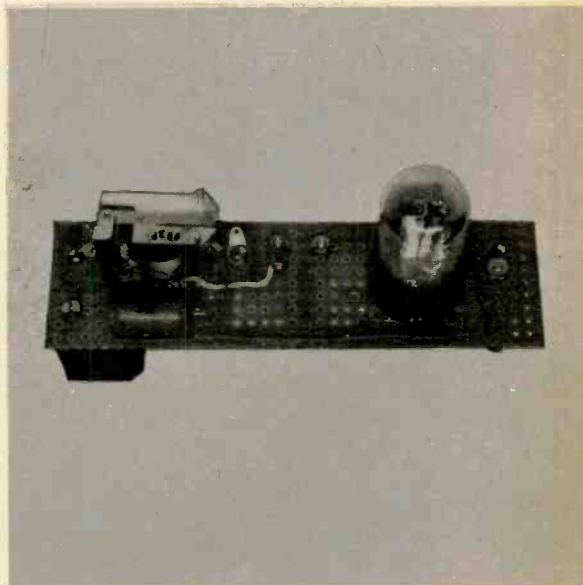
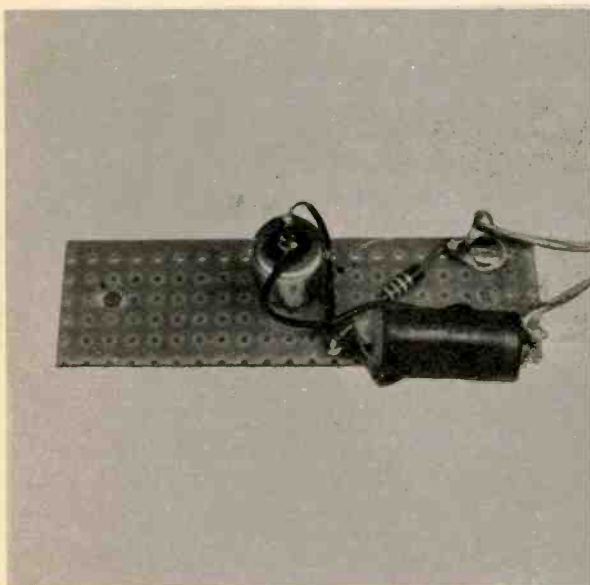
By Harvey Pollack

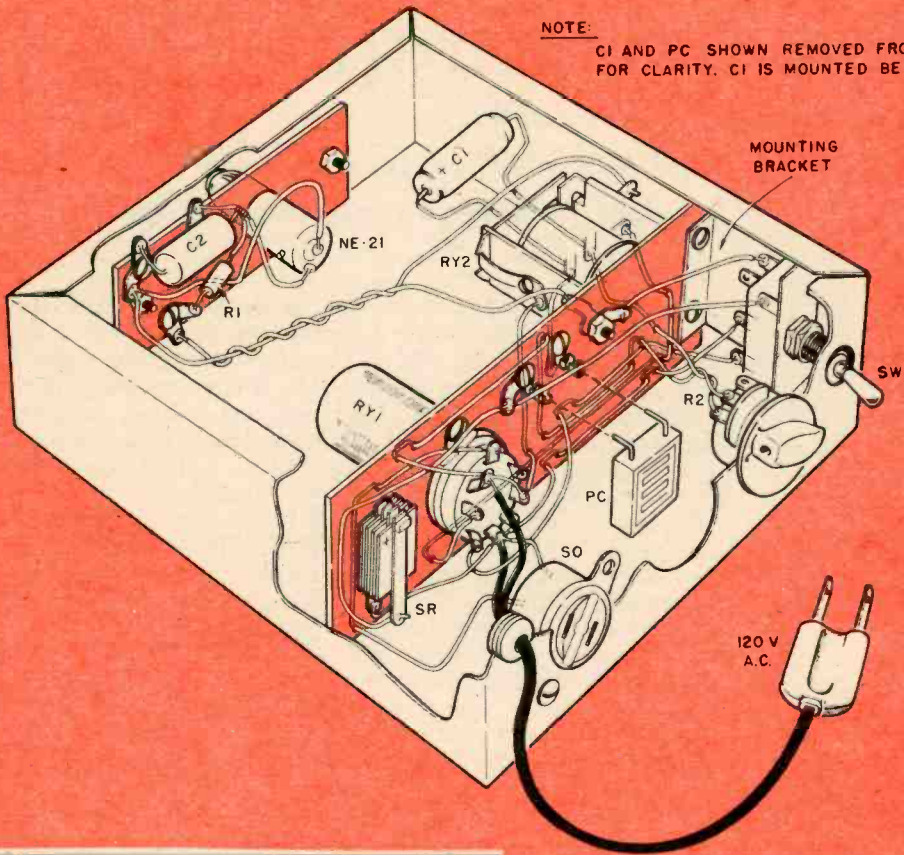
Build this effective countermeasure against home burglary. It automatically turns on lamp at night.

ACCORDING to some recent newspaper surveys, the best measure against home burglarizing is to leave a lamp or other light on at night. Of course, if you are going away for an interval greater than a day or two, this poses some problems. Apart from the fact that electricity costs money, a lamp that burns continuously is a dead give-away to a criminal that happens to be "casing" the neighborhood. This is like hanging a sign that says "Nobody Home" in your window!

Comparatively little in the way of time, effort and money is involved in building the SKYWATCHER, an electronically controlled lamp base that will turn on one or more lamps with the coming of night. At daybreak, regardless of the weather or the density of the clouds, it will extinguish the lights until the next evening. But that's not all! The SKYWATCHER has been designed with other unique and uncanny "abilities." For example, suppose you go out during the afternoon and return after nightfall; you will find the lamp glowing brightly when you return so there will be no fumbling for light switches or pull-cords. You leave the lamp on for the evening and, when you

Below left is the neon-winker sub-chassis. The leads are soldered directly on the base of the bulb at center. C2 may be seen with R1 above it. Below right is RY2 with C1 below it. At other end of board is thermal relay RY1.

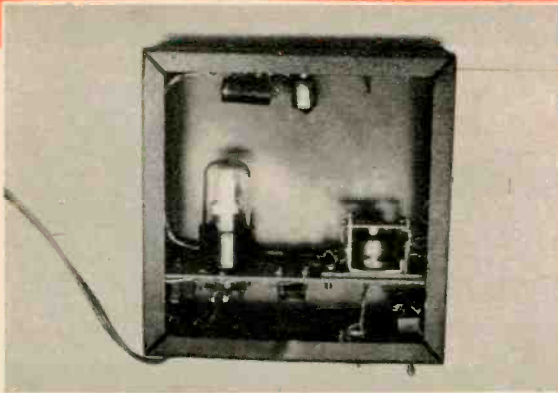




NOTE:
C1 AND PC SHOWN REMOVED FROM CHASSIS
FOR CLARITY. C1 IS MOUNTED BELOW RY2.

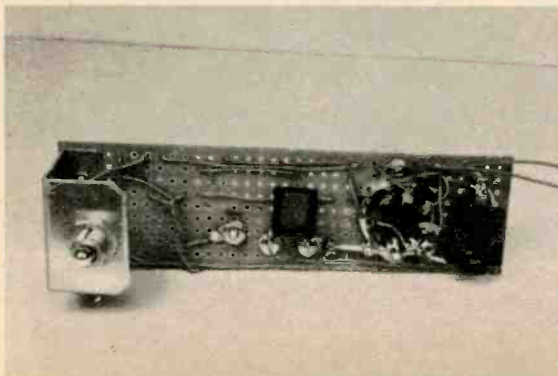
MOUNTING
BRACKET

120 V
A.C.



The two sub-assemblies, in guide above, are wired before mounting in chassis. To avoid any shock hazard don't connect any of the wires to the metal chassis.

Bottom view of unit. Appearing like a tube, RY1 is visible at left. RY2 is on the same board to the right. Complete unit costs about 70¢ a year to operate.



Underside view of the larger sub-chassis shows, from left to right, toggle switch with bracket, photocell (center), octal socket for RY1, and selenium rectifier.

Electronics Illustrated

are ready to retire, you turn off the switch. The lamp does not extinguish immediately, but remains lit for a sufficiently long period of time to enable you to reach the bedroom without hurrying or stumbling into things in the dark. The arrival of daylight triggers a little winking neon bulb into action so that you are reminded to turn the SKY-WATCHER on again to ready it for the next night. Once the switch is moved to ON, the neon light goes out and, to all intents and purposes, everything about the lamp is off.

Construction should be started by cutting a piece of perforated bakelite measuring $6\frac{1}{2}'' \times 1\frac{5}{8}''$ from a larger sheet. This serves as the sub-chassis that supports most of the electrical components.

A 1-inch round hole cut with a tube-socket punch acts as the window in the rear apron of the base through which sky light can reach the photocell located about 1 inch behind the hole. To avoid unsightly screw heads on the sides of the base, a short bracket cut from scrap aluminum is used to hold the sub-chassis firmly in place by drilling it with a $\frac{1}{2}''$ hole so it will fit over the shank of the toggle switch. The parts are quite

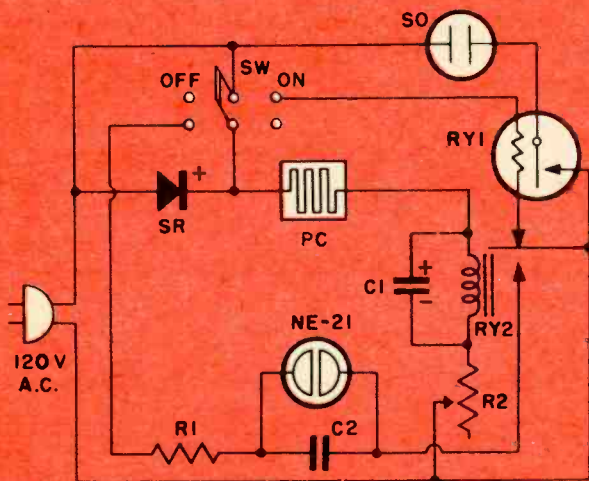
light in weight so that the toggle switch can do double duty—as a switch and as a bracket retainer. The bracket is folded so that it holds the sub-chassis about $1\frac{3}{4}''$ back from the rear apron. The photocell is held to the bakelite sheet by two solder lugs that may be bent outward to permit the transparent face to lie about 1" back of the hole and directly in line with it.

The time-delay relay looks like an octal tube and is held by an octal socket. The hole for the socket is most easily cut by a slow-speed 1" drill. However, you can cut it by first drilling with a $\frac{1}{2}''$ drill and then reaming or filing it to its final 1" diameter.

A second small piece of perforated bakelite is utilized to support the neon-winker, its capacitor, and its resistor. Drill a $\frac{3}{8}''$ hole in its exact center and slowly, ream it out until the NE-21 glass bulb just slips through and is held by friction. After assembly, the perforated sheet is held away from the front apron by two decorative-head screws passed through a couple of $\frac{3}{8}''$ spacers. Make the neon-winker peep hole in the front apron of the chassis quite small—say $\frac{1}{4}''$ —to keep it subdued and unobtrusive.

[Continued on page 107]

Schematic and parts list. Photocell resistance: dark-1 megohm, in bright light-under 100,000 ohms.



PARTS LIST

- C1—8 mfd. 200 v miniature electrolytic
- C2—1 mfd. 200 v paper
- NE-21—Neon lamp
- PC—Photocell, cadmium sulfide, Hupp Powermaster CDS-10
- R1—330,000 ohm $\frac{1}{2}$ w
- R2—25,000 ohm linear taper potentiometer
- RY1—Thermal time delay relay, Amperite 115NO60
- RY2—SPDT, 10,000 ohm coil Potter & Brumfield LB-5 10,000
- SO—AC chassis receptacle
- SR—Selenium rectifier, 65 ma. 120 v
- SW—DPDT switch
- Chassis—7" x 7" x 2" black ripple, Bud CB-789
- Bakelite—Perforated sheet $7\frac{1}{2}'' \times 6\frac{3}{4}''$
- Octal socket, bakelite
- Line cord, plug, solder lugs, hardware

Revive Your Speedlight

By Marshall C. Anderson

With a simple conversion you can renew the life of a Speedlight—and no additional parts are needed.

MY EARLY vintage speedlight had been powered by a pair of rechargeable wet cell batteries. The batteries were long-since worn-out and gone. In addition, one of the two large condensers in the power pack was shorted out and useless. Repairs and replacements would have been expensive, yet it seemed a shame to relegate it to the junk pile while there were still useful parts in it.

I solved the battery problem by converting the light to AC operation and the condenser problem by simply removing the blown-out condenser from the circuit. Result—a speedlight

Since conversion, this unit has given 2 years of perfect service. A battery charger replaces the wet cells, and a shorted condenser has been removed.



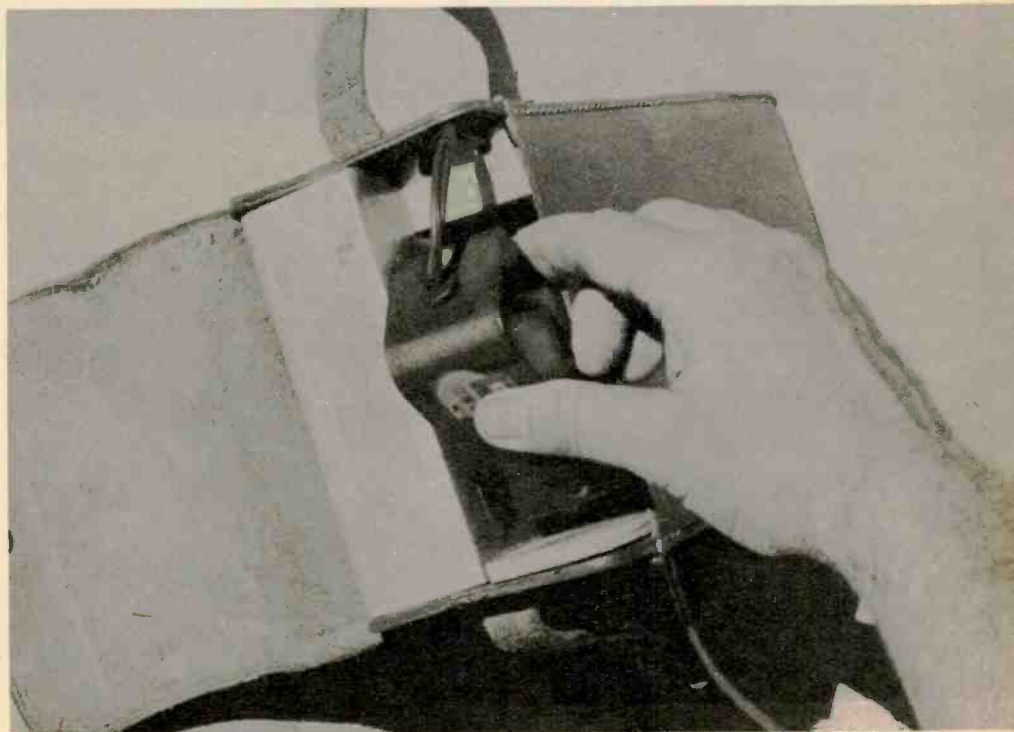
The original wet cell batteries, no longer rechargeable, are removed and discarded.



The battery charger wires are connected to the leads that originally went to the wet cells.



The charger and AC cord fit easily into the space formerly occupied by the batteries. Re-cycling time of Speedlight using the charger is slightly longer than with batteries.

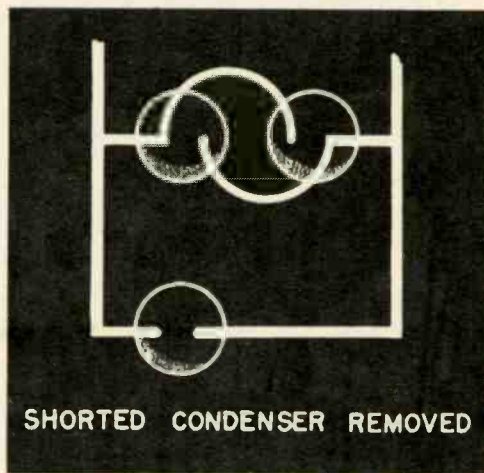
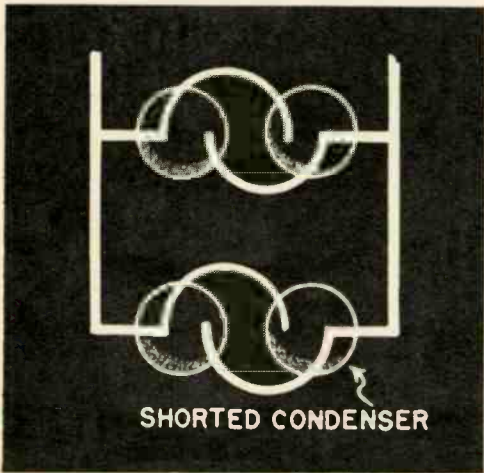




Bad condenser is replaced with a light wooden box (center right) to support the other parts.



Relay points are cleaned with very fine grade of emery cloth. See text for adjusting process.



"Bridging" the circuit. Text explains how to compensate for reduced light output that results.

that has served for over two years without missing a beat. Cost for repairs—zero.

A word of caution is in order before you open the case of any speedlight. The high voltage power supplies of these sets produce anywhere from 1200 to 3000 volts. Before working on a speedlight, let the set stand overnight. This will permit the condensers to lose most of their charge. If the light is in use, fire the lamp to discharge the circuit, then continue to push the firing button several times to bleed off as much charge as possible. Then let the set stand overnight before opening the case to work on it. When the case is opened, immediately short out the condensers several times by using a screw-

driver with insulated handle and shorting between terminals of condensers.

A speedlight powered by rechargeable wet cells can very easily be converted to AC operation by using the original battery charger as a power supply. The conversion costs nothing and can save a speedlight for which you no longer wish to buy batteries. Usually the chargers are dry rectifiers. Your light will not re-cycle as fast with the AC power supply as it did on fully-charged batteries since the capacity of the battery charger is small. On the speedlight shown, recycle time on AC operation using the old battery charger is 45 seconds.

[Continued on page 108]

The ABC's of Electronics-5

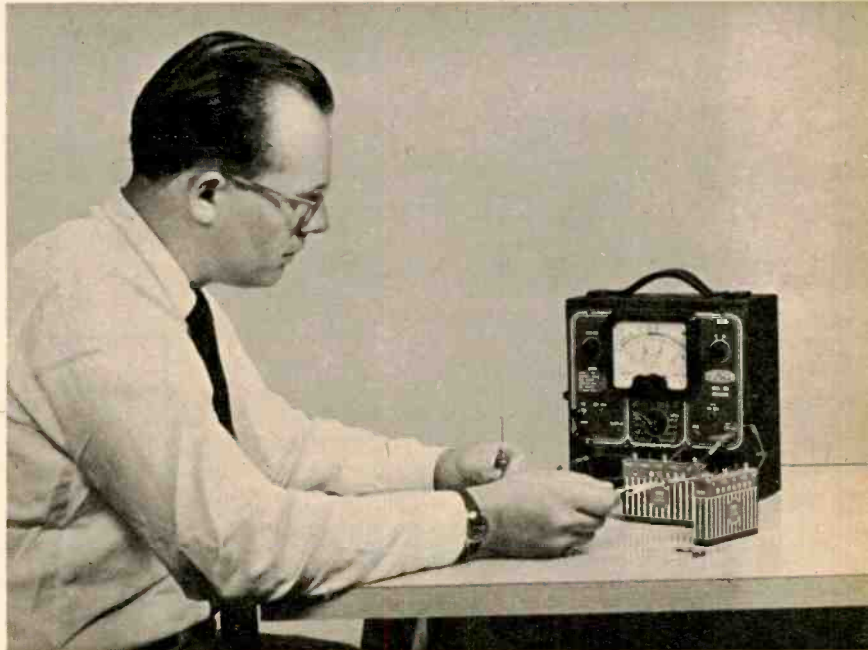
By Don Hoefler

Part five in this series describes Kirchhoff's Laws, used to solve problems where Ohm's Law falls short.

THE relationships between voltage, current and resistance defined in Ohm's Law enable us to determine circuit conditions in many types of complex series-parallel arrangements. But, just when we think all is smooth sailing, we run into a criss-cross arrangement, or a circuit having more than one source of electromotive force. We find to our dismay that Ohm's Law just doesn't give us enough to work with. At this point we must turn to other techniques. Among them is the application of Kirchhoff's Laws.

This subject isn't nearly so sticky as you might gather, judging from the short shrift it usually gets in elementary textbooks. Every electronic technician, whether hobbyist or professional, should have this accomplishment under his belt, but very few do. So, if you'd like to elevate yourself a cut or two above the

The various forms of Kirchhoff's Laws, as they appear in these problems, may easily be demonstrated with the aid of resistors, batteries, and multimeter.





“...and here’s EI’s gift to you.”

Christmas is a time when we all get ties we don’t want, handkerchiefs we don’t need and shirts we wouldn’t be seen in.

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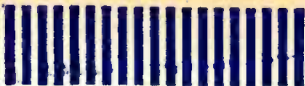
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average, come along as we delve into some most interesting concepts in the electronic art.

One way of putting the First Law, which seems to convey the concept as well as any, is as follows:

All of the voltage drops occurring within a continuous circuit are exactly equal to all of the voltage rises.

This doesn't mean that each source voltage necessarily has an equivalent drop somewhere in the circuit, but rather that the sum total of all the sources equals the sum total of all the drops. As a practical example, look at Fig. 1.

Between end points A and B there is a battery supplying 100 volts. Since the negative terminal of the battery is the source of excess electrons, the electron current is said to flow from A to B, and there is a voltage rise between these two circuit points of 100 volts.

Now the 10 amperes of electron current in continuing from point B to point C must pass through an 8 ohm resistor. This will cause a difference of potential between these two points, which by Ohm's Law, $E = I \times R = 10 \times 8 = 80$ volts. The resistor is, of course, not a

source of voltage. On the contrary, it is a loss device. There is therefore said to be a voltage drop of 80 volts between B and C.

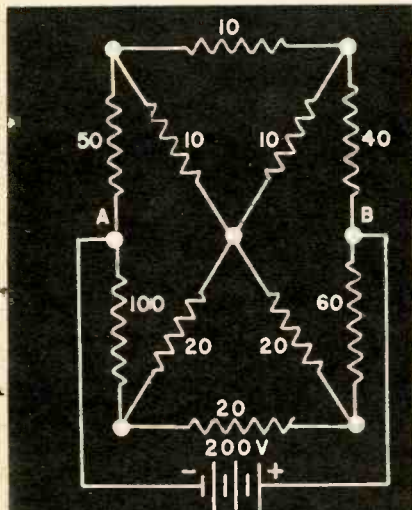
Let's go on. From C to D we encounter another loss, this time equal to $10 \times 15 = 150$ volts. Hence, there is a 150 volt drop between these two points. Then between D and E we have the second battery, connected in the same direction as the first, to provide another voltage rise of 200 volts. Finally, from E to A there is another drop of $10 \times 7 = 70$ volts.

Now let's add up all of the rises and drops:

Rises	Drops
100	80
200	150
	70
300 volts	300 volts

The sums are in fact equal, just as the First Law promised. Another way of stating this Law is based on the thought that the voltage drops are actually subtracting from the voltage rises. If this is true, then each of the drops would be preceded by a minus sign. Then in this example the sum of the rises is 300 volts and the sum of the drops is -300 volts.

[Continued on page 88]



Find the resistance between Points A and B using Kirchoff's Laws. See solution next month.

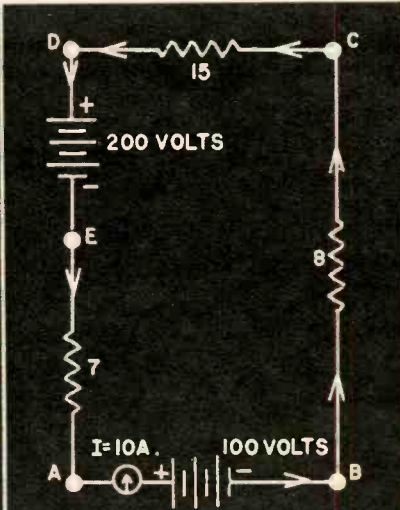


Fig. 1. Voltage conditions in this simple series circuit illustrate Kirchoff's First Law.

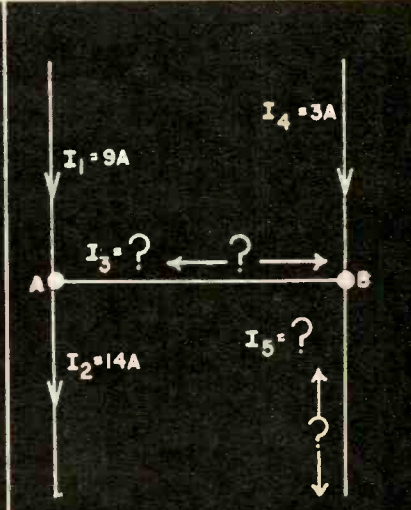


Fig. 2. Current conditions in this circuit illustrate an example of Kirchoff's 2nd Law.

Knight 5-Transistor Portable

A beginner builds this receiver kit for his first project—and here are some reactions.

FROM kit to complete radio in an evening! That's the story of a new 5-transistor portable radio that can be assembled by anyone who recognizes the business end of a pair of long-nose, side-cutting pliers.

You don't even have to know how to solder to build this one. Complete instructions in the art come with the kit, along with a few special notes on "Tinning the Iron," and "Printed Circuit Board Soldering."

The set shown on these pages was put together in just four and a half hours by a novice who didn't know a transistor from a transmitter, or a capacitor from a cake pan. The step-by-step instruction book that comes with the Knight 83Y766 by Allied Radio Corporation spells out the smallest detail.

"Study the pictorial diagrams," says the booklet, which then goes on to refer each operation to one of the ten illustrations. *[Continued on page 88]*

First check components against parts list. Card (left) simplifies resistor location.

Circuit board cuts assembly time and error. Here, oscillator coil is soldered in place.

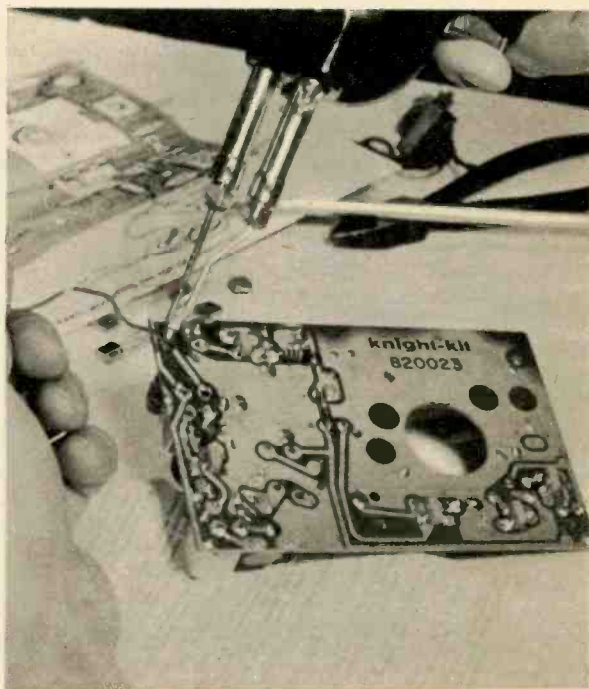
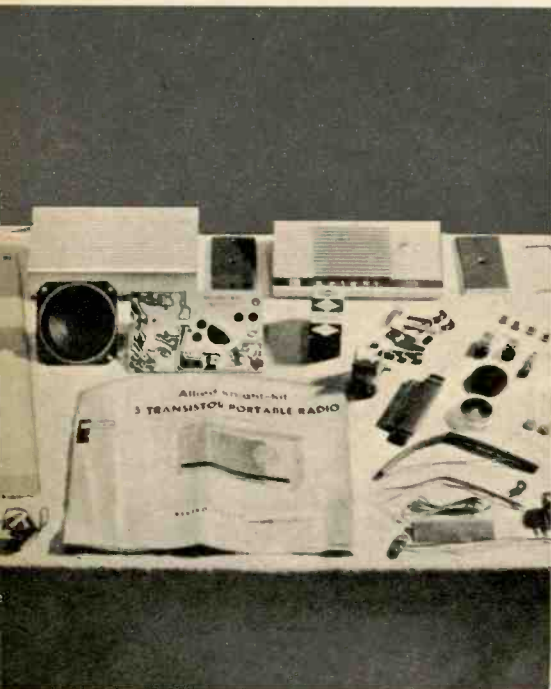




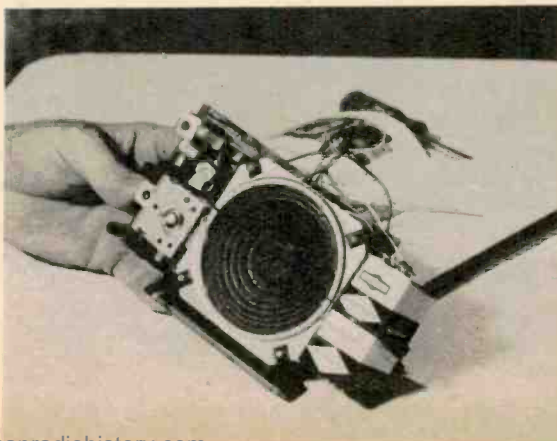
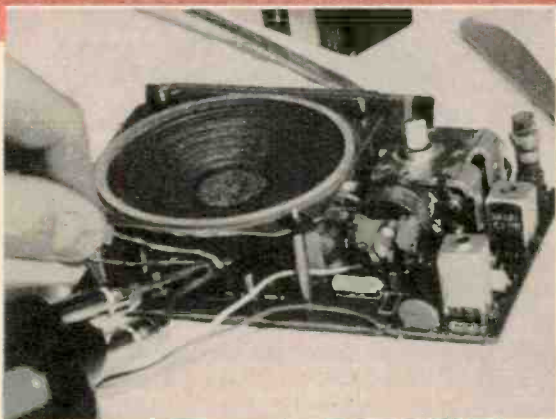
Photo by Mike Bonvino

On the left side of the complete receiver is a pull-out handle and earphone jack. The earphone for private listening can be purchased for \$3.17.

To assist in the mounting of parts, code letters are stamped right on the circuit board. Component wires are inserted in holes, bent, and soldered.

Driven by push-pull transistors, the 3½" speaker is capable of full room volume. 200 hours of playing time is claimed for a single 9-volt battery.

November, 1958



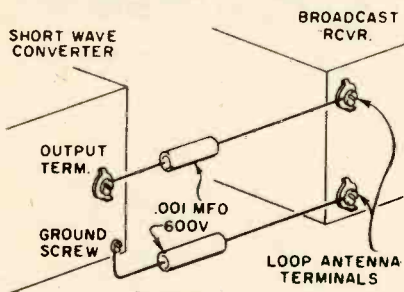
The Electronic Brain

All questions of an electronic nature will be answered by the Brain. If the question is of general interest, it may be printed in a future column.

Connecting a Short-Wave Converter

Most short-wave converters have single wire output. My broadcast receiver has two antenna terminals, one on each side of the loop. What is the best way to connect the converter to my receiver?

Robert Bussey, Arlington, Texas

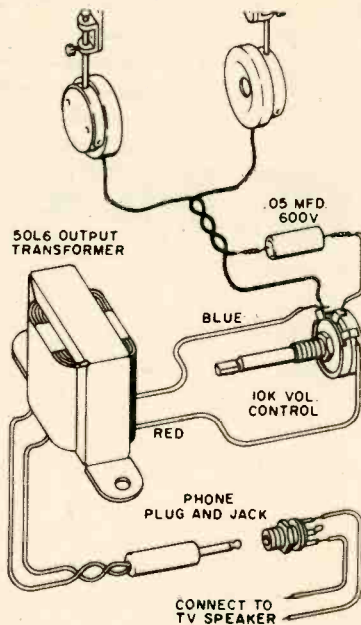


Connect the converter output terminal to either antenna terminal on the receiver loop through a .001 capacitor as shown. Repeat this procedure—again through a .001 mfd capacitor—connecting the second loop terminal to any screw on the converter case or chassis. Test the reception by listening carefully to a short-wave station that is likely to remain on the air for some time. Then, reverse the leads at the loop terminals and compare the volume and noise with the previous test. Make your final connections those which provide the best results. You can do no damage if you work with capacitors of the size suggested.

Headphones For TV Set

Can you give me a circuit which will permit me to connect a set of headphones to my television receiver so that a person who is hard-of-hearing will be able to listen at the same time as the rest of the family listens to the loudspeaker? I would like to include a volume con-

trol to be used with the headphones.
Harry Goynes, McAllen, Texas



Since the headphone signal will have to be quite loud to satisfy one who is hard-of-hearing, a matching transformer has been included to do the job right. When purchasing the transformer, order an output type designed to match a 50L6 tube to the voice coil of an 8 ohm speaker. This is suggested because you will find such transformers readily available and quite low in cost.

If you don't already have the headphones, purchase a pair having an impedance from 3000 to 5000 ohms, the higher the better. Then, using a 10,000 ohm audio taper potentiometer, connect the circuit as shown. It would be wise to bring the connections from the loudspeaker out to a standard phone jack mounted on the television cabinet. ●

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- ✓ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
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- ZERO CENTER METER — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

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but in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale. SICO used its new full-view 6-inch meter.

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- D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
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- CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
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Knigh 5-Transistor Portable

Continued from page 83

A light-weight soldering gun was found helpful in assembling the set as shown in the accompanying photographs. The parts are, of course, tiny and the gun made it easy to apply the drop or two of rosin core solder needed to firmly fix the plainly numbered parts to the correspondingly numbered positions on the circuit board.

"I've never seen anything so easy in my life," said Jack as he turned on the switch of the finished radio. "The instructions are simpler than those on a ready-mix cake box."

Characteristic of all transistor sets, there is no warm-up period before pleasant tones drift from the surprisingly large 3½" speaker enclosed in the finished radio's compact little cabinet.

"For anyone who hasn't fooled with electronics before, I'd say this was a good place to start," Jack said. "The set will certainly be handy when the World Series rolls 'round again."

We did note, however, one possible source of difficulty. The mounting of the tuning condenser on the circuit board is not a very rigid arrangement. A slight detuning and a loss in volume occurred when the case was first put on. It seems that when the case is tightened down, the board is warped just enough to cause pressure on the tuning condenser. This was corrected when the case was repositioned, but there is a possibility of it happening again.

The complete kit, ready for assembly, with nothing more required than pliers, screwdriver, and soldering iron, sells for \$29.95.

The ABC's of Electronics-5

Continued from page 81

In this case all of the voltage drops may be considered as cancelling out all of the voltage rises. In mathematical terms, the sum of +300 and -300 is zero. For this reason, Kirchhoff's First Law is sometimes stated as: *The algebraic sum of all the voltage rises and*

drops occurring within a complete circuit is zero, which is just another way of saying the same thing.

Kirchhoff's Second Law also states the same general concept, but in terms of current rather than voltage:

The amount of current entering any junction point in a circuit is equal to the amount of current leaving it.

Fig. 2 is only part of a circuit, as much as is shown having several branches to form an "H." The currents in each of the branches are DC, flowing in one direction only, but in two of the branches the directions are unknown. The amount of current in each of these branches must be determined as well.

Starting with the upper left-hand section, it is seen that flowing into point A is a current of 9 amperes, due to I_1 . Flowing out of A, however, is I_2 amounting to 14 amperes. This is a difference between I_2 and I_1 of 5 amperes. Where does it come from?

In this case the only place it possibly can come from is the branch between A and B. It seems reasonable to assume then that this branch makes up for the deficiency by virtue of I_3 , which must therefore equal 5 amperes and flow in the direction B to A. Let's check that out.

If I_3 is in fact flowing into A from B, then point A becomes the confluence, like two rivers flowing together, of I_1 and I_3 , which combine at this point to make a total value of $9 + 5$, or 14 amperes. Then, flowing out of A into the lower left branch is I_2 , also equal to 14 amperes. Thus we see one justification for Kirchhoff's Second Law. But what about the other unknown, the I_5 branch?

We know now that I_3 is 5 amperes, flowing from B to A. And we know that flowing into B is I_1 , in the amount of 3 amperes. At this point then, to the best of our knowledge, the current out of point B is 5 amperes and the current flowing in is 3 amperes, a discrepancy of 2 amperes. But this cannot be. The difference *must* be made up by I_5 . In the lower right leg there must be 2 amperes of current, and it must be flowing upward into B. Hence, we can determine from Kirchhoff's Second Law, not only the value of an unknown current, but also the direction in which it is flowing. —●—

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The Procedure: To apply for the Graduate Specialist Program, visit your local Army Recruiting

Station. Your Army Recruiter will give you an enlistment screening test. After passing this initial qualification test, you will be interviewed by the Recruiter who is an experienced counselor. He will discuss your academic background and interests with you. Based on your own abilities and desires, he will help you select a first choice course and two alternates. If quotas for your first choice course are filled, you may still become a Graduate Specialist in one of your selected alternates. Your Army Recruiter will then forward your application for processing. You will later receive a formal letter notifying you that a place in a course of your choice is waiting for you. Not until after high school graduation and shortly before your course begins will you actually enlist, and then only for three years. Before enlistment, you will take two final tests, the Armed Forces Qualification Test and the Army Qualification Battery. After making qualifying scores in these tests relating to your particular chosen field, you are ready to enlist as an Army Graduate Specialist.

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Aircraft Components Repair	Neuropsychiatric Procedures
Engineer Equipment and Maintenance	Dental Laboratory
Atomic Weapons Electronics	Medical Laboratory Procedures
	Photographic Laboratory Operation

FM Multiplex

Continued from page 47

process, will only accept 41,000 CPS. A special detector removes the audio and introduces it to a low-pass filter. This final stage prevents higher interfering frequencies from passing through. The output of the adaptor may then be fed to an amplifier and speaker.

It is possible to use many present day FM receivers for sub-channel reception with the addition of an adaptor. Most recent tuners have a jack marked "Multiplex" into which the future adaptor can be plugged. If there is no such provision, this output may be added by tapping off the proper stage in the receiver (at the detector before de-emphasis). Most high-quality FM tuners with proper alignment and bandwidth should present no problem when used with the adaptor.

Due to the rapidly increasing interest in stereophonic sound, several manufacturers are designing multiplex adaptors for home receivers to sell for approximately fifty dollars. The most popular sub-channel frequencies among the broadcasters appear to be 41 kc and 67 kc. This is a carefully chosen combination which may be used in a two sub-channel operation simultaneously.

WGHF in Connecticut successfully broadcast stereophonically using one main and one sub-channel. The second sub-channel was, at the same time, carrying background music to commercial locations. Fidelity was reported to be excellent with no "crosstalk" between signals. WBAI in New York has announced imminent entry into the field of stereo with multiplex once the adaptors are available.

Upwards of fifty FM stations around the country are now multiplexing primarily for commercial background music to restaurants, stores, etc. As the use of adaptors increases, no doubt many stations will provide stereo broadcasts for the home. The AM-FM type of stereo broadcasting now utilized by some stations is subject to several limitations on the AM side; including fading, static, and limited frequency response. Multiplex is essentially an FM-FM system

with all the attendant advantages.

"Compatibility" has keynoted the development of the stereo disc. This concept prevents equipment from becoming obsolete each time a new system develops. Such is the case with multiplex since it does not interfere with existing programs. However, it is evident that a person listening to a stereo program without a multiplex adaptor would receive only one side of the orchestra. To alleviate this "incompatibility" the Crosby "Sum and Difference" technique has evolved.

In this system the *sum* of the two studio microphone voltages feeds the main channel and is received on a conventional FM tuner. The *difference* voltage is transmitted over the sub-channel. It is then a function of the multiplex receiving adaptor to use the difference voltage to split up the signals and feed them to separate amplifiers. KGLA-FM in Los Angeles has recently completed a series of successful tests using the Crosby system.

Several other uses of multiplex are looming into view. They are worth mentioning here since they offer a means of insuring the economic well-being of the 530 FM stations now on the air. With the competition of TV for the listener's time, FM is trudging an arduous road to financial stability. Commercial multiplex applications include business information services via facsimile and radio call systems for vehicles. In the developmental stage for multiplex is "slow-scan" television, a series of still pictures transmitted in a far narrower band than required for pictures in motion. Chain stores could use this device for promotion and it would allow banks to compare signatures between two remote points. Indirectly these uses could insure our continued enjoyment of FM broadcasting.

Stereo sound on multiplex will be a sensible addition to a hi-fi system. If the equipment can already reproduce stereo tape or disc, the adaptor is the only additional item necessary. If not, a simple amplifier and speaker can be added to use with the sub-channel. Not only will multiplex bring excellent stereo listening, but will provide an invaluable means of auditioning discs and tape over the air before purchases are made



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Stereo Preamplifier Kit


Continued from page 51

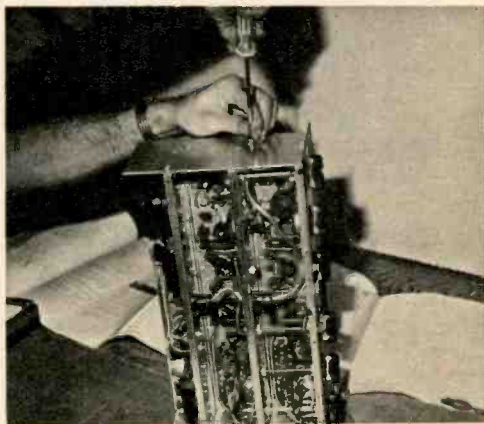
preamps. Separate hum balance controls are provided for each channel to insure optimum adjustment. Wiring time for the last section and final mechanical assembly of the three chassis ate up another 5 hours.

Each channel of loudness and level controls can be adjusted individually and then locked together by simply pushing in the inner knob.

The other necessary stereo features such as independent treble and bass controls for each channel and mono-stereo switching are included. The two independent input selector switches and a 4-position channel switch will enable any program source to be fed to either amplifier without the necessity of unplugging leads. The input sensitivity of the channels is very high (2 mv. input provides 25 volts out) and any low output monaural or stereo phono cartridge will drive the accompanying power amplifier (s) to full output.

The specifications of the Heath pre-amp are very good and our tests revealed no significant deviations from them. We would not suggest the SP-2 as a first project. It would be far wiser to build one of the power amplifiers and judge from your experience with it whether you want to tackle the SP-2.

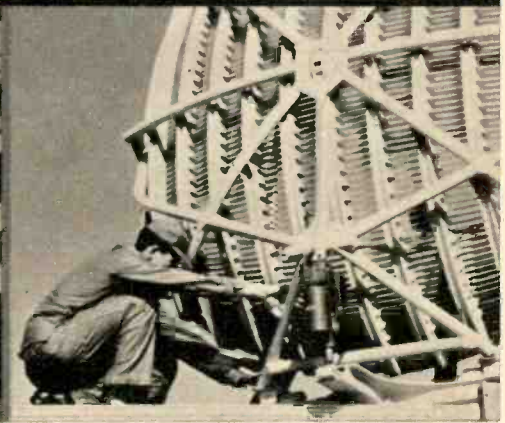
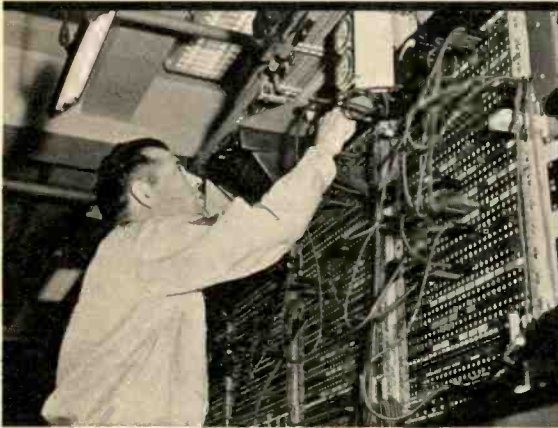
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Stereo Records: An Appraisal

Continued from page 37

M-49) are hung directly above each other, not spread out in front of the orchestra. But the microphones are directional in their sensitivity patterns and "look" at the orchestra at different angles, along diagonal lines. Since both mikes are on the same vertical axis, as if they were both hung from the ceiling on the same string, this setup is known as "coaxial miking."

Facing diagonally across the orchestra into the two far corners, the coaxial microphones achieve a 50-50 compromise between depth and directionality.

There is no inevitable conflict between A-B stereo and coaxial stereo. Some engineers believe that A-B stereo is the ideal recording method for small jazz groups where it is desirable for each player to be pinpointed for his solo. In these small groups musicians usually are lined up next to each other in a lateral spread which does not exceed the length of the average living room wall. In other words, A-B stereo is fine where the original dimensions of the group are about the same as the speaker spacing in the home. On the other hand, coaxial stereo, or the A-B technique with a fill mike, may be preferable for symphonic recordings where depth is more significant than spread and where the original dimensions of the concert stage have to be reduced for home playback.

Even the touchiest critics of the new stereo discs agree that the "third dimension" in stereophonic sound gives the music an entirely different "feel" from what is heard on conventional phonographs.

As new physical dimensions of sound are added by stereo reproduction, our emotional response to the music also seems somehow enlarged.

All this is a part of the stereophonic "payoff." But it presupposes stereo at its best—true in spatial representation, free from distortion, and without compromise on any of the customary hi-fi standards.

One thing is certain even now: hi-fi is a continuing adventure and a new phase of this adventure has just begun with the advent of the stereo disc.

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Stereo Survey

Continued from page 34

lied and Lafayette have all put forth attractively priced units.

Stereo adaptors have been offered to the monaural hi-fi owner as a kind of link between what he now has and a second monaural amplifier he might buy. Some adaptors—such as the Fairchild and the Dynakit—literally make a stereo unit out of two monaural units, physically as well as electrically.

The stereo adaptors do add some of the extras found on complete stereo control panels but they are not universal devices. Most are designed for use with specific models of monaural amplifiers. Thus, the Dynakit stereo control, \$12.95, is a handy gadget, if you're using two Dynakit monaural preamps. The \$13.50 Bogen STA-1 performs a similar function, but only with certain Bogen amplifiers.

The Scott model 135 "Stereo-Daptor" costs more—about \$25.00—but has wider use. In addition to most Scott amplifiers, it may be connected into systems using separate monaural preamps and power amplifiers, or using two identical all-in-one amplifiers that have tape monitoring facilities.

Units such as these are "passive" in that they contain no tubes. A new "Stereo Remote Control" by Lafayette Radio, available in kit form for \$29.50, uses two tubes and provides for a third channel, which can be adjusted to eliminate the sometimes annoying "ping-pong" effect between two stereo speakers. What's more, it may be used remotely up to 50 feet from the amplifiers under its control.

Speakers for Stereo

If speaker systems for monaural hi-fi were the subject of much discussion, the disagreement is compounded in stereo. The all-out approach, in which your present speaker system simply is duplicated, is generally the safest, but it can be the costliest. And in some cases, duplication is not a good idea. Two corner horn systems, for example, have been found not too satisfactory on stereo. As a means of avoiding costly, and sometimes incorrect, duplication,



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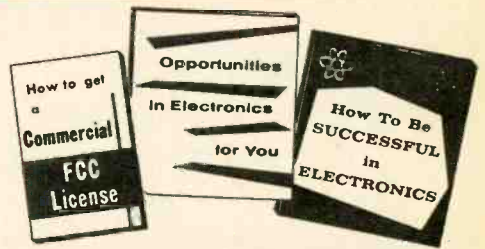
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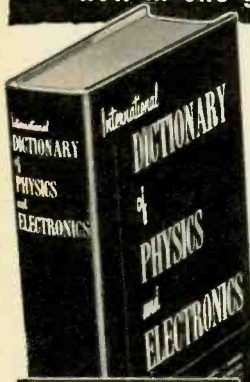
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one manufacturer is offering stereo add-
on speaker systems in which the driver
elements used are similar to those in
the same company's larger systems. The
add-on unit is smaller, lower-priced,
and can be spotted along the wall. Ob-
viously, in such an approach something
has to give; in the case of the Electro-
Voice "Stereon" the thing that gave was
the bass end. These units are designed
specifically to reproduce sound above
200 or 300 cps, on the theory that bass
below these frequencies is not direc-
tional. Consequently, goes the explan-
ation, all the bass—from both channels
—can be fed to one speaker (the origi-
nal full range speaker) and stereo will
still be possible.

Whether such an arrangement will
prove ultimately satisfying is something
each listener should decide for himself.
Certainly it represents a space-saving
and money-saving compromise. On the
other hand, it seems that the stereo add-
on speakers are best used with mating
full-range units made by the same com-
pany. A Stereon, matched with a full
range, low-efficiency speaker system,
did provide directionality, if not as
much depth as that obtained from two
full-range speaker systems. Admittedly,
this is a subjective judgment and open
to debate. Less open to debate is the
loss in signal strength that was apparent
in the full-range speaker when hooked
up, as per instructions, to the Stereon
and its accompanying filter network. A
good amplifier, with plenty of reserve
power, should be able to overcome this
loss.

As things stand now, two matched
non-corner speaker systems provide the
best stereo results, with the quality of
the overall sound depending largely on
the quality of the individual speakers.
Any two separate speakers will furnish
stereo; whether that stereo is truly hi-fi
and natural-sounding is another matter.

Matching speaker systems can be
chosen from the bookshelf type units,
using small resonators or the acoustic
suspension principle, through the small,
floor-standing models, to big consoles.
After a point, in speaker selection, ob-
jective discussion leaves off and per-
sonal taste rules. What may sound
thrillingly heady to one man may sound
head-achy to another.

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Convert Your Record Player

Continued from page 43

The voltage outputs of the left and the right channel coils of a stereo cartridge may be represented by diagonal lines, the resultants of vertical and lateral (horizontal) components. These coils are so set up that the horizontal component of each is in phase with the other and in the same direction. That means that their electrical polarities are identical. The vertical components, however, are in opposite directions, indicating that their polarities are out of phase. Thus, for example, a sideways movement would produce equal and identical lateral voltage components. But a vertical thrust of the stylus would produce vertical components in each channel of equal voltage, but opposite in polarity.

Therefore, if we were to tie both outputs together with a strapping switch the lateral components of both channel outputs would add, but the vertical components would cancel. Since the vertical rumble motion is the villain in stereo, the object of our test is to compare it to the lateral output to see if it is appreciably disturbing.

To make the test, connect the strapping switch as shown in the diagram, making the soldering connections at the record player end of the audio cables.

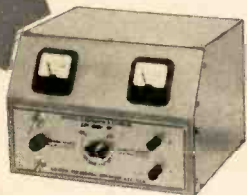
Now, with the volume control of your amplifier turned up to a comfortable listening level, play the "silent groove" test record and listen to the rumble output. Next, close the strapping switch so that you hear the lateral components only. If the output with the switch closed is noticeably less, the vertical rumble is considerable. On the other hand, if the difference is small your record changer will do the job for stereo.



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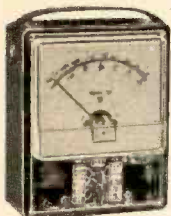
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Fix Your TV Set

Continued from page 65

Inspect a diagram showing the locations of the tubes in your set. Such a diagram is often pasted into the cabinet; it is also included in the service data for your set, available from the set manufacturer.

Find the tube in the tube location diagram that has the function you are concerned with. Say your picture shows a loss of width. The chart informs you that a defective horizontal output tube can cause this. Look for the tube designated HORIZONTAL OUTPUT in your tube location diagram. Using it as a map, locate the tube you are looking for.

Remove the tube (turning the power off first), replace it with a new one of the same type number and check receiver operation. If the original symptoms have disappeared, leave the new tube permanently in the socket.

Some of the terms used in the chart call for some clarification.

RASTER refers to the white light on the screen when there is no picture.

LOSS OF VERTICAL SYNCH refers to a condition where picture roll or jumpy movement in the vertical direction occurs from time to time.

LOSS OF HORIZONTAL SYNCH refers to the impossibility of synchronizing the picture horizontally.

HORIZONTAL PULLING refers to a condition where portions of the picture pull out sideways from time to time.

HORIZONTAL NON-LINEARITY is a condition where the picture is distorted in the horizontal direction. Horizontal non-linearity is revealed in the test pattern when the horizontal wedges are not equal in width.

VERTICAL NON-LINEARITY is a condition where the picture is distorted in the vertical direction. Vertical non-linearity is evident in the test pattern when the vertical wedges are not equal in length.

Next month we'll talk about the tuner, a common source of trouble in your TV set. There'll be hints on how to perform channel alignment without removing the chassis from the cabinet, and other measures to keep it in good operating condition.

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1B3GT	6A7	6BK7	6SK7	12AT6	24A
1H4G	6A8	6BL7GT	6SL7GT	12AT7	25AV5
1H5GT	6AB4	6BN6	6SN7GT	12AU6	25BQ6
1L4	6AC7	6B06GT	6SQ7	12AU7	25DN6
1L6	6AF4	6B07	6S57	12AV6	25L6GT
1N5GT	6AG5	6B26	6T4	12AV7	25W4GT
1Q5GT	6AG7	6BZ7	6T8	12AX7	25Z5
1R5	6AH4GT	6C4	6U8	12AX7	25Z6
1S5	6AH6	6C5	6V6	12AZ7	35A5
1T4	6AK5	6C6	6W4GT	12B4	35B8
1U4	6AL5	6C8	6X4	12BA6	35C5
1U5	6AL7	6CB6	6X5	12BA7	35L6GT
1V2	6AM8	6CD6G	6X8	12B86	35W4
1X2	6AN5	6CL6	6Y6G	12BF6	35Y4
2A3	6AQ5	6CG7	7A4/XXL	12BH7	35Z5GT
2A7	6AQ6	6CM6	7A5	12BQ6	37
3BC5	6AQ7GT	6CM7	7A6	12BR7	39/44
3BC6	6AR5	6CN7	7A7	12BY7	42
3B26	6AS5	6CS6	7A8	12CA5	43
3CB6	6AT6	6CU6	7B4	12J5	45
3CF6	6AT8	6DE6	7B5	12K7	50A5
3C56	6AU4GT	6DO6	7B8	12L6	50B5
3LF4	6AU5GT	6F6	7C4	12Q7	50C5
3Q4	6AU6	6H6	7C5	12SA7	50L6GT
3V4	6AV8	6J4	7C6	12S7	50X6
4B27	6AV5GT	6J5	7C7	12SK7	56
5A58	6AW8	6K7	7E6	12SN7GT	57
5AT8	6AX4GT	6K8	7E7	12SQ7	58
5AV8	6AX5GT	6L7	7F7	12V6GT	71A
5AW4	6B8	6M8	7F8	12W6GT	75
5BK7	6BA6	6N7	7H7	12X4	76
5J6	6BC5	6O7	7N7	12Z3	77
5T8	6BC8	6Q7	7Q7	14A7 12B7	78
5U4G	6BD6	6S4	7X7/XXFM	1486	80
5U8	6BE6	6S7	7Y4	14Q7	84 6Z4
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LISTEN

University sounds better



Shooting for the Moon

Continued from page 59

taining the scanner enters the moon's gravitational field at about 20,000 miles from the moon's surface, it is shot into orbit around the moon; creating a moon for the moon, so to speak. This is accomplished by sending out a radio signal from earth (Hilo, Hawaii) which triggers the fourth stage rocket.

The moon's distance from the earth varies between 221,000 and 252,000 miles and proper conditions for launching the moon-bound rocket occur only on four consecutive days each month.

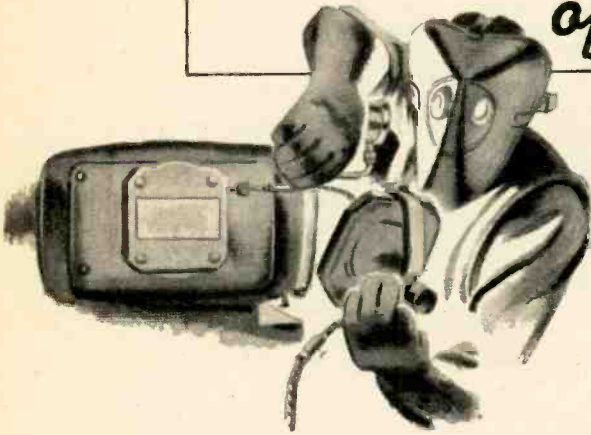
Landing a rocket with equipment intact on the moon is an Army project and involves additional problems. The moon's gravity must be offset and braking the space vehicle by means of reverse thrust rockets is one possibility. Radar focused on the moon and radio signals from the rocket are fed into a computer on earth which tells immediately the distance still to be traveled, the rocket's exact speed and the moon's gravitational pull. At the precise split-second, a signal radioed from earth starts the rocket's reverse engines.

On the lunar surface, batteries of telemetry instruments developed by the Navy begin to broadcast their discoveries. We soon know how hot the moon gets when the sun strikes it through a sky without atmosphere, and how quickly it cools off at night. Intensity of cosmic rays and other vital information if man intends to travel in space and on other planets can also be gathered by electronic telemetry equipment.

The possibility exists that a hydrogen bomb will be exploded on the moon to observe the reaction where there is no atmosphere, but scientists fear such an explosion might contaminate the moon to a degree that further exploration of its surface would not be practicable.

Probably a dozen or more unmanned trips will be made to the moon before we send out a man with a 50-50 chance of returning safely. Before the first earthling sets foot on the moon's surface we will know thousands of new facts about it, facts made known to us by the electronic instruments enclosed in the early moon shots.

The Secret of an Atom



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The ROSICRUCIANS (AMORC) San Jose, Calif.

Model Airplane Record

Continued from page 68

der position; two pulses the opposite position.

To operate the auxiliary control (spoilers in this case) a fast or "quick blip" signal triggers the second escapement, located in the wing. A Citizenship self-neutralizing type, it is so mounted that in one neutral position the spoilers are extended, in the other, retracted. Each quick blip changes the auxiliary escapement from one neutral to the other without affecting the rudder control.

Numerous dry runs of radio and battery supply were made by E. J. Lorenz, radio designer for this project, and Norman Rosenstock. They prepared motor-driven printed-circuit keying discs for continuous tests by laminating micarta "bumps" to a flat, circular plate to obtain the number and length of pulses desired. A transistorized CG single channel receiver operated for 480 hours before failure of an electrolytic condenser.

Weeks of tests on the Essco twin- (dual purpose) tube receiver told us it could be operated for 16 hours continuously, keyed electronically 66 times a minute on one Yardney LR05 battery for filament and one 30-volt hearing aid battery for plate. The CG receiver operated for 43 hours keyed twice a minute on six-second pulses using two Voltabloc V500s.

Ordinary dry batteries would certainly prove unsatisfactory for an all-day flight where plane design had to meet international weight and size limitations. Also, their changing voltages would undoubtedly affect receiver sensitivity adjustments.

Various modern batteries of the nickel-cadmium, zinc-nickel, and mercury types do a good job for their weights and sizes. Four Yardney LR05 batteries will run radio, a servo and auxiliary escapement for more than 12 hours, with the number of control impulses sent to the plane varying from 8-15 per minute. Four Voltabloc V500s do the same job and two in parallel will operate a Bonner multi-servo for better than 6,000 pulses.

Initially expensive, these batteries save money in the long run. The four Yardney cells costs \$28, but take 60 rechargings. For ordinary model flying they would give at least 60 flights per charge, provided charging procedures were carefully followed. Voltabloc batteries can be left on charge for 90 days without harm and none require rest periods.

In early tests, a 250 watt transmitter for traffic lights emitting 27.255 mc almost killed the project and it was necessary to travel to distant, little-used airports away from the powerful carrier of the lights. These emissions would actuate a carrier-wave receiver (like the Essco) and spiral the plane into the ground. On a tone-modulated receiver like the CG, the lights' carrier would block the model's receiver and the plane would fly away. It did twice, but the changing note of the traffic carrier triggered the spoiler escapement, causing the plane to descend.

After 60 test flights, the rubber-wound escapement was a decided weak link. Two rubber motors of 36" length were geared in series to provide the required turns. These were not enough. A Victory (Mighty Midget) electric motor was designed into an automatic winding device. Faltering rubber tension would start the motor. When tension again built up, the motor would stop.

At this writing, tests of simpler servos to wind the rubber are underway. At first, all motor-driven servos with single channel operation resulted in high battery drain when starting.

Transmitter? No problem, providing at least one spare is available. Large, replaceable battery packs, vibrator supply or a car battery and vibrator will run a transmitter designed to operate either a tone- or carrier-wave single channel receiver.

If a dawn-to-dusk model flight is ever achieved, the designs described here will be the ones to do it. But much depends on the unpredictable—the human error factor, weather and radio interference. For the modeler such a flight has all the elements—suspense, adventure, frustration—of putting a satellite into orbit. —●—

The Skywatcher

Continued from page 75

sive. Connections are made to the NE-21 lamp by soldering directly to its brass sleeve and bottom-button contact.

Most of the wiring should be completed before the final installation of the bakelite sheets in the chassis. Leave 3-inch wire leads projecting from the sub-chassis for later connection to the AC receptacle, the sensitivity control (R2), and the toggle switch (SW). The wires that connect the sub-chassis to the neon-winker must be longer, of course, to reach from the back to the front of the chassis.

Before applying power, an ohmmeter should be used to detect short-circuits or other low resistance paths that might indicate an error. Also check to be sure that neither leg of the incoming AC is touching the chassis.

Set R2 at about half-rotation and, with switch SW in either position, apply power. As the photocell is alternately shielded and exposed to light of medium intensity, the sensitive relay (RY2) should open and close positively. Starting from a "cold" condition, cover the photocell with SW set ON, plug any lamp into the receptacle and wait for the thermal relay (RY1) to turn on the lamp. Now expose the photocell so that the sensitive relay pulls in and wait for the lamp to extinguish. The neon-winker should not flash for either of these settings. Now throw SW to its OFF position with the photocell still exposed to the light and the sensitive relay still latched; the neon tube should now flash on-and-off to inform you that the SKYWATCHER is off and not readied for the next evening. Moving SW back on ON should stop the flashing.

Absolutely no trouble was experienced in getting this model to perform according to the original design. However, neon lamps have somewhat different performance from one to the next. If the winker does not light at all when the photocell is illuminated, try paralleling R1 with a second 330,000 ohm resistor. If this does not correct the trouble, try reducing R1 to about 200,000 ohms with the paralleling resistor in place. ●

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Revive Your Speedlight

Continued from page 78

Let's consider next an inexpensive repair for a shorted condenser. A blown condenser can sometimes be identified by its appearance. The case of a shorted condenser will be burned or overheated. Speedlight condenser units may consist of one or two large condensers, or of several smaller ones connected in parallel. If the speedlight uses a single condenser and this shorts out, of course, nothing can be done but replace it or discard the set. If two or more condensers are used, you can put the set back in operation by removing the bad condenser and wiring around it.

After the light output of your speedlight has been reduced by removing a bad condenser from the circuit, it will be necessary to establish a new guide number. You can do this easily by setting up your camera and light a measured ten feet from the subject and shooting a series of test exposures. Vary the lens aperture one stop each time. A card with the *F* stop written on it can be included in the picture for identification. Use your usual film and development procedure. After developing, choose the correct exposure from your series and multiply the *F* stop used by ten to arrive at the new guide number. The guide number on the speedlight shown is 80 with Verichrome, after conversion.

Relay points are another source of trouble on units using a relay. The points are dressed with a very fine grade of emery to remove pitting or burning. Remove only enough metal to smooth and polish the contact points. After dressing the relay points, synchronization with the camera shutter should be checked. This is done by removing the back from the camera and holding the light behind the opening. Use a sheet of tissue paper in front of the lens to cut down the light so it won't blind you. Fire the speedlight by tripping the camera shutter. Looking into the lens, you should see a full circle of light, indicating that the shutter is wide open when the light fires. If it is out of synchronization, turn the relay adjusting screw slightly and recheck until light fires in sync. ●

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Continued from page 53

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A Launching Pad

Continued from page 62

4. Have one or two adults prepare a plan for launching. This plan should include all possible data about the rockets to be launched. Attached to this plan should be a schedule of launchings. All of this should be part of a letter to the local military authorities requesting permission to use the military ranges near your locality.

5. Before submitting the letter have one or two adults call on the Commanding General of the Post or Commanding Admiral of the Station in question and seek his advice.

Local communities can help in building an effective core of trained scientists by building static test stands. The officials of Fairfax County, Virginia, have announced that Fairfax County will build a static test stand to be used by all High Schools of the county. This stand will be staffed with qualified help and the amateurs will be given an opportunity to first test their rockets many times before a live launching.

The Launcher

The launcher described in this article will take rockets of varying sizes, with and without fins.

The Firing Circuit is of utmost importance because it is here that a real factor of safety should be built into the design. Many clubs and groups have been interviewed by your author and I have yet to meet a group that does not consider the firing circuit the one piece of equipment that is all important from a safety point of view.

The firing circuit consists of two small red boxes with double lead wires between them. One box is located in the block house for the static stand or in the block house for the launcher. Both of these red boxes are so designed that a key is necessary to open the lock and the key cannot be extracted when the box is open. To extract the key, the boxes must be shut and locked.

To connect your rocket for testing and launching, it is essential that you proceed as follows:

1. The two red boxes are connected with double lead wires, the length to

be determined by the type of block house that has been constructed and other safety factors.

2. Box No. 1 is then taken to the site where the rocket is to be tested.

3. The one and only key is then inserted in the lock of Box No. 1 and the box is opened.

4. The two rocket lead wires are then inserted and extended through the holes A and B of Box No. 1 and connected to the two terminals within the Box No. 1.

5. Box No. 1 is then shut, locked and key withdrawn.

6. You then proceed to Box No. 2 in the block house.

7. The key is inserted in Box No. 2 and the box is then opened. You will notice on the circuit diagram that when the key is inserted into Box No. 2 and the key is turned, the key then helps to complete the circuit. Also, as you open the lid on Box No. 2, notice the copper rod across the bottom of the lid. Thus, when the box is shut, the copper rod shorts out the double leads from Box No. 1 and breaks the circuit in two places between Box No. 1 and Box No. 2.

8. In order to fire, insert the male plug into a source of power.

9. The circuit is now armed and ready to fire.

10. To fire, push down on the push button.

If the rocket fires or if the rocket leaves the launcher, that part of the test or shoot has been a success. You now proceed as follows:

11. Disconnect the plug from the source of power.

12. Shut Box No. 2, lock the box and withdraw the key.

13. Proceed now to Box No. 1 and unlock the box and disconnect the rocket leads.

14. Shut and lock Box No. 1.

You are now ready for the next test or launching.

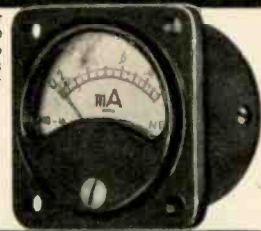
In case of a misfire, first press the push button again and this time hold it down for five seconds. If the rocket fails to fire, then follow instruction 11 and 12 above and wait 30 minutes before you proceed with caution and protective clothing to Box No. 1. There should be a protective wall between you, Box No. 1 and the rocket. —

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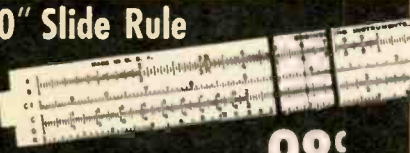
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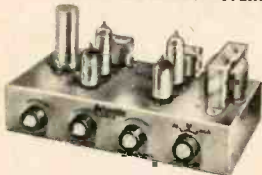
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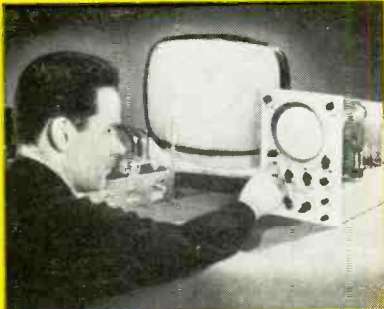
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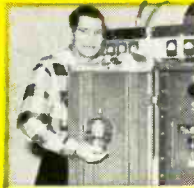
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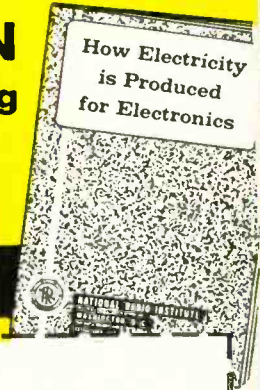
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source in stereo, therefore, need only be a system designed specifically to reproduce that directional part of the audio spectrum above 300 cps. Based upon this fact, Electro-Voice engineers developed the STEREO, an uncompromised second channel loudspeaker to match even the largest bass producer ... a compact, functional furniture piece allowing greatest placement flexibility for optimum stereo. The STEREO is designed to complement any full-range speaker by reproducing only those frequencies required for stereo, thus eliminating your need for a *second* expensive bulky enclosure.

HERE'S WHAT HAPPENS:

Low bass frequencies from *both* stereo channels are properly phased through the XX3 STEREO 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 STEREO ... to give you full dimensional stereo ... inexpensively, compactly.

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

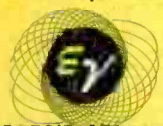


(In larger rooms, by the way, when you'll want stereo with the scope and magnitude of the latest movie processes ... you add-on two additional STEREONS, placing them inconspicuously around the room. The two central STEREONS simply parallel each of the channels and are adjusted to a slightly lower level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

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

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

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



Electro-Voice® **ELECTRO-VOICE, Inc.**
 Buchanan, Michigan
 Foremost in Electro-Acoustics — High Fidelity Loudspeakers and Enclosures for STEREO, Microphones, Phono-Cartridges and Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.

STEREO'S STANDARD

STEREO III—3-way system for use with high efficiency systems. Employs MT30 mid-bass coaxial assembly and T35 VHF driver, built into integral 200 cps taper rate horn. Integral crossover network limits overall input to signals above 300 cps crosses over electrically at 3500 cps to Model T35 VHF driver. Flat response ± 2 db 300 cps to 19,000 cps. Two AT37 level controls at rear provide overall level match to full range speaker system. Quality match assured by individual control of "Presence" and "Brilliance" control. Available in mahogany, walnut, and limed oak. Size: 25" high, 17 1/2" deep, 7 1/2" wide. Shipping weight: 37 lbs. Net \$129.50
STEREO IA—Identical to Stereo III, for use with normal efficiency

systems. Uses MT30B and T35B driver components. Shipping weight: 33 lbs. Net \$99.50

XX3 STEREO CONTROL FILTER—For use with Electro-Voice Stereons. Uses matching transformer and crossover network components. All signal of 1st channel above 300 cps feeds Stereo; all signal below 300 cps from this channel is combined with full range output from second channel to utilize full bass reproduction capabilities of a single full range system. Input impedance from both amplifiers 8 ohms, output impedance 16 ohms nominal. Size: 5 1/2" high, 4 3/4" wide, 5 1/4" deep. Shipping weight: 8 lbs. Net \$30.00

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