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ELECTRONICS ILLUSTRATED

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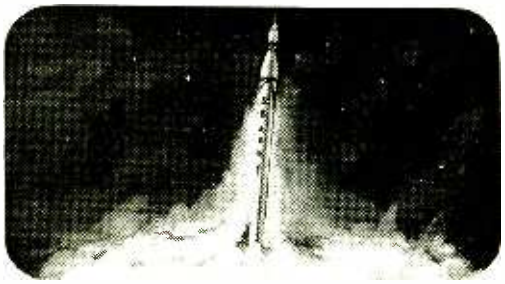
- How To Listen To Stereo
- Exposure Meter for Enlargers
- Sun Powered Receiver

Learn from men who are pioneering electronics!



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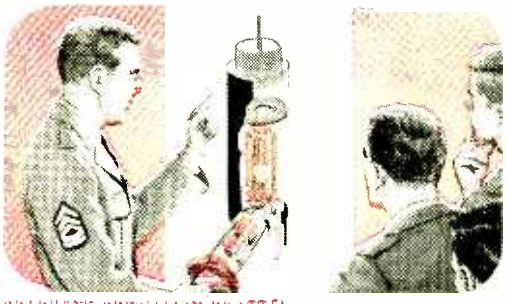

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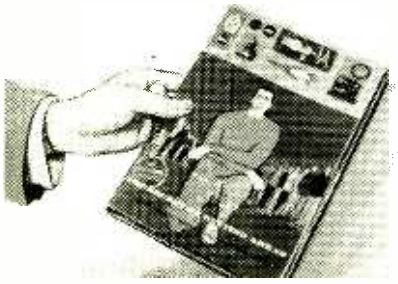

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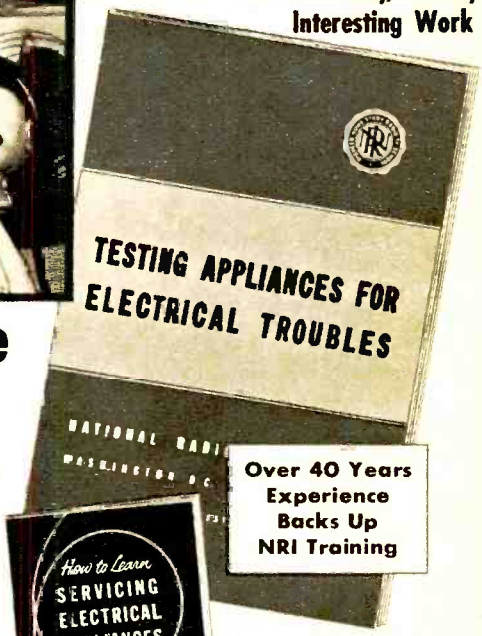

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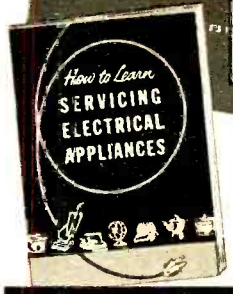
Appliances are necessary to comfortable, convenient living. Owners pay well to keep them in repair. The field is amazingly big. In addition to major appliances such as electric ranges, air conditioners, refrigerators, there are over 40,000,000 electric irons, 5,000,000 electric blankets, 15,000,000 coffee makers, plus more millions of vacuum cleaners, fans, toasters, mixers, etc.



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ELECTRONICS ILLUSTRATED

A FAWCETT PUBLICATION

Vol. 2, No. 6 JUNE, 1959

Contents

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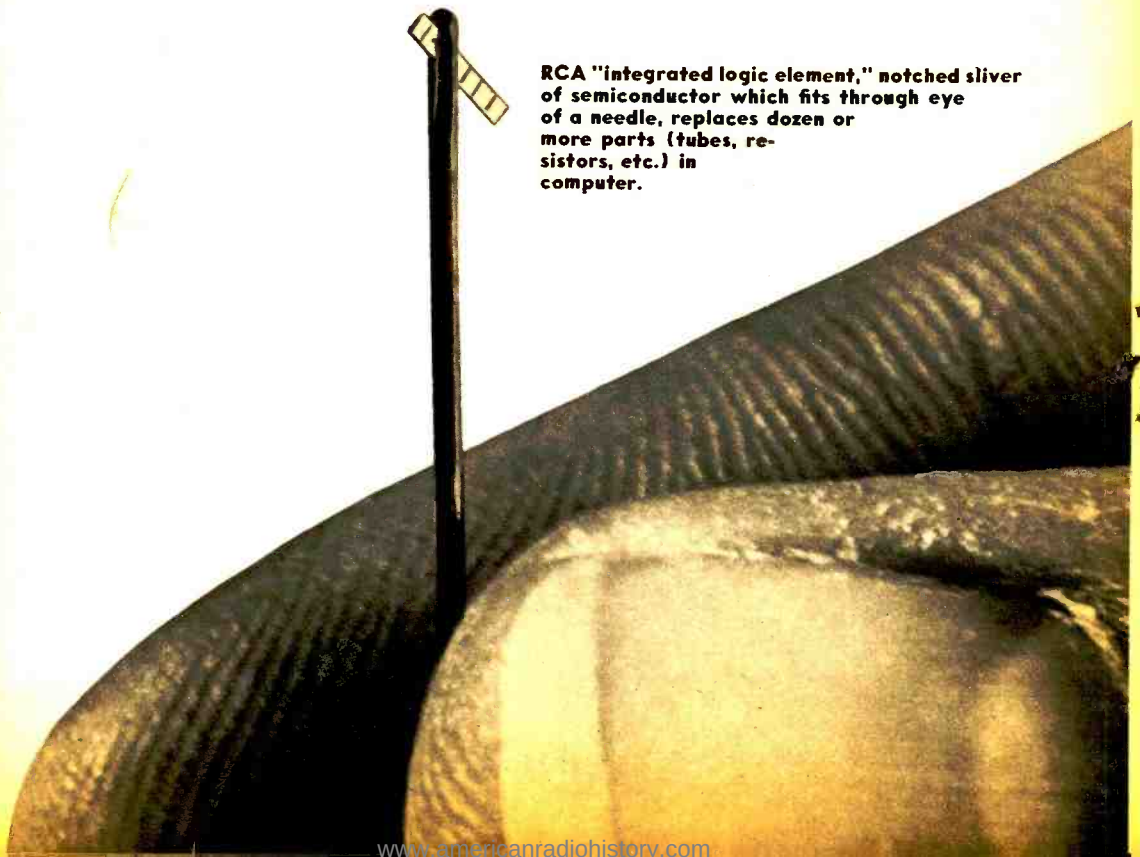
A Message From the Editor

IF the pioneer auto inventors were to look at the multifinned, chrome-bedecked automobiles on the highway today, would they recognize them for what they are? Probably not, and yet, the automobile took over 60 years to change its image. Electronics has actually changed its look in even shorter time. Up until 10 years ago electronics was the vacuum tube. Any radio old timer could look into a piece of radio gear: industrial, military or consumer—here were the vacuum tubes, here the capacitors, the resistors, the transformers, etc. Now with the accent on microminiaturization and ultrareliability, electronic components are no longer familiar looking. Electronic design and research engineers have taken a cue from modern art, given complete rein to their fancy, and come up with important new concepts in the process.

If you have been reading the feature articles in *ELECTRONICS ILLUSTRATED* you know what I'm talking about. For those of you who have not been regular readers of *EI*, I refer you to the article called "Miniaturization is Big" on page 52 for some startling eyefuls of the new look in electronics.

If you are a college or high school student or the parent of one, you may be interested in obtaining a new booklet now available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. for 15c. This 24-page booklet describes jobs available to high school and college students in various branches of the government for the summer. Such departments as the Agricultural Research Service, the Weather



RCA "integrated logic element," notched sliver of semiconductor which fits through eye of a needle, replaces dozen or more parts (tubes, resistors, etc.) in computer.

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Hundreds of men 17 to 55, started to make money in the Electronics field before they even finished their DeVry Tech program. Many made the training pay for itself as they learned! Because DeVry Tech's program is so practical, YOU should be able to do the same. You work scores of projects; you learn by watching home training movies; you follow clear, step-by-step instructions. You really learn principles and master many skills. No wonder DeVry Tech men are found in so many real-pay, bright-future jobs in this great growing field!

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At home in your spare time you use the same basic method followed by students in our Chicago and Toronto laboratories. You learn to use tools, follow diagrams, when you build any or all of this valuable equipment: the STEREO SYSTEM . . . or a 5-INCH OSCILLOSCOPE and VACUUM TUBE VOLTMETER . . . or a 21-inch TV SET. You have many choices! DeVry Tech's program is so thorough that you will likely be surprised at your progress. Send the coupon for details.

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2051

ONE OF THE BIGGEST OPPORTUNITY FIELDS OF THE CENTURY!

Bureau, Smithsonian Institute, Department of Medicine and Surgery are listed and the requirements are given.

Transistors are now used almost everywhere; more and more design engineers think of transistors first for new equipment. However, vacuum tube manufacturers feel that the tube has capabilities which far exceed those of transistors for certain applications. G-E, Westinghouse, Tung-Sol, Sylvania and other manufacturers have recently produced new tubes which match the transistor in size, ruggedness and almost, but not quite, low power requirements. Now comes the Nuvistor from the RCA Tube Department. This is described on page 62 of this issue and we predict that this tube will result in new products which transistors have not been able to bring us, such as battery operated TV.

We have a sun-powered radio receiver in this issue for you to build containing International Rectifier Corporation's new sun battery module which consists of five small rectangular sun batteries encapsulated in a small plastic case. Just one thing, this sun battery, model SM5-1020A sells in parts stores for about $22.50. This isn't cheap—but the Sun is! The complete receiver with sun battery will come to about $50, much less than any comparable commercial unit, and you need never replace batteries.

We've got some very exciting items for you in our next issue. Elgin Ciampi, widely known authoritative skin diver, will describe how he used an electronic metal detector on a treasure hunt underwater off Bermuda.

Radiation belts are in the news and to explain what they are and how they affect us, we interviewed Dr. Fred Singer, pioneer researcher in this field. We'll bring you his tape recorded comments next month. We'll also tell you how to install a TV antenna, or replace, clean, or reorient the one you have for better reception. *EI* is now evaluating all the new code teaching courses and we will give you a complete report on them in July. See you then.

Charles Tuppen

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

Model 77—VACUUM TUBE VOLTMETER . . . Total Price $42.50 — Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months.

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

Specifications

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS**: —10 db to + 18 db + 10 db to + 38 db. + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **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.

AS A DC VOLTMETER:

The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER:

Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER:

Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only

$42.50

Superior's New Model TV-50A GENOMETER

7 Signal Generators in One!

- ✓ *R.F. Signal Generator for A.M.*
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- ✓ *Audio Frequency Generator*
- ✓ *Bar Generator*
- ✓ *Cross Hatch Generator*
- ✓ *Color Dot Pattern Generator*
- ✓ *Marker Generator*

Model TV-50A GENOMETER . . . Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months.

This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV Color TV

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pottern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only

$47.50

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USE APPROVAL FORM ON NEXT PAGE

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Total Price...$15.85—
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- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakages, etc.
- Will measure current consumption *while the appliance under test is in operation.*
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

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• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

INCLUDED FREE *This 64-page book—practically a condensed course in electricity. Learn by doing.*

Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique. • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads

Only **$15.85**

Superior's New Model 82A **A truly do-it-yourself type**

TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

(1) Turn the filament selector switch to position specified. (2) Insert it into a numbered socket as designated on our chart (over 600 types included). (3) Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

FEATURES:

• Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case

(Picture Tube Adapter available for $5.50 additional)

Only **$36.50**

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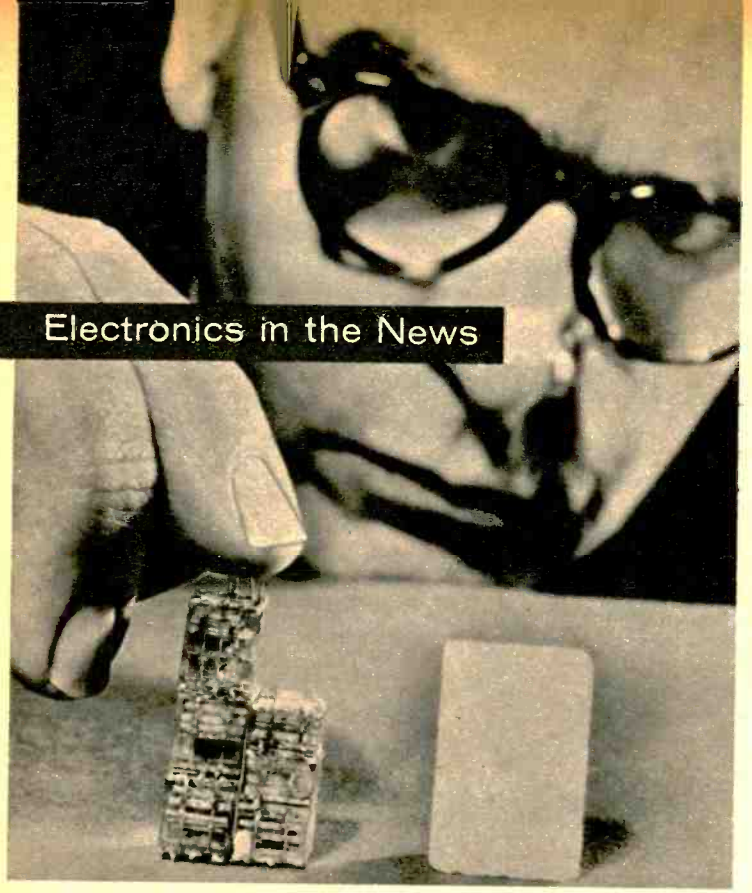
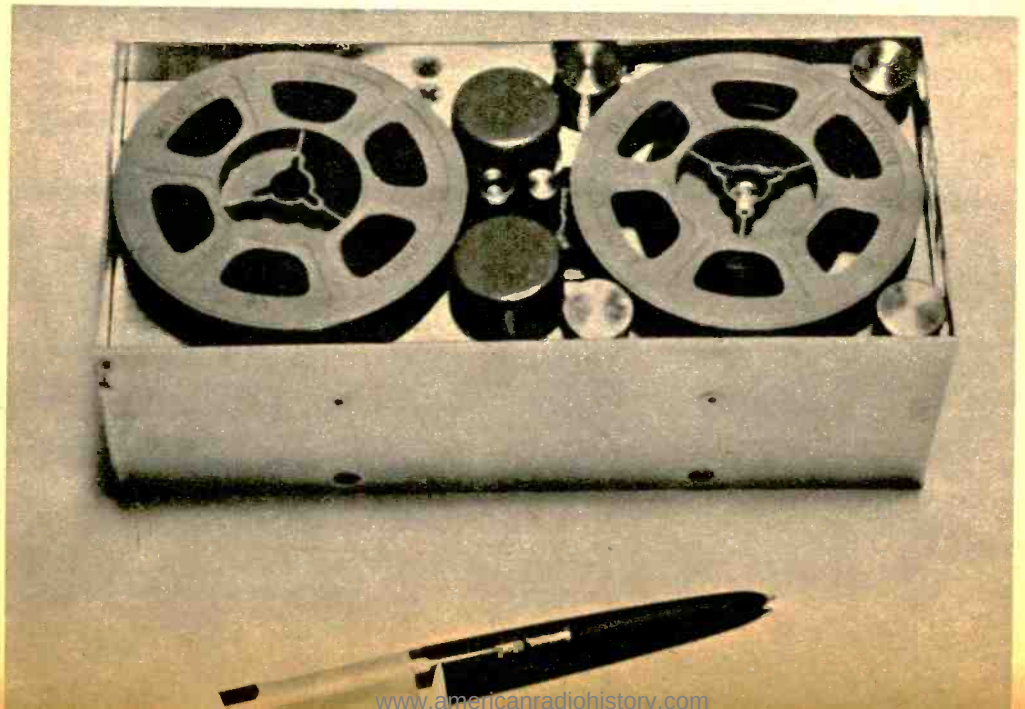
- ☐ Model TV-50A.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 70.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model 82A.....Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Include Model 82A Picture Tube Adapter at $5.50

Electronics in the News



This micro-module military radio is about the size of a sugar lump as you can see. Its components are deposited on thin wafers sandwiched and held together by riser wires. The "sugar-lump" radio was developed by RCA working in conjunction with the Signal Corps. It's part of their micro-module program whereby electronic equipment can be reduced in size by a factor of 10 or more as compared with present miniaturization techniques.

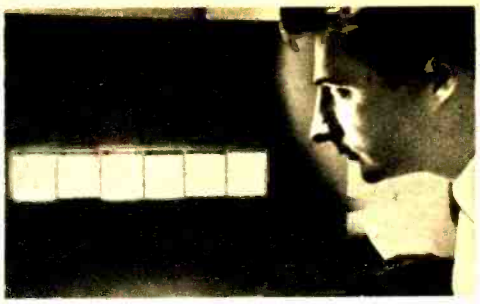
This is a four-track stereo tape recorder that is only about the size of a kitchen matchbox and weighs approximately 3 pounds. Made completely of American parts, the recorder functions for about 90 hours from its self-contained batteries. It is designed to accommodate two 2¾-inch 8mm movie reels with quarter-inch tape and run at 3¾ ips for 30 minutes of recording time. Its frequency response is in excess of 12,000 cps. For this homemade project, Keith Johnson of Stanford, Calif. received an award from Miniature Precision Bearing. More about miniaturization on page 52.



. . . News

The new Carillon stereo amplifier, model 6060, from Bell Sound Division combines two 30-watt power amplifiers with two preamplifiers in one compact chassis. It has separate bass and treble controls for each channel, high and low frequency noise filters and a single knob balance control. Dual outputs are provided for 4, 8, and 16 ohm speakers and recording. The rear panel has position for dual mike inputs as well as tape amp, tape head and auxiliary inputs. $219.95.

—o—



RCA has developed electroluminescent panels that glow six colors (greenish yellow, yellow, blue, white, red) in addition to green which has been the only color achieved thus far. Each panel consists of an extremely thin layer of electroluminescent phosphor (two thousandths of an inch) which is applied on a glass plate approximately one-eighth of an inch thick. When an alternating voltage is applied to the panels, they glow in soft color tones.

These electroluminescent panels may be used for decorative or display purposes. Eventually applications will be found in electronic computers.

LET RCA TRAIN YOU IN ELECTRONICS

RCA Institutes celebrates Fifty Years of Electronic Training by introducing its newest Home Study Course . . .

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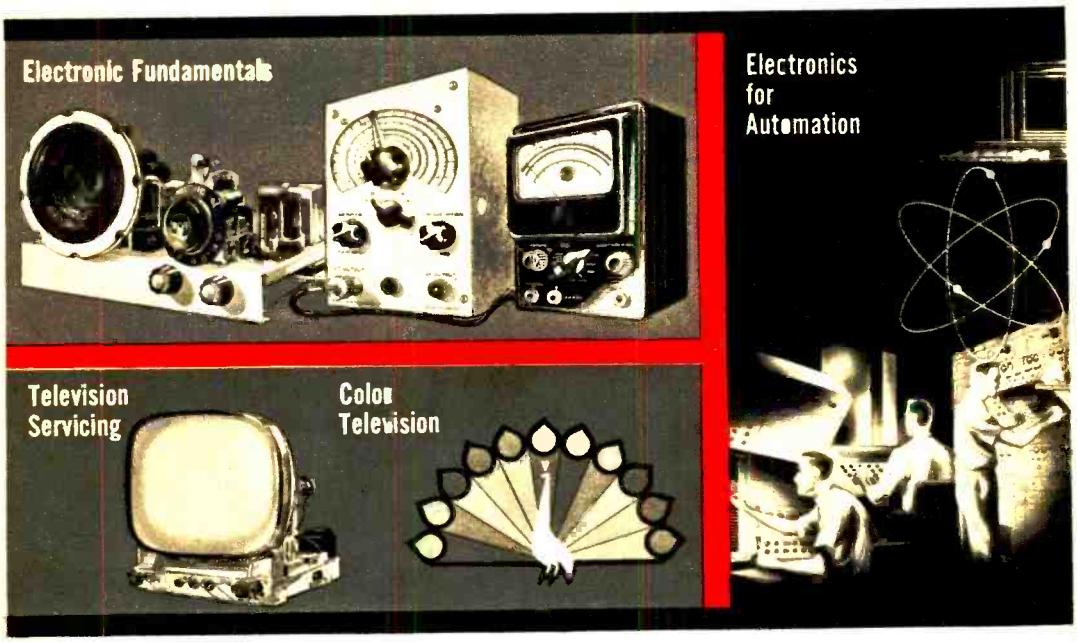
. . . Now you have *four* comprehensive courses for your electronic training . . . from basic electronic theory to the more advanced principles of color TV and Automation.



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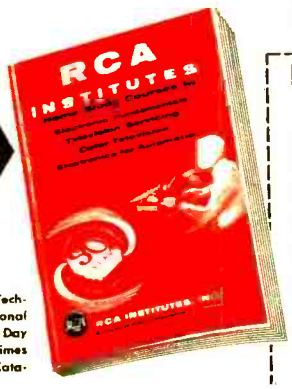

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A Service of Radio Corporation of America
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Without obligation, send me the FREE catalog of Home Study Courses. No salesman will call.

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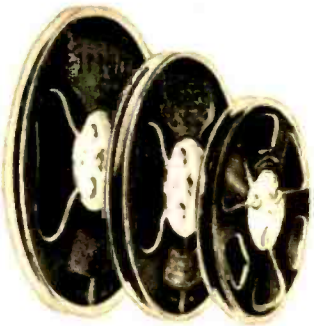
To save time, paste coupon on postcard.

. . . News

Attention last minute crammers! From the Sleep Learning Research Assn., Olympia, Washington, comes a machine designed to teach you while you sleep. Lessons are recorded on "endless" magnetic tape which plays over and over during sleeping hours and may again be played while the studier is awake. It is important to note that this method is not guaranteed and is extremely controversial.

Tape material may be played through an amplifier and loudspeaker included in the machine and thus be used to teach many students at the same time. The Electronic Educator is presently available only to experimenters and organized research groups. Further information is available from the Sleep-Learning Research Assn.

—o—



Irish brand magnetic recording tape designed especially for European recorders is now available through the dealers of ORRadio Industries. The "Continental Series" offers a 5¾" reel with longer lengths of tape. This reel can also be used on many American made recorders.

build this great new knight-kit®

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stereo hi-fi amplifier...save up to 50%

COMPARABLE IN EVERY WAY TO WIRED AMPLIFIERS COSTING TWICE AS MUCH

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knight-kit 20-watt stereo hi-fi amplifier

Newest complete Stereo high-fidelity amplifier at an amazing low $44.50. Incomparable value: Includes two built-in preamps for magnetic cartridges. Single switch selects phono, tuner or auxiliary stereo inputs, plus stereo reverse on each; also switches monophonic input to both amplifier channels. Bass and treble controls boost and attenuate. Special clutch-type concentric volume control permits individual channel balancing, plus overall volume control. Total output is 20 watts (10 watts per channel at less than 1½% distortion). Response, 20-20,000 cps, ± 1.5 db. Hum and noise better than 85 db below full output. Has four pairs of stereo inputs: magnetic cartridge, ceramic cartridge, tuner, auxiliary. RIAA equalized for stereo discs. Expertly designed push-pull output circuitry. Beautiful custom-styled case, 4¼ x 13¼ x 9". With case, tubes, all parts, wire, solder and instructions. Shpg. wt., 27 lbs.

Model Y-773. Knight-Kit Stereo Amplifier, F.O.B. Chicago... **$44.50**

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. . . News

A compact stereo accessory, the Knight-Kit Universal Stereo Control, provides a centralized control of stereo hi-fi systems which have separate amplifiers for each channel. The controls included permit balance of volume of each speaker, play either channel through one or both speakers, also channel reversal and phase controls. The case is gray metal with aluminum and ebony trim. The kit, 83Y778, is "4½"x7¾"x4" and is available from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Illinois for $9.95.

—o—

The new Stereo Studio Dynetic integrated tone arm and cartridge featuring a tracking force of 1½ to 2½ grams is available from Shure Brothers, Inc., 222 Hatrey Avenue, Evanston, Illinois. Though it is designed for the stereo cartridge, the tone arm will also accept the Studio Dynetic monophonic pickup. The recommended load impedance for the stereo cartridge is 50,000 ohms and the claimed frequency response is 20 to 20,000 cps ±2½ db. The stereo integrated tone arm and cartridge will sell for $89.50 with .7 mil diamond stylus.

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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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We Want Many More Shops This Year

This 37 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, a great many such shops are NOW IN BUSINESS AND PROSPERING. We are helping and training ambitious men to become future owners and operators of these shops in all areas.

FOR UNSKILLED INEXPERIENCED MEN ONLY — WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

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FAMOUS RTS BUSINESS PLAN

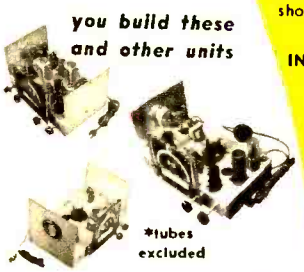
find out how you can open

A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

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:

1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.



you build these and other units

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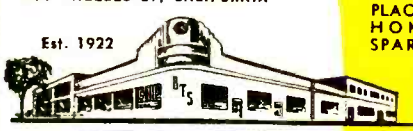

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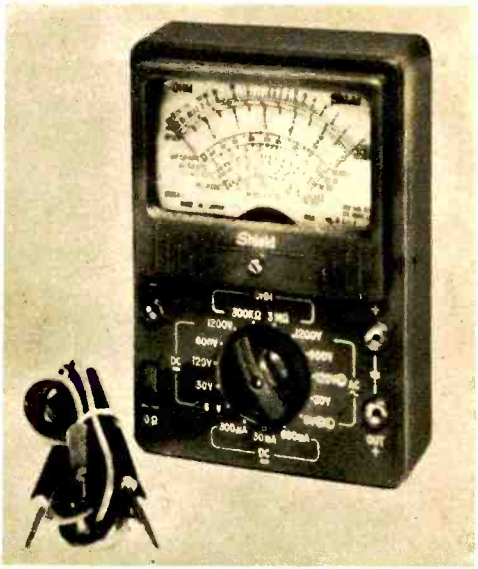
. . . News



Olson Radio Warehouse announced the release of a new compact 3,300 ohms per volt multitester No. TE-117 with a 3″ rectangular meter and 1% precision shunts and resistors. It has 5 AC and DC ranges, 0-6-30-120-600 and 1200 volts. DC current 0-300 μa 0-30-600 ma. Resistance is 0-300,000 ohms and 0-3 megohms. Price is $9.46.

Available from Olson Radio Warehouse, 260 S. Forge St., Akron, Ohio.

—o—

International Rectifier Corporation is now manufacturing a miniature silicon bridge rectifier that is many times smaller than a comparable vacuum tube circuit. These rugged devices may be operated at temperatures up to 165°C. Bridge rectifiers are available with DC output currents ranging from 50 ma to 1.2 amperes.

BUILD 16 RADIO CIRCUITS AT HOME

with the New Deluxe 1959 PROGRESSIVE RADIO "EDU-KIT"®

Reg. U.S. Pat. Off.

only $22.95

A Practical Home Radio Course

Now Includes

- ★ TRANSMITTER
- ★ SIGNAL TRACER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ School Inquiries Invited
- ★ SOLD IN 79 COUNTRIES

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 training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

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

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

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 genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

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

FREE EXTRAS

SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS • ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- 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. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

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

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

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

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

☐ Send "Edu-Kit" Postpaid. I enclose full payment of $22.95.
☐ Send "Edu-Kit" C.O.D. I will pay $22.95 plus postage.
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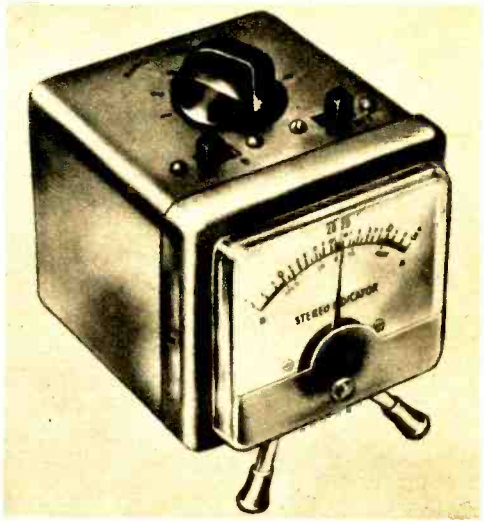
1186 BROADWAY, DEPT. 512AE, HEWLETT, N. Y.

. . .News



Lafayette has just introduced a new stereo balance indicator incorporating a two coil galvanometer type meter. The signal from each stereo channel passes through a full-wave bridge rectifier to the meter. When both signals are equal and balanced the scale will read zero. Individual channels may be measured by means of the two slide switches. The sensitivity of the meter may be varied by the 7 step range control. This unit may also be used as a VU meter when terminated across a 600 ohm load. The model TM-66 is available from 165-08 Liberty Ave., Jamaica, N. Y. $11.95.

Life-Lite, the handy pocket flashlight, can be recharged by plugging into any household outlet. The batteries are hermetically sealed. It's finished in two-tone gray and gold case and priced at $5.95. Available from The Walton Company, 125 East Broadway, Box 163, New York 2, N. Y.

. . . News

Transitape, the new two speed tape recorder made by Steelman, operates on standard mercury penlight batteries and uses conventional 3-inch reels and tape. Each reel will hold up to an hour of voice recording, dual track. The recorder measures 2⅞" x 6½" x 9¾" and weighs about five pounds. It comes complete with microphone and carrying case. Recordings may be made while walking, at conferences, etc. Available from Steelman Phonographs & Radio Co., Inc., 2-30 Anderson Avenue, Mt. Vernon, N. Y. $200.

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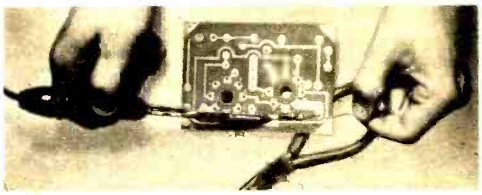

L. I. Electro-Labs of Hewlett, N. Y., has announced production of the Solder Chief, a new lightweight, balanced soldering iron. It features fast heating and full concentration of heat at the tip. The pointed tip of this 30-watt iron makes it particularly useful when working with miniature components. Under $2.00.

Do you WISH you were EMPLOYED in ELECTRONICS?

F.C.C. LICENSE—THE KEY TO BETTER JOBS

An F.C.C. *commercial* (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire *licensed* technicians.

WHICH LICENSE FOR WHICH JOB?

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

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radio telephone license qualifies you to install, maintain and operate every type of radiotelephone equipment (except amateur) including all radio and television stations in the United States, its territories and possessions. This is the highest class of radiotelephone license available.

GRANTHAM TRAINING PREPARES YOU

The Grantham course covers the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics. Some of the subjects covered in detail are: Basic Electricity for Beginners, Basic Mathematics, Ohm's and Kirchhoff's Laws, Alternating Current, Frequency and Wavelength, Inductance, Capacitance, Impedance, Resonance, Vacuum Tubes, Transistors, Basic Principles of Amplification, Classes of Amplifiers, Oscillators, Power Supplies, AM Transmitters and Receivers, FM Transmitters and Receivers, Antennas and Transmission Lines, Measuring Instruments, FCC Rules and Regulations, and extensive theory and mathematical calculations associated with all the above subjects explained simply and in detail.

OUR GUARANTEE

If you should fail the F. C. C. exam after finishing our course, we guarantee to give additional training at NO ADDITIONAL COST. Read details in our free booklet.

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Your First Class Commercial
F.C.C. LICENSE
QUICKLY!

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Grantham School of Electronics *specializes* in F.C.C. license preparation. Correspondence training is conducted from Washington, Hollywood, and Seattle; also, resident DAY and EVENING classes are held in all three cities. Either way, by correspondence or in resident classes, we train you quickly and well.

This booklet FREE!

This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Roy E. Alexander, Pikeville, Kentucky	1st	12
Robert J. Conley, 129 W. 46th St., New York 36, N. Y.	1st	14
W. R. Smith, 1335 E. 8th St., Long Beach, Calif.	1st	12
Howard E. Martz, 301 S. Penn. St., Fairmount, Ind.	1st	24
John W. Dempsey, Box 55, Rising Sun, Md.	1st	12
Donald H. Ford, Hyannis RD, Barnstable, Mass.	1st	12
Richard J. Falk, 2303 Holman St., Bremerton, Wash.	1st	22
Denson D. McNully, 1117 N. Houston St., Amarillo, Texas	1st	9
James D. Hough, 400 S. Church St., East Troy, Wisc.	1st	12
Odie B. Perry, Jr., Rt. #3, Zebulon, N. C.	1st	12
Milton C. Gee, Rt. #1, Washington, N. J.	1st	11

Grantham School of Electronics

Hollywood Division — 1505 N. Western Ave. Hollywood 27, Calif. *(Phone: HO 7-7727)*

Washington Division — 821-19th Street, N.W Washington 6, D.C *(Phone: ST 3-3614)*

Seattle Division — 408 Marion Street Seattle 4, Wash. *(Phone: MA 2-7227)*

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(Mail in envelope or paste on postal card)

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821-19th, NW Washington • 1505 N. Western Hollywood • 408 Marion Seattle

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

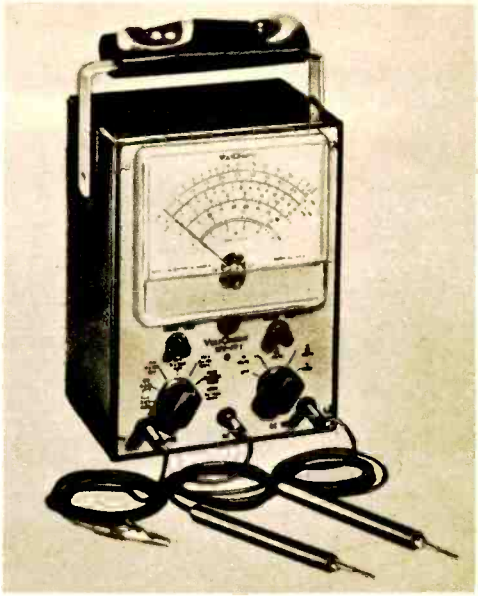
Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes 98-G

. . . News



The RCA Voltohmyst is now available as a kit, sold as the model WV-77E. This is a vacuum tube voltmeter with high input impedances on all AC and DC voltage ranges and provision for zero center indication. The resistors in the ohmmeter section are protected by a separate fuse. Price of this kit with printed circuit board is $29.95 Net.

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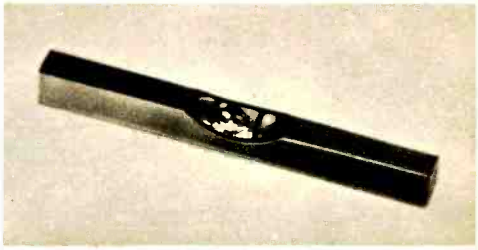


A device designed to tell whether your turntable is level has been announced by Robins Industries. A slewed turntable may distort the sound from the record player. The spirit-level is housed in a gold anodized aluminum case and has clear markings for easy reading. The TL-1 can be obtained from 36-27 Prince St., Flushing 54, N. Y. for $1.15.

Accredited by the National Home Study Council

good training doesn't cost . . . it pays!

How To Get an FCC License (Commercial)

Get Your FCC License Quickly

We Guarantee to train you until you receive Your FCC License

Get all 3 FREE

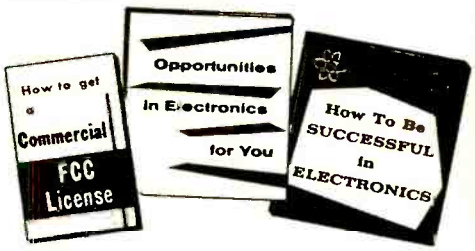
We guarantee

to train you until you receive

Your FCC License

—or your money back

The Master Course in Electronics will provide you with the mental tools of the electronics technician and prepare you for a First Class FCC License (Commercial) with a radar endorsement. When you successfully complete the Master Course, if you fail to pass the FCC examination, you will receive a full refund of all tuition payments.



Cleveland Institute of Radio Electronics

Desk EI-9, 4900 Euclid Ave., Cleveland 3, Ohio

Cleveland Institute training results in job offers like these:

Radio Operator

Capital Airlines (Ohio) is looking for a radio operator. A touch typing speed of 40 wpm is necessary. Must have at least a restricted operator's permit, but a radio-telephone 2nd or 1st class license is desirable.

Service Technician

Man needed in Cleveland, Ohio, to service and maintain electronic medical instruments and equipment. Must have a solid knowledge of electronic fundamentals. A car is required. Company benefits include retirement plan.

And our trainees get good jobs

"Investment in training really pays off"

"Thought you would like to know that in almost two years since I completed your course and obtained my first phone license, my pay has increased $5 per week every six months. I don't believe any other investment could pay off as well as this one did."
Harold E. Phipps, North Augusta, S. C.

Cleveland Institute of Radio Electronics

4900 Euclid Ave. Desk EI-9 Cleveland 3, Ohio

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Broadcasting
- ☐ Radio-TV Servicing
- ☐ Home Experimenting
- ☐ Manufacturing
- ☐ Telephone Company
- ☐ Amateur Radio
- ☐ Other

In what kind of work are you now engaged?

In what branch of Electronics are you interested?

Name Age

Address

City Zone State

EI-9

◀ See Page 24 for EICO'S BEST BUYS in "HAM" GEAR.

Special Report

Two-way Radio for Everyone

All about the new band just opened by FCC—no test required; equipment available as low as $50.

A BRAND new 22-lane expressway has been opened to the public. You can use this freeway to talk from your home to your office or to a neighbor's house. Or you can set up your own private telephone system between the mainland and that cabin on the island. The farmer can have a private radio link between the house and the barn.

Just like the taxicabs and police cars, you can now have a two-way radiotelephone in your car with which you can keep in touch with home or office. There are no toll charges to pay. You can use two-way radio for business or for purely personal convenience. Unlike the hams, you don't have to pass a technical

Using International Crystal Mfg. Co.'s "Citizen Bander" (Custom) atop Fawcett Building as base station, ELECTRONICS ILLUSTRATED staffer talks to technical editor across New York City with small Springfield unit (top of page).

Here the Marrow Radio Co.'s Desk Radiophone is used in office to contact field units on 4 channels.

This portable radiophone by Gonset has a built-in power supply for 12-volt car battery operation.

examination and you don't have to know anything about electronics to get a Citizens radio license.

If you're a boating enthusiast, you can set up your own ship-to-shore radio system. Just install a Citizens radio on your boat and another at home. In many inland lake areas, which are far removed from shipping lanes, boat owners do not enjoy the safety and convenience of ship-to-shore radio. Now, the berth operator or marine equipment dealer can install a Citizens radio with which he can hear pleas for assistance or more supplies from boats also equipped with Citizens radiotelephones.

Citizens radio is not new, but the class D category is new and low-priced equipment for this 22-channel band is now available from several manufacturers. There are already more than 125,000 Citizens radio stations licensed as class A stations which operate in the 460-470 megacycle UHF (ultra high frequency) band, class B stations which operate on 465.00 megacycles as a single party-line channel, and class C stations which are not for radiotelephone communication but are used for remote control of garage doors, model aircraft, etc.

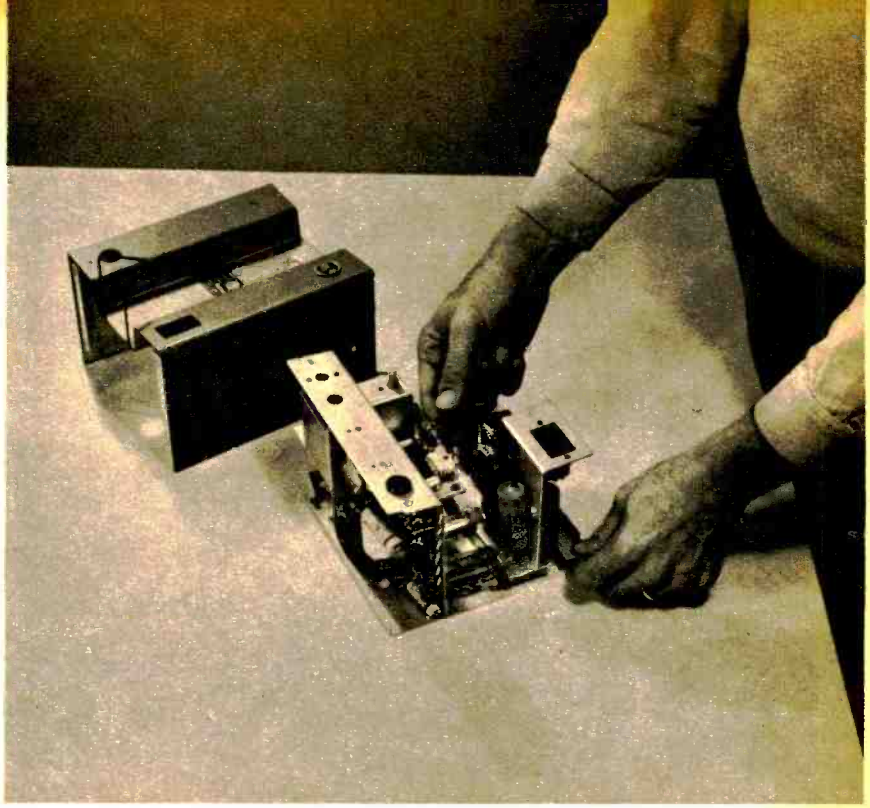
The good news about class D is that it operates on 26 and 27 megacycles, near the VHF region. This makes for greater range and allows for simpler and more stable circuitry. It's like going from UHF television to VHF!

Equipment for the new class D service is available in portable, mobile and stationary types ranging in price from $50 to $360. Range is ordinarily about five miles between a vehicle and a fixed point. However, if the antennas are up in the clear, 20 mile range and even further might be obtained. Class D stations use AM (amplitude modulation) only and transmitters are crystal controlled, as required by FCC regulations. Each unit contains a transmitter and receiver.

To equip your car with a Citizens radio, you can use a portable set which gets its power through the cigarette

This Vocaline transceiver is for class B only at 465 mc but, class D gear may be forthcoming.

Class D Citizens radio may also be used for business as is this Kaar Engineering Corp. unit.



The power supply of the radiophone is on a separate subchassis; all tubes are shock mounted for mobile use. An external horn speaker is available optionally.

lighter receptacle. Or you can install a more professional type set under the dash, on a permanent basis. In all cases, however, when installed in a car, an outside antenna should be used, even if it is fastened to the car on a temporary basis with a suction cup.

At home, in the office, barn or store, the radiotelephone can be mounted on a table or shelf. Most of the transmitter-receivers will operate from the AC receptacle or from batteries. Various types of power supplies are available to suit the installation.

The kind of performance you will get depends greatly upon the kind of antenna system you install. Most of the sets are provided with built-in antennas which suffice for minimum range. However, better results can be obtained by installing a good outdoor antenna system. It is comparable to operating a TV set with an indoor "rabbit ears" antenna or a good outside antenna. The latter is obviously much better.

Communicating Range

Communicating range depends more on having a clear path between the antenna of the base station and the mobile unit and less on transmitter power. Over short distances, the signals are reflected around intervening objects, but when two intercommunicating stations are quite far apart, large intervening objects can cause a loss in range.

Range depends also on what else is on your channel at the same time. Background noise, ignition noise and strong signals on an adjacent channel (which may not be heard—but the effect may be felt) may reduce the practical range.

How far one car can talk to another depends mainly on whether there are trees along the road. When trees are in foliage, they absorb radio signals. Also, the range is greater if one or both cars is near or on the crest of a hill. The car-to-car range can vary from less than a mile to as much as ten miles.

Under typical conditions, Citizens radio equipped cars can keep in touch with a base station within a radius of four to seven miles. The range depends upon the location of the base station antenna as well as its elevation above trees and surrounding objects. If the antenna is installed on top of a 100-foot tall building, the theoretical base-to-mobile range is 15 miles.

Antennas

The prospective user of class D Citizens radio has a limited choice in mobile antennas. The radio may be equipped with a small whip antenna that plugs into the top of the set. Outdoors and inside a building this may work fairly well but within the steel body of the car, the range will be limited. It is like installing the headlights inside the car. Some light will get outside, but not anywhere near as much as when the headlights are mounted outside where they belong.

The most obvious type of antenna for the class D Citizens band is a bumper mounted whip. The whip is about 7 feet long and is connected to the radio unit through coaxial cable. The body of the car serves as the ground plane of the antenna system. (Ideally, the antenna should be located in the center of the car roof, but this is generally impractical and unsightly, giving the vehicle a Toonerville Trolley appearance. So, the best bet is to install it on the rear bumper.)

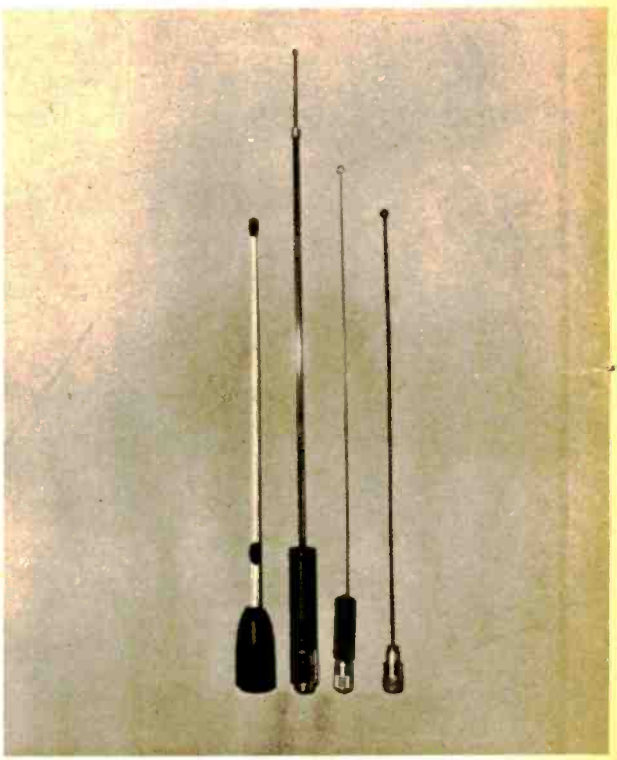
A shorter version of the whip may also be used. This is the base loaded type with a coil at its base which electrically lengthens the antenna even if it doesn't do so physically. It is about 24 inches long overall and comes in a telescoping version too.

At base stations (home, office, etc.), an omnidirectional antenna is generally used because it enables communication with vehicles or portable sets in all directions. Directional antennas can be used, of course, for fixed station use.

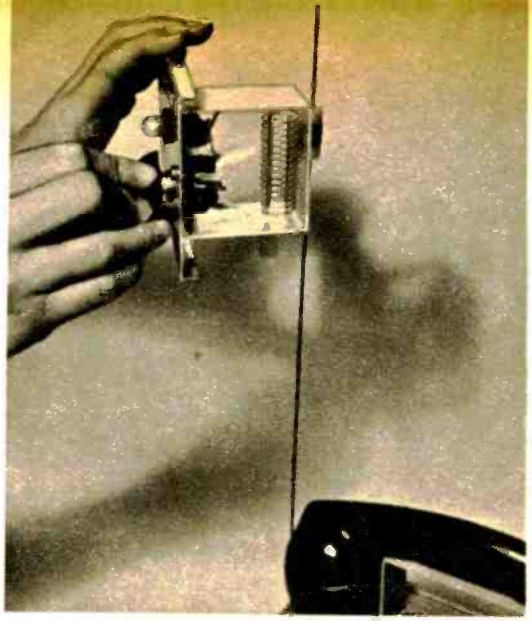
The antenna for a class D station must not extend over 20 feet above the surface on which the antenna support is mounted. If the antenna is mounted on top of a pole protruding from the ground, the antenna and pole must not extend upward more than 20 feet. If

[*Continued on page* 94]

Class D Citizens band radiophones are ideal for small pleasure boats. Shown is RCA unit.



Antennas for boats, cars, etc., on Citizens band. Two in center have loading coil in base.



Unit is held close to antenna and its knob tuned until bulb glows.

citizens band

Power Indicator

By Jay Hollander

Are you "getting out" with your 27 mc transmitter? Check its power in an instant with this wavemeter.

ONE of the most likely reasons for poor performance in a small transmitter is no power in the antenna. This absorption-type wavemeter will tell you in an instant whether the energy is actually being radiated. The indication is a direct one—the radio frequencies alone light the bulb. This system is more reliable than a pilot bulb working directly from the power supply. Another convenient feature is that you can tune the transmitter by watching the glow of the bulb. This is important with low power

Panel shows bulb and knob. Tuning scale isn't needed.

At right, all the parts are pictured prior to assembly.

since a tiny misadjustment in tuning quickly reduces the output to zero.

The circuit is simple; a coil, variable capacitor, and a bulb, all wired in series. With the transmitter on, the unit is held close to the transmitter antenna and the knob rotated until maximum brightness on the bulb is seen. The various component values were chosen so that the unit tunes 27 megacycles with the capacitor halfway meshed. Rotating it in either direction enables you to cover the complete Citizens Band.

Once the bulb is lit, the transmitter may be tuned for maximum output. In order not to detune the antenna with the wavemeter, it is a good idea to hold its coil as far from the antenna as possible without losing the indication. However, while using it with a transmitter radiating less than one watt, it appears necessary to place the coil directly against the antenna loading coil, as seen in the photo.

A plastic box encases the coil, bulb and capacitor to prevent damage to them. The plastic does not at all reduce the power picked up by the wavemeter coil. The one used here was salvaged from a Walsco container originally filled with solder lugs.

A wavemeter is not intended to measure exact frequency since it tunes rather broadly. But, due to its simplicity, with no need for a power supply, it is an excellent power monitor. Use it, too, to tell whether your voice modulation is OK. As you talk into the microphone, the bulb will flicker in step with your words.

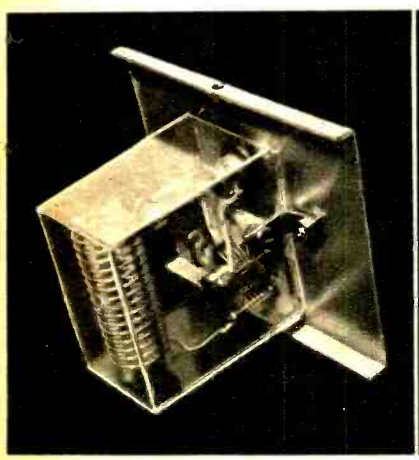
When mounting the two L-brackets to the plastic case you'll find it simple to make the holes for the nuts and bolts. Just place the tip of a hot soldering iron on the plastic. After a small hole has melted through, withdraw the iron and ream the hole to desired size with a round file.

For those who wish to wind their own coil, the dimensions are given in the parts list. The commercially available unit however will facilitate construction One turn was unwound from its lower end to serve as a supporting lead. This is visible in the final photo, connecting to the lower end of the tuning capacitor. Once the plastic case is mounted the coil will be held in its proper place.

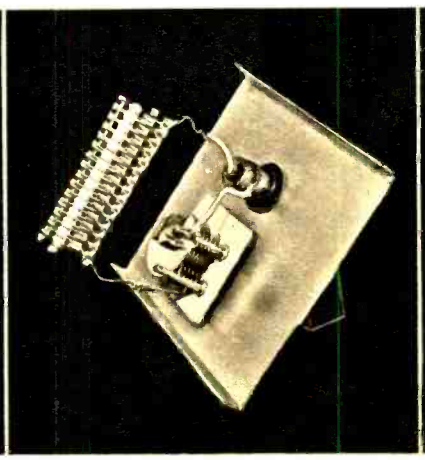
PARTS LIST

C—35 mmfd variable capacitor (Hammarlund HF-35)
L—Coil, 15 turns air wound #18 wire, total length 2", diameter ⅝" or use ready-made B&W Miniductor #3006
PL—Pilot light indicator, #49 bulb
Misc.—Scrap aluminum 4"x3", rubber grommet for bulb, 2 small L-brackets, plastic case 2¼"x2¼"x1⅜"

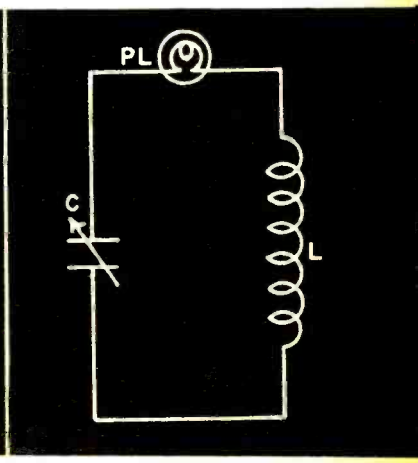
Rear view of completed model. Note L-bracket that holds plastic box to panel.



Bulb is pushed through rubber grommet on panel and the wires soldered to it.



Schematic shows series wiring. Values were chosen to cover 27 mc band only.



how to get

A Citizens Radio License

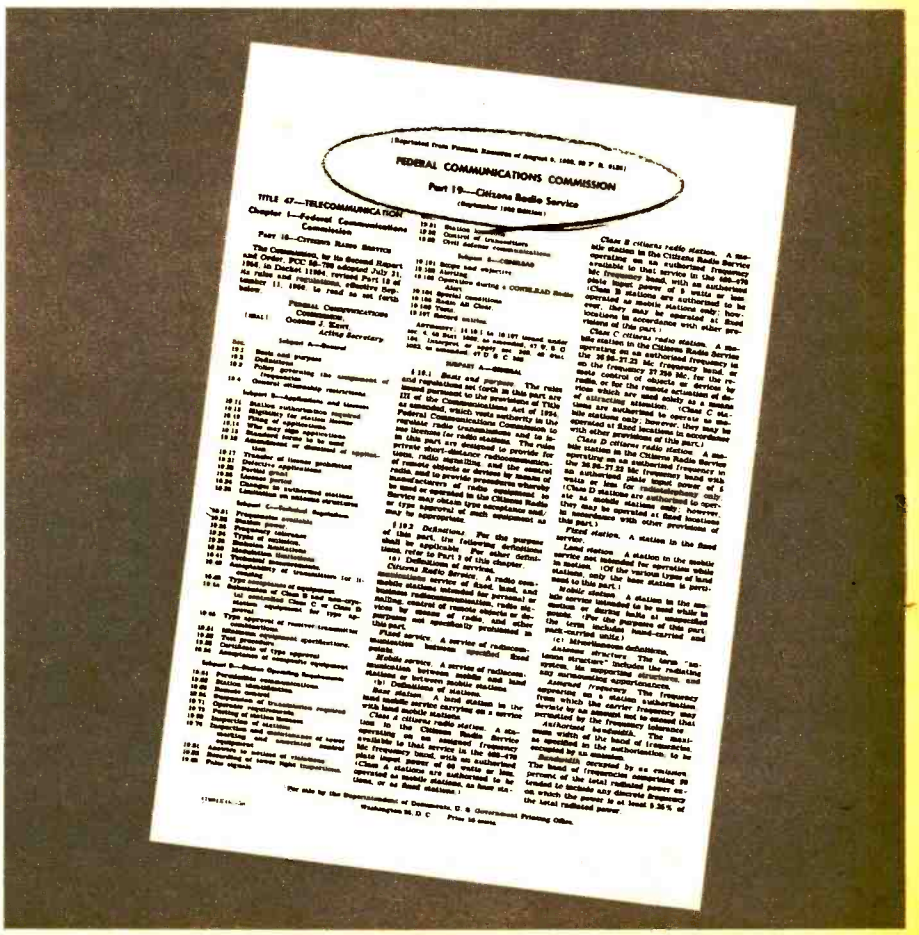
By Len Buckwalter
Associate Editor

Fill out and file your application correctly to avoid delay in receiving your station license.

IF you're over eighteen and a U. S. citizen, you're eligible for the newest of the Citizens Radio licenses—the class D band. Compared to other FCC licenses, this one's a snap—if you go about it the right way. An improperly filled-out form can cause a delay of months in receiving your license.

The first step is to get a copy of the FCC regulations covering

Part 19 of the FCC's rules and regulations deals with Citizens Radio. It must be in the applicant's possession when the license form is filled out.


FEDERAL COMMUNICATIONS COMMISSION

Part 19—Citizens Radio Service

this service. It's a 9-page booklet containing a wealth of information on frequencies, operating practices, and technical data that will be of direct interest. Aside from the fact that you must certify on the license application that you have Part 19 in your possession, it serves as a valuable "handbook." Request "Part 19, Citizens Radio Service, September, 1958 Edition." Mail the letter with a dime enclosed to;

Superintendent of Documents
Government Printing Office
Washington 25, D. C.

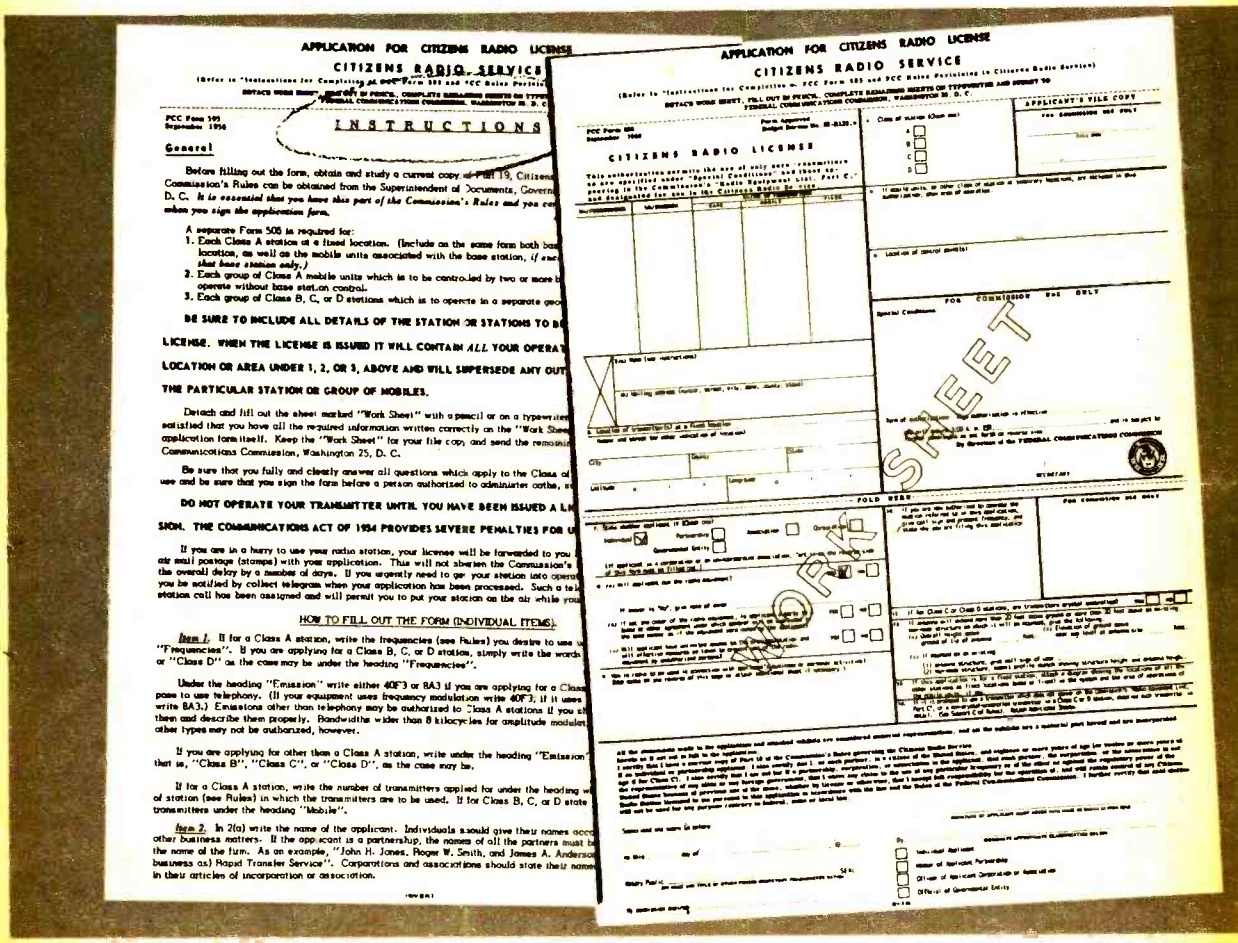
At present we'll ignore class A, B, and C stations and consider Class D only. These others are at extremely high frequencies for which commercial "type approved" equipment must be used—and their communicating range is limited compared to the Class D band, around 27 megacycles.

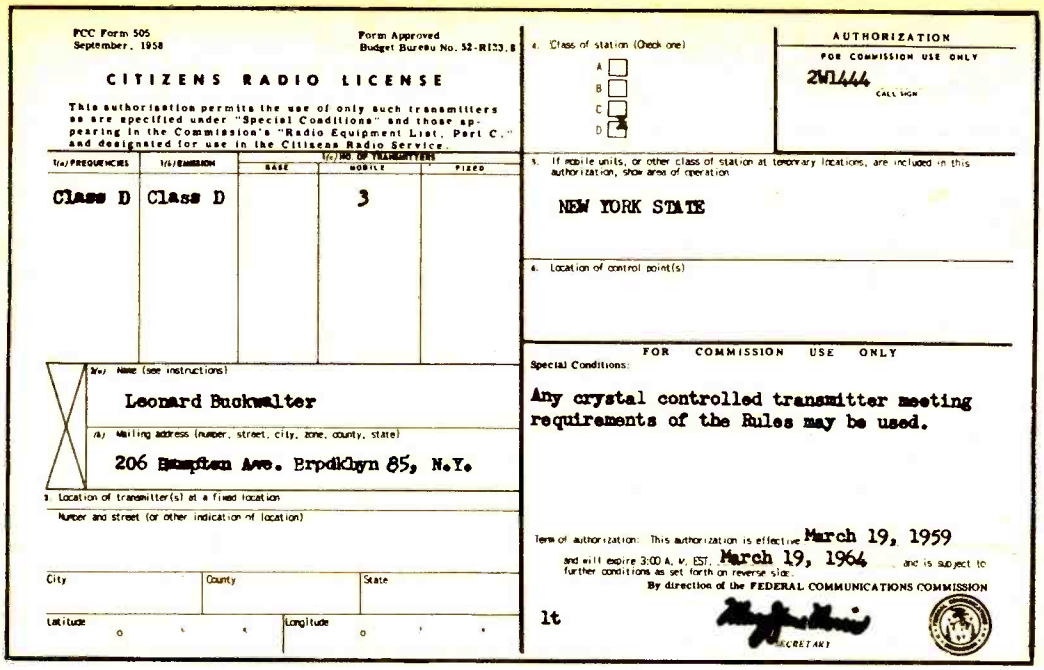
As you read Part 19, several points become apparent. If you decide to build your equipment it must conform to certain specifications. Even if commercially-made or kit units are used it's good to become acquainted with these points since you might want to change the channel frequency or modify the antenna system.

The transmitter must be crystal controlled, you can't tune a dial and transmit in a clear spot in the band. Twenty-two distinct channels are available and

An instruction sheet is provided that explains each of the items found on the Work Sheet.

After this Work Sheet is filled out, items are typed onto actual form, similar in appearance.





FCC Form 505
September, 1958

Form Approved
Budget Bureau No. 52-R133.8

CITIZENS RADIO LICENSE

This authorization permits the use of only such transmitters as are specified under "Special Conditions" and those appearing in the Commission's "Radio Equipment List, Part C," and designated for use in the Citizens Radio Service.

1(a) FREQUENCIES	1(b) EMISSION	1(c) NO. OF TRANSMITTERS: BASE	MOBILE	FIXED
Class D	Class D		3	

2(a) Name (see instructions)

Leonard Buckwalter

2(b) Mailing address (number, street, city, zone, county, state)

206 Hampton Ave. Brpdklyn 85, N.Y.

3. Location of transmitter(s) at a fixed location

Number and street (or other indication of location)

City | County | State

Latitude ° ' " | Longitude ° ' "

4. Class of station (Check one)

A ☐
B ☐
C ☐
D ☒

AUTHORIZATION

FOR COMMISSION USE ONLY

2WI444

CALL SIGN

5. If mobile units, or other class of station at temporary locations, are included in this authorization, show area of operation

NEW YORK STATE

6. Location of control point(s)

FOR COMMISSION USE ONLY

Special Conditions:

Any crystal controlled transmitter meeting requirements of the Rules may be used.

Term of authorization: This authorization is effective March 19, 1959 and will expire 3:00 A. M. EST. March 19, 1964 and is subject to further conditions as set forth on reverse side.

By direction of the FEDERAL COMMUNICATIONS COMMISSION

lt

SECRETARY

The license itself (above) is renewable every five years. Note call assignment at upper right.

range from 26.965 to 27.255 megacycles. If you desire to change channels by plugging in a different crystal it must be identical in type to the one supplied (except for frequency, of course). The requirements are that the crystal tolerance be .005 percent. Keep away from war surplus crystals since they will not perform in the same manner as the more recent "overtone" type used in most Citizens Radio gear.

Crystal control is used on some of the receivers, too, which eliminates the need for receiver tuning. In this type, the receiver crystal(s) are replaced when the transmitter frequency is changed. This is not necessary if a tunable receiver is employed. The frequency of a *receiving* crystal is not the same as the transmitter crystal, though both are on the *same* communicating channel. Consult the manufacturer for this information, since it varies from one unit to the next.

The rules go on to state that Citizens Radio is for "short-distance radiocommunications." Consequently there are certain limitations on power and antenna. The final RF amplifier is limited to an *input* power of 5 watts (determined by multiplying the plate current by the plate voltage of the final tube). Also, the antenna may not exceed a height of 20 feet above any man-made or natural formation. The transmission line from the transmitter to the center of the radiating portion of the antenna must not exceed 25 feet. The implication is that you can't place the transmitter and antenna on top of a mountain while you sit in the valley with a long mike cable and control wires—you have to be on the mountain, next to the equipment. Check the other antenna considerations in Part 19, especially if you live close to an airport.

The regulations provide useful information for the individual who wants to design and build his own gear. The specs on bandwidth, emission, and modulation are given. Of course this is automatically taken care of if commercially-built equipment is purchased.

The license application form itself is usually packed with the equipment you buy. If not, request "FCC Form 505, September 1958." There is no charge for this form. The address is:

[*Continued on page* 87]

EI builds a citizens band

Walkie-Talkie

The first to appear in kit form, these Springfield units provide effective short range communications.

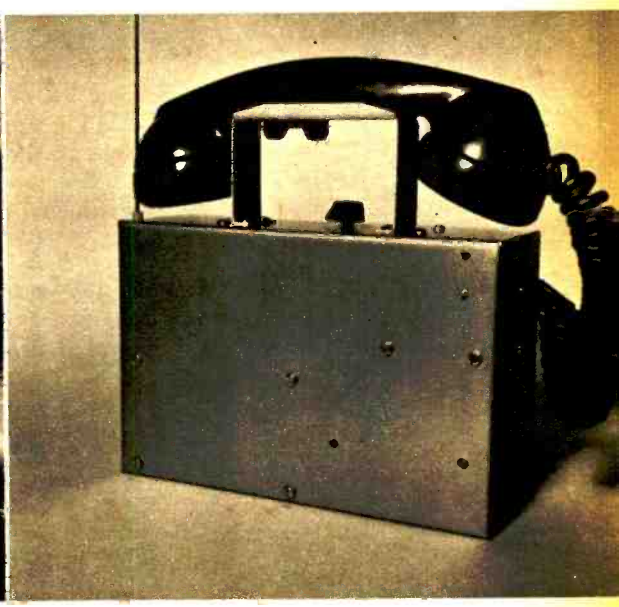
THE portability of a walkie-talkie makes it a valuable adjunct to many fields. This type of unit can lend itself well to construction, farm, TV service work, boating, and sports events. They even have been used up and down an elevator shaft to coordinate the work of two repairmen.

The Springfield Enterprises units described here are available in semi-kit form. The word "semi" is used since the electronic chassis is wired at the factory with just the battery case, transformer, and handset interwiring left for the builder.

The actual construction steps, detailed in the photos, took about three hours per unit. Although no particular difficulty was encountered, there are a few precautions to be observed. The electronic chassis has several air wound coils which must not be crushed or altered in any way as the chassis is positioned in the metal case. Just don't force it into position, angle it around until all the mounting holes line up correctly.

The telephone type handset comes wired with a straight cord that the builder replaces with a retractible coil cord. This coil cord, supplied with the kit, is terminated on each end with three wires. It is important to insert the end of the cord with the

Tests were conducted in busy midtown area. Other unit was atop high building nearby.



Knob on case, below handset, tunes receiver. Transmitter frequency is crystal controlled.

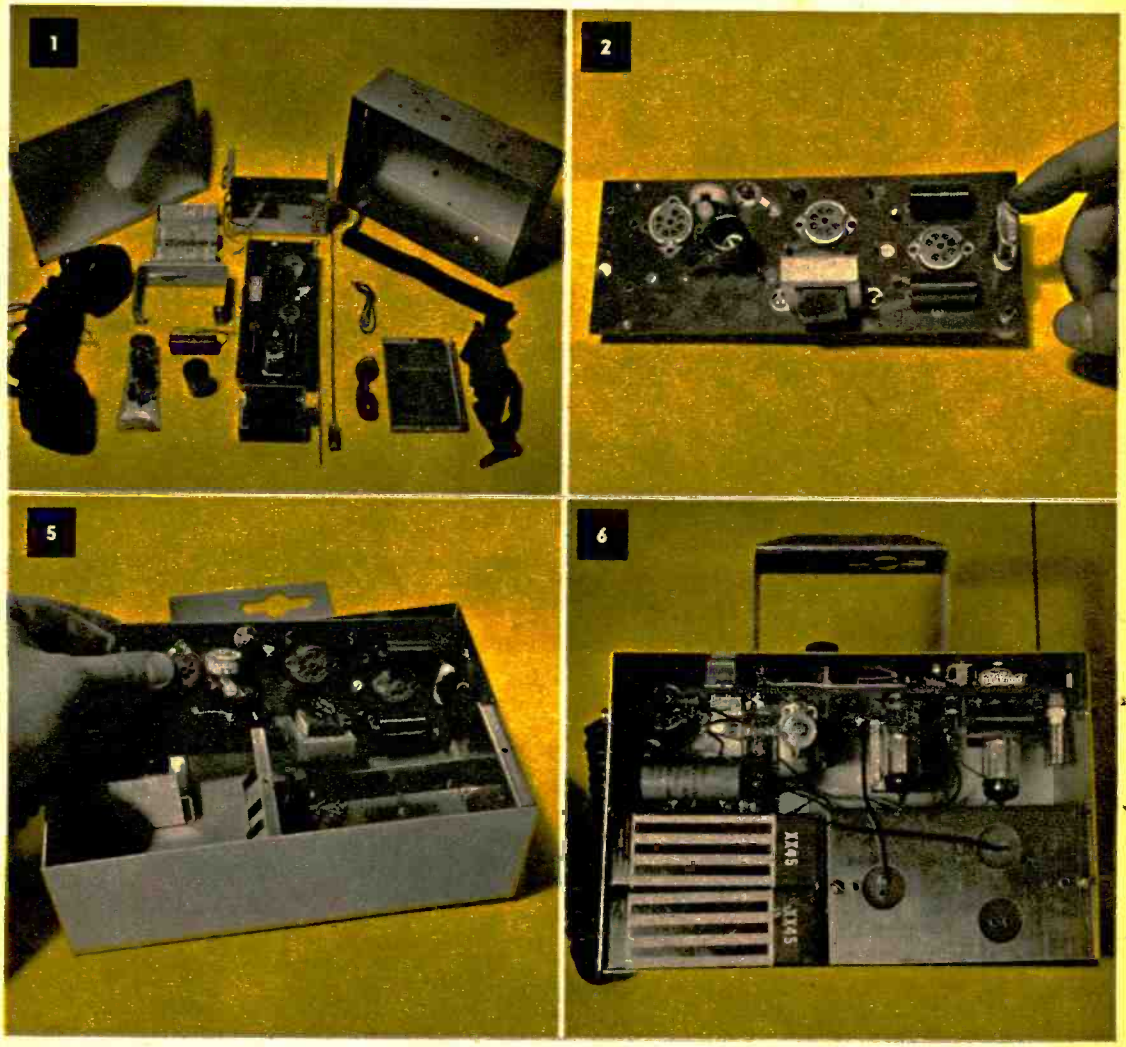
longer wires into the handset. The shorter leads are then inserted into the main chassis case. If this is not done, the lengths will not reach their proper lugs.

It is strongly recommended that once the unit is wired, and batteries inserted, that the voltages be checked with a meter. There are convenient test points on the chassis. This can avert a mishap with batteries or components stemming from incorrect wiring.

After completing the two units, it was decided to check them out in an area of tall buildings. Between many points in a quarter-mile radius they performed well, especially when the two antennas could "see" each other. Where obstructions blocked the signals the results, of course, were erratic.

Since the operating frequency is 27.225 mc, bordering on the lower edge of the VHF region, the range should in-

1. All the components supplied are pictured here. 2. Topside view of electronic chassis. Three dual-triode tubes plug into sockets. Finger points to crystal that controls transmitter.



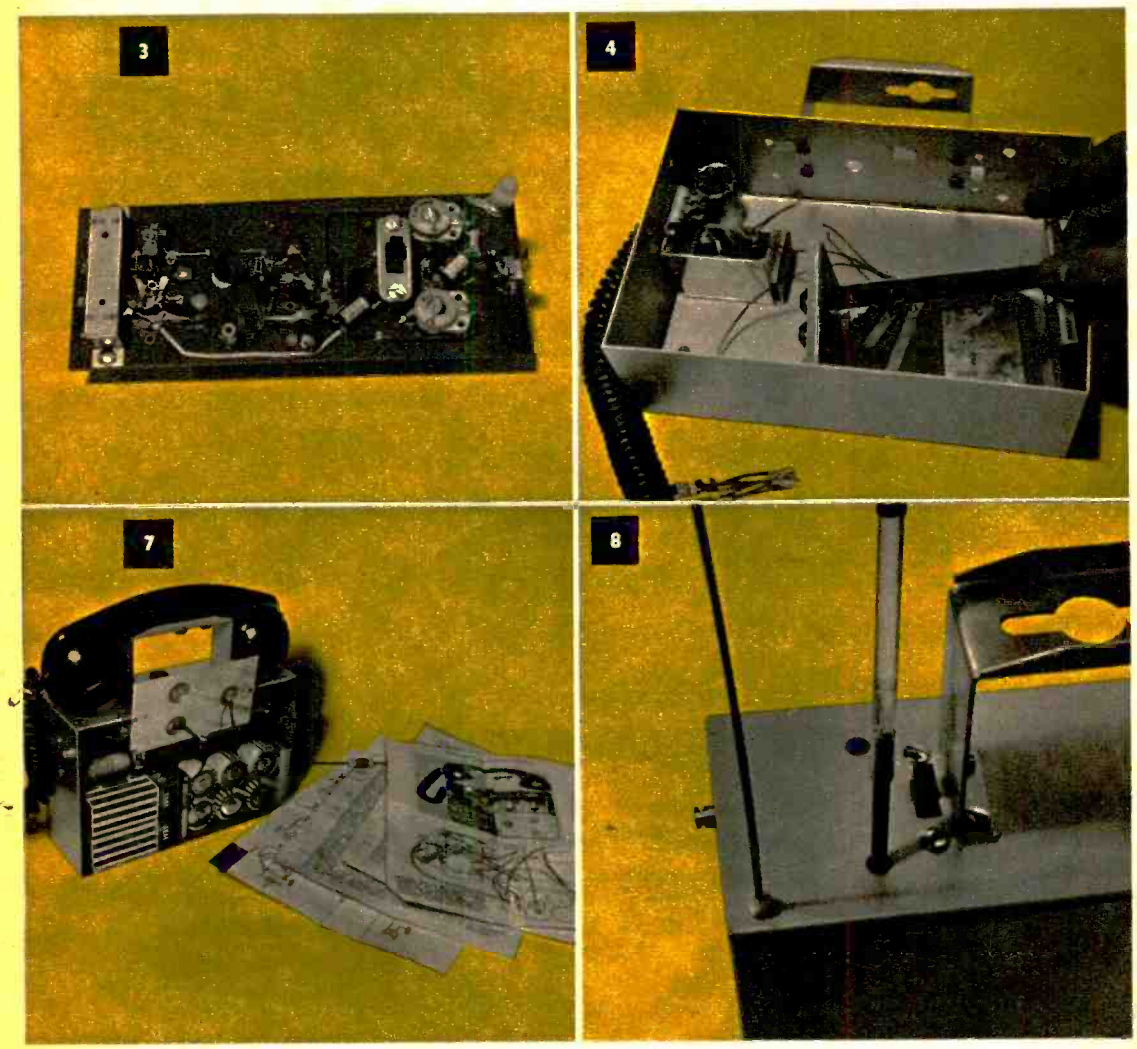
5. Chassis is carefully slipped into place, then bolted. 6. Completed unit with side panel removed and all wiring finished. Note the upside-down position of the three miniature tubes.

crease considerably when the units are used in open country or at high elevations. In some cases "skipping" will carry signals great distances, though you can't count on these paths for daily, reliable communications.

This kit is available in separate packages as follows: the electronic chassis is $18.98; hardware, handset cradle, case, battery holder, cord, and antenna at $9.98; handset is $6.98; matching transformers (2) are $1.98; and crystal is $3.98. Thus, the total cost of each unit amounts to $41.90. Batteries, which are purchased separately, amount to $5.73 for each set.

It is possible to change the frequency of these units by plugging in a different crystal. It is important to follow the manufacturer's recommendation on this since the crystal must be of the proper cut and frequency tolerance.

3. Underside view of electronic chassis showing prewiring of critical circuits done at the factory. 4. Audio transformers are at upper left. Battery holder is slipped into place at lower right.



7. Battery complement, visible here, includes six 1½ volt cells and two 67½ volt cells. Four printed sheets are instructions. 8. To right of antenna a non-metallic screwdriver tunes the output.

RCA Service Co. technicians enjoy skin diving in Caribbean.

Antenna rigging in mountains of Columbia courtesy of RCA International.

how to get

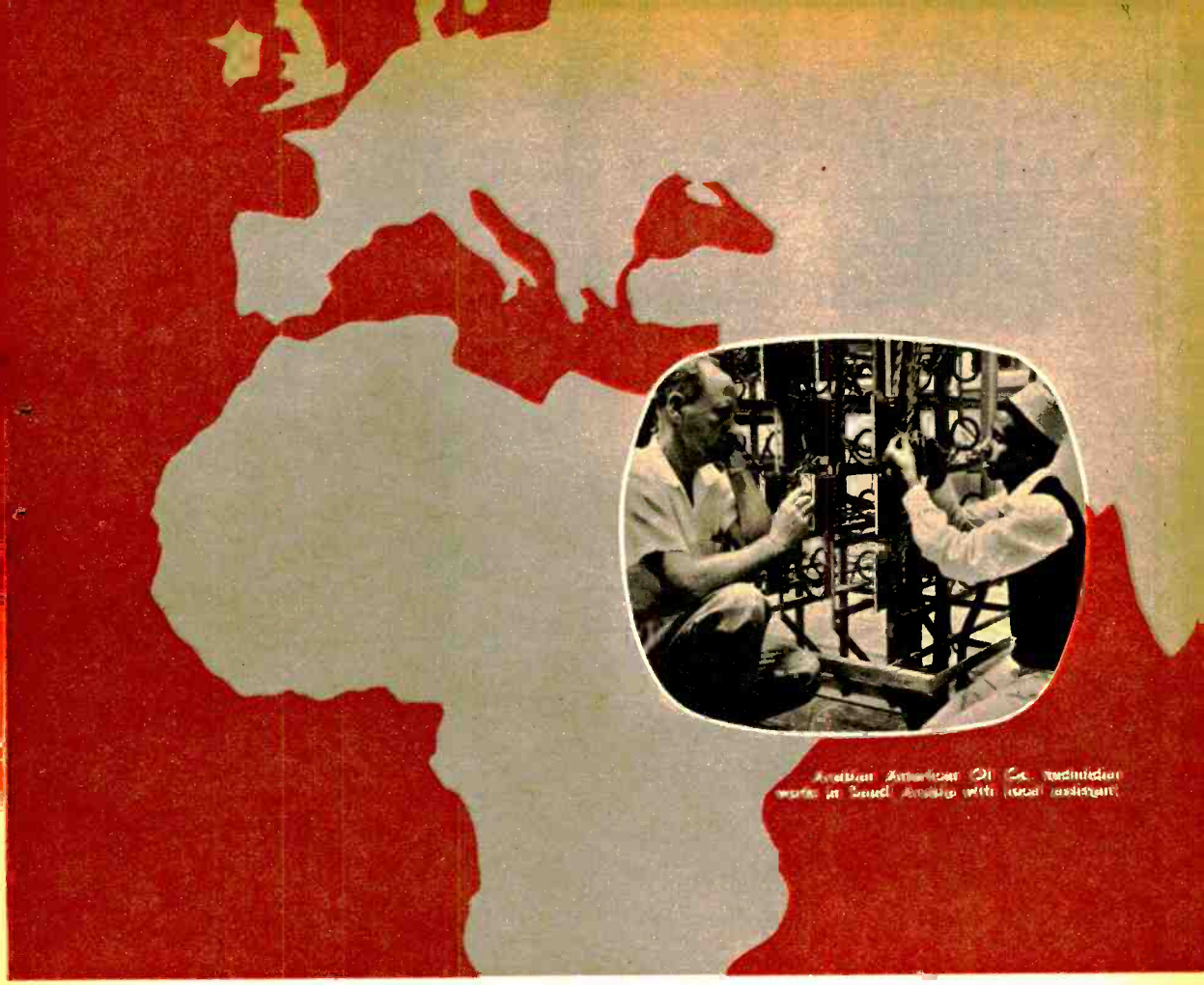
Overseas Jobs in Electronics

By Harry Kursh

What are your chances of landing a job outside the United States? What's it like working abroad?

A WASHINGTON, D. C., newspaper erroneously reported that a certain agency in the Federal system was a key source of information about jobs for Americans who want to travel abroad. Within a week the office was swamped with nearly 10,000 letters. Unfortunately, the office was unable to help any of the job seekers, but many officials learned the hard way that the travel bug had bitten America.

Never before have so many Americans traveled abroad, but the most enviable of them all are the lucky ones who get paid while overseas. At the moment, it is estimated that some 300,000 Americans are working outside the United States, and many more



would like to see what's over the horizon.

Let's face it: these jobs are not easy to get. But if you know the ropes, you're a giant step ahead of the others. In addition, if you happen to be qualified in some area of electronics, you're in a better boat by far.

Where would you like to go? Europe? Asia? Africa? Are you the kind who likes to hunt and fish on your time off? Climb mountains? Sightsee in exotic corners of a remote country?

Or do you want something that will test your ruggedness, like tackling the electronics maintenance problems in the frozen Arctic? Or do you want the kind of job that will enable you to sock away lots of moolah so that you can come back to the States with a fat bankbook?

To help you find what you're looking for, *Electronics Illustrated* had me contact experts in the United States Department of Labor, the Department of Commerce, Civil Service Commission, and some three dozen private corporations in the electronics field. In addition, I talked with the personnel chiefs of several government agencies in charge of overseas projects for which electronics specialists are employed. Out of all this, we can put together, step by step, all the facts that can help you beat the competition for overseas jobs.

But first let's look at some essential background: Of all the Americans working abroad, only about 25,000 are employed by private firms. This means that the bulk of overseas jobs are with governmental agencies such as the Army, Navy, Air Force and the Federal Aviation Agency. This does not mean that you have to enlist in the armed forces, but it does mean that your

chances of getting an overseas job as a civilian are best if you have, or get, Civil Service status.

What about pay? Working conditions? Social life? Opportunities for continued employment? You can get a fairly good idea from these typical replies from a spokesman of a large electronics company engaged in missile tracking in the Carribean.

Q. Do you require technicians to sign contracts?

A. *No. One year, however, is the desired and normal tour of duty overseas.*

Q. What is the range of pay for technicians?

A. *It ranges from $85 to $110 per week.*

Q. Are there any "extra" compensations?

A. *There is a 30 percent differential paid to technicians overseas. Room and board is furnished.*

Q. What are the working hours overseas?

A. *Normally the hours are from 7 a.m. to 3:30 p.m.*

Q. What about time off and vacations?

A. *Five days vacation every three months and a four-week vacation after one year. After working hours each man is on his own.*

Q. What are the living accommodations like on these islands?

A. *Generally barracks type, more often a large barracks building divided into two to five-man apartments, furnished with beds, lockers, etc.*

Q. Can families accompany technicians overseas?

A. *Bringing families is not encouraged. There are family accommodations at some locations, but since job locations sometimes shift, it is not conducive to family life.*

Q. What sort of social and recreational facilities are available for overseas personnel?

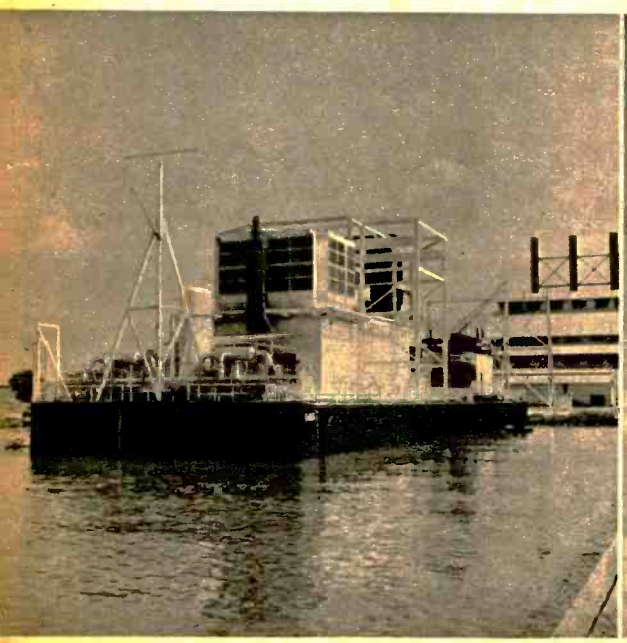
A. *It is usually limited in terms of physical facilities. Hobbies are very big, especially skin diving and aviation. Many men learn to fly, even buy their own small planes.*

Q. What promotional opportunities are open to men overseas?

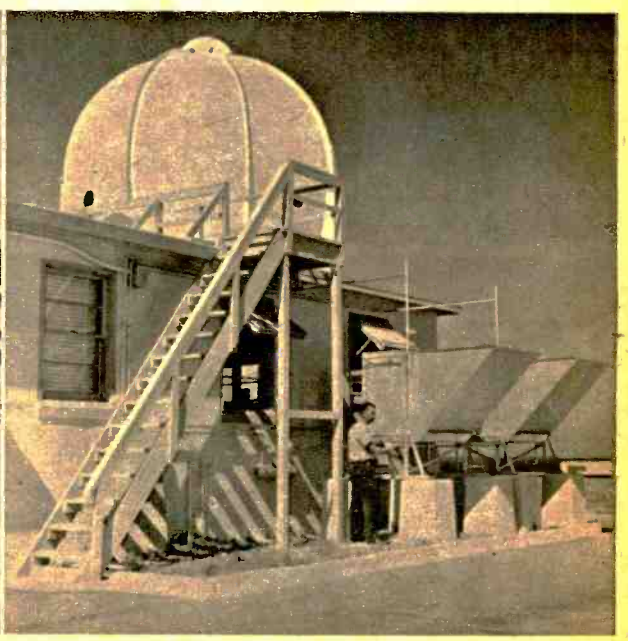
A. *Very good because of the turnover*

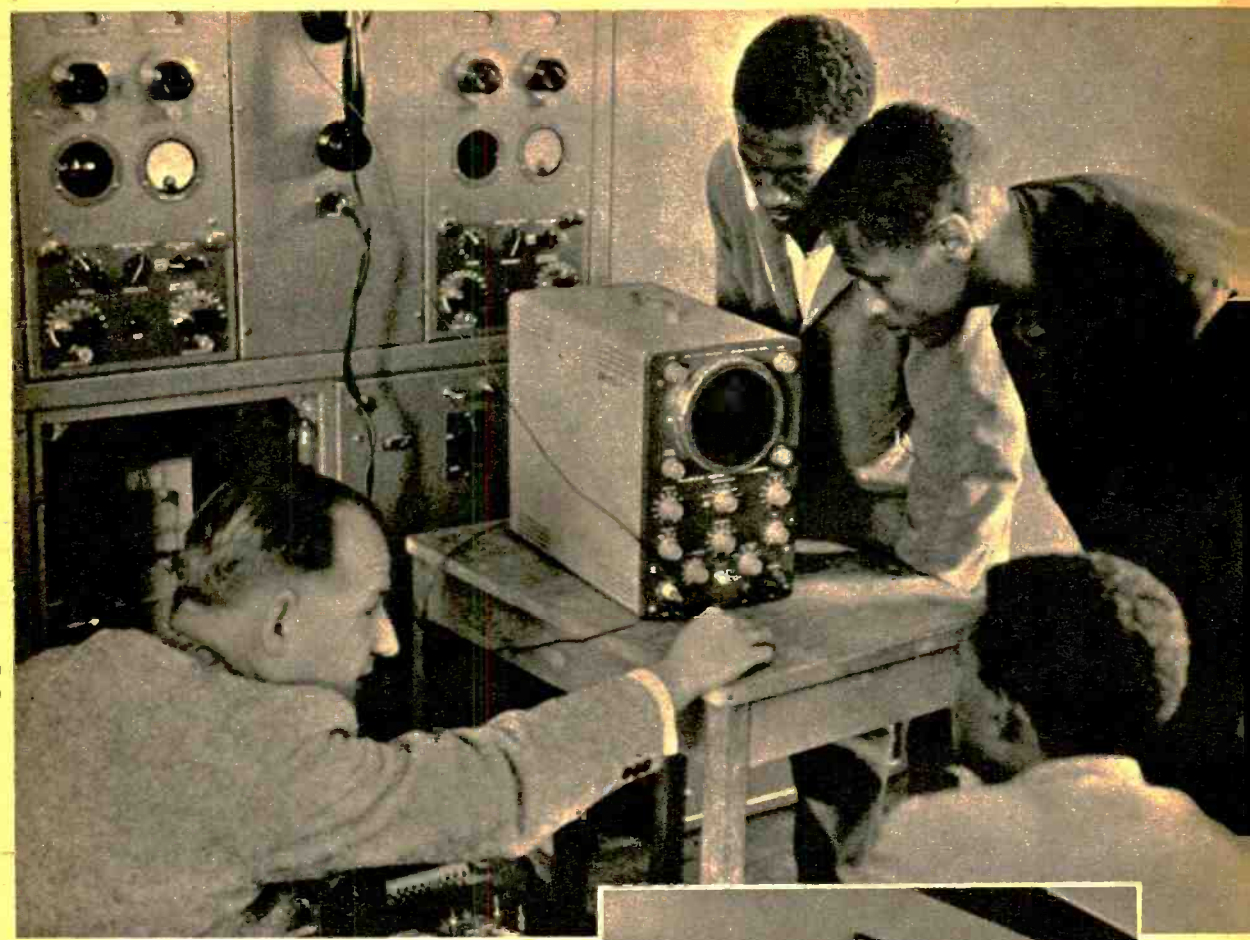
[*Continued on page* 103]

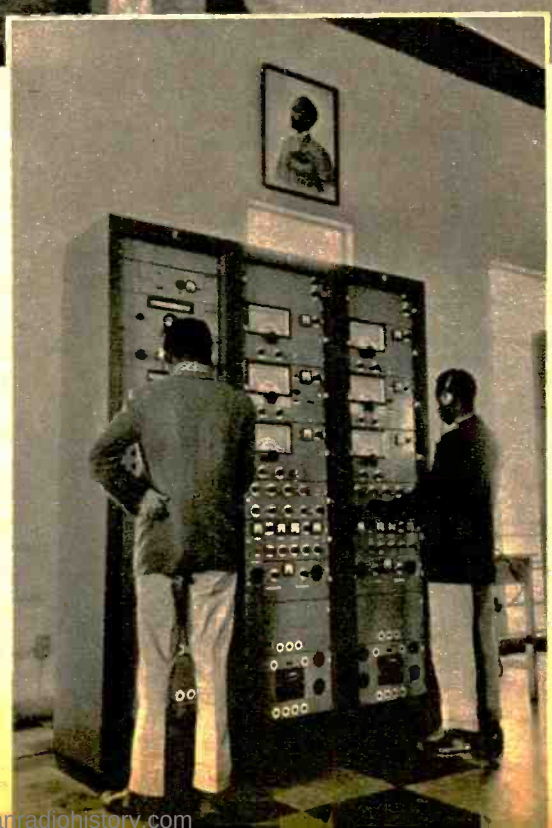
Creole Petroleum operates this floating power plant in Venezuela. Where there's electricity there are usually components that need care.



Here is a typical missile tracking station on a small Caribbean Island. It is operated by the RCA Service Co.; home base in Florida.







Many newly emerging countries are trying to develop a native skilled labor force. Here a foreign instructor in electronics has journeyed to exotic Ethiopia to teach the finer points of the oscilloscope. At right, under photo of Emperor Selassie, local students try their hand at tuning several modern communications receivers.

how to

Listen To Stereo

By Robin Lanier

Vary your speaker placement according to these suggestions for the most pleasing stereo effect.

YOUR new stereo outfit doesn't give you the exciting musical "space" and "direction" you hoped for?

Maybe all it needs is a small change in the position of the two loudspeakers. They have to be in the right places if you are to get the third dimension effect that makes stereo such a big experience.

And *you* have to be in the right place, too. Lets be frank about stereo listening. The complete stereo effect with its miraculous sense of reality depends largely on your sitting in a fairly small area which is in front of the speakers and at the same distance from both of them.

In other parts of the room the sound will be wonderful, with a full, rounded tone superior to most of what we go from mono-

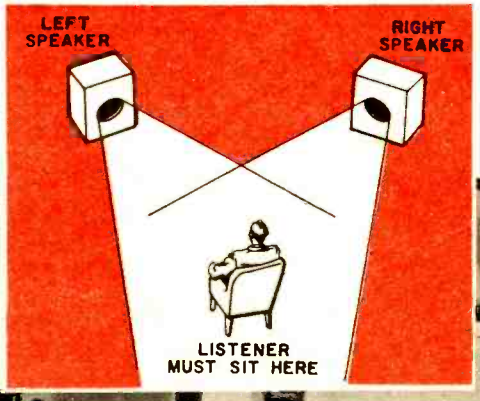


Fig. 1. Although this arrangement restricts the listener to a small area, effects of the room on the sound are minimized. The ears are tightly "coupled" to the speakers and receive the sound directly, with no bounce from other surfaces.

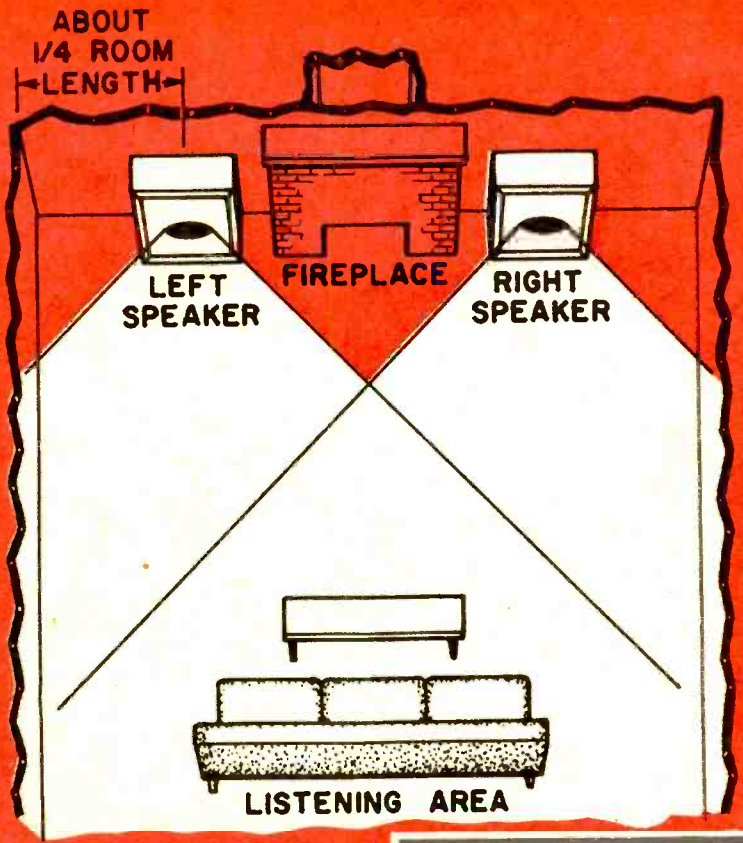


Fig. 2. Above, standard placement in a rectangular room compromises between directional and diffused sound.

Poor separation between left and right sound channels results when the two speakers are too close together.

If both speakers face into corner (note left speaker), sound deflects in several different directions.

Pointing speakers outward aids separation when enclosures must be near each other.

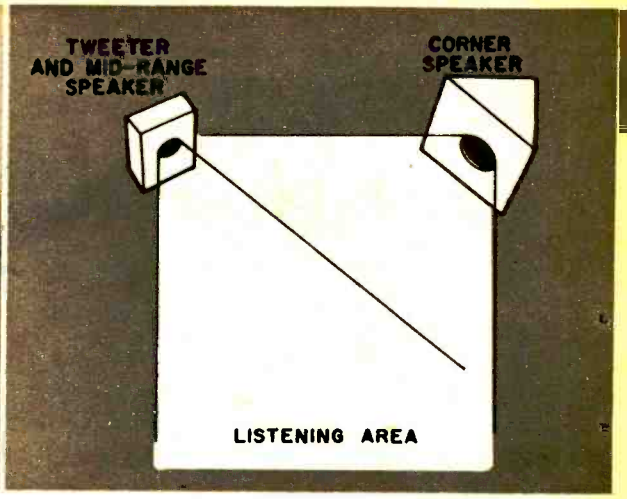


Fig. 3. A tweeter and mid-range speaker may be used with a corner unit as described in text.

phonic reproduction. But when everything is properly set up and you are in the right place to listen, amazing things happen. With a good stereo record, you have the sensation that the instruments are *right down there,* on a stage some distance in back of your living room wall. When a full orchestra lets go in a fortissimo it is bigger than anything you ever heard in your living room before.

The first general rule is that the middle and high frequencies should reach you directly from the speakers (or on one bounce, as described later) with no upholstered chairs, tables, or other objects between your ears and the speakers. Let's say the plan of your living room is somewhat like that shown in Figure 2. The speaker placement that usually works best is illustrated. The listening area is where the beams of highs from the two speakers cross, and you must be fairly close to the same distance from the two speakers.

The speakers should be far enough apart to make an angle of about 35 to 70 degrees with the listener. If the two speakers are too close together, stereo effects will be lost; if they are too far apart, there will be the much-discussed "hole-in-the-middle" that splits the sound image into two separate parts.

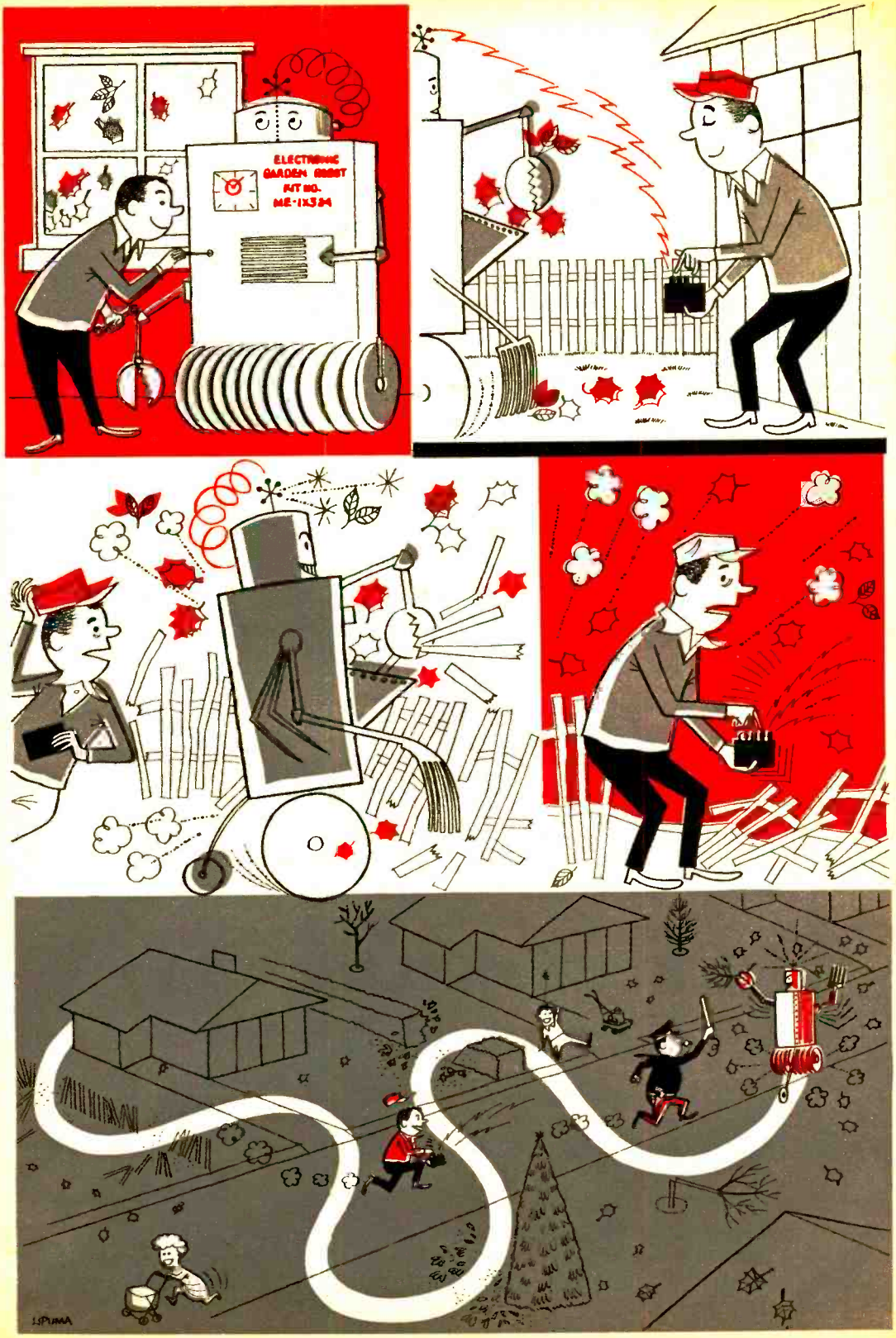
What about putting the speakers right in the two corners? As everyone knows, this position produces the strongest bass with any given speaker. It will work well for stereo if, again, the speakers are not too far apart. Since the two beams of highs are coming directly at you, you will get a stereo effect, but it may sound unnatural with speakers spread so widely.

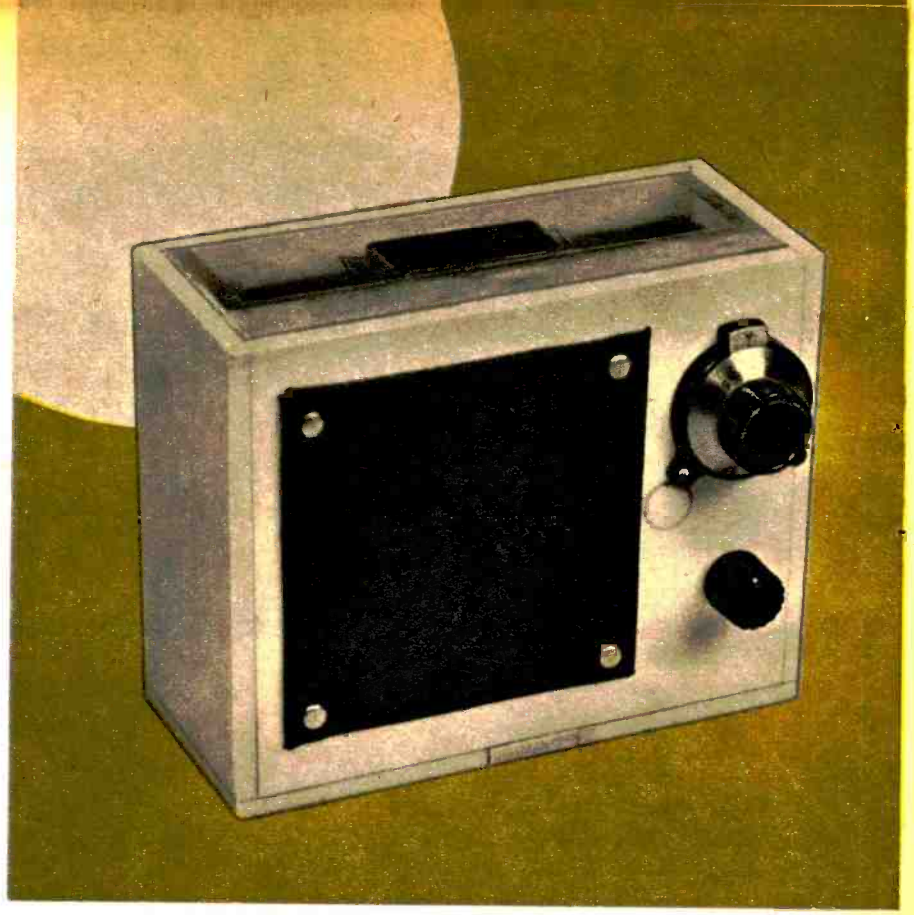
There is another arrangement, producing what we can call "ultimate stereo" shown in Figure 1, which you may like—some listeners do. (Personal taste is a big factor in stereo speaker arrangement, as it is in every part of high fidelity.) The two speakers are fairly near the listener, each about 3 to 6 feet away, and pointed directly at him so that the centers of the two beams of highs cross at his head. The tweeters should be about on a level with the seated listener's ears.

This arrangement approaches closely the effect you get from listening to stereo with headphones. It will bring out that "right there" quality in many stereo records that otherwise have a rather diffused sound. However, it is extremely sensitive to movement on your part—move your head a foot or two and everything changes.

The differences between this place-

[*Continued on page* 102]





Solar cell is at top center. On front panel are large tuning knob and volume control.

A Sun Powered Receiver

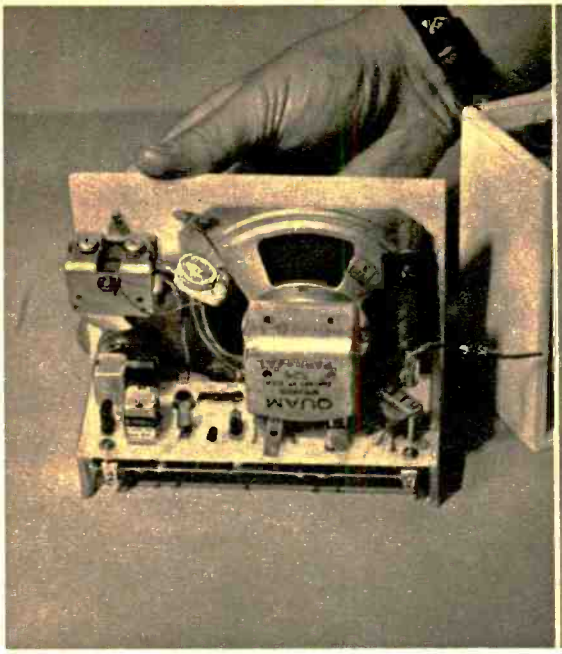
By Lester Thayer

Build a sensitive receiver powered by the sun. Its solar cell eliminates the need for batteries.

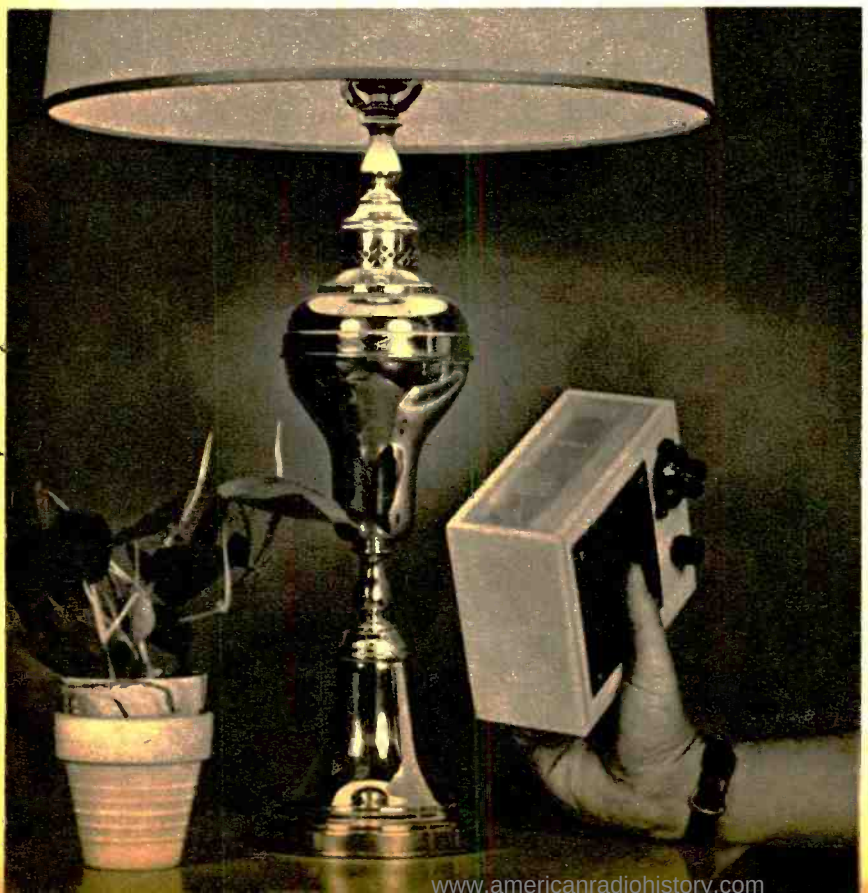
HERE is a superhet broadcast receiver that uses no conventional battery in its power supply. The operating voltages are generated by a silicon solar cell. Not only will it function in sunlight, but develops enough power from strong artificial light so it may be used indoors too.

No external antenna or ground is required due to the sensitivity of the superheterodyne circuit used. Building time is not unduly long since the design has been simplified as much as possible. It is important to use the parts specified for proper operation of the completed set, especially the coils and transformers. Proper tracking and sensitivity of the set depends on a matched set of coils and tuning capacitor, as stated in the parts list. Total cost of parts and solar battery ($22.50) is about $50.

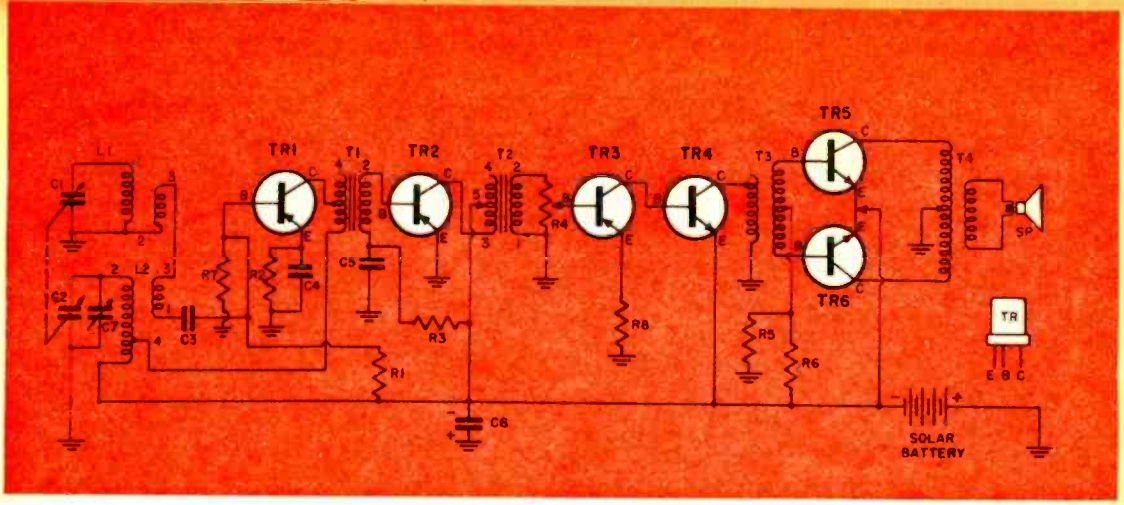
Most of the components, transistors, resistors and capacitors, were wired on a plastic board that measures 5⅞" by 1¾". A perforated phenolic board will also serve the purpose and is easily



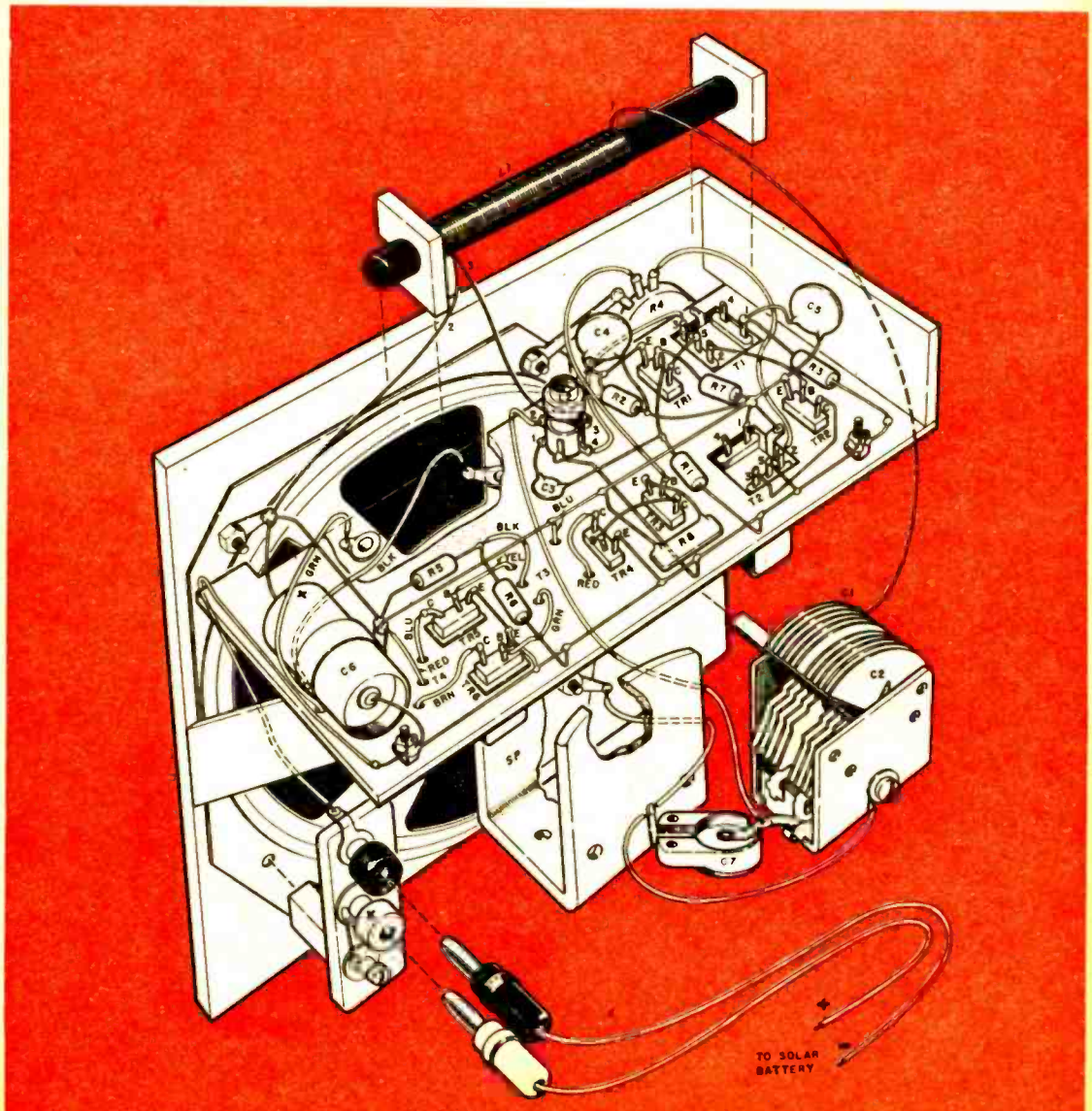
After removal from cabinet, top of chassis is visible. When fastening speaker to front panel be sure it doesn't strike any components on chassis. Photo at right shows solar cell, top view.

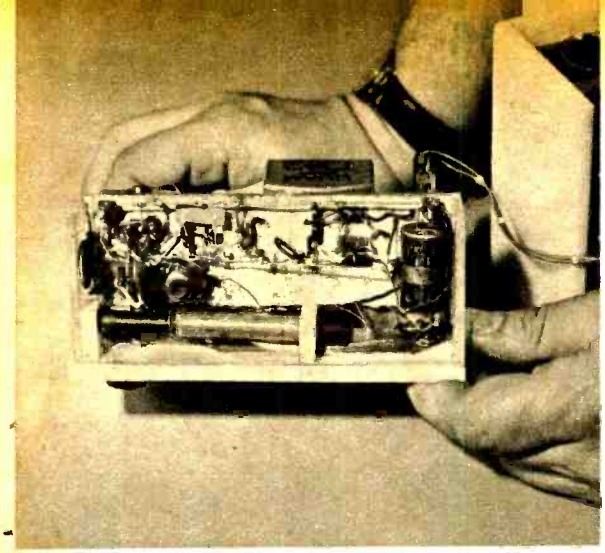


The radio will play when placed under strong artificial light. 150 w bulb used here.



Note, in lower right of wiring guide below, plus and minus leads to solar battery. Plus lead connects to red terminal on solar battery, minus to the other.





Underside of chassis. Antenna loopstick is at the bottom, mounted in plastic brackets.

Solar cell is fastened to transparent top panel. Finger points to red (+) terminal.

available. Note that the speaker, volume control, tuning capacitor, and loop antenna all mount to the front panel of the case. The case used by the author is not a standard component. However, one may be fabricated by the builder to the following dimensions; 6½" wide, 2¾" deep, and 5¼" high. Don't use metal—wood or plastic should be employed to prevent shorts.

After construction has been completed, alignment should be done to bring the set to its maximum sensitivity. If a signal generator is not available it is possible to line it up "by ear." First, close the oscillator trimmer and open the antenna trimmer, both on the main tuning capacitor. They are the two screws located on the body of the capacitor. The oscillator section (C2) has an additional trimmer to increase its tuning range. It is C7 and should be adjusted to its maximum capacity position along with the oscillator trimmer on the tuning capacitor.

Next, close the main tuning capacitor plates to about half-way. With a nonmetallic screwdriver, adjust the slug in the oscillator coil (L2) and at the same time rock the tuning capacitor in the center of the dial until a station is heard. Gradually shift the rocking of main tuning capacitor until it is nearly closed, bringing in the local station in your area nearest 600 kc. Return the dial to about 1,000 kc and adjust the oscillator trimmers to bring in the loudest signal. Return to the 600 kc station, and while rocking the dial at this point, adjust the oscillator coil slug for loudest reception. Repeat these last two steps until no more than one-quarter turn of the slug is necessary. Adjust the antenna trimmer to peak the weak, usually the upper, end of the broadcast band.

You will notice that the author's model uses no on-off switch. If this is desired, purchase the volume control R4 with a switch on it. Wire the switch in series with the postive lead from the solar cell to ground. -●-

PARTS LIST

C1,C2—Main tuning capacitor. Use Miller #2110
C3—.002 mfd disc capacitor
C4,C5—.01 mfd mica capacitor
C6—100 mfd 6 volt electrolytic capacitor
C7—7-45 mmfd ceramic trimmer capacitor, variable
R1—100,000 ohm ½ watt resistor
R2,R6—560 ohm ½ watt resistor
R3—33,000 ohm ½ watt resistor
R4—1,000 ohm potentiometer, audio taper, with on-off switch if desired (See text)
R5—2,700 ohm ½ watt resistor
R7—27,000 ohm ½ watt resistor
R8—500 ohm 2 watt resistor
L1—Antenna coil, Ferrite. Use Miller #2003
L2—Oscillator Coil. Use Miller #2002
T1—IF input transformer. Use Miller #2041
T2—IF output transformer. Use Miller #2042
T3—Driver transformer (Argonne AR-109)
T4—Output transformer (Argonne AR-119)
TR1—RCA 2N247 transistor
TR2—Raytheon CK768 transistor
TR3—RCA 2N109 transistor
TR4,TR5,TR6—Sylvania 2N35 transistor
Solar Battery—International Rectifier SM5-1020A
SP—Speaker, 4" with 3.2 ohm voice coil

Miniaturization is BIG!

By Mel Mandell

Making electronic parts smaller and smaller to meet demands of the Space Age is now an American art.

GETTING a big kick out of your little transistor radio? Impressed by some hard of hearing relative praising his new "invisible" hearing aid?

These advances must be credited to the new American art of electronics miniaturization. Yet they are primitive compared to the wonders that will eventually come about as a result of our race to the moon and beyond.

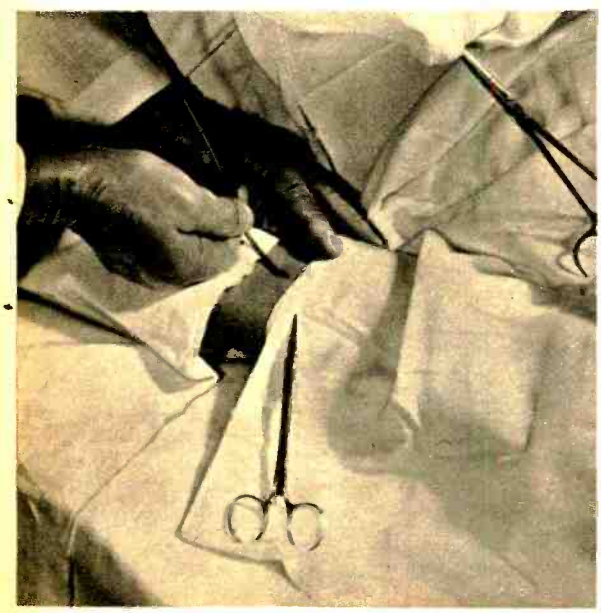
Although foreign craftsmen have traditionally been the leaders in making tiny, precise units, a growing army of American housewives has taken over the title as masters of the miniature. Working with powerful microscopes in factories that are more antiseptic than hospital incubator rooms, American workers,

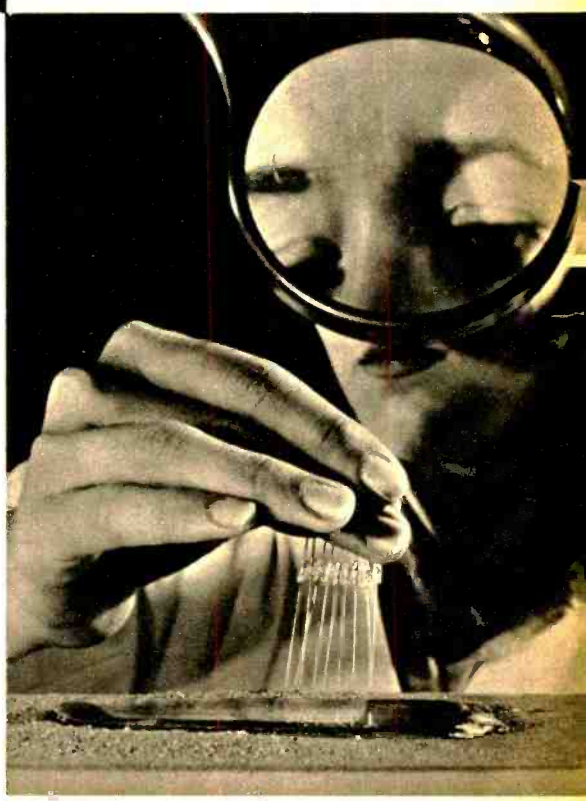
Magnifying lens, tweezer are used to inspect Honeywell sub-subminiature snap switch weighing 1/28-ounce. Missiles, aircraft use hundreds like it.

Thinner than a human hair, strand of nylon is threaded with .001" wire at G-E lab. One-mil drill makes holes for X-ray diffraction.

Solid-state devices have aided advance of miniaturization. Here, ends of tiny diodes are "tinned" at Hughes Aircraft Co. plant.

Sensitive Gulton microphone at end of heart catheter is so tiny it does no damage passing through arm vein and chest into the heart.





most of them married women, are mass producing the fanciful designs of scientists and engineers who specialize in shrinking.

Most of their electronic products handle familiar jobs easier, faster, or more attractively. But the most exciting examples of miniaturization do what has never been done before. These are the sensitive instruments crammed inside the American satellites and moon probes—tiny gauges that are unlocking the secrets of space. Here on earth, tiny diagnostic microphones that can be slipped into a living human heart are performing equally exciting "miracles."

It is not possible to say just when miniaturization began. The development of the famous proximity fuse of World War II was a big boost. This midget radio or radar set, placed in the warheads of naval and artillery shells, insured many more hits by causing the shell to explode close to the target so that some deadly shrapnel was sure to hit.

The late Harry Diamond, the man who headed the team that conceived the proximity fuse, coined the word "miniaturization." Since the latest proximity fuses are only 1/100 the size of the original, it's not surprising that Diamond's "miniaturization" has lost out to new catchwords — sub-miniaturization, micro-miniaturization, and now *ultra*-miniaturization.

Researcher David A. McLean, of Bell Telephone Labs, says that an object, to deserve the title of "miniature," should be at least 50-75 percent smaller than the previous standard version. Therefore, a "sub-miniature" part should be at least half the size of the older miniature version, and so on.

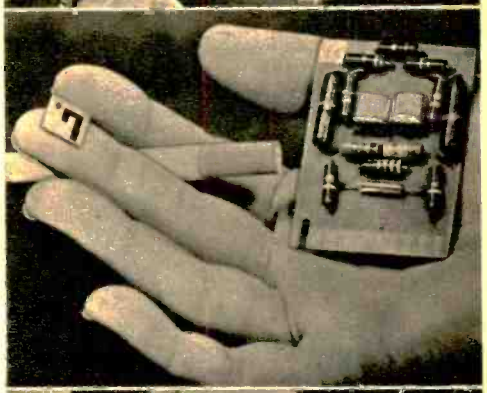
When they sit down to design miniature electronic parts, engineers generally throw away the rule book. They rarely hesitate to work with costly materials such as palladium, rhodium, ultra-pure silicon, or comparatively cheap gold. Since only specks are used, it doesn't matter that some of these metals cost up to $500 per ounce!

Some accidental innovations have given these designers a big helping

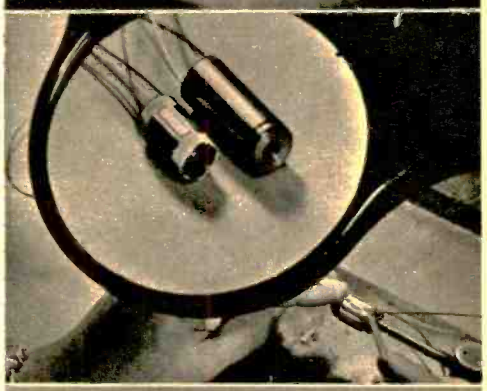
[*Continued on page* 98]

Final assembly room of G-E miniature relay plant in Waynesboro, Va., is typical of antiseptic precautions taken in miniaturization. Sealed off from rest of building, assemblers work over microscopes in room where the temperature and humidity of dustless air is very rigidly controlled. Right, inspector electronically tests friction of miniature ball bearing.

Closed circuit TV with magnification supplements microscope in checking crucial tolerances of stereo needle at Fidelitone plant.



Latest ordnance proximity fuse barely covers a finger tip. It is shown in comparison with recent, almost obsolete miniaturized version.



Smaller than a man's thumb, this G-E motor is rugged enough to withstand stresses of high altitude flying, temperatures down to -67°F.

Working parts of latest Otarion "Listener" hearing aid, packed into temple bar of eye glasses, are twice as powerful as 1954 model.

Miniature Precision Bearings, Inc.

build your own

Weather Station-2

By Paul Hertzberg

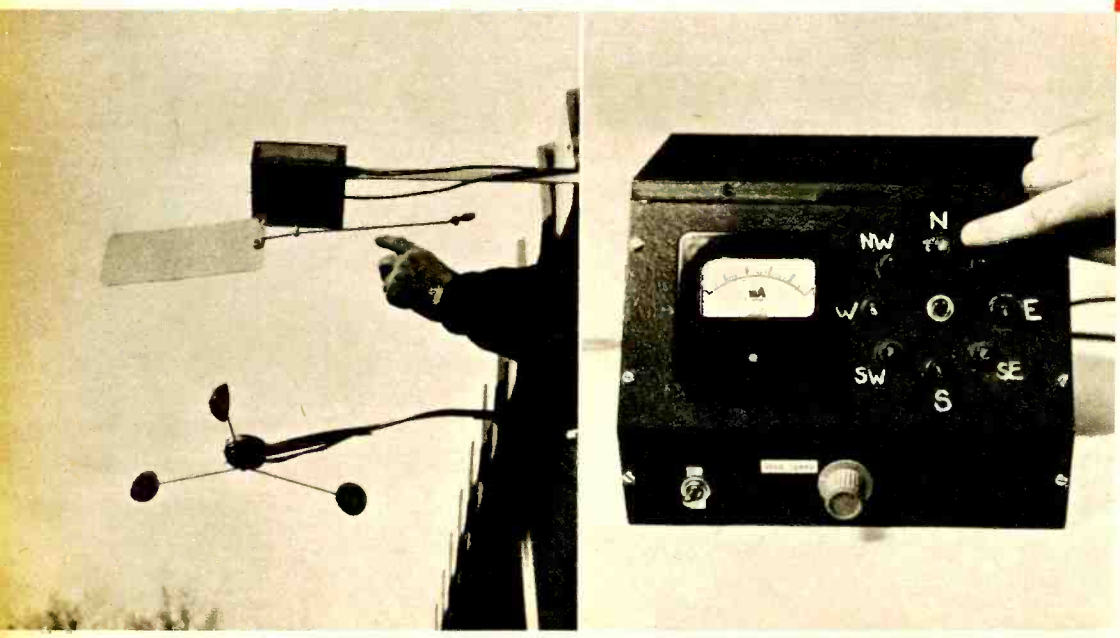
This month a wind direction indicator is added to the wind velocity meter described last month.

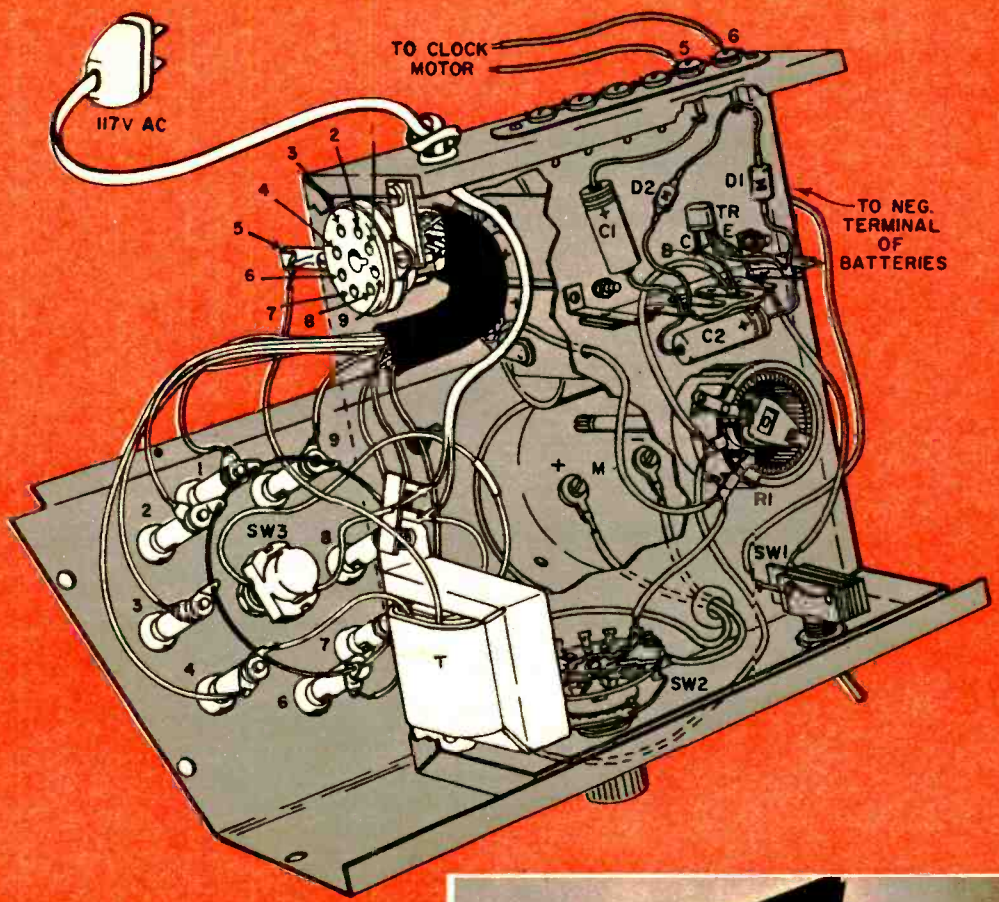
WIND direction can be of great value in weather forecasting. Winds from certain directions usually carry specific types of weather with them. With this device you will be able to detect changes in the wind's direction.

It is constructed in conjunction with last month's wind speed indicator. If you wish to build this direction indicator alone, some slight changes will be necessary as far as housing the indicator bulbs.

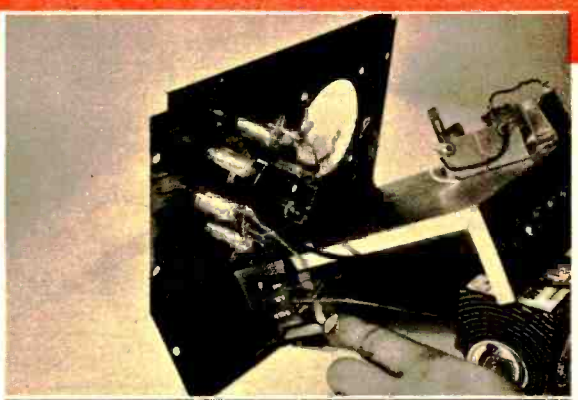
A portion of the front panel of the wind speed indicator was originally left blank so the indicator bulbs for direction could be mounted at this time. Eight bulbs are equally spaced around a 2½" diameter circle on the front panel of the cabinet. Each bulb is pushed through a rubber grommet with a ⅜" opening mounted in a ½" panel hole. An on-off switch is mounted at the center of the circle of the bulbs. This switch controls the AC line voltage to the small filament transformer that lights the bulbs.

Finger points to wind direction indicator on bracket. Note the vane on one end, counterweight on the other. Box above it is sender housing. Last month's velocity indicator is mounted below. At right, bulbs show wind direction.

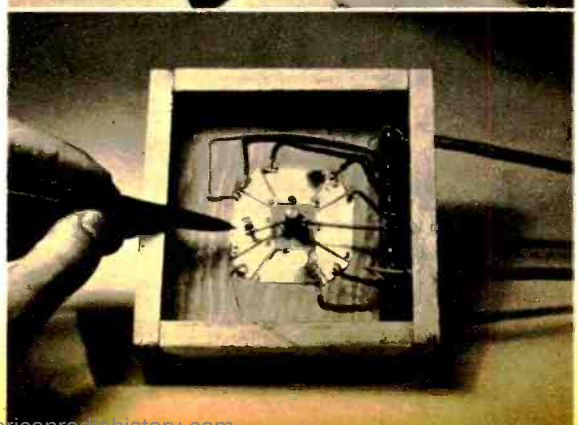




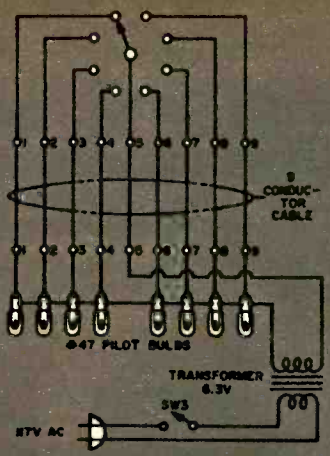
In guide above, parts and wiring in white are the added components for building wind direction indicator.



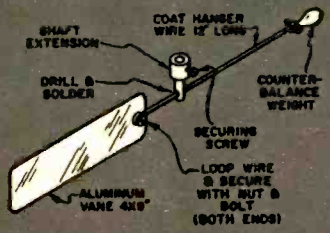
Note circle of indicating bulbs on rear of panel. Finger is pointing to transformer T below the chassis.



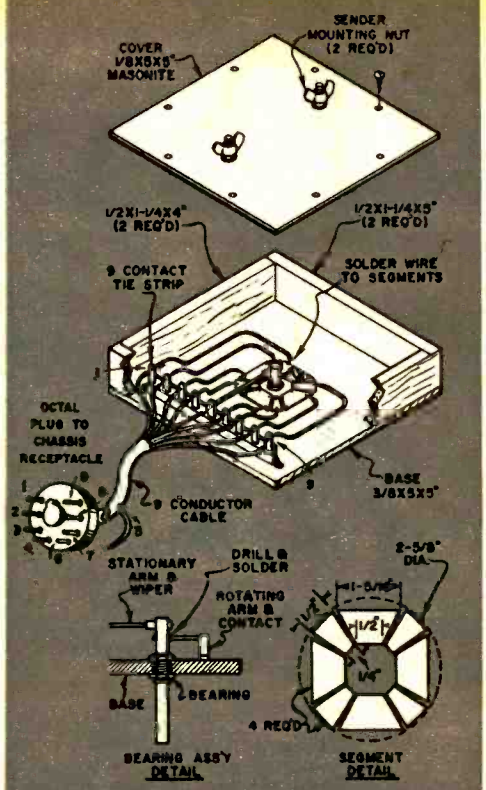
Segments in sender box correspond to the eight compass directions. The wiper contact arm is pointed out.



Circuit schematic. Segments and wiper arm are at the top, chassis parts below.



Detail of wind vane construction. The counterweight may be a lead sinker.



Sender box with associated components. Apply Grafoline lubricant on segments.

Mount the small transformer close to the front panel on the under side of the chassis. This will still leave space for any additional construction parts for the future. A small tie lug is used to join the incoming line cord, the input leads of the transformer and the on-off switch. One lead of the secondary (6.3 volt winding) is common to all the bulb shell contacts and the other lead goes to the rotating arm of the sender unit by way of a nine conductor cable. Terminate all the bottom contacts of the bulbs at a female connector mounted on the side of the chassis. The author used a junk box octal connector and used the chassis as the common ninth connection. Make sure the leads are in order as are the points of the compass. The sending unit is constructed with a piece of ½" wood serving as a base. A 5" square piece will do nicely. If you wish more "elbow room" to work, increase the size to 6" square. Mount a panel bearing through a suitable size hole in the center of the wood. Cut out 8 pieces of metal to be used as the contacts as shown in the plans. Fasten these contacts in place with small nails. The wiping contacts can be made quickly from any heavy stiff wire and some scrap pieces of brass or bronze. Solder leads from each contact segment onto the tie lug strip in order, as the points follow around the compass— N, NE, E, SE, S, SW, W, NW.

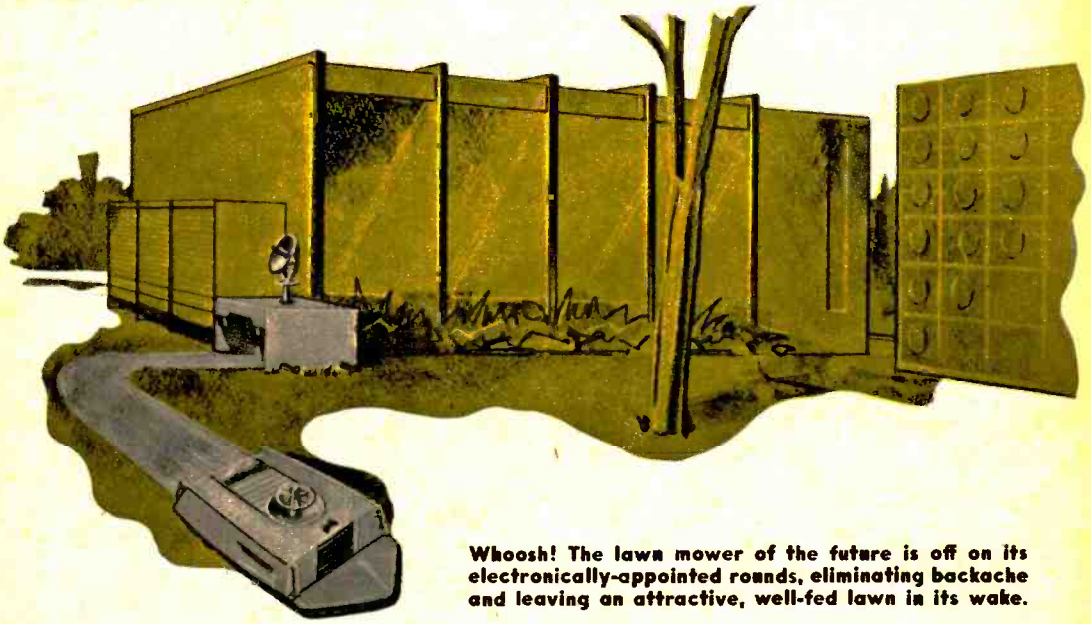
The sender is totally enclosed by

[*Continued on page* 107]

PARTS LIST

T—Filament transformer 117 volt AC primary to 6.3 volt AC secondary (Stancor PS-8415 or equiv.)
SW3—SPST on-off switch
Pilot bulbs—Eight #47 lamps with bayonet sockets
Misc.—Cable (9 conductors), nine ½" rubber grommets, phosphor bronze or brass for segments, octal plug and chassis receptacle, 9-terminal tie lug, wire coat hanger, AC line cord, wood ½" pine or plywood for box, shaft extension, bearing assembly.

Electronic Lawn Mower

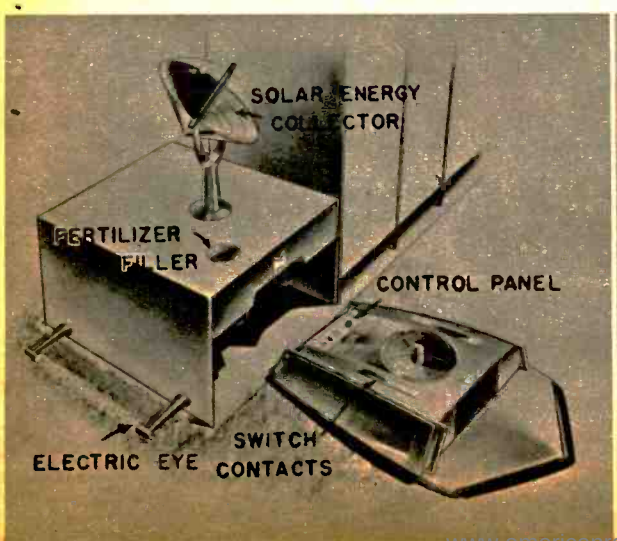


Whoosh! The lawn mower of the future is off on its electronically-appointed rounds, eliminating backache and leaving an attractive, well-fed lawn in its wake.

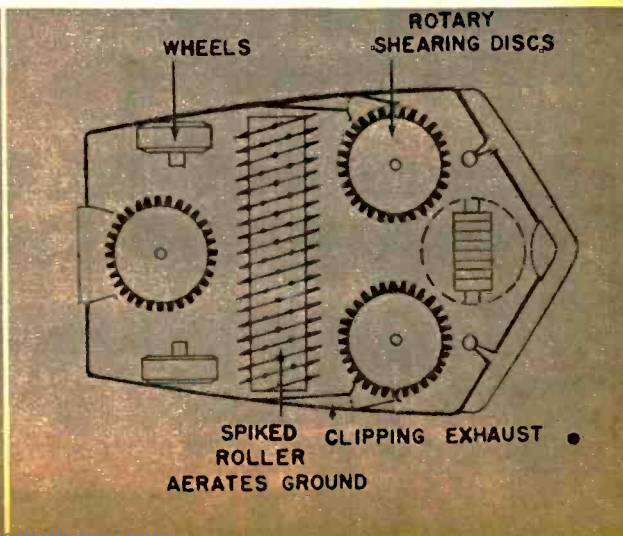
HOMEOWNERS, rejoice! Soon you won't have to do any work at all when lawn mowing time rolls around. The device that will make this wonderful state of affairs possible already has been put on the drawing boards by Moto-Mower, Inc. An electric eye will "read" the height of the grass. If it is tall enough to require cutting, the mowing cycle is started automatically—if the moisture gauge says the grass isn't too wet.

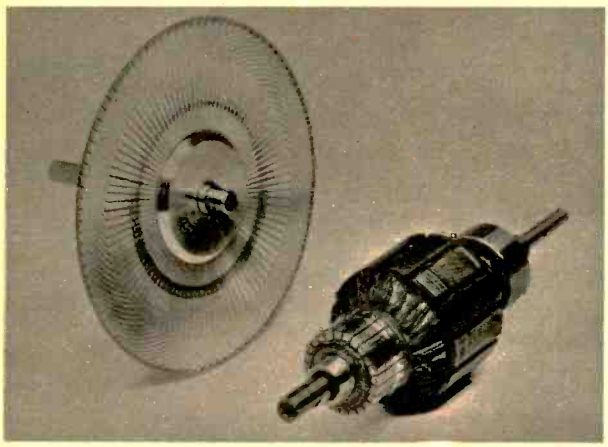
Solar-charged batteries power the mower, which has three overlapping toothed shearing discs and uses the same cutting principle of some electric razors. [*Continued on page* 113]

Sun-tracking solar energy collector and antenna sit atop mower's shelter. Control panel has knobs for setting cutting height, speed, etc.

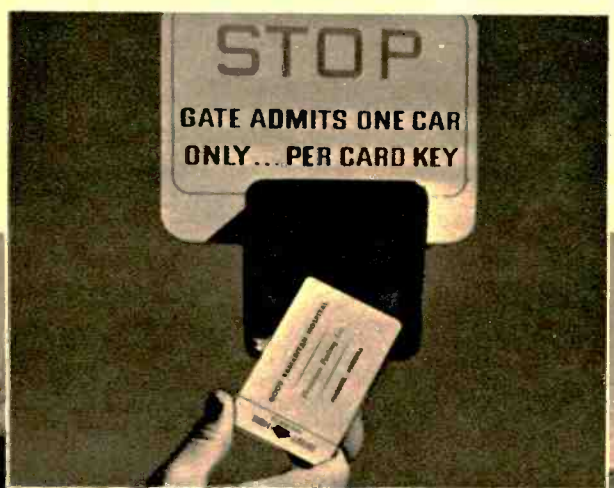


Clippings are expelled through side and rear exhaust ports. Spiked roller can also dispense chemicals. Steering roller (front) pivots 180°.



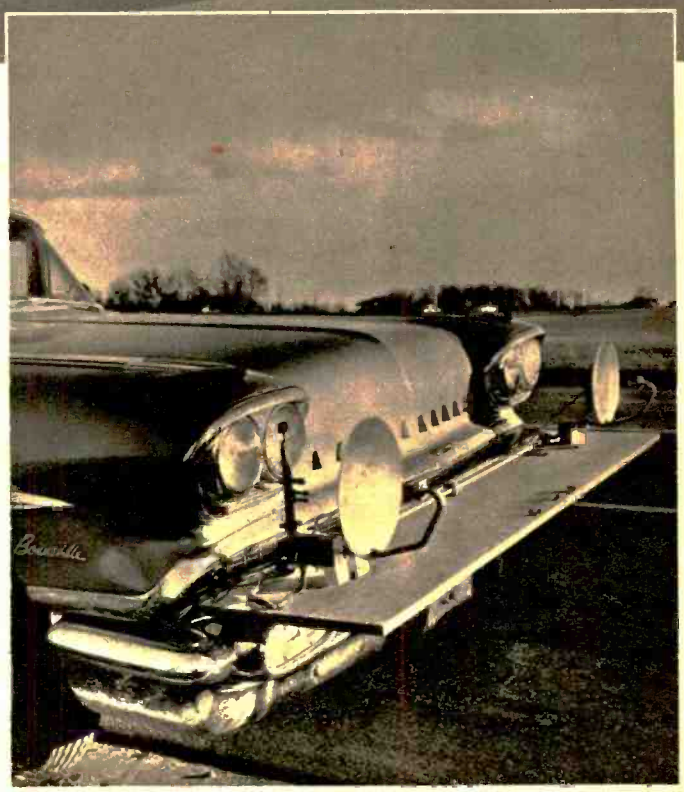


Printed circuitry has invaded the world of electric motors. At left, conventional DC armature sits beside printed counterpart which weighs 1/8 as much. "Pancake" requires no hand soldering. Made by Photocircuits Corp., it is expected to find widespread use in fractional horsepower sizes used in magnetic tape transports, etc.



The irritation of searching for a parking space is over for hurried doctors at Good Samaritan Hospital, Phoenix. A new electronic parking lot gate can be raised only by inserting a "key" card into a slot where it is "read" by a photocell. When the car's wheels hit a treadle on the other side, the gate closes again, automatically.

Cadillac Cyclone



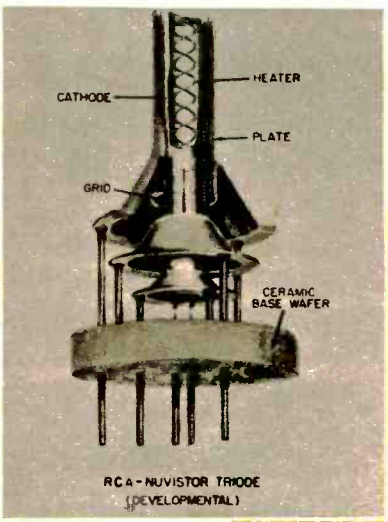
Using doppler radar, Delco Radio has developed a proximity warning device for cars. It is being used for the first time in the nose cones of the Cadillac Cyclone, above. At right is the breadboard design. A reflex klystron generates power at 16,140 mc which is piped to one reflector and beamed ahead of the car. These microwaves bounce back when they strike an object ahead, and are collected by the other reflector. Piped to a crystal detector, the frequencies of the outgoing and incoming signals are compared. Any relative motion between car and object ahead causes a frequency difference which, when amplified, activates in-car warning devices on dashboard.

Introducing the Nuvistor

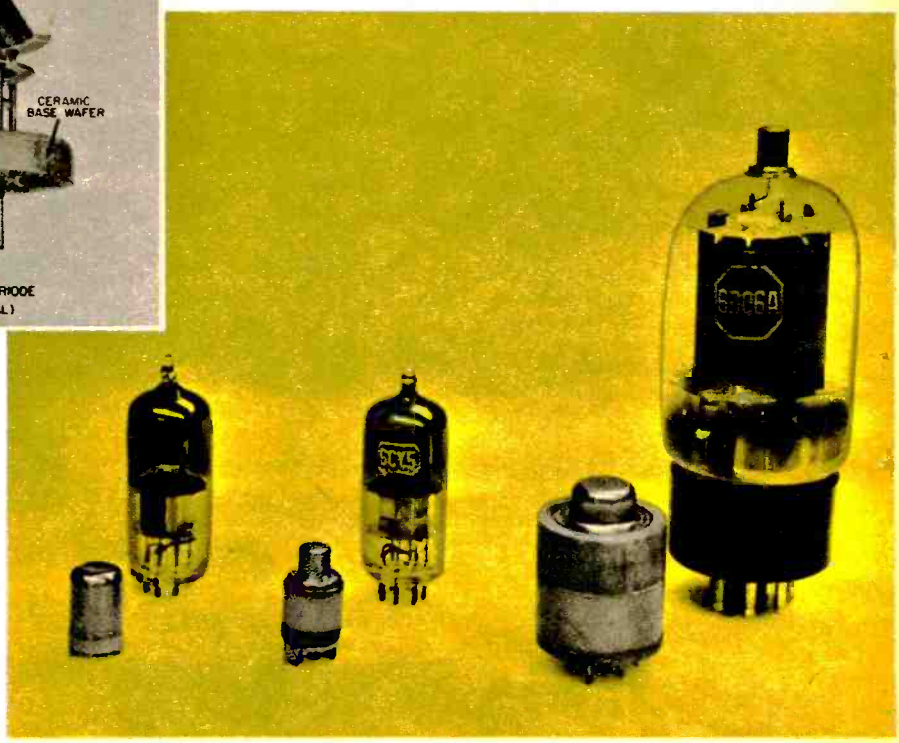
New thimble-sized electron tube design is hailed as a major breakthrough in increasing tube life.

SMALL and rugged, the Nuvistor, RCA's vacuum tube answer to the transistor, embodies structural design elements not before seen in electron tubes. A strong ceramic wafer is the platform for an array of electrodes, each secured by a tripod-like structure. The small cylindrical electrodes are half the size of those found in miniature tubes and are supported in an open-end cantilever construction designed to withstand considerable shock and vibration. No micas, no glass, no spot welding.

In a scaled-down tube, cathode efficiency and high frequency performance generally improve, but the big stumbling block has been the increase in cathode current density. Grid and plate operate at much higher temperatures and this factor tends to



Structural assembly of the Nuvistor triode is diagrammed at left. The materials are processed at high temperatures in an effort to eliminate gases and impurities. Below, the unusual design concept is displayed alongside the more familiar vacuum tubes they are supposed to replace. From left: Small-signal triode, tetrode, beam power tube.



With the aid of a microscope, inner assembly of the Nuvistor is inserted into its tiny metal case. Indexing lugs on the case shield the leads during insertion into the tube socket.

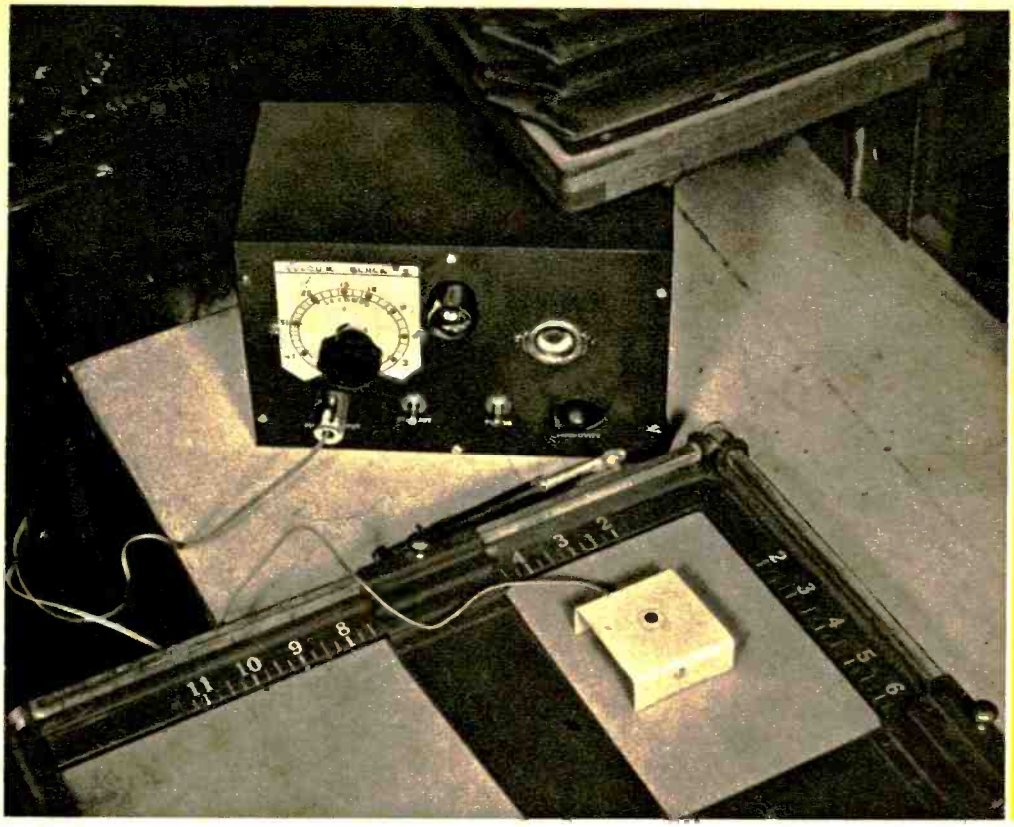
Using only a fraction of the plate power of conventional television tuners, this set gave improved reception with a "nuvistorized" tuner. Hand holds "large" miniature tubes.

limit tube life and reliability. In the Nuvistor, however, an attempt has been made to scale down the electrode spacings to a greater degree than the other dimensions and to provide more efficient thermal paths for the removal of excess heat. This scaling differential permits use of lower voltages, with correspondingly less power input. A direct result of lower current is longer heater and cathode life. Also, not as much high voltage insulation in the tube, socket and associated circuit elements is necessary.

These tubes are specifically designed to combine the miniaturization and ruggedness of the transistor-type structure with the proven ability of the vacuum tube to operate well at high frequencies. The electrode spacing in the Nuvistor, according to RCA, can be 50 times larger than the electrode spacing in a transistor intended for comparable performance. Therefore, the high frequency Nuvistor is easier to make, resulting in much lower cost.

Both consumer and military applications are planned for the Nuvistor. Experimentally, RCA has made a "nuvistorized" TV tuner. A small-signal triode and tetrode are under development, as is a beam power tube suited to audio output and TV horizontal deflection applications.

Further reductions in size and power requirements and an additional increase in performance and reliability are expected to enhance the Nuvistor tube design. RCA indicates it will start full mechanized production of the new triode and possibly other Nuvistors sometime next year.



Exposure Meter For Your Enlarger

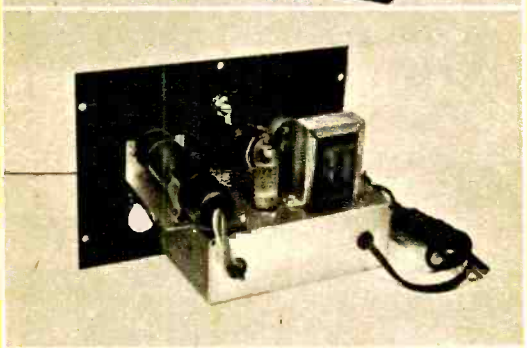
By Harvey Pollack

Get perfect exposures every time with no test strips. This device can be built for about $12.

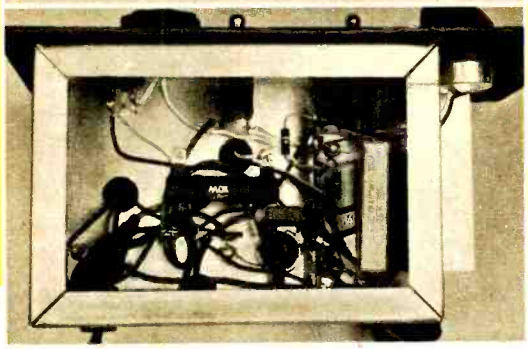
THE use of test strips is still common practice in determining enlargement exposures from rank amateur all the way up to the topnotch photographer. Those who have attempted to use one of the inexpensive illumination comparators on the market have probably found that they involve just as much guesswork as the making of test strips. On the other hand, some photographers with an unlimited budget have tried costly microammeter enlarging meters and have found that the light range is not nearly wide enough for all commonly encountered negatives.

Here is an instrument that contains no costly microammeter or other current indicating device. Instead, it utilizes an electronic tuning eye to indicate light vs. instrument balance. A tuning eye (6E5) costs $1.47 compared to a standard meter that sells for

Front view with white calibration card slipped into place. A card is made for each enlarging paper type.



Rear view shows chassis secured to front panel. Note tuning eye, left, fastened to panel by an angle bracket.



Underside shows R2, a 10 watt resistor at center. Grommets above and left of it prevent lead chafing.

anywhere between $10 and $20 depending upon sensitivity. The other parts, as the photos and diagram show, are standard, inexpensive radio components. Even the power transformer, the most costly single item in the circuit, is catalogued at only $2.58 at popular distributors.

The use of a quarter-inch light window in a cadmium selenide photocell permits the precise placement of the sensor at exactly the point on the projected image that you desire. For any but the smallest enlargements, the brightest negative area is almost invariably larger than a quarter-inch in diameter making it unnecessary for the photocell to overlap into darker regions. If your calibration is accurate, the instrument will be capable of giving you perfect enlargements every time.

The range covered by the unit is so wide that there is no enlarger on the market for which exposure readings cannot be obtained. A sensitivity control prepares the instrument for compatibility with the brightest of condenser enlargers or the softest of diffusion enlargers. In fact, its range is so great that it may be calibrated as a foot-candle meter, if desired, for measuring room illumination.

Provision is made for using replaceable dial-calibration cards made of ordinary 3″x5″ library stock. Thus, if you use half a dozen different kinds of enlarging paper, or if you stock grades No. 1 through No. 4 in any given brand, all you have to do is slip the matching card into the panel holder. This avoids possible confusion between several exposure scales on the same card, and makes identification of timing positive.

The small chassis is supported by the

PHOTO-INPUT socket (SO1), the STANDBY switch, and the POWER switch while the SENSITIVITY control shank is outside and to the right of the chassis. The latter must be mounted so that its lower edge is at least ½ inch above the bottom of the panel to clear the flange that runs around the case. The AC line cord comes out the *side* of the case rather than the back; this allows you to use the meter upright or face upward for either table or shelf placement, respectively, without having it rest on the AC cord. Every time a wire passes through metal it should be grommeted carefully to avoid eventual fraying. Live rubber grommets measuring ¼" ID for a ⅜" hole were used in most spots. Small parts like resistors and capacitors are not allowed to float. They should be secured to terminal strips placed in advantageous positions.

Since the whole "works" is part of the panel-chassis assembly, all the metal drilling, punching, and fastening should be completed before wiring is begun. Mount all the sockets, switches, and potentiometers as well as the transformer and the terminal strips first. The wiring is absolutely uncritical except in one respect: the yellow wire going to the grid of the tuning eye tube should be kept as short as possible. The Amphenol tuning-eye socket assembly has 22" color-coded leads as identified in the diagram. These should be cut to length only after all other parts are placed. Incidentally, resistor R7 in the schematic is part of the socket assembly and need not be purchased separately.

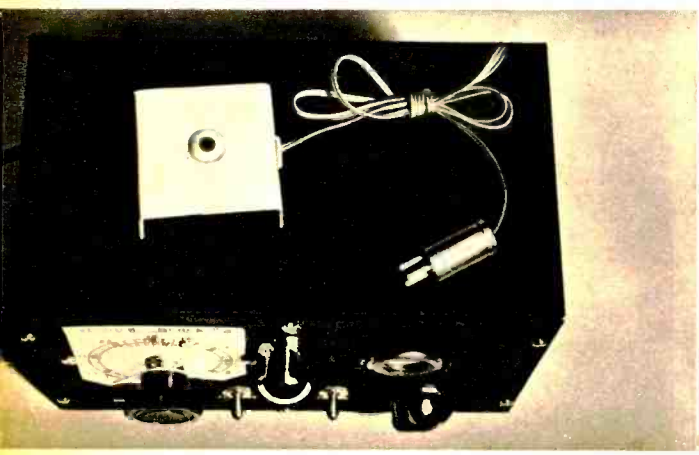
The little CL-3 transparent "window" must face upward toward the enlarger lens when readings are taken. Any kind of mounting is satisfactory provided that it is clearly visible under darkroom conditions (white color is

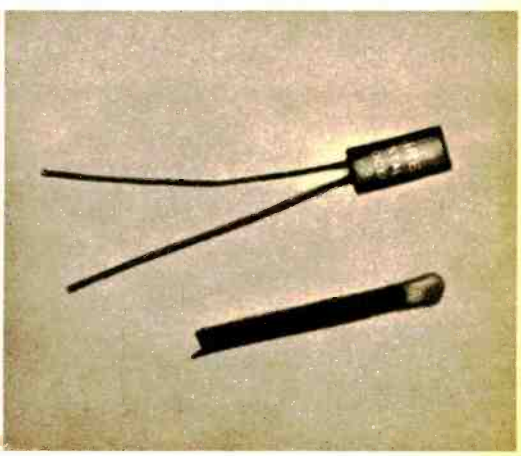
[*Continued on page* 110]

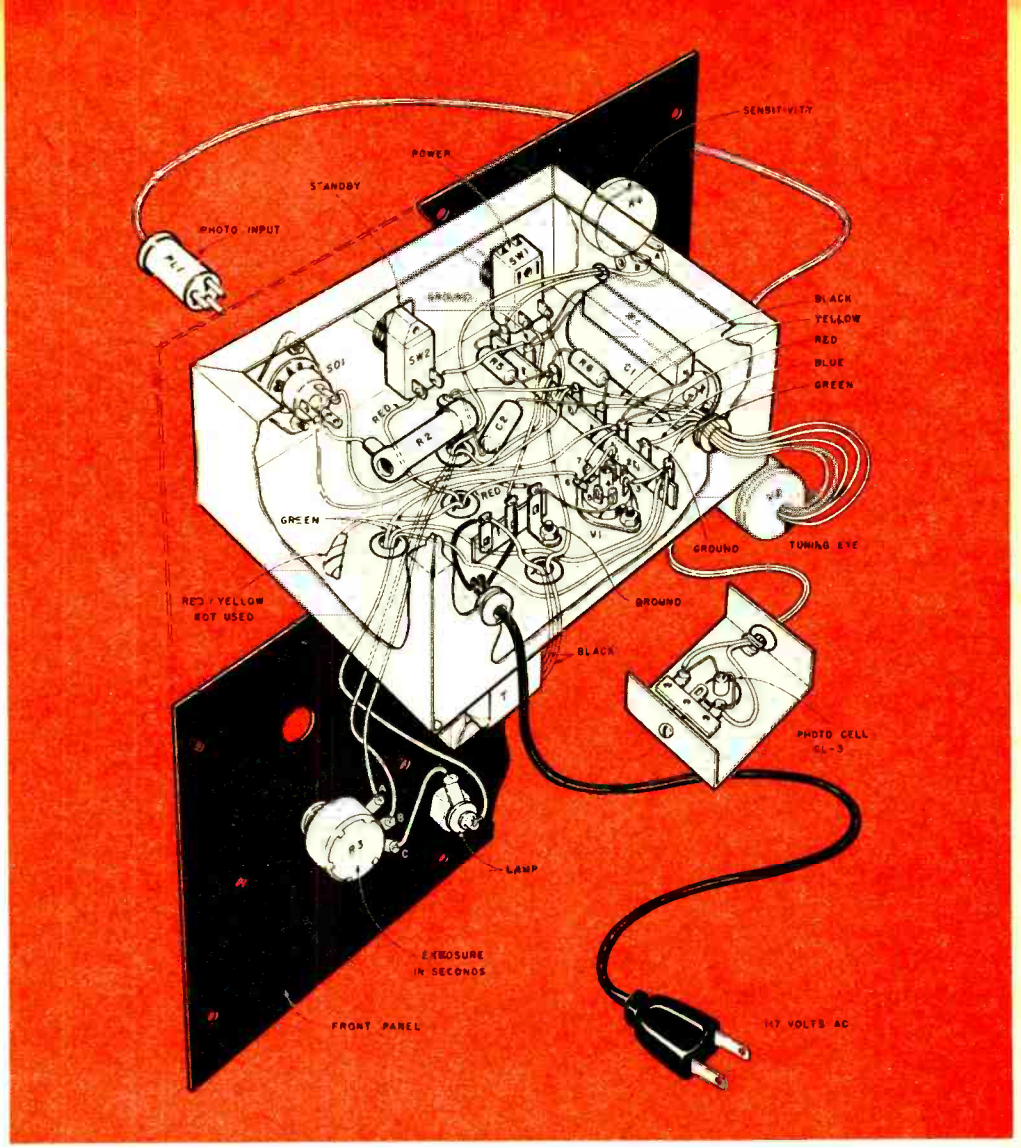
PARTS LIST

C1—8 mfd 350 volt electrolytic capacitor
C2—.01 mfd 200 volt tubular capacitor
R1—25,000 ohm 10 watt wirewound resistor
R2—10,000 ohm 10 watt wirewound resistor
R3—10,000 ohm 5 watt wirewound potentiometer (Clarostat CRL WW103)
R4—1 megohm carbon potentiometer, linear taper (IRC Q-11-137)
R5—100,000 ohm ½ watt resistor
R6—1 megohm ½ watt resistor
R7—1 megohm, built into Amphenol socket assembly for tuning eye
CL-3—Cadmium selenide photocell. Type CL-3, Clairex Mfg. Co.
PL1—Three prong plug (Amphenol type 91-MPM-3L)
SO1—Three prong socket to match PL1 (Amphenol 78-PCG-3)
SW1,SW2—SPST toggle switches
T—Power transformer 250 volts, center tapped, at 25 ma, 6.3 volts at 1 ampere (Stancor PS-8416)
V1—6X4 rectifier tube with 7 pin miniature tube socket
V2—6E5 tuning eye tube. Use with tuning eye assembly Amphenol 58-MEA-6
Panel lamp—#53 bulb with socket and shield assembly (E.F. Johnson 147-329 for bayonet base lamp)
Chassis—Aluminum 4"x6"x2" (Bud AC-431)
Cabinet—Black crackle steel 5"x6"x9" (Bud CU-1099B)
Misc.—8 rubber grommets ⅜" OD, line cord, three terminal strips, knobs

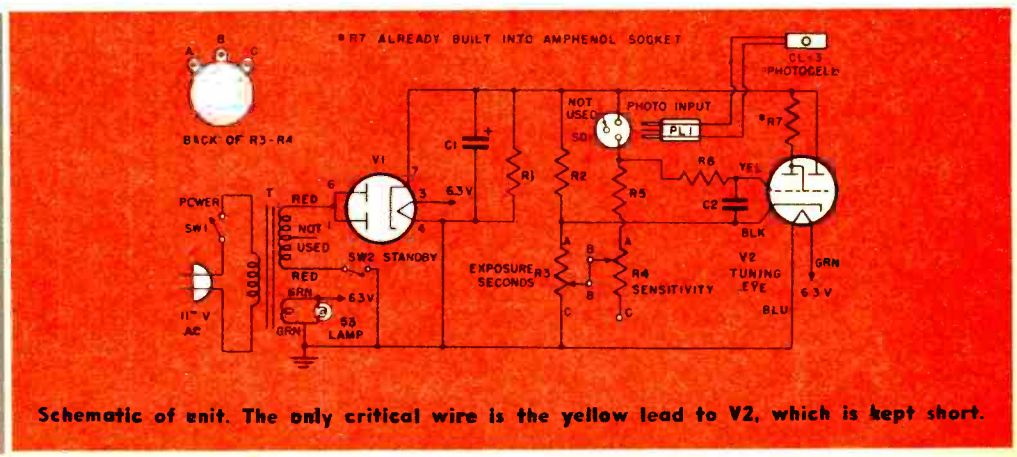
Photocell carrier atop the case is made of scrap aluminum painted white. Actual cell at right is compared in size to a match. Its tiny diameter permits precision measurement of light.







Follow wiring guide above. For clarity, a section of the front panel has been displaced downward.



Schematic of unit. The only critical wire is the yellow lead to V2, which is kept short.

New gear and old, heaped under the swap shop tent, gets the once-over from passing amateur. Object on antenna is someone's misplaced hat.

A walk around the parking lot is sure to turn up some very interesting, often unusual mobile rigs. Here's a mobile beam for 50 mc hamming.

It's Hamfest Time Again

By Carole F. Hoover, K9AMD

When the "hams" get together for a day in the sun, they meet unseen friends and have a barrel of fun.

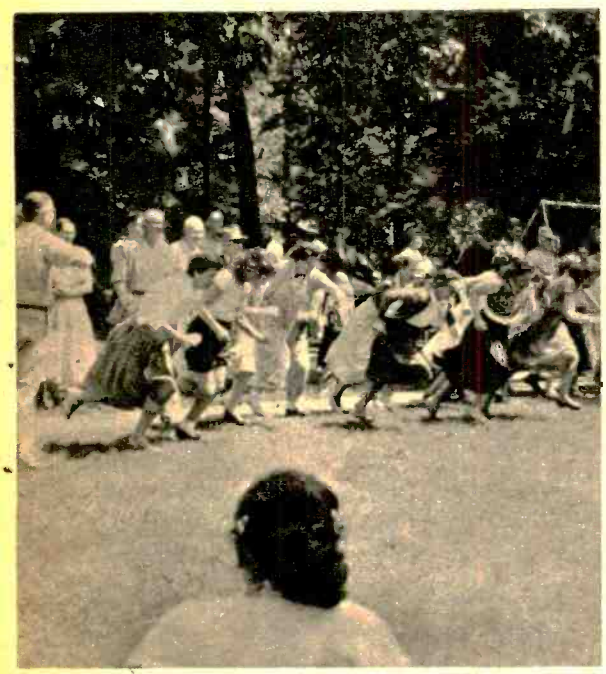
"HAMFEST" weather is any sunny day between the last blizzard and the first frost. Hardly a weekend passes during the warmer months that somewhere in the country radio amateurs aren't getting together for a day of fun.

Have you ever passed a row of cars on the highway each with a taller-than-usual-antenna waving in the breeze? If you have, chances are it was a caravan heading for a hamfest. Inside those cars, if the local laws permit, the drivers chat back and *forth* between themselves, or perhaps to a station ahead telling them where to turn in order to rendezvous with dozens, even hundreds, of other hams and their families.

Once at the hamfest park or pasture, the first item is to register for attendance prizes, then start hunting up old friends. Free coffee and doughnuts are on hand to welcome hamfesters, and everyone is in an especially gay spirit, for at long last they may meet up with radio friends they have never seen.

New and old transmitters, receivers, [*Continued on page* 106]

Most hamfesters bring along whatever surplus gear they no longer want in hopes of trading or selling it. Many sales are made right out of the automobile trunk that brought the gear to the hamfest site.



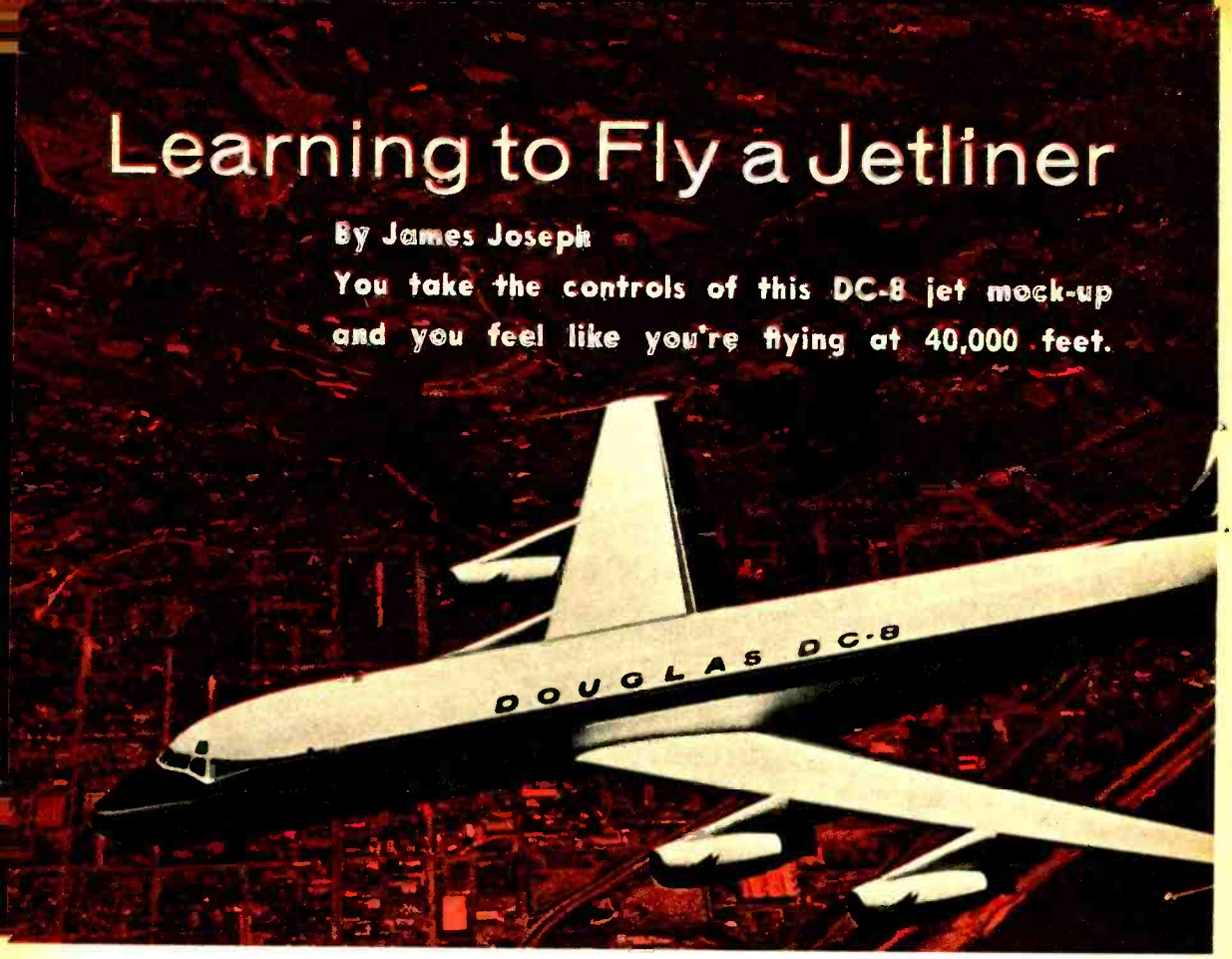
Wives temporarily deserted by their ham hubbys, who are out hunting for bargains, get together for a frolicsome footrace before picnic.

Prospective buyers and curious hams peer into cars and luggage compartments in search of new equipment and ideas for their own rigs.

Learning to Fly a Jetliner

By James Joseph

You take the controls of this DC-8 jet mock-up and you feel like you're flying at 40,000 feet.



Here a $5-million jetliner streaks over the coastline. Before a pilot even climbs into the cabin he has "flown" it several times across the continent.

SWEAT beading his forehead, the veteran airline pilot stepped from the "jetliner's" gadgeted cockpit.

"I'd have sworn we were at 40,000 feet," he said in disbelief, "yet we never left the ground."

Physically, Link Aviation's $1.5 million DC-8 flight simulator is as ground-bound as a clip-winged pigeon. Electronically, it flies—and feels—exactly like the four-engined jet superliner it imitates. Its plush cockpit, an instrumented duplicate of the DC-8's, pitches and rolls in "rough weather," heels hard into a turn, noses groundward as the pilot shoves the stick forward.

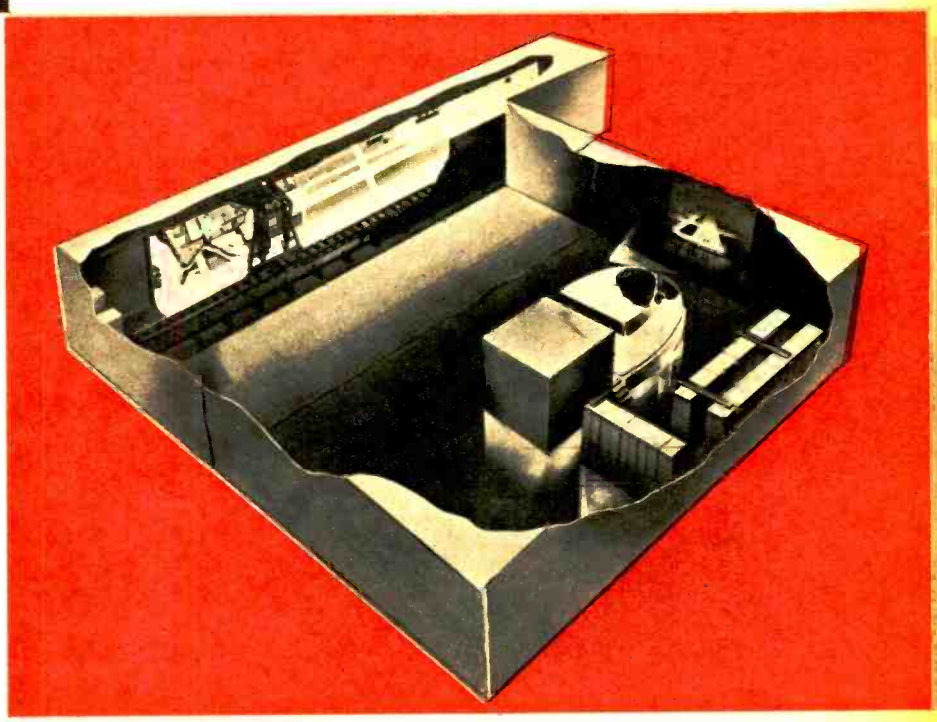
Duplicated is every jet-age sight and sound—the onrushing blur of the runway, the shrill start-up of the husky J-75 jet engines, the hiss of air at near-sonic speeds over the "ship's" aerodynamic surfaces.

Real as life, too, are fire-control devices, cabin pressurization and communications. The voice of the control tower operator is authentic and "live."

Rigged with airborne homing devices, including GCA and radar, every instrument in the simulator reacts precisely as in actual flight. Pilots and their crews are actually learning to "fly" Douglas' spanking-new DC-8 before stepping into Real McCoy.

Pilot "coming in for landing" in computer-controlled simulator takes firm grip on power controls as runway stretches before him.

Simulator cutaway shows part of computer, right, cabin with TV projector and screen, and terrain model, left, scanned by camera.



There have been other flight simulators, but none with the visual acuity of the DC-8's electronic twin. Closed-circuit television, its close-up lenses scanning a three-dimensional, 70-ft long scale model of an actual runway, projects the airfield on a life-sized (12x15-ft) screen set in front of the simulator's cabin. Harnessed electronically (through computer voltages) to the pilot's controls, the camera apes the plane's every maneuver as its lenses "fly" over the terrain model. From his seat, the pilot has all the sensations—sight, sound and feel—of take-off and landing.

So starkly true-to-flight is the simulator that recently, when a pilot streaked in too fast for a landing, his first officer bellowed, "Pull up, Joe! You're going to crash!"

Above 600 feet the terrain is distant and blurred. The houses and highways barely discernible. As the pilot noses in for a landing, things come into focus: Houses loom large, streets whiz by and the runway beckons. As he "touches down" the airstrip flashes beneath him. Just as realistic is the scream of jet-engines and the lifelike protest of the tires contacting concrete.

"Landing" at night or in poor visibility, the simulator's pilot is "talked in" by the tower operator who is an actual towerman in a simulated control tower. He can switch to any one of several navigational aids including ADF, automatic direction finding and ILS, instrument landing system.

Behind it all lurks a room-sized analog computer whose 5000 tubes, 540 DC amplifiers and hundreds of relays and servo motors animate the most costly and authentic flight simulation device ever concocted by electronics.

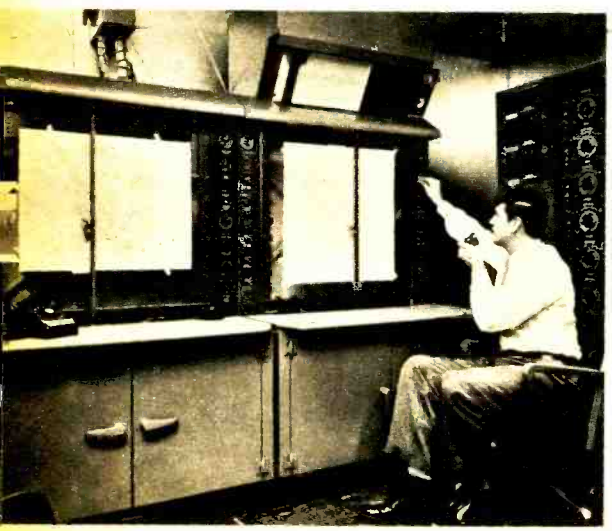
Pilots can be flight-trained for a fraction of the $5000 per hour it costs to check out a crew in an airborne DC-8, and the real super-jet is not risked.

Besides the economies in flying electronically is the matter of safety. The pilot who streaks down-runway with his first load of passengers is no cockpit novice. He's "flown" upwards of 25 hours in the simulator (currently United operates one at Denver and another is homebased at Douglas' Los Angeles plant). Additionally, of course, pilots have spent hours more in the DC-8 itself.

When engineers wanted to find out how conveniently a pilot could reach any of a dozen emergency levers and buttons, they ran simulator check-runs. Rigged as the device is with a trouble

[*Continued on page* 100]

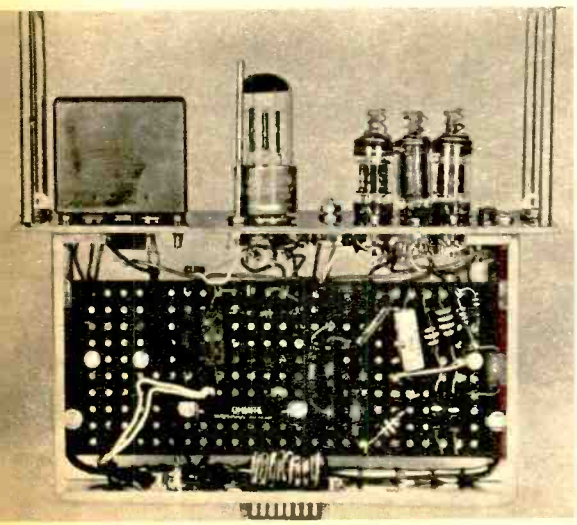
Many navigational aids and instrument approaches of six different airfields with radio check-points can be rigged by "control tower."



Here's what crews-in-training see before entering and after leaving mock-up of cabin. While inside they are as busy as if in flight.

Multi-lensed TV camera on moving track is controlled by pilot's stick and the computer. It scans this 70' scale model of actual runway and 3-D terrain. To see what pilot sees while landing, revolve photo a quarter-turn to the left. Camera scans at plane's speed.

More than 500 of these DC amplifiers take tiny signals from simulator, feed them to computer, then may re-amplify to reposition instruments.



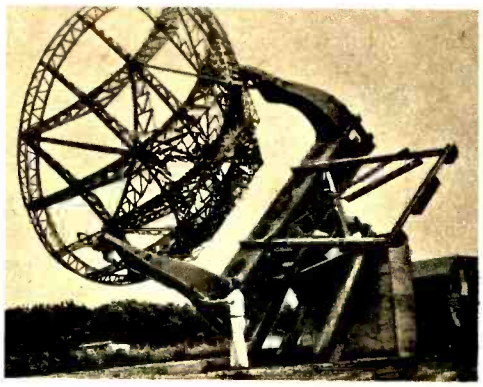
When pilot "flies" simulator, he is actually flying this mammoth analog computer having over 5000 tubes, a multitude of servo motors.

The Electronic Brain

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

Celestial Radiation

Are radio waves emitted by planets? If so, what is the source of their radiation?
Richard Hackney, Fountain City, Tenn.



National Bureau of Standards' radiotelescope in Colorado records celestial radiation.

Radiation, in the form of radio waves of a few meters in length, has been detected coming from various regions of space. Sometimes it appears as though a star or group of stars emit these radio waves; in other instances, there is no visible star or constellation that could possibly act as the source.

Many universities and other groups have set up huge radio-astronomical "telescopes" for studying these radiations. (See photo.) At the present time it is believed that matter, in the course of being disintegrated, emits the wavelengths in question during its death throes and that a thorough understanding of the radiation might provide clues to the origin of the universe.

FM Conversion

Is it possible to convert a commercial FM "televerter" into an FM radio without connecting it to a television set?
A. E. Brendel, Roseville, Michigan

An FM converter for use with television receivers contains, at the most, an RF amplifier for the 88-108 mc band and a local high frequency oscillator to produce an intermediate frequency matched to that of the sound section of the TV receiver. In other words, the TV receiver supplies all the IF and audio amplification, as well as the demodulation.

Thus, to make the converter serve as a complete FM radio, you would have to build up all of these stages to go with it. This would be costly and difficult.

Measuring Capacitors

Can you tell the maximum capacitance of a variable capacitor by counting the number of plates?
J. S. Boles, West Linn, Oregon

Since the capacitance of any capacitor depends upon the area of adjacent plates, spacing between plates, number of plates in each section, and the dielectric constant of the insulating material between plates, it is obviously impossible to determine capacitance merely by counting plates. The measurement of capacitance is best accomplished by means of an impedance bridge or a capacitance-meter.

If you can make accurate measurements of areas and distances, however, you can obtain a very good approximation of maximum capacitance by calculation. Here is the equation you will use for *air-dielectric* variables:

$$C = 0.224 \times \frac{A}{d} (p - 1)$$

In this equation, C is the capacitance in micromicrofarads, A is the area of one side of one plate in square inches, d is the distance between any two adjacent plates (one rotor and one stator) in fractions of an inch, and p is the total number of all the plates. If the plates are not all the same size, use the area of the smaller set as A.

Twinkling Christmas Lights

Referring to the EI *article "Christmas Lights that Twinkle to Music" (January 1959), I have several questions: (1) Can regular Christmas tree lights be substituted for the pilot lamps, (2) Do they have to be in series? (3) Will they provide enough light for outdoor use? (4) What transformer could I use instead of the one called T1 in the schematic diagram?*

Don Singleton, Pasadena, Texas

Let's take your questions in order.

(1) No. The string of No. 47 pilot lamps serve as the cathode return for the 6CL6 tube and require only 150 milliamperes to light to full intensity. Ordinary Christmas tree lamps need much more current than this so that they would hardly glow in this circuit.

(2) Yes. The series resistance serves to limit the plate current of the 6CL6 to its rated value.

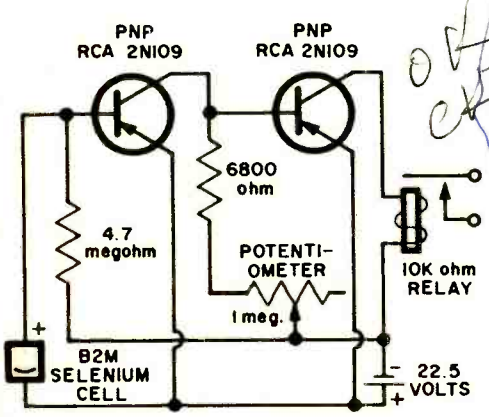
(3) In the circuit shown, these lights glow brightly. Of course, they *are* only pilot lights and would be effective outdoors only after dark.

(4) Any standard, inexpensive output transformer having a large turns ratio can be used. Examples are: Stancor A-3327 or A-3857, Thordarson 26S47 or 24S54.

Light Powered Relay

I should like a circuit that would operate a 10K, 2 ma pull-in relay from a solar cell illuminated by 100 foot-candles of light. Can this be done?

Robert Cooper, Chicago, Ill.



The circuit we are reproducing is taken from the booklet "Photocells and Sun Batteries" published by the International Rectifier Corporation. When this circuit was tested, it was found that a 10K relay such as the Potter and Brumfield LS-5 triggered when the illumination on the solar cell was only 4 foot-candles.

The photocell we used in testing the circuit was an International Type B2M solar cell available at all jobbers and distributors for less than $1.50. Some of the new silicon cells manufactured by the same company (the B2M is a selenium cell) have even greater sensitivity.

Characteristic Impedance

I notice that various cables and transmission lines are described in terms of resistance units such as "300 ohm" twinlead and "72 ohm" coaxial cable. What does this designation mean?

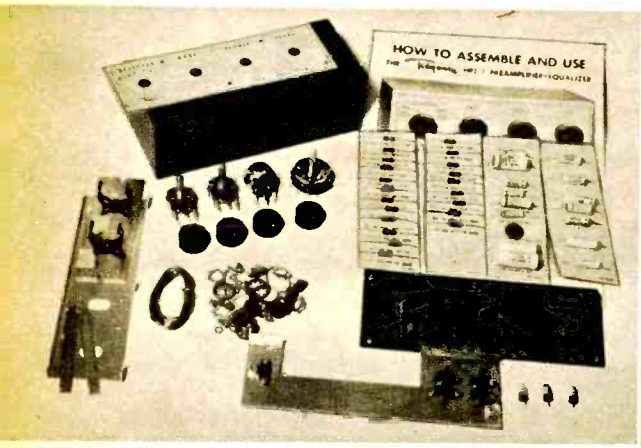
L. E. Etheridge, Represa, California

These are *impedance* rather than resistance designations. Any transmission line has a natural "surge" impedance which is governed by the inductance and capacitance per unit length of the cable. If a generator producing an AC signal feeds one end of this cable, it would appear to the generator that it was "looking into" an impedance equal to the characteristic impedance of the line.

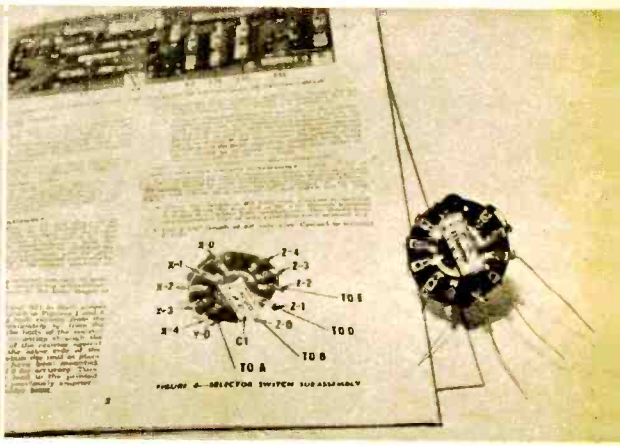
For example, consider 300 ohm twinlead. A signal generator supplying current to one end of an infinite length of this transmission line would find itself delivering current just as though it had been connected across a 300 ohm resistor. Of course, this is a theoretical consideration since we cannot ever expect to find an infinitely long cable anywhere.

In practice, the usefulness of the impedance rating of transmission lines can be explained this way: if a transmission line is terminated in an impedance equal to its characteristic impedance, the load will not reflect any energy back down the line but will absorb it all. Reflected pulses on a television leadin, for instance, cause multiple images or closely-spaced "ghosts" on the screen, which often prove objectionable.

Well-shielded case is possible, unit produces no heat.



Parts layout. Resistors and capacitors are on cards at right for quick identification.



Selector switch is prewired before mounting. Its photo in the manual shows lug numbering.

EI assembles

A Transistor Preamplifier

Low hum and small size are featured in the Regency HF T-1K, an easily assembled preamplifier kit.

THE reduction of both hum and microphonics makes a transistor preamp especially suited to hi-fi use. Small overall size can be an advantage, too. These features are incorporated into the Regency HF T-1K Preamplifier-Equalizer, an attractive package at $34.95.

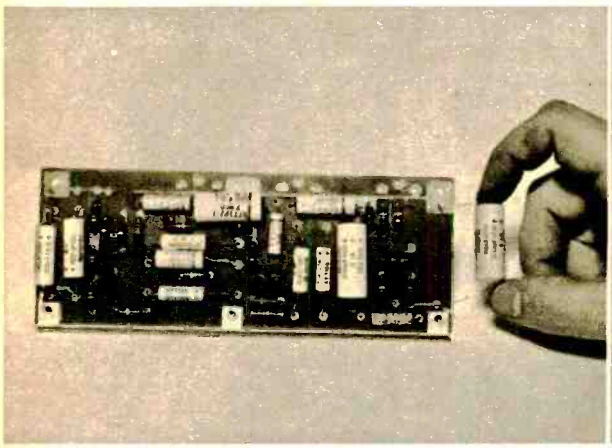
Construction time ran about four hours, mostly a process of inserting and soldering the resistors and capacitors in a printed

board. The instruction manual uses a photographic technique that is easy to follow (see illustration). Care must be exercised in soldering to this or any printed board. Ample space is devoted in the manual to point up the precautions.

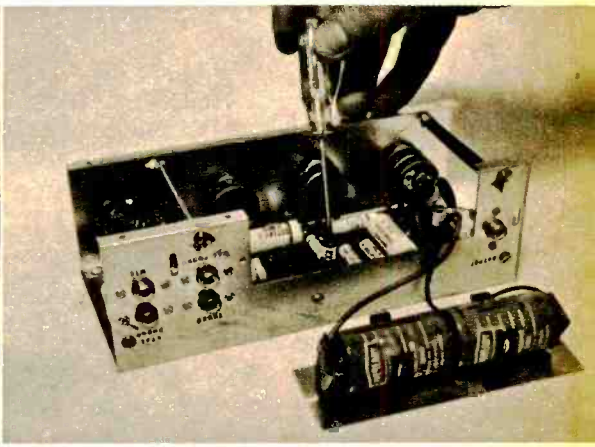
The various inputs may be identified by looking at the photo showing the rear of the unit. Actually, there is only one equalization position for a magnetic phono pickup, that is RIAA. Older recordings can be compensated for by varying the tone controls. Though the input circuit on magnetic phono is intended for the General Electric RPX cartridges, the manual gives data for altering it to accommodate other makes.

Since the current drain on the batteries is only 2.6 ma, the use of dry cells in the power supply should not prove too disadvantageous. Battery life is in the vicinity of 500 hours. Remember, too, that dry cells do not introduce the hum often associated with AC power supplies.

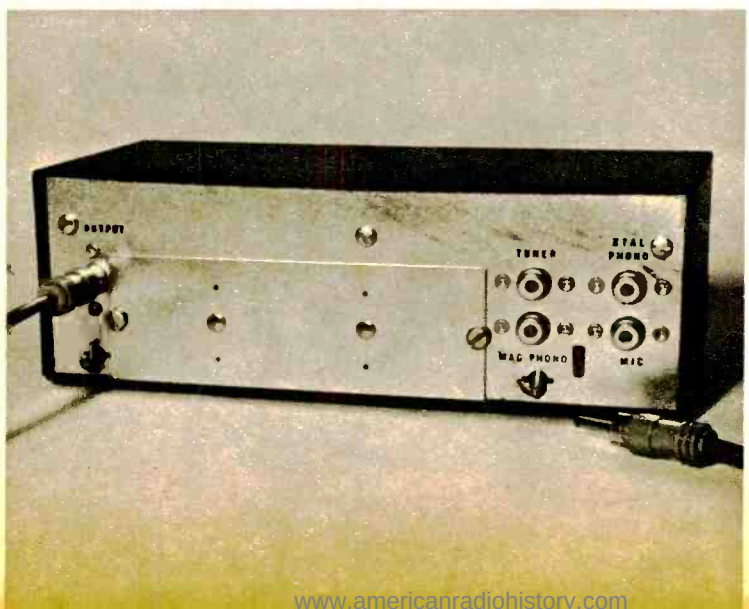
During several listening tests, the preamp was placed along side a more conventional tube type. Switching back and forth revealed surprisingly little perceptible difference between the two. Considering ease of construction and performance, *EI* rates the Regency HF T-1K a Good Buy.



Parts are inserted into the printed board and then soldered to the foil on the other side.



Two 9 volt batteries supply power. Screwdriver points to one of the three transistors.



Rear of unit. Output to main amplifier is at left, inputs, right, battery plate, center.

is this

All-Electric Auto

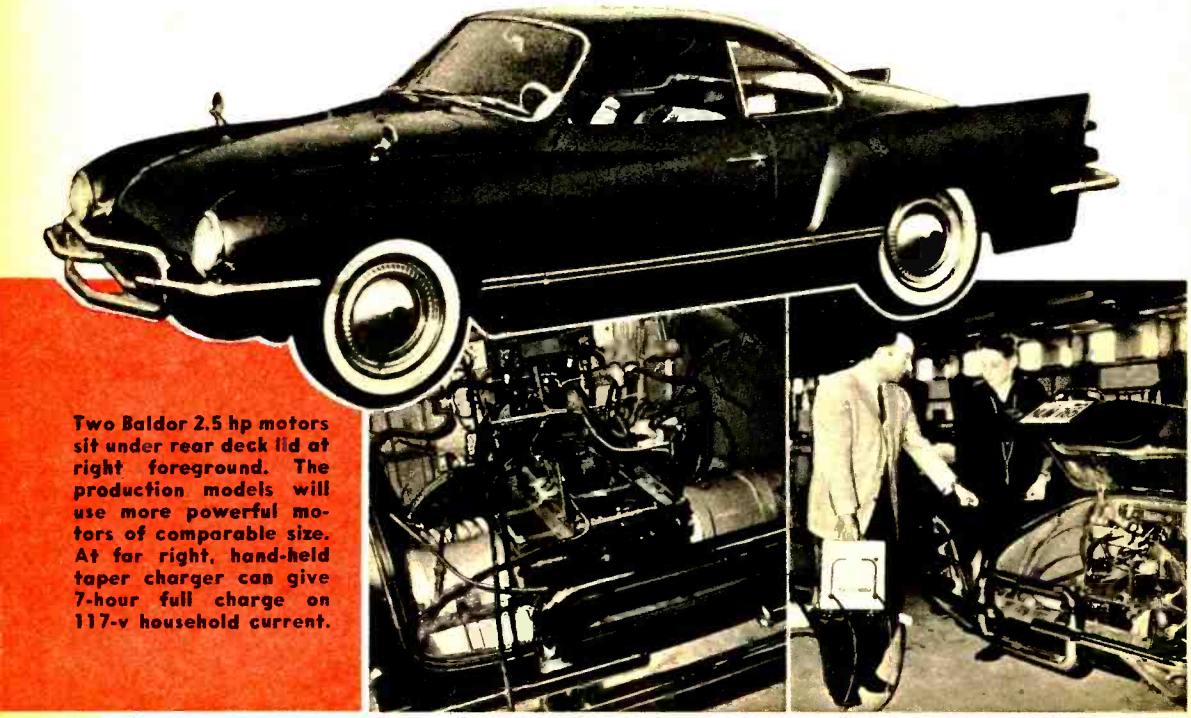
the second car in your future?

By Joe H. Wherry

What are the advantages of a car with 600 lbs. of batteries in one model? "Plenty," says an expert.

ELECTRIC cars are definitely on the way back. Having driven the prototype of the Stinson Aircraft Company's new Charles Town-About, I must admit to being enthusiastic. If I hadn't seen the beginnings of work on the first batch of pilot production models, however, I'd never admit to this enthusiasm because the prototype's performance is like most other small cars I've driven. Still, the handwriting is on the wall—Stinson Aircraft Tool & Engineering Corporation of San Diego is no upstart, but a financially sound enterprise with a staff and production facilities to match its ambitions. Detroit has already announced the De Soto Cella-I dream car which, though still in the thinking stages, is envisioned to be powered by a "totally new source of power."

Bearing a striking resemblance to the Karmann-Ghia (except for domestic tail fins), Stinson car, under all-electric power, handles like other small cars.



Two Baldor 2.5 hp motors sit under rear deck lid at right foreground. The production models will use more powerful motors of comparable size. At far right, hand-held taper charger can give 7-hour full charge on 117-v household current.

Yes, gasoline taxes are getting higher!

Incapable of contributing to the smog and air pollution problems of our large cities, electric autos would certainly meet with the approval of most city fathers. Speaking before the Society of Mining Engineers, Eugene W. Ayres, director of research for Gulf Oil, somewhat surprisingly indicated that the internal combustion engine is not quite the ideal engine for mass transportation. Certainly there are other possibilities such as electric cars, nuclear cells, or both.

Therefore, this first of what promises to be a gradual return to gasless cars merits close attention by those interested in electronics. Even as we go to press a midwest firm is rumored to be ready to produce electrically powered commercial trucks for metropolitan use.

Here's how this Stinson electric car stacks up: Before the end of the year, 500 are scheduled to be delivered, 100 going to utility firms and the other 400 to the public in San Diego County, Calif.

The car received its name from Dr. Charles Graves, Stinson executive vice-president, who is devoting nearly full time to the Town-About project.

Over two years ago Stinson decided that the complications of ignition systems and the problems associated with them might as well be directed toward strictly electrical everyday transportation. This car has no ignition as such. The exact circuitry of the projected production model is a closely guarded secret. But there are some rather exotic plans kicking around in the loft at Stinson. Right now the car is powered by direct current stored in four heavy duty truck batteries. These take up the entire space behind the two front seats. The prototype is a slightly restyled Karmann-Ghia Volkswagen, minus the small rear seats and the original engine. The four batteries are 12-volt units connected in series to put out, at full charge, 48 volts at 30 amperes.

This charge is good for a total run of 77 miles. The batteries must then be recharged at a cost of about 18 cents worth of 110-120 V household current from the owner's own garage. The cost of driving the 77 miles is ridiculously low. Aside from the brushes in the two electric motors which operate through a conventional gearbox and differential on the prototype, about the only other things that are subject to wear and tear are the tires. There is no oil system, no cooling system, and the chassis and suspension parts can be maintained and repaired by any automobile mechanic.

The production versions will have a moulded Fiberglas body. In the two-seater, the new owner will find a con-

[*Continued on page* 108]

Prototype car has auxiliary battery (for headlights) and test equipment in front luggage compartment. This will be removed later.

Many battery arrangements have been tried. Here Dr. Charles Graves, Stinson VP, points to test meter mounted over a seat-full of power.

Two ammeters and voltmeter replace usual oil and fuel gauges on prototype dashboard. Of course, car has no exhaust or ignition.

A small fluorescent lamp will glow in the presence of antenna radiation. It is held very close to the upper portion of the antenna whip or mast.

Fixing Your Marine Radio

By Leo Sands

In an emergency, your life may depend on your boat radio. Here is how to keep it in top condition.

SINCE a radiotelephone on a boat is a safety device, it must be in working order to be of benefit. It is ordinarily kept in good condition by a licensed technician. However, if the radio quits and a licensed technician is not aboard, only the skipper, his crew and passengers are on hand (if any) to put it back in working order.

There are certain preventive maintenance and repair measures a boat owner can perform. There are others he is prohibited from doing because of FCC regulations.

When the radiotelephone fails, the first thing to check is the power source. On small boats, this is usually a 12-volt storage battery. Many boats are equipped with charging generators coupled to the engine which replenish the power consumed from the battery by the radio, lights and other electrical devices.

If a charging generator is not used, the battery may give out after extensive use of the radio. It is wise to check the battery before sailing. A hydrometer or a voltmeter, or at least a test lamp, should be kept on board for checking the condition of the battery. If the battery voltage is less than 11 volts you are in trouble.

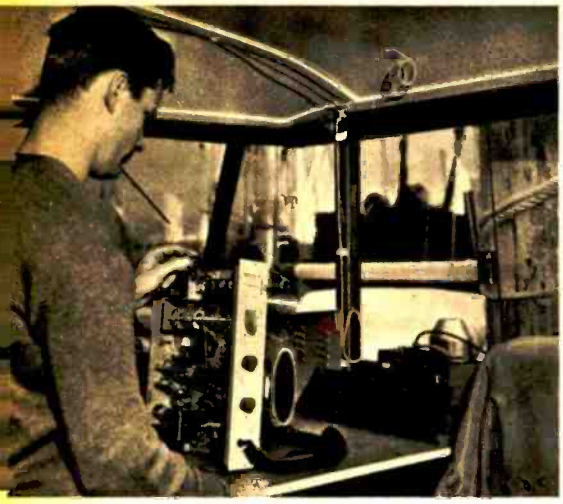
If it turns out that radio failure is due to a dead battery, shut off the radio and all other loads. After a rest period the battery might put out enough power to enable temporary operation of the radio.

However, if the battery is OK, check the battery wires and the radio fuse. If a pilot light is provided on the radio, it should glow when the switch is turned on unless the bulb is burned out.

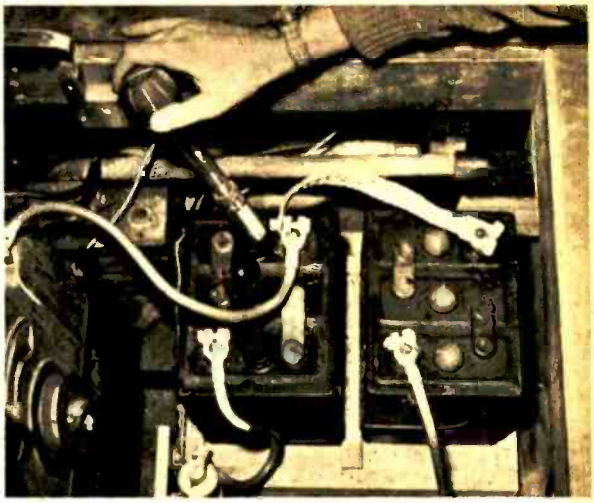
If it is the fuse, it should be replaced only with one of the same rating. If the new one blows, the trouble may be a defective component within the set or a defective vibrator. A spare vibrator should be kept on hand. If the fuse blows again after a new vibrator is installed, you might as well give up plans to use the radio until you can get a technician to fix it.

However, if there is power and the fuse and vibrator are OK, the next thing to determine is if the trouble is in the receiver or transmitter. Receiver trouble can be quickly diagnosed by turning up the squelch control if the set is equipped with one and switching from one channel to another. Noise should be

At lower left tubes are being checked. Note that the tube in the tester is being tapped to determine if there is an intermittent short. At right the vibrator, part of the power supply, is replaced with a spare unit.



Only receiver crystals may be replaced by an unlicensed person. There is one per channel.



Before sailing, the condition of the boat's batteries should be checked with a hydrometer.

heard on all channels. If one is quiet, suspect a crystal. If all are quiet, suspect a bad tube or trouble in the antenna circuit.

Burned out tubes can sometimes be located by noting if they all light. Some glow very dimly. Discoloration of the glass generally means nothing. After the set has been on for a few minutes, a dead tube can be detected by noting if it is warm or cold. A spare set of tubes should be kept aboard for such emergencies. By substituting new tubes, one at a time, allowing time for each new tube to warm up, the defective tube can usually be found.

If the receiver works but the transmitter is suspected of being inoperative, it can be checked by touching one end of a fluorescent lamp, another handy thing to have aboard, toward the top of the antenna. It should glow when the transmitter is on.

Most sets are equipped with an antenna current indicator, either a lamp or a meter. If the lamp does not glow, it may be burned out and the fluorescent lamp can be used to determine if the transmitter is putting out power. Better yet, keep a simple field strength meter handy. One like the Heath PM-1 power meter, available in kit form, is very useful. Merely connect a short piece of wire to its input binding post and place it near the antenna leadin wire. When the transmitter is turned on, the meter should indicate the presence of radio frequency power.

If the fluorescent lamp doesn't glow when one end of it is held against the top of the antenna, or if the field strength meter reads zero, the transmitter is out of order or something is wrong with the antenna system.

Try all channels to make sure that it isn't crystal trouble which is usually the case if only one channel fails to function. If all channels are out, check the antenna for broken connections. Also check the ground which is an extremely important part of the antenna system. The receiver may work well without a good ground connection, but the transmitter will not.

If the antenna system is OK and the receiver works but the transmitter does not, the trouble could be in the relay which transfers the antenna from receiver to the transmitter when the push-to-talk button is pressed. The relay contacts may mate but not establish a good connection. Don't file or sandpaper relay contacts. Have the relay checked by a competent technician when back at shore.

If it is obvious that a transmitter tube is defective, replace it with a new one

[*Continued on page* 105]

Hi-Fi Clinic

Send in your questions on hi-fi, the clinic answers each one by mail. If of general interest, they will appear in this column.

Turntable Speed

I have a 78 rpm portable phonograph. Would it be possible to slow it down to 33 1/3 rpm by use of resistors to cut down the power to the motor? Also, is there some way to measure the rpm?

Raymond Putnam, Corning, N.Y.

Use of resistors in series with the motor will reduce the power to the degree that the turntable would have a difficult time going around. The best way to convert the player is to replace the motor with one of the 3-speed type. The arm should be changed too for one of the correct stylus type and weight.

Rpm may easily be measured by use of a strobe disc, available at electronic or hi-fi distributors. It is placed on the rotating turntable and observed under the light of a flourescent bulb. If the speed is correct, the printed dots on the strobe will appear to stand still.

Multiplex Adapter

Where is it possible to obtain a schematic and parts list for a simple, inexpensive FM multiplex adapter to be used with a regular FM tuner?

M. O. Bennett, Pittsburgh, Pa.

At the present time it is not feasible to construct a multiplex adapter due to its special coil requirements, However, the EICO company is designing a kit which should be available in the near future.

Stereo Stylus

Is it safe to put a 1 mil (.001") diamond needle for microgroove records in my stereo cartridge and use it for monophonic records only, and use the stereo needle for stereo records only?

Edward Szymanski, Pittsburgh, Pa.

The stereo stylus may be used without difficulty for both monophonic and stereo records. If your present stereo stylus is not a diamond, it is advisable to change it over to one of this type.

Never play a stereo record with a monophonic pickup since this will ruin the recording.

Transients

What is meant by the term "transient distortion," often mentioned in discussions of speakers and amplifiers?

Charles Barbetta, Fort Wayne, Ind.

A piece of equipment may faithfully reproduce tones of a steady nature but perform poorly on sudden peaks or short pulses of sound. These "transients" are often in the form of orchestral attacks or other sounds of an intense, complex nature. Good transient response contributes much to clean hi-fi sound.

One of the important requirements for low transient distortion is very wide frequency response that extends beyond the limits of audibility. Another is the reduction of the "hang-over effect" so the amplifier or speaker reacts only for the duration of the pulse and no longer. This can be accomplished by "damping." Loudspeakers are particularly prone to hang-over, which is corrected by damping materials and reducing the mass of the moving parts as much as possible.

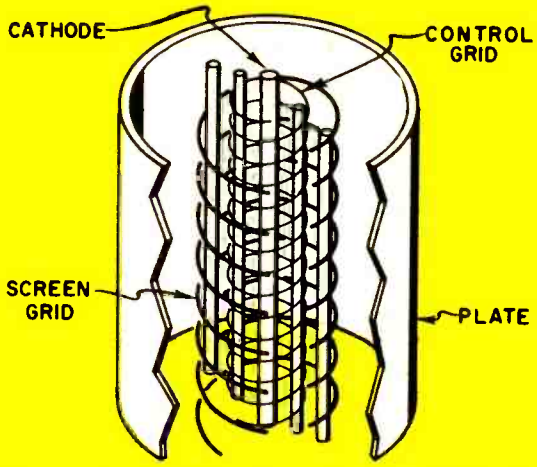
Testing for transient response is done by feeding in a square wave (which is a rapid on-off pulse) and observing the resulting patterns on an oscilloscope. Various departures from the square waveform reveals distortion.

Microphone Repair

Is it possible to repair a crystal microphone? Mine seems to have dropped in output.

John A. Munn, Haverhill, Mass.

Some manufacturers supply replacement crystal cartridges for this purpose. Magnetic types are also available for replacement.



Cutaway showing internal construction of tetrode tube. Electrons from the cathode travel through control grid, screen grid and then to the plate.

The ABC's of Electronics-12

By Donald Hoefler

The four element tetrode is explained in this part—especially the operation of its screen grid.

THE advancement of the electronic art truly got under way in earnest with Dr. DeForest's invention of the triode tube, which he called the *audion*. While that tube could be used for all three basic electronic applications, namely, oscillation, amplification, and detection, it sometimes had the tendency to slip from one mode of operation to another.

Particularly when used as an RF amplifier in a receiver, where several stages were tuned to the same frequency, the triode forgot that it was supposd to be an amplifier, and suddenly became an oscillator. The result was the loud howl or whistle so familiar to old-time radio fans.

The villain turned out to be *interelectrode capacitance*, shown in Fig. 1. Each of the tube elements acts as the plate of a capacitor, the dielectric between the plates being the vacuum within the tube. These capacitances are small, and so at low and medium frequencies their reactance, in ohms, is so high that they pose no serious problem.

But at high frequencies the reactances drop so that the capacitances begin to have a considerable short-circuiting effect. Of

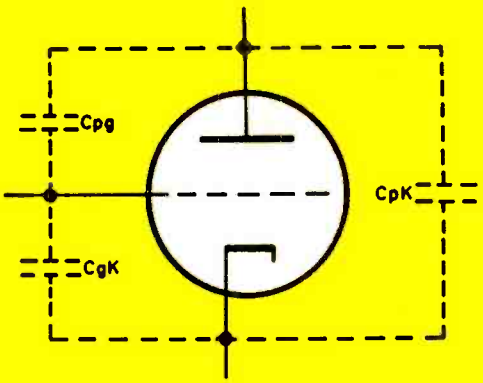


Fig. 1. A triode has capacitance between its internal elements, indicated by dotted lines.

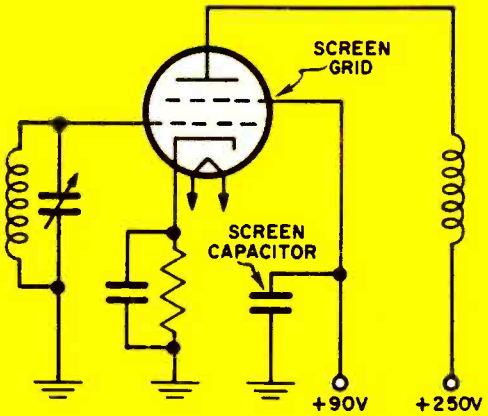


Fig. 2. Screen grid in the tetrode reduces interelectrode capacity by shielding effect.

the three capacitances shown in Fig. 1, by far the most troublesome is that between plate and grid, C_{PK}, which permits *feedback* of some of the plate circuit signal energy into the grid circuit.

If this energy is out of phase (opposite in polarity) with that in the grid circuit, it will have a partial cancelling effect, and will therefore reduce the output. If it is in phase with the grid signal, the feedback will add to the input in a process called *regeneration*. If the feedback energy is great enough in this closed circuit from grid to plate and back to grid, the tube will go into sustained *oscillation*, and thus become an oscillator rather than an amplifier.

Another phenomenon occurring in the triode is the concept of *space charge*. When the cathode of a vacuum tube emits electrons, not all of them will reach the plate. Some will remain in a crowd immediately surrounding the cathode, where they will tend to repel other electrons attempting to leave the cathode and travel to the plate.

The net effect of the space charge then is to reduce the flow of electrons between cathode and plate. How effective it may be will depend to a large extent on the amount of positive "pull" existing within the tube. This is one of the factors which led to the development of a tube which has a second grid with a fixed positive potential.

The arrangement of the elements in the tetrode tube is shown in Fig. 2. The construction is very similar to that of the triode, except that an additional grid appears between the control grid and plate. This screen grid acts as an electrostatic shield to bar the feedback path between grid and plate. It is maintained at a positive DC voltage with respect to the control grid, but as far as radio frequencies are concerned, it is at ground potential.

This seemingly contradictory statement is a concept which turns up again and again in electronic design, so we might take time to go into it a little more thoroughly. A typical tetrode RF amplifier circuit is shown in Fig. 2. Note that any current flowing from the screen grid encounters two possible paths, one to the DC supply voltage and the other through the screen grid capacitor to ground.

Direct current cannot pass through a capacitor, however, so all of the DC must follow the right leg to the power supply. Radio frequencies, on the other hand, can take either course. But the bypass capacitor is of such value that its reactance is extremely low at radio

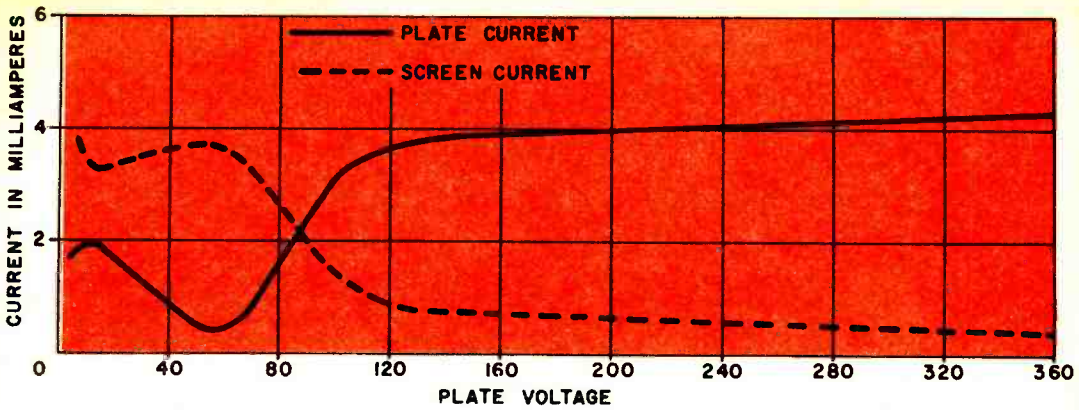


Fig. 3. As explained in text, graph shows plate and screen currents as plate voltage is varied. Note area around 40 volts where increasing plate voltage results in decreasing plate current.

frequencies. It therefore is practically a short circuit as far as RF is concerned. Since the RF therefore encounters much less opposition from the capacitor than from the power supply, nearly all of it follows that path directly to ground.

When electrons are emitted by the cathode, they must pass through the open meshes of both the control grid and screen grid. As in the triode, the control grid is maintained at a fixed negative bias. Since the screen grid is normally operated at a lower voltage than the plate, most of the electrons continue right on through it and strike the plate. Some screen current also flows but the important thing is that the screen greatly minimizes the space charge effect, with the result that the tetrode is more sensitive than the triode and has less interelectrode capacitance.

A very interesting phenomenon which occurs in the screen-grid tube is illustrated in Fig. 3. This graph shows how both the plate and screen currents are affected by variations in plate voltage. The screen potential is assumed constant at 90 volts.

In the upper region, from around 120 volts and up, the plate current rises with increasing plate voltage, although rather slowly. But notice what happens in the area between 20 and 60 volts. While the plate voltage goes up, the plate current goes *down*. Let's see how that can be.

Remember that in this case the plate voltage (20-60) is less than the screen voltage (90). Now since the screen voltage is fixed, the speed with which electrons strike the plate will depend upon the plate voltage. If they hit with sufficient force, other electrons loosely held in the plate material may be knocked free, out into the space between screen grid and plate. Electrons emitted in this manner are known as *secondary electrons*.

Since the screen has a higher voltage than the plate, these secondary electrons go to the screen grid instead, and screen current increases as shown by the broken line in Fig. 3. This flow of electrons from plate to screen is the opposite of the usual direction, and plate current diminishes. It later increases as the plate voltage continues to rise, while screen current falls off until, when both the plate and screen voltages are equal (90 volts), the currents are also equal.

This condition at low plate voltage, where increasing it only tends to decrease the current, is called *negative resistance*. The result is just the opposite of that normally encountered in a resistor. Because of this, when the tetrode is used as an amplifier, the plate voltage should always exceed the voltage on the screen. Otherwise instability and severe distortion will occur.

This concludes our discussion of the tetrode, a valuable tube type due to its high power sensitivity and ability to perform well at higher frequencies.

Next month we'll talk about beam power and super-control tubes. These types have variously shaped elements for specialized jobs.

Citizens Radio License

Continued from page 36

Secretary Federal Communications Commission, Washington 25, D. C. The completed forms are returned to the same address. Blank forms are also available at FCC field engineering offices found in many of the larger cities. However, filled-out forms must be sent to Washington, D. C. where all call letter assignments are made.

From time to time bulletins regarding Citizens Radio are issued. It's wise to request them from the FCC when securing the license forms. They usually provide a non-technical explanation of aims, practices, and other information about this type of radio service.

The application is comprised of three basic sheets: Instructions, Work Sheet, and the actual form itself. The Work Sheet is identical in format to the actual form and is filled out in pencil. The Instruction Sheet gives an explanation of each item on the Work Sheet and serves as a guide. After checking out the Work Sheet the information is transferred to the actual form. The entries on the form must be *typewritten*. A separate form is required for each station requested. These additional forms are supplied with your initial request for the application. As indicated in the instructions *all* Class D stations are considered "mobile." However they do not have to be mounted in a car or operate from batteries.

Once the actual application form is complete it must be notarized. Don't sign the bottom until you are at the Notary Public's office. Then mail it to the FCC at the address given and be prepared for a wait of at least sixty days.

The Citizens Radio Service was brought into being to provide radio-communication channels for personal and business use. It was not intended for frivolous purposes or used merely for the sake of communicating. This service fills a need for a short-range communicating system embodying low cost, low power, simple licensing procedure, and a minimum of restrictive regulation. Red tape has been cut to a minimum, you do not need the services of a consulting engineer, legal assistance, or filing fees.

According to a discussion we had with a high FCC official, the Citizens Radio service is comparable to a party-line telephone. There is a great deal of freedom in its use but you do have to respect the rights of other subscribers. Unbroken transmissions of ten to fifteen minutes will certainly limit the usefulness of the band and open the way toward tightening the restrictions. Through the medium of monitoring stations the FCC issues citations (warning tickets), and in more flagrant violations a license revocation. The value of this may be appreciated when one listens in to the older Citizens wavelengths. Even though these upper frequencies limit the communicating range, the amount of activity is amazing, especially in large cities. In the Class D band an additional source of interference is introduced. "Skipping" takes place at 27 megacycles. This phenomenon will carry signals hundreds (even thousands) of miles with little loss in strength, depending on time of day, season, and sunspot cycle.

The Citizens Radio service is definitely not a "no-license ham band." The only time CQ should be used (that is, a general call to any station who happens to be listening) is in time of dire emergency. If you want to "rag chew" acquire a ham license. The Novice amateur license is easily obtainable with a minimum of theory and code speed. You will then be in a position to reward your conversational ability with an "RCC" certificate. Entry into the Rag Chewers Club, sponsored by the American Radio Relay League, requires that you conduct a solid half-hour contact with a fellow ham who is already a member. The Citizens service is strictly a communications medium and thus differs sharply in this respect with recognized ham operations.

The Citizens Radio service has been anxiously anticipated for a long time. It fits well into the underlying idea of allocating frequencies according to the "public interest, convenience, or necessity."

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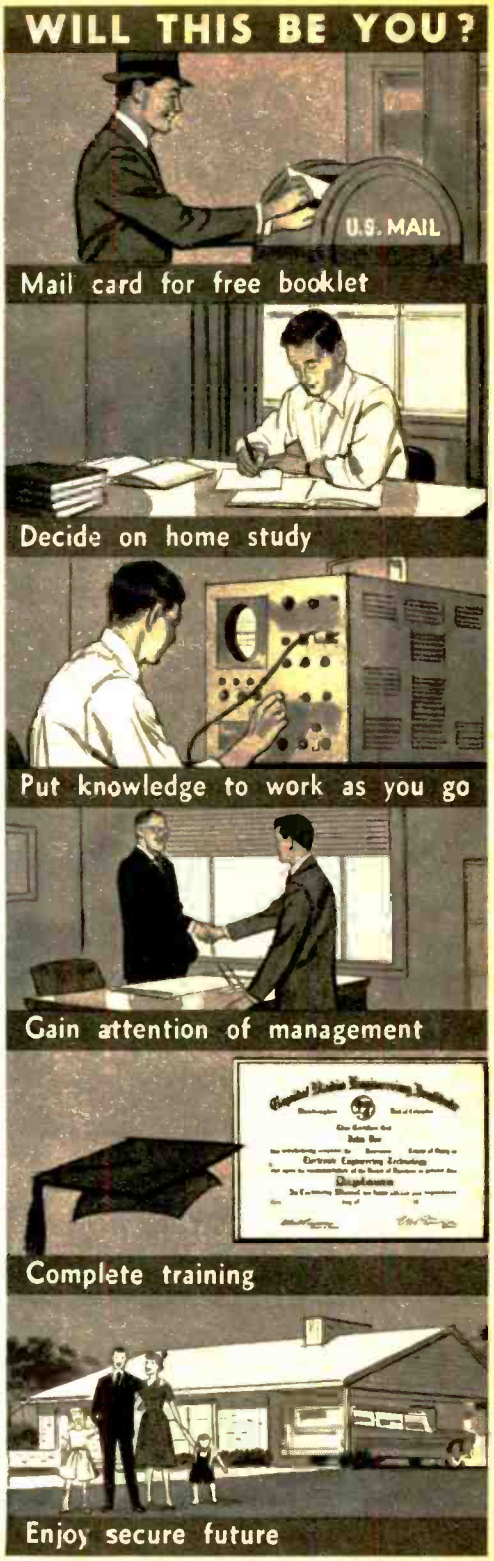


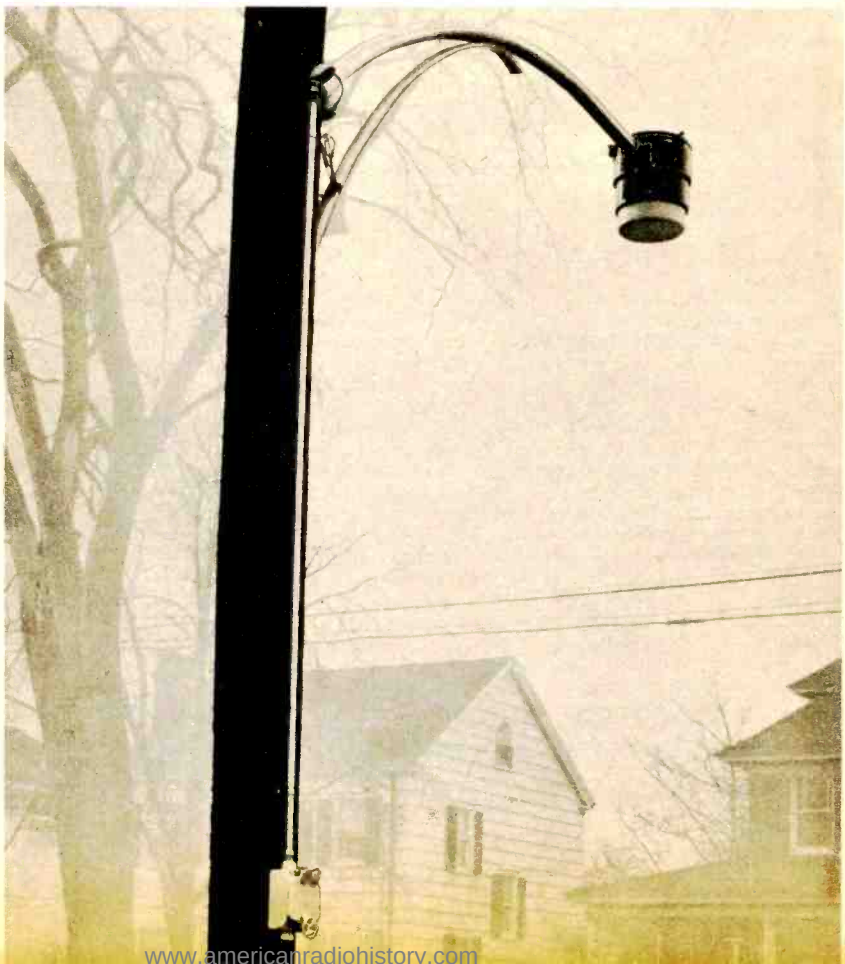
Cagey Canister Over The Highway

Your driving habits may not be what you think they are. This radar-sensing device sorts highway data.

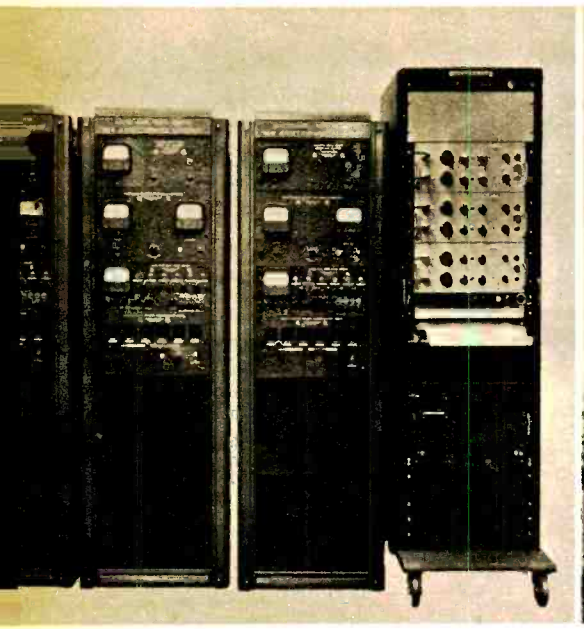
DID you ever wonder what that small object attached to the highway overpass, or the street lamp post might be? Perhaps you never even noticed it; but traffic engineers have stationed it over the road to keep them posted on how you drive your automobile—and whether or not you consider their traffic regulations realistic.

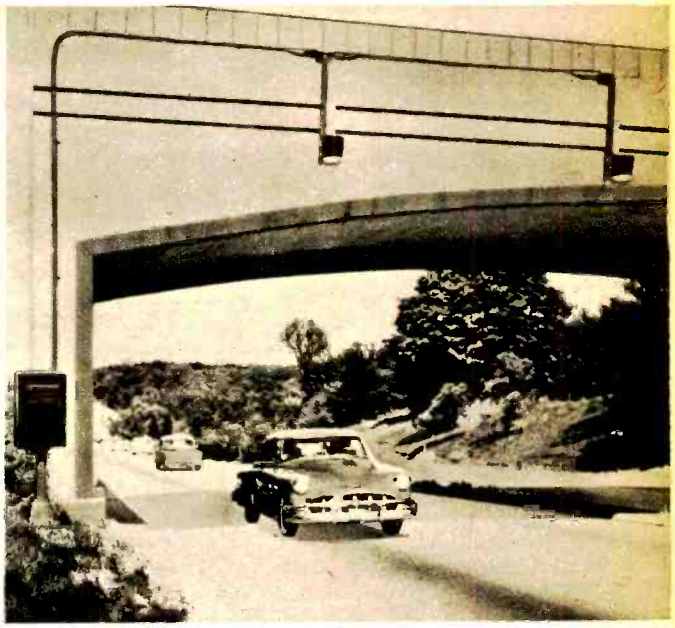
Actually, the device is a radar-sensing unit, part of an overall system that counts the cars in each lane and records their speed. It is not a radar speed trap by any means, and no person has

Inconspicuously posted on telephone pole, this small radar unit works 24 hours a day supplying information on the motorist's driving habits, from how fast he goes under varying weather conditions, to when he shifts lanes.



Three electronic traffic monitors in New Jersey receive information on speed and numbers of cars in each of turnpike's three lanes. Data is presented on meters and recorded on graph. Right, photo of overpass on Connecticut's Merritt Parkway shows how radar is mounted over each lane.





ever gotten a ticket based on its reported information.

The units suspended over each lane of the New Jersey Turnpike, for instance, feed data on car speed and traffic volume to Turnpike Authority headquarters at New Brunswick, via telephone lines. From meters and a permanent graph record, traffic engineers have gathered some interesting statistical data concerning American drivers that has helped them plan for better highways of the future.

Has it seemed to you that traffic is heavier in the far left lane when the weather is bad? Well, now it can be regarded as a fact. Instead of keeping to the right, as is generally required by law, traffic monitors working with the radar units, show that the average driver habitually shifts to the extreme left lane when it rains or snows. Also, he will stay in the far right lanes only when the traffic is light. As soon as it gets heavier, he moves to the middle lane, then to the far left.

Traffic engineers figure the thinking goes something like this: "The right lane is intended for slower cars. I drive faster, and therefore prefer to drive in a 'faster' lane."

In most states, however, the law requires you to stay in the right lane, and move to the left only to pass another vehicle. But signs to this effect are more often than not ignored. Now highway engineers and law authorities are wondering whether these signs serve any useful function at all. For one thing, the shift to the left lane in bad weather may mean the driver is looking for a visual marker, such as the edge of the middle island or the solid white line, to aid his driving. Perhaps a bright, broken white line as a lane divider could serve as an adequate visual marker, making it unnecessary for him to move to the left.

There are three radar sensing units in use on the New Jersey Turnpike at the present time, one above each of the northbound lanes at a point near Linden, New Jersey. Data on the southbound lanes has already been gathered. Each unit is connected by a separate telephone line to an electronic traffic monitor at headquarters. There the radar pulses are counted electronically, re-

cording the actual number of vehicles. The information is displayed in terms of vehicles per hour. The electronic devices also do some computing, figuring the average speed of a specific group of cars at various times of day, and under varying weather conditions.

The information from all three lanes is permanently recorded by a graphic recorder and can be quickly checked to determine periods of heaviest or lightest traffic, and during what hours cars move at various average speeds.

Do you feel the other guy, not you, is always going too fast? Not true. One thing the New Jersey authorities have learned is that only a few drivers exceed the legal speed limit of 60 mph. In fact, the average speed of vehicles on this turnpike is 57 mph. Watching the needle at headquarters swing as each car passes under the radar unit, you see that most stay under 60 mph.

The electronic equipment was developed by the Automatic Signal Division of Eastern Industries, who also developed a system for control of traffic signals on city streets. This latter system makes use of radar sensing units to determine direction of traffic and rate of traffic flow. Computers then decide in what direction the flow of traffic should be given preference.

In Baltimore, for example, 1200 cars travel each hour in one lane which formerly could handle only 450 cars per hour. In Philadelphia, after an opening-day short-circuit that jammed traffic, the average speed of vehicles in the downtown area has been increased 50 percent since electronics has been employed as a traffic director. The sensing units used in these traffic control systems also provide permanent information about the habits of drivers.

Before these electronic devices came into being, traffic signals operated on a time basis, and were adjusted on the estimates of traffic engineers who were required to predict where the traffic would be headed and how many cars could be anticipated. But experts agree, it is almost impossible to predict what the American motorist will do. Now, with electronics to monitor traffic, the engineers who plan our streets and highways will have specific, up-to-date information on our driving habits.

Two-Way Radio for Everyone

Continued from page 31

the pole is mounted on the roof of a tall building, the top of the antenna must be 20 feet or less above the top of the building, the height of the building is not counted. The antenna, however, must be no more than 25 feet away from the transmitter.

Class D Citizens radio transmitter power is limited to five watts *input* to the final RF amplifier of the transmitter. This means that the transmitter puts out about two to three watts. When used with an antenna with 3 db gain, effective radiated power is doubled. When used with a 10 db gain directional antenna, the effective radiated power is increased to 20 to 30 watts and is increased by about 80%, provided that line-of-sight conditions are maintained. A better antenna is a cheap way, in the long run, to get increased range and reliability because it requires no maintenance and consumes no power.

An FCC form 505, which is customarily furnished with the equipment at time of purchase, is used for filing an application for a Citizens radio station license. There is no charge for the license which can cover any number of transmitters used in any general area by a single licensee. An operator's license is not required. Specific information on how to fill out this form is given in the article on page 34.

You can build your own class D equipment if you wish. It must conform with FCC standards and the transmitter must be crystal controlled.

The FCC also requires that Citizens radio station licensees provide means for monitoring Conelrad alerts. In the event of an impending enemy attack, normal radio and TV broadcasting ceases. Citizens radio stations must also cease transmissions. An ordinary home radio may be used as a monitor.

Operation

Operating a Citizens radio is extremely simple. Most sets operate on only one frequency. No tuning knobs are provided. All you do is turn the set on and listen. If the channel is clear, pick up the microphone and press the button

on the microphone while talking. Release the button to listen.

Some sets, however, are operable on as many as four channels. Some are provided with a tunable receiver which permits reception on any channel in the band. The transmitter, however, is fixed-tuned to the authorized frequency. When such a set is used, the receiver is tuned to the desired channel first.

Citizens radio stations may communicate with any other Citizens radio station without restriction. Of course, the equipment cannot be used for any unlawful purpose nor can profanity be transmitted. It is necessary that you identify your station by announcing your call letters at the beginning and end of every transmission except when carrying on a series of communications of less than three minutes duration or when carrying on a conversation of more than ten minutes in length. In such cases, the station call letters must be transmitted at least once every ten minutes.

CLASS D CITIZENS RADIOTELEPHONES

MANUFACTURER	MODEL	PRICE	CHANNELS	POWER	COMMENTS
GONSET 801 South Main St. Burbank, Calif.	G-11 No. 3304 No. 3303	$124.50 $124.50	one one	12 volts DC 115 volts AC	Crystal controlled superheterodyne receiver.
GLOBE ELECTRONICS, INC., 3417 W. Broadway Council Bluffs, Iowa	CB-100	$129.95	three	115 volts AC or 6 or 12 volts DC	Crystal controlled superheterodyne receiver.
INTERNATIONAL CRYSTAL MFG. CO. 18 N. Lee Avenue Oklahoma City, Oklahoma	Custom Deluxe Command	$ 89.95 $118.50 $144.25	one one one	115 volts AC 6/12 volts DC and 115 volts AC 6/12 volts DC and 115 volts AC	Tunable receiver. Tunable receiver. Crystal controlled receiver.
KAAR ENGINEERING CORP. 2995 Middlefield Rd. Palo Alto, Calif.	TR-325	$360.00	one	6/12 volts DC and 115 volts AC	Designed especially for use on vehicles. Shock mounting is provided for use in rugged applications. Crystal controlled receiver.
MORROW RADIO MFG. CO. P. O. Box 1627 2794 Market St. N.E. Salem, Oregon	Desk Radiophone	$149.50	four	115 volts AC	For use as base station or for point-to-point communication. Crystal controlled receiver.
	Mobile Radiophone	$149.50	four	12 volts DC (also 6 volt model)	For use in vehicles. Crystal controlled receiver.
	Mobile	$ 99.50	one	12 volts DC (also 6 volt model)	
	Pocket Radiophone	$ 99.50	one	Self-contained batteries	All transistor model for short-range applications. Crystal controlled receiver.
RCA RADIOMARINE PRODUCTS DIVISION Building 1-5 Camden, New Jersey	CRM-P2A-5	$124.95	one	6 volts DC and 115 volts AC Also available for 12 volts DC and 115 volts AC	Lightweight, readily portable. Crystal controlled receiver.
SPRINGFIELD ENTERPRISES P. O. Box 54 Springfield Gardens, New York	TRX 27A	$ 41.90	one	Self-contained batteries	Tunable receiver.

Note: All types employ crystal controlled transmitters which may be equipped with crystals for any of the 22 channels in the 27-mc class D Citizens Band.

SHIPPED ON APPROVAL

IN-CIRCUIT CONDENSER TESTER

Model CT-1

AN ABSOLUTE 'MUST' FOR EVERY SERVICEMAN!

Here is an in-circuit condenser tester that does the whole job. The CT-1 actually steps in and takes over where all other in-circuit condenser testers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation. . . .

in-circuit checks:

- Quality of over 80% of all condensers even with circuit shunt resistance present . . . (leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of 100% of all condensers . . . (leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

Model CT-1 — housed in sturdy hammertone finish steel case complete with test leads **$34.50** Net

SIZE: W–6" H–7" D–3¼"

SPECIFICATIONS

• Ultra-sensitive 2 tube drift-free circuitry • Multi-color direct scale precision readings for both quality and value . . . (in-circuit or out of circuit) • Simultaneous readings of circuit capacity and circuit resistance • Built-in hi-leakage indicator sensitive to over 300 megohms • Cannot damage circuit components • Electronic eye balance indicator for even greater accuracy • Isolated power line

MINI-CHECK TUBE TESTER

Model MC-1

A Real *ECONOMY* MULTIPLE SOCKET TUBE TESTER without sacrifice in *ACCURACY, SPEED* or *VERSATILITY*

Here is a multiple socket tube tester designed to meet limited budgets. Although low in price it boasts a unique circuitry that enables you to check over 600 tube types — and has a range of operation that far exceeds others in its price class.

Model MC-1 — housed in sturdy wrinkle finish steel case **$39.50** Net

SIZE: W–9" H–8½" D–2¾"

SPECIFICATIONS

• Checks emission, inter-element shorts and leakage of over 600 tube types. This covers OZ4s, series-string TV tubes, gas regulators, auto 12 plate volt, hi-fi and foreign tubes • 3 settings enable a test of any tube in less than 10 seconds • Employs dynamic cathode emission test principles • 3½" D'Arsonval type meter — most accurate type available . . . its greater sensitivity means more accuracy . . . its jewel bearing means longer life • 17 long lasting phosphor bronze tube sockets • Combination gas and short jewel indicator • 9 filament positions • Handy tube chart contained in special back compartment • New tube listings furnished periodically at no cost • Detachable line cord

plus these BONUS FEATURES . . . found in no other low price tube tester

✓ Checks for cathode to heater shorts ✓ Checks for gas content ✓ Checks all sections of multiple purpose tubes . . . will pickup tubes with one "Bad" section ✓ Line isolated – no shock hazard ✓ Variable load control enables you to get accurate results on all tubes ✓ Positively cannot become obsolete as new tubes are introduced.

IN-CIRCUIT RECTIFIER TESTER

Model SRT-1

Checks all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc.

With the growing trend towards compactness, portability and low price, TV manufacturers are resorting more and more to producing series-string TV sets employing selenium, germanium or silicon power rectifiers. Now the need for an in-circuit rectifier tester is greater than ever.

THE SRT-1 CHECKS ALL POWER RECTIFIERS IN-CIRCUIT AND OUT-OF CIRCUIT WITH 100% EFFECTIVENESS FOR:

✓ Quality ✓ Fading ✓ Shorts ✓ Opens ✓ Arcing ✓ Life Expectancy

Model SRT-1—housed in sturdy hammertone finish steel case complete with test leads **$29.50** Net

SIZE: W–6" H–7" D–3¼"

SPECIFICATIONS

- Checks all types of power rectifiers rated from 10 ma. to 500 ma. (selenium, germanium, silicon, etc.) both in-circuit or out-of-circuit.
- Will not blow fuses even when connected to a dead short.
- Large 3" highly accurate multi-color meter . . . sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests.
- Cannot damage or over heat rectifier being tested.

SIMPLE TO OPERATE Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales. . . .

TRANSISTOR TESTER

Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY

Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors can develop excessive leakage, poor gain, shorts or opens, the need for TRANSISTOR TESTER is great.

SPECIFICATIONS

• Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current • Checks all diodes for forward to reverse current gain • All tests can be made even if manufacturers' rated gain is not available • Less than half a minute required for tests of either transistors or diodes • Large 3" meter is extremely sensitive yet rugged . . . with multi-color scales designed for quick easy readings • Power is supplied by an easy to replace 6-volt battery — current drain so small, service life almost equal to shelf life. Battery cannot be drained due to accidental shorting of test leads • Cannot burn-out its own meter or damage transistor or diode under test • Long test leads and insulated test clips enable tests without entirely removing transistor from circuit • Test leads are identified by E.I.A. color code so that connection to the correct terminal is assured • Comes complete with replaceable transistor set-up chart that fits into a special rear compartment.

Model TT-2 — housed in sturdy hammertone finish steel case complete with test leads **$24.50** Net

SIZE: W–6" H–7" D–3¼"

IMPORTANT FEATURE: The TT-2 cannot become obsolete as the circuitry is engineered to enable you to check all new type transistors as they are introduced. New listings will be furnished periodically at no cost.

EASY TO BUY IF SATISFIED
see order form on facing page

CENTURY

INSTRUMENTS ARE ALL GUARANTEED FOR ONE FULL YEAR

All CENTURY instruments are so brilliantly engineered and so durably constructed of top quality components that all carry an ironclad guarantee against defective parts and workmanship for one full year.

FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

1 DC Probe 2 AC Probe 3 Lo-Cap Probe 4 RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maze of encangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

SIZE:
W-7¾"
H-9"
D-4¼"

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMINTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs

OUTSTANDING FEATURES

- Completely portable — self powered with long life batteries — permits use everywhere
- New advanced pentode amplifier circuit assures amazingly low battery drain
- Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s
- Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC
- Simplified multi-color easy-to-read 4-scale meter
- No heat operation assures rigid stability and accuracy
- Immune to power line fluctuations
- Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments
- Meter completely isolated — practically burn-out proof
- Hand-crafted circuitry eliminates the service headaches of printed circuitry
- 1% resistors used for permanent accuracy
- Separate RF ground return for low-loss RF measurement
- Microphone type co-axial connector
- Matching cover protects instrument face — snaps on and off instantly.

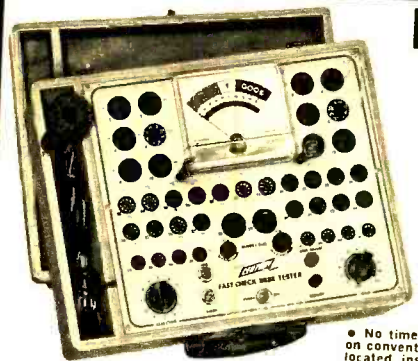
SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 — fully wired and calibrated, housed in handsome hammertone finish steel case, complete with MULTI-PROBE and thorough instruction manual covering all the applications in detail.

$58.50 Net

CENTURY'S extremely low prices are made possible because you are buying direct from the manufacturer.



SIZE: W—14⅝" H—11¼" D—4⅜"

Model FC-2 — housed in hand-rubbed oak carrying case complete with CRT adapter

$69.50 Net

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK
Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

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

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

CENTURY ELECTRONICS CO., INC.

CHECK INSTRUMENTS DESIRED

☐ Model CT-1 In-Circuit Condenser Tester $9.50 within 10 days. Balance $5 monthly for 5 months.	$34.50
☐ Model MC-1 Mini-Check Tube Tester $9.50 within 10 days. Balance $6 monthly for 5 months.	$39.50
☐ Model SRT-1 In-Circuit Rectifier Tester $4.50 within 10 days. Balance $5 monthly for 5 months.	$29.50
☐ Model TT-2 Transistor Tester $4.50 within 10 days. Balance $5 monthly for 4 months.	$24.50
☐ Model VT-1 Battery Vacuum Tube Volt Meter $14.50 within 10 days. Balance $11 monthly for 4 months.	$58.50
☐ Model FC-2 Fast-Check Tube Tester $14.50 within 10 days. Balance $11 monthly for 5 months.	$69.50

Prices Net F.O.B. Mineola, N. Y.

111 Roosevelt Avenue, Dept. 406, Mineola, New York

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....
Please print clearly

Address .....

City ..... State .....

Miniaturization Is Big

Continued from page 55

hand. Most important was the unexpected invention of the transistor at the Bell Labs. The heatless transistor is only a fraction of the size of its equivalent vacuum tube and demands much less of its mates in an electronic circuit. Therefore, in size and operating conditions, the new device was an enormous challenge to the makers of the other electronic parts.

In manufacture, the miniature product is handled like an incubator baby. Since a particle of dust acts like gravel inside a miniature part, the air entering the factory must be filtered. Since a drop of sweat will ruin almost any miniature part, the temperature and humidity must be rigidly controlled. The assemblers are dressed in lint-free clothes. To keep dirty air out, the pressure in the room is slightly higher than normal so that clean air flows out when the air lock is opened.

Workers must be carefully selected, trained, and to some extent pampered for the eye-straining, repetitive operations. Most manufacturers find married women best because they have the highest degree of the required "sitability." Handicapped men who have adjusted to their handicap are also sought.

Engineers accustomed to conventional plants are amazed at all the measuring instruments strategically located about these new plants. Actually, that's the secret of their success. Successful miniaturization is more measuring than making, according to one production manager.

In missiles, the major skill we possess to counter the Russian progress in rocketry is miniaturization. Although the Russians and Chinese Reds make the garden variety of transistors, those suitable for personal radios, and a few more sophisticated ones, we still lead in advanced types that can survive in satellites and missiles and related electronic telemetering components.

For all its advantages, miniaturization is also a headache to the armed forces. As military electronic equipment grows ever more complex and compact, repair problems tend to increase. The remedy is "modular" construction, building equipment out of blocks of small components tied together into a functional unit that can virtually be plugged into a major circuit.

Since it is extremely difficult, if not impossible to poke around inside these building blocks (some "micro-modules" are much smaller than a lump of sugar), military repairmen in the field must either send them back to a heavily equipped depot or throw them away. Taxpayers may be shocked to learn that the Defense Department considers it cheaper to throw away rather than repair all plug-in blocks worth $300 or less—and some people in the Pentagon want to raise this figure to $1000!

The benefits of military miniaturization steadily seep down to the business, scientific and medical worlds.

The heart catheter microphone is a prime example of how the miniaturizers help save lives. The basic heart catheter is a bare, thin tube that is slipped harmlessly through a vein in the patient's arm all the way into the heart. Once inside, its probings can be followed by X-ray as the specialist uses it to draw samples of blood from the various chambers. Using a catheter with a minute microphone mounted on the business end, the specialist can now hear faint valve sounds from *inside* the heart, a fact of great significance in making a correct diagnosis.

The present marvels of miniaturization are really elementary compared to what the future will bring. Here are just a few examples:

- Dick Tracy's wristwatch radio will soon be called clumsy.
- Miniaturization will help make the TV set of the 1970's as flat as a picture frame.
- Powered by tiny, life-long batteries, miniature prosthetic devices in the body, such as a heart stimulator, will run effortlessly for years, or the life of the patient. The general practitioner will be able to carry a basic electronic diagnostic laboratory around in his little black bag.

Like atomic energy, miniaturization is another example of beating swords into plowshares.

Learning To Fly A Jetliner

Continued from page 73

console, any conceivable emergency can be concocted merely by pushing a button. Researchers would simulate a trouble, then stop-watch the pilot's "reach." If he failed to trip the proper safety device within a given number of seconds, the control was moved closer to his seat and the change incorporated in the DC-8 itself.

Want to "fly" the DC-8? Climb into the pilot's seat, fasten your seat belt, and let's bring the electronic jet in for a landing from 40,000 feet.

As you nudge the wheel forward, the simulator's cockpit—electronically actuated—noses downward. The time-lag between stick movement and aircraft response is authentic to the split-second. Simultaneously, a complex of signals flashes to the mammoth computer. For really, it's the computer you're "flying."

Lightning fast, the computer takes cognizance of your decreasing altitude (and actuates the altimeter on your control panel). At the same time, the electronic brain makes a hundred other quick computations: Your rate of descent, glide angle, speed, the effects of wind on fuel consumption, etc.

Controlled by computer-monitored voltages, every dial and gauge behaves as in actual flight. The cockpit heels a fractional degree to starboard (to simulate the drain of jetfuel from your port wing tanks). As the cabin tips, heeled by hydraulic pistons concealed beneath the "cabin," a light flashes warning you of an adverse load condition. Instinctively, you switch to the starboard fuel tanks to equalize the load.

With every move of the controls, the computer readjusts the "loading" on the stick, rudder pedals and flaps, which react and resist realistically. Suddenly, you "streak" thru the clouds toward the still-obscured airport below. The tower operator's voice booms in your earphones.

"Flight No. 45 . . . you're two degrees right of course. Correct your approach."

A hundred yards away in an air conditioned radio room, the "tower operator," his eyes on a glide path indicator and airstrip alignment chart, has noted an error in your approach.

Quickly, you glance at the localizer needle on your ILS panel. Just as the towerman said, you're two degrees off course. As you bank to correct your glide, the cabin tilts as in real flight.

Like most pilots who fly the simulator, you're sweating. Your hands are clammy on the wheel. If at the moment someone leaned over and whispered, "Take it easy, fella. You're still on the ground," you wouldn't believe him.

Now you've dropped to 1,000 feet. You gesture toward your first officer in the seat beside you.

The first officer nods and actuates the "wheels down" controls. A signal flashes to the analog computer which, in turn, monitors an audio signal generator—an electronic sound-making device. As the wheels "lower," you hear a telltale whine. The sound is coming from three speakers concealed in the simulator.

Now, one mile out from the airstrip, you "break thru the clouds." Suddenly the "airport"—projected on the big screen—blurs below.

Seconds later the towerman shouts a warning: "Flight 45, you're coming in too high . . . check your altimeter!" You glance at the indicator and see that you are a good 100 feet high for a normal approach. Quickly you correct the error.

You're landing visually, thanks to closed-circuit television.

The track-mounted TV camera scans the three-dimensional and precisely scaled model of the airport, its runways and populated approaches. The camera is controlled by the computer which, in turn, responds to the pilot's every maneuver. It has mirrored close-up lenses and can move forward (duplicating airspeed), sideways (ship's tilt) and backwards (to simulate altitude). It also duplicates the plane's pitch and roll.

Bright daylight or night landings can be rigged. At "night," miniature lights outline the runway.

You're "landing" now, the airstrip flashing beneath you. As you touchdown, the wheels squeal, the engines roar and the stick is heavy in your hand. Flying electronically, you never really left the ground, but you'd swear you had really been at 40,000 feet.

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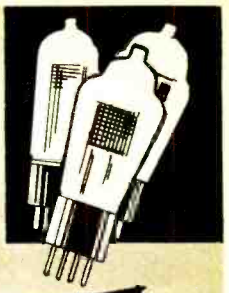

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OZ4	3BC5	6AB4	6BA6	6CL6	6S8GT	7B5	12AT7	12SJ7	3B
1A7GT	3BN6	6AC7	6BC5	6CM6	6SA7	7B6	12AU6	12SK7	39/44
1B3GT	3BZ6	6AF4	6BC8	6CM7	6SD7GT	7B7	12AU7	12SN7GT	41
1C6	3C86	6AG5	6BD6	6CN7	6SF5	7B8	12AV6	12SQ7	42
1C7	3Q4	6AH4GT	6BE6	6CQ8	6SF7	7C4	12AV7	12V6GT	43
1F4	3S4	6AH6	6BF5	6CR6	6SG7	7C5	12AX4GT	12W6GT	45
1F5	3V4	6AK5	6BG6G	6CS6	6SH7	7C6	12AX7	12X4	50A5
1G4	4BQ7A	6AL5	6BH6	6CU5	6SJ7	7C7	12AZ7	14A7/12B7	50B5
1H5GT	4B58	6AM8	6BJ6	6CU6	6SK7	7E5	12B4	1486	50C5
1L4	4BZ7	6AN8	6BK5	6D6	6SL7	7E6	12BA6	14Q7	50L6
1L6	4CB6	6AQ5	6BK7	6DE6	6SQ7	7E7	12BA7	19	56
1N5GT	5AM8	6AQ6	6BL7GT	6DG6GT	6SR7	7F7	12BD6	19AU4GT	57
1R5	5AN8	6AQ7	6BN6	6DQ6	6T4	7F8	12BE6	19BG6G	58
1S5	5AT8	6AR5	6BQ6GT	6F5	6U8	7G7	12BF6	19J6	71A
1T4	5AV8	6AS5	6BQ7	6F6	6V6GT	7H7	12BH7	1918	75
1U4	5AZ4	6AT6	6BR8	6H6	6W6GT	7N7	12BQ6	24A	76
1U5	5BR8	6AU4GT	6BS8	6J4	6X4	7Q7	12BR7	25Z6GT	77
1V2	5J6	6AU5GT	6BY5G	6J5	6X5GT	7S7	12BY7	26	78
1X2	5R4	6AU6	6BZ6	6J6	6X8	7X6	12CA5	27	80
2AF4	5U4	6AU8	6BZ7	6J7	6Y6G	7X7	12CN5	35	84/6Z4
2BN4	5U8	6AV5GT	6C4	6K6GT	7A4/XXL	7Y4	12D4	35A5	117Z3
2CY5	5V4G	6AV6	6CB6	6K7	7A5	7Z4	12F5	35B5	
3A4	5V6GT	6AW8	6CD6G	6N7	7A6	12A8	12K7	35C5	
3A5	5X8	6AX4GT	6CF6	6Q7	7A7	12AB5	12L6	35W4	
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Listen To Stereo

Continued from page 46

ment and the others shown are: (1) The direct highs from the speaker are much stronger than any reverberation or bounced-off-the-walls sound you may get; (2) Treble will be stronger in relation to bass; (3) As noted, the area in which you get the full effect is small.

"Ultimate stereo" is also tricky because it emphasizes every fault on the records, all the peakiness or distortion in the tweeters. But it is fun, and highly instructive to try.

You didn't like it? Let's take a big jump in the opposite direction. Suppose we turn the speakers completely around so they are facing into the corners. Now you are getting the beams of highs bounced out from the corners of the room. The beams will be diffused and broken up somewhat, particularly if there is a bookcase or other irregular surface in the corner. Since the highs reach you over several different paths which are slightly different in length, there will be an increase in the amount of bounce sound.

With many records, this increased path gives a vibrant, rich sound. This can easily be overdone. If there is too much of it, the sound begins to get confused and thick.

What happens to the stereo effect? It will be much less "sharp." If the record has good separation, with the instruments strongly placed right, center, and left, they will probably still be spread out with the speakers turned around. But you will likely lose the feeling that the instruments are right down there on a stage, 30 or 40 feet away in a concert hall.

This is not necessarily bad. We say again that it's a matter of taste. The big rich, alive sound is extremely attractive with many recordings, particularly those with a full symphony orchestra. Nobody will argue with you for a second if you like this better than the actual sense of having a concert hall recreated in your living room. A lot depends, too, on the recording. Some of them have plenty of richness to start with, others are sharper and will benefit more from the added reverberation.

If you want to try this reversed-speaker arrangement, push the speakers around in the corners, at different distances from the walls and at different angles, until you hear what you like best. Sometimes moving the speakers six inches makes a magical difference in the sound quality.

Maybe you are in a different class altogether. Like thousands of other audiophiles, you have a large corner speaker system, filling the only spot in the room that can be assigned to a large speaker box. The established decor and your marital harmony would both be seriously damaged by any addition or change.

This does not mean that you have to give up stereo; far from it. You need, again, to get that balancing beam of highs from the second channel, coming in at a respectable angle, and with about the same strength and quality as the highs from your corner speaker. Figure 3 shows the arrangement that will do this.

You need a small, unobtrusive speaker cabinet with speakers for the mid-range and highs, fed by your second channel amplifier. Depending on the size and shape of the room, you can move it along a wall adjacent to the corner speaker, and set it at an angle that will match, at the listening area, the beam of highs from the big speaker. This will give you a good stereo image.

But every stereo record is different; every room is a little different; and your own taste is a more weighty factor than many of the differences discussed. So you have no reason to feel thwarted by lack of money and space for a second big system. Try the smaller second speaker system.

Both channels must be set at the same volume level. You can do this by setting the system to play stereophonically and putting on a monophonic recording of a singing voice. Sit at the same distance from both speakers. The voice will come from a definite point between the speakers (if they have been phased together). If the voice is far over to the right, raise the volume in the left channel to pull it toward the middle. When the voice is exactly midway between the speakers, the channel volumes are balanced.

Overseas Jobs In Electronics

Continued from page 43

of personnel. The normal one-year tour creates openings in leader and managerial positions in communications, timing, telemetering, optics, and radar. It is not unusual for a technician to wind up his tour as a manager.

Q. Does completion of an overseas assignment mean the end of the man's job with the company?

A. *Every attempt is made to keep him in the company, at such places as Cape Canaveral, Patrick Air Force Base, or at any other preferred location in the U. S.*

Of course, while these replies portray a fairly typical picture of overseas employment with a private firm, keep in mind that conditions will vary according to the location. You couldn't think of skin diving, for instance, if you happen to go to a station in Iceland or Alaska.

But what about working for Uncle Sam? Is it any different? Essentially, the picture is the same, except that you must have Civil Service status and your chances of more permanent employment are greater. As a result of recently passed laws, chances of advancement through government-sponsored training, either on or off the job, are greater than ever.

Governmental pay is generally on a par with private industry, except for those top-ranking engineers who can usually demand hefty five-figure incomes. The Federal Aviation Agency, for example, is constantly in need of electronics engineers and technicians. The standard Civil Service pay ranges from $4,480 to $12,770 per year for engineers; and from $4,980 to $8,330 per year for technicians. But these figures do not show the "extras" that go with an overseas assignment.

You also have to keep in mind that government vacation policies are quite liberal, providing for as much as 26 days of vacation leave with pay each year. But vacation days are computed as "working" days, so that if you took 20 days off you can stretch it to well past a four weeks vacation.

However, since the overseas assignments are also the most-wanted jobs in government, as well as private industry, preference to these assignments is given to those who are already working for the government agency in the United States. Right now, according to the Civil Service Commission, skilled technicians are among the most urgently needed workers for overseas assignments.

Now, let's get down to the bread-and-butter facts. *How do you go about getting an overseas job?* The question is best answered in two parts, jobs in private industry, and jobs in government.

To get an overseas job in private industry, first decide in what area of the world you'd like to work. Look for the company that is hiring personnel for jobs in these areas. To do this, you have to be your own Sherlock Holmes. But apart from classified advertisements in newspapers, you can pick up many clues at the sources most people know little or nothing about. A little pamphlet with many hints is yours for the asking. Just write to the *U. S. Department of Commerce, Bureau of Foreign Commerce, Washington 25, D. C.*, and ask for, "Employment Abroad, Reference Sources." You can also get it from your nearest Department of Commerce Field Office, listed in the phone book under U. S. Government.

This pamphlet does not mislead you into thinking that getting an overseas job is easy, and yet it tells you how to run down all the clues.

Next, pick the companies you might like to work for overseas. Send each a letter of application. Be thorough and be honest. In your letter state whether you'll take only an overseas job, or whether you're willing to work for the company here at home, pending an overseas assignment. Give your complete educational background, work experience (be specific), age, marital status, whether you're willing to travel with or without your family (if you have one), and how long you're prepared to remain overseas. Be sure to mention your military status and your citizenship.

If you have a special interest in Latin America, the *Pan American Union, Washington 6, D. C.*, will send you a free bulletin on the facts about jobs in Latin America, plus a "Partial List of United

States Firms Operating in Latin America." Do not overlook large oil companies who operate in South America and the Mid-East.

Another useful source for direct and up-to-date information about companies offering overseas jobs in many different lines of work is a unique mimeographed publication called "Overseas Jobs." It is sold on newsstands.

At this point, we must inject an urgent word of caution. Unfortunately, many unscrupulous characters are trying to cash in on your yen to travel. They operate under a wide variety of guises, but the usual technique is to make it look as if they are running some sort of special employment agency for overseas jobs. Some say they can put you in direct touch with someone who will hire you for a foreign post. In almost all cases, they try to get you to hand over an advance fee, or sign a contract that will hook you for a fat piece of change. Sometimes, for a price, they'll send you a list of job openings, hot off the press. What you'll most likely get is a list of companies copied right out of an export-import trade directory.

Don't be a sucker. Before you pay or sign anything in advance, check the facts. "In this connection," says the Department of Commerce, "the local Better Business Bureau, banks, chambers of commerce, and similar organizations should be in a position to offer advice."

Your best bet for an overseas job in electronics is as a civilian worker with the Army, Navy, Air Force, Federal Aviation Agency, and the United States Weather Bureau. You have to obtain Civil Service status to work for Uncle Sam. Therefore, to get a good idea on what it's all about and what to do, write to the *U. S. Civil Service Commission, Washington 25, D. C.,* and ask for the pamphlet called, "Federal Jobs Outside the Continental United States."

Each of the Defense agencies frequently put out their own bulletins about available overseas jobs. Write each (Army, Navy or Air Force) care of *Office of Civilian Personnel* in Washington.

For jobs with the Federal Aviation Agency, write to: *Federal Aviation Agency, Personnel Office, Placement Division, Washington 25, D. C.*

For Weather Bureau jobs, write to *U. S. Weather Bureau, Department of Commerce, Washington 25, D. C.*

If you happen to be bankroll-conscious, remember one important thing about working overseas. It often gives you an opportunity to salt most of your money away. For one thing, there are the "extras" like bonus pay, free room and board (or at a nominal cost), and usually lots of overtime if you want it. Also, at many defense department installations you can take advantage of PX privileges for low-cost purchases of just about anything you might need.

You also should keep in mind that overseas workers can benefit from tremendous tax advantages if they remain overseas long enough to earn all or most of their income for any given tax year outside the Continental United States. In some cases, this income may be entirely tax free. It's certainly worth looking into; and if you should go overseas, your own particular tax status should be evaluated with the aid of a tax specialist or by writing to the nearest Office of Internal Revenue.

In any case, don't expect to come home a millionaire. This, of course, is always possible. One such case is the story of Jim Ryan, a World War II veteran from a small town in Connecticut. Jim was discharged from the Army as an electronics technician. An Army personnel man, however, talked him into taking a job in Central America, near the Panama Canal, as a civilian employe with the Army.

After a few years down there, Jim fell in love with nearby Caracas, Venezuela, where he used to spend most of his holidays. It happened that then, as now, Venezuela was a booming country and there was a tremendous demand for television sets. An expert TV technician himself, Jim saw a good thing coming. He made arrangements to import used TV sets, repaired them, and sold them at handsome profits in Caracas. Today, he has one of the biggest TV and electrical appliance businesses in Venezuela, a couple of Cadillacs, a luxurious home, a country ranch, and his own plane.

You may not be another Jim Ryan, but if it's fun, travel and adventure you're looking for, an overseas job may be the answer to your dreams.

Fixing Your Marine Radio

Continued from page 82

if a spare is available. Now, if the transmitter works, watch the antenna current indicator lamp. It should glow and brighten as you talk into the microphone. If it doesn't, don't operate the transmitter until checked by a licensed technician. Even if it does, have the transmitter frequency checked at the earliest convenience.

Tubes are not as frequent a cause of improper operation as is the case with TV sets because of the few actual hours of use given the average marine radio. However, tubes should be checked at regular intervals. The best way is to call a technician to check the tubes who can perform other preventive maintenance functions on the same service call.

The boat owner, however, may check his own tubes by removing them from the set and testing them with a tube tester. If this is done aboard ship, at dockside, power for the tube tester may be piped in from shore through an extension cord. However, it is much safer to use a DC-to-AC converter, deriving power from the ship's battery, because of the extreme danger of shock. The hazard is greatly increased because of possible contact with the water and the power line at the same time.

If a tube tester is not available, the tubes can be removed for testing at a radio shop.

It is good practice to replace the vibrator at least once every season. It may fail when the radio is must urgently needed. Antenna, ground, and power connections should be checked and tightened frequently.

FCC rules require that the frequency of each transmitter channel be checked under normal operating conditions when the radiotelephone is initially placed in service and each time it is reinstalled after it has been removed from the vessel for repair or storage. (This is not a requirement when a radio-telephone of a portable nature is used.) Also, the frequency should be checked whenever a repair is made to the set which might affect its transmitting frequency.

The frequency check must be made

with an accurate instrument which will indicate the actual frequency measured or the amount of deviation from the prescribed frequency. The measurement and date it was made is recorded in the ship's records and must state the frequency or deviation as measured, not just "OK," and the record must be signed by the person who made the measurement.

Frequency measurements may be made by anyone qualified to do so. FCC rules do not stipulate that an operator license is required. The station licensee shall be held responsible for proper operation of the transmitter, regardless of who makes the measurement.

A commercial instrument for frequency measurement is a relatively expensive device. On board ship, however, military surplus BC-221 frequency meters are popularly used by service technicians for measuring transmitter frequencies.

When a boat is put in moth balls for the winter, the radiotelephone can be removed for maintenance and storage. It should be kept free of dust and stored in a dry place. Before putting it on the shelf, wrap it in paper to seal out dust. In the spring, blow out any dust that may have accumulated. And, after it is put on board, check the transmitter frequencies if you have the competence and adequate equipment, or, better yet, call a service technician.

What You Cannot Do

Unless you possess a first or second class radiotelephone or radiotelegraph license you should not:

Tamper with internal transmitter tuning controls

Replace transmitter crystals

Replace transmitter components.

While FCC regulations state that only a properly licensed operator can make adjustments or repairs which might affect transmitter frequency, it is for an expert to determine what parts are concerned. Therefore, it is the safest policy for unlicensed persons to leave the transmitter alone.

What You Can Do

An unlicensed person may repair or adjust transmitter tuning controls in the presence of and under the supervision of a person that is properly licensed.

A boat owner is required to have a third class operator license, but does not have to possess a first or second class license, to operate his radiotelephone. Anyone may talk over the radio with his permission but he cannot waive his responsibility.

Anyone competent to do so may repair or adjust the receiver. Very little skill is required to:

Check the battery

Inspect the battery cables

Inspect the antenna system

Test the tubes

A marine radiotelephone of the type used on pleasure craft is nowhere near as complex as a TV set. It is a relatively simple device. The difference is, and that is why a license is required, that if the transmitter operates improperly, it can cause harmful interference to others.

If it is so simple, one asks himself, why does a marine radiotelephone cost more than a TV set? There are good reasons. First, it is a safety device and must be reliable. Second, it must be able to withstand the rigors of shipboard use, and, third, it must meet FCC technical standards.

It's Hamfest Time Again

Continued from page 69

antennas, etc., are displayed and hundreds of questions are asked of the owners and manufacturers' representatives. Perhaps the biggest attraction is the "swap shop"—the ham's version of a bargain basement. Everyone who has a piece of gear he no longer wants or needs brings it along in hopes that someone else will buy it or trade him something useful. Newcomers are amazed at the amount of surplus radio equipment, old and new, factory built or home-brew, that is heaped on tables, the ground, or sold out of open car trunks.

The XYLs (ham-talk for wives) and children aren't left out of the day's fun. Special contests, games, and baby-sitting services are planned to keep everybody happy while the OM (Old Man) tramps around bargain hunting.

Of course, the day wouldn't be complete without a tour through the

parking area to look at mobile radio installations, dynamotors, and unusual antenna rigs.

At noon all the fun centers around the family picnic basket, and before long the afternoon program begins with a few short talks on new developments in ham radio, and the introduction of guests. Then comes the drawing of prize winners. Everyone has the feeling he'll carry home a piece of new equipment or pocket a sizeable cash prize. As the prizes are carried away, there are groans of disappointment, but even the losers agree, "It was exciting while it lasted."

When all the prizes have been awarded, all the equipment swapped, and all the hands shook, it's time to start for home again, wishing "73" to everyone, and looking forward to next year's hamfest.

Weather Station—2

Continued from page 58

forming a box around it. Cut out a side of the box and drill a hole through it so that the nine conductor cable will just squeeze through. This will help make the box weatherproof. Once the lead is through and the wires soldered to terminal strip you can complete box.

The cable length is determined by the distance between the sender and the indicator chassis. Make sure that the cable leads are connected in the same order as on the tie lug of the sender.

The moving vane is made from a shaft extension, coat hanger wire, a piece of sheet aluminum and a small counterweight. The larger the area of the vane, the more sensitive it will be to a shift in wind direction. It was found that the size vane shown would turn easily in a wind of only a few miles per hour.

Once the sender is mounted at a spot where it will receive the full force of the wind, it will be necessary to orient the vane properly so that the north bulb will light when the wind is blowing from the north and so forth. Manually turn the sender shaft extension until the east or west bulb lights. Tighten the vane set screw so that the vane points toward the sunrise for east or the sunset for west.

All-Electric Auto

Continued from page 79

ventional steering wheel in the usual place, the usual brake pedal, very likely even a clutch pedal and gear shifting lever, and an instrument panel. The instruments will be quite different except for the speedometer. In the current model there are two ammeters, one telling the driver just how much juice he's taking out of the batteries and the other indicating the remaining amount. The other instrument is a voltmeter. The headlights of the prototype are operating off an auxiliary 6-volt battery inside the luggage compartment. This, Graves explained, was for testing only. Production models' lights will operate from the battery pack.

The test car motors put out a rather unsatisfactory 2.5 shaft horsepower each, or a total of 5 horsepower. As *Electronics Illustrated* readers well know, the horsepower of electric motors is not comparable to that of gasoline engines. Production models will have 3.2 hp DC motors made by Baldor Electric of St. Louis. The 6.4 available shaft horsepower is the working equivalent of 22 brake horsepower. Even 22 bhp doesn't sound like much, but many of today's small imported cars have little more. The production motors have a maximum 2,700 rpm.

Further cooperation between Stinson and Baldor point to the likelihood of a regenerative braking system which will not only reduce the wear on the conventional brake linings, but will also throw current back into the batteries. The two motors run only when the driver exerts pressure on the accelerator. The ignition key, for lack of a more descriptive term, is used only to unlock or turn on one of the two contact switches. The other switch is on the accelerator. Thus, when stopped at an intersection, no current is drained from the batteries.

Stinson has been engaged in a full-blast battery testing program. "We've tested about every suitable battery available at the present time," Dr. Graves told the writer. "Most of the batteries, including those which have replaceable cells, have given about the same performance."

When I expressed curiosity about the possibility of using nickel cadmium batteries or some of the other supposedly "super" batteries, Dr. Graves replied that, "We are sticking to the average, readily available, moderately priced batteries simply to hold down the initial cost to the consumer."

The price of the car when it goes on sale later this year will be somewhere around $2,500. The batteries on the production versions will be concealed beneath a false floor behind the seats. Nevertheless, the wise owner should learn how to read a hydrometer.

Stinson president, Dean Van Noy, who has been manufacturing electric golf carts for a number of years, told us that the batteries will cost around $150 dollars per car when they are bought by the company for 500 cars at a time. The batteries that will be used will have a life of about 3 years, at which time the car owner would have to replace them at a cost comparable to an engine overhaul on the average car.

This car, it should be understood clearly, is not intended as a family all-purpose vehicle. Rather, it is being designed as essentially a second car to be used for shopping or commuting in and from suburban areas. Only 7 hours are normally required to recharge the batteries by the taper-type charger, containing silicon rectifiers manufactured by the Lester Equipment Company of Los Angeles. However, this charger, which comes as standard equipment with the car, can be reset, according to Van Noy, to give a safe and complete charge in 4 hours. Total charge is achieved with 6.88 kilowatt-hours. Actually, if one lived 70 or more miles from his destination, the batteries could be recharged at a service station by merely having the attendant plug in the charger. Cutoff is automatic.

The performance of the prototype is not fabulous due to an overweight condition. The batteries alone weigh close to 660 pounds, not 400 as has been reported. However, Stinson is tooling to produce lighter plastic bodies and a new aluminum frame which will bring the weight of production models down to no more than 2,000 pounds. Then, instead of taking some 30 seconds to get up to 50 mph as is the case with the test

car we drove, the same speed should be reached in about 20 seconds, especially in view of the increased power of the production motors. The top speed of the 3,000-pound proto is 58 mph. Stinson plans to increase the overall range between charges to well over 90 miles and the top speed to 70 mph.

According to Dr. Graves, Stinson has been considering nuclear power. "There are no weight or space problems with the latest nuclear devices, but we have not installed any of these. Nuclear generated electricity remains a distinct possibility in the future."

Swamped with mail and inquiries, Stinson officials indicate the pilot production models will be ready for final testing by this summer. These will be closely followed by the first 100 cars slated for utility firms scattered across the nation. It is the author's opinion that passenger-carrying electric cars will be available to the public in limited numbers before this year ends.

Here is an opportunity for electronics technicians everywhere to devote their talents to a wide open field. With municipal authorities everywhere putting the pressure on Detroit to come up with a smogless car, the virtues of electric power present the greatest possibilities of success.

Exposure Meter

Continued from page 67

best) and that it will support the cell firmly. You can use a plastic "pill-box" or a block of wood, if you wish. I preferred bending a piece of scrap aluminum measuring 3¾"x2¼" to form ¾" side legs. A ⅜" hole is then drilled in the geometric center of the square top of the carrier and a ¼" OD grommet inserted in it.

Circuit performance testing can be carried on without bothering with the enlarger. Place the device on the workbench and, with only the safelight on, turn on the POWER switch. The photocell should be plugged in, the SENSITIVITY control turned fully clockwise, and exposure timing potentiometer knob turned fully *counterclockwise.* (The sensitivity of this circuit is so great

that other room light should be reduced to a minimum; certainly *changes* in room light values must be avoided at this point.) After a 30 second warm-up period, turn on the STANDBY SWITCH. If the wiring is all correct, the tuning eye should glow and the shadow area should be about 60 degrees; that is, the eye should be "open."

Now slowly rotate the main control clockwise while you observe the eye. At some intermediate position, the eye should close. Cover the cell with your hand and note that the eye closes more tightly as evidenced by an overlapping of the bright areas. Backing off the main control should again make it open.

To test the sensitivity control, place a 100 watt incandescent lamp over the cell, about three feet away. With this on, it should be impossible to close the eye using only the main knob while the SENSITIVITY is full on. Now, leave the main control fully clockwise and slowly rotate the SENSITIVITY control back. At some point in the rotation, the eye should again close. If the instrument performs as described, it is ready for calibration.

The replaceable calibration cards are cut from 3″x5″ library stock and are slotted as shown in the pictures to fit over the shank of the main timing control. Two binder-head screws, one on each side of the card, serve as retainers to hold the scale vertical.

Select a negative that has a clean, clear (shadow) area for calibration. It should be a normal negative with good highlights as well. Focus this negative on the easel with the iris wide open and the height adjusted for the smallest enlargement you ever intend to make. Place the photocell in the deepest portion of the shadow area (brightest illumination) and determine if you can close the eye with the main knob while the SENSITIVITY is full on. This will work with diffusion enlargers and most single-condenser types; it may not work with some double-condenser enlargers. If such is the case, back off the SENSITIVITY and try again. When you find point where the eye just closes, mark panel at the SENSITIVITY pointer and leave knob set this way for all future work with this particular enlarger.

For the conditions described, you are

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now ready to mark the scale card for the shortest exposure you will ever make. Be sure that the main control is set so that the eye is just *barely open* and place a pencil mark opposite the pointer on the main timing knob. Remove the photocell and, using the standard test strip method, determine the correct exposure time for this lens opening on normal enlarging paper (grade No. 2). Enter this figure in seconds next to the pencil mark.

Now rotate the main pointer about 1/10 of its full motion counterclockwise and the eye will open. Replace the photocell in exactly the same spot it was before and now carefully close the enlarger iris diaphragm until the eye again virtually closes all the way. Repeat the test strip procedure and again mark a calibration time on the card opposite the new pointer position. This process is carried on all the way to the point where the iris is almost closed.

For different grades of the same brand of enlarging paper, it is not necessary to repeat the calibration procedure. Standard practice suggests that an increase of exposure time of 35% is correct for each successive harder grade. For example, if the exposure time for normal paper (No. 2) on a given setting is 10 seconds, then very close to 15 seconds will be required for No. 3 paper of the same manufacture. Thus the scales can be made up for all grades from soft (No. 1) to very hard (No. 4).

Electronic Lawn Mower

Continued from page 59

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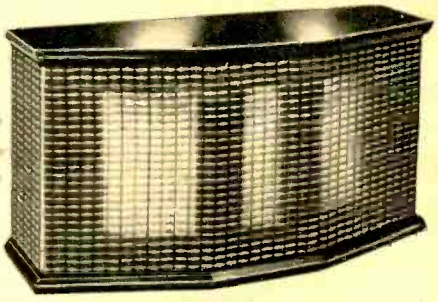

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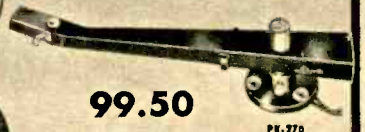

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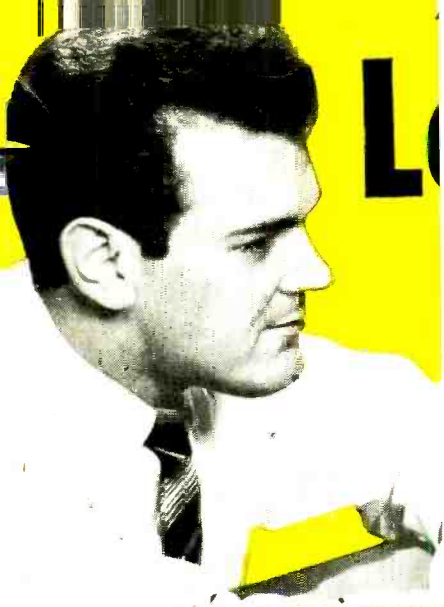

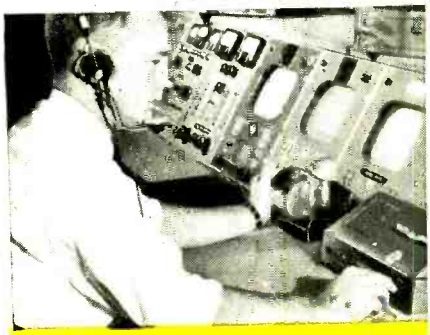

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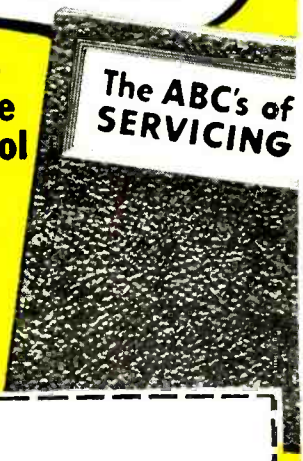

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