ELECTRONICS ILLUSTRATED

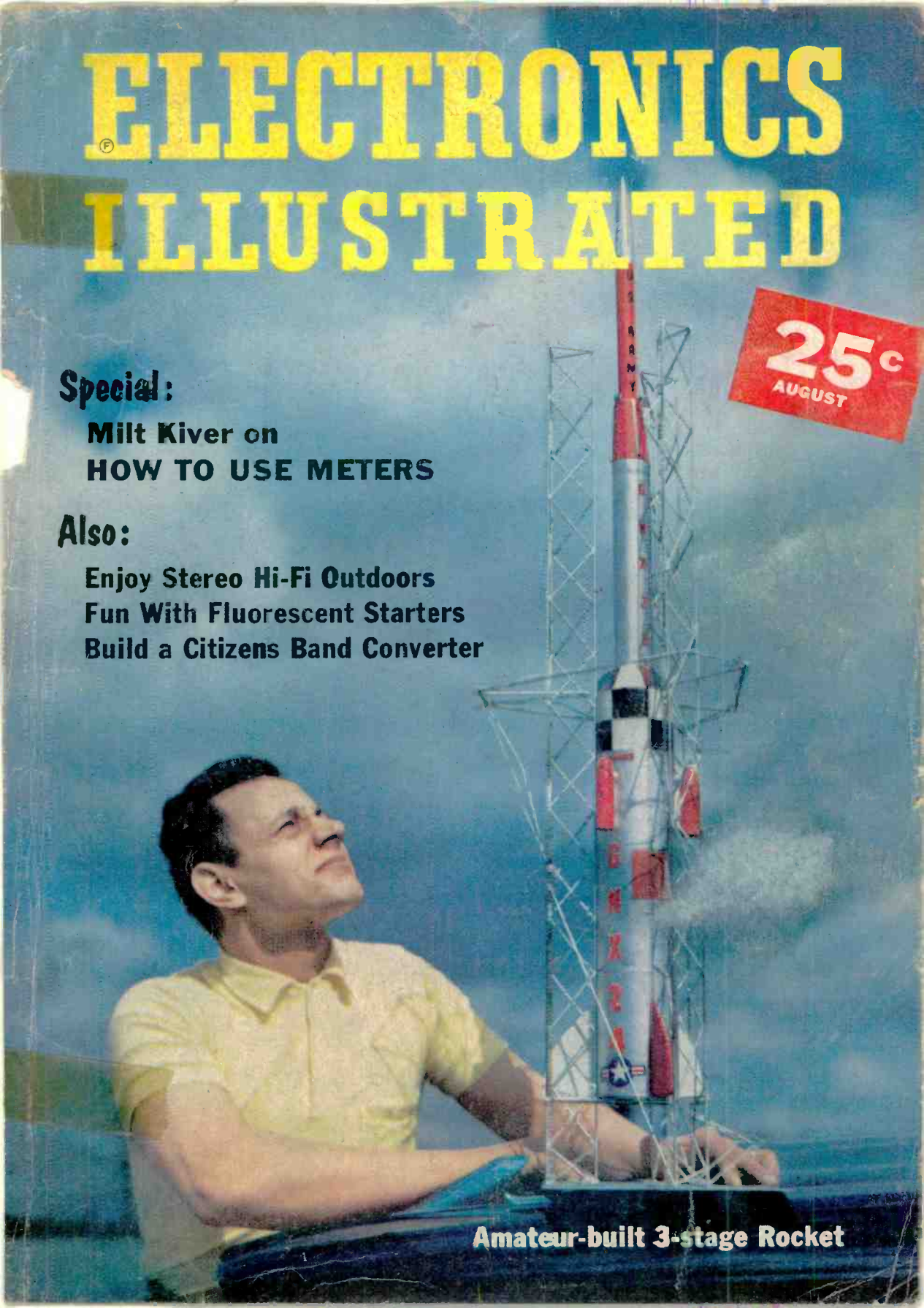
25c
AUGUST

Special:

Milt Kiver on
HOW TO USE METERS

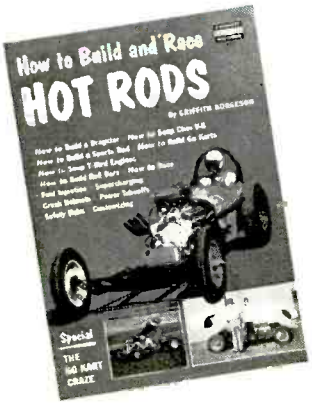
Also:

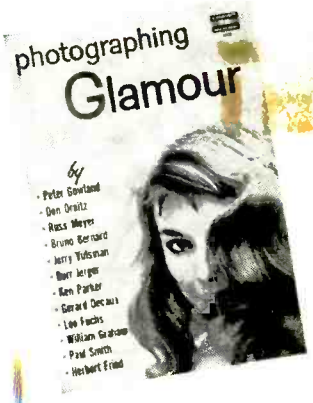
Enjoy Stereo Hi-Fi Outdoors
Fun With Fluorescent Starters
Build a Citizens Band Converter



Amateur-built 3-stage Rocket

FAWCETT HOW-TO BOOKS





PLYWOOD PROJECTS You Can Build • Headboards, desk, cabinets, tables, racks, bookcase, divider. (No. 414)

How To Build and Race HOT RODS • Go Karts, dragsters, sports rods, soup T-Bird & Chev V-8, etc. (No. 413)

PHOTOGRAPHING GLAMOUR • Gowland, Ornitz, Meyer, Yulsman, Jerger and many others. (No. 412)

WATER SKIING HANDBOOK • Fundamentals, equipment, driving boats, motors, jumping, shows. (No. 411)

PHOTOGRAPHY HANDBOOK • Underwater nudes, camera tricks, offbeat glamour, montages. (No. 410)

TV REPAIR AND MAINTENANCE • Receivers, tubes, sockets, sound, antennas, trouble shooting. (No. 409)

NEW GOLF SECRETS OF THE PROS • Hogan, Venturi, Snead, Middlecoff, Casper, Ford, etc. (No. 408)

HOW TO BUILD • Outdoor barbecues, patios, terraces, swimming pools, walls, fences, paths, steps. (No. 407)

BOATING HANDBOOK • Piloting, sail racing, hull and engine care, build a dock, outboards. (No. 406)

CANDID PHOTOGRAPHY • Nudes, glamour, children, humor, animals, camera news, salon section. (No. 405)

ELECTRONICS GUIDE • Hi-fi, short-wave, TV repair, outer space, tape recording, ham receivers. (No. 404)

OUTBOARD BOATING HANDBOOK • New boats, motors, maintenance, kits, racing, trailers, etc. (No. 403)

MOBILE HOMES AND TRAVEL TRAILERS • Towing, touring, regulations, parks, clubs. (No. 402) Also available in hard cover edition at $2.50 per copy.

How You Can Grow BEAUTIFUL ROSES • Soil, tools, planting, care, pruning, arranging, showing. (No. 401) Also available in hard cover edition at $2.50 per copy.

Peter Gowland's FACE and FIGURE Photography • Posing, props, backgrounds, nudes, lighting. (No. 400)

HANDY MAN'S HANDBOOK • Plumbing, Air Conditioning, Heating: repair, installation, costs. (No. 399)

SMALL CAR GUIDE • Specifications, roadtests, prices on 55 latest models, Volks, Austin, Fiat, etc. (No. 398) Also available in hard cover edition at $2.50 per copy.

Photographing The FEMALE FIGURE • Poses, action, props, lighting, techniques, portraits. (No. 348)

HOW TO BUILD IT • Kitchen cabinets, coffee table, bar, garage doors, fences, closets, log cabin. (No. 397)

HOW TO DRAW—Fun with Pencil and Pen • Proportion, human figure, perspective, animals, children. (No. 396)

FAMOUS GUNS From The Winchester Collection • Revolvers, rifles, marksmen, pioneer arms, ammo. (No. 395) Also available in hard cover edition at $2.50 per copy.

PRACTICAL ELECTRONICS • Hi-Fi tips, tests, TV, novice ham station, transistor intercom, etc. (No. 394) Also available in hard cover edition at $2.50 per copy.

To order direct, send 75c per copy for regular edition or $2.50 per copy for De Luxe edition to: FAWCETT BOOKS, Dept. EI-8, Greenwich, Conn. Add 10c per copy mailing charge for all books. Specify title and number. Canadian orders cannot be accepted.

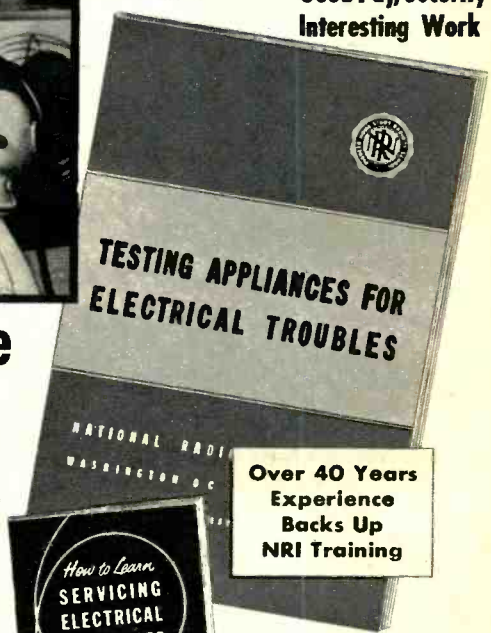
A FAWCETT HOW-TO BOOK 75¢

AT YOUR LOCAL NEWSSTAND, LEADING DRUG STORE, SUPER MARKET, HARDWARE STORE AND BUILDING SUPPLY DEALER

Make More Money Soon Fixing Electric Appliances

Actual Lesson FREE

Fast Growing Field Offers Good Pay, Security Interesting Work



Learn at Home in Spare Time

Earn more money. Enjoy doing important, interesting work. Learn Electrical Appliance Servicing. This is a field of increasing opportunity. Today every wired home has many electrical appliances and millions and millions of new appliances are made and sold each year. Find out more about this great, growing field. Find out how NRI can train you, at home and in spare time to be an Appliance Service Technician. See how you can start soon to make extra money servicing appliances.

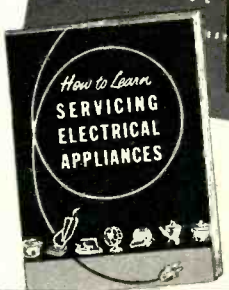
Add to Your Income Soon After Enrollment

Opportunities Increasing for Service Technicians

NRI Training is practical, thorough. You get easy-to-understand lessons, *and* NRI supplies parts to build professional type Multi-Use Tester. Use it to get practical experience. Soon, you can add to your income by servicing appliances. Build a profitable *sideline* for your spare time—qualify for a good job—develop a business and be your own boss. As an Appliance Service Technician, your opportunities are broad—your services wanted, gladly paid for, highly regarded in your community.

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.

Over 40 Years Experience Backs Up NRI Training



Find Out What Appliance Repair Offers You

Learn and Earn With Tester Diploma When You Finish

Locate appliance troubles easily with Portable Appliance Tester you build. You use it to learn and do actual electric appliance repair jobs. For only $3.00 with enrollment and $6 per month, get training including Tester—a small price to pay for increased earnings. Mail coupon for Sample Lesson and Book—your first step toward more interesting work, bigger earnings. **NATIONAL RADIO INSTITUTE, Dept. KH9, Washington 16, D. C.**

Mail Coupon FOR LESSON AND BOOK FREE

National Radio Institute
Dept. KH9, Washington 16, D. C.

Please send me Electric Appliance Servicing Lesson and Book FREE. (I understand no salesman will call.)

Name_____ Age_____

Address_____

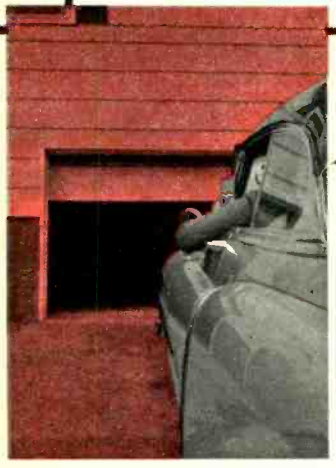
City_____ Zone_____ State_____

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

ELECTRONICS ILLUSTRATED

AUGUST, 1959 Vol. 2, No. 8

A FAWCETT PUBLICATION



CONTENTS

ELECTRONICS ILLUSTRATED is published monthly by Fawcett Publications, Inc., Fawcett Place, Greenwich, Conn. W. H. Fawcett, Jr., President; Gordon Fawcett, Secretary and Treasurer; Roger Fawcett, General Manager; Roscoe K. Fawcett, Circulation Director.

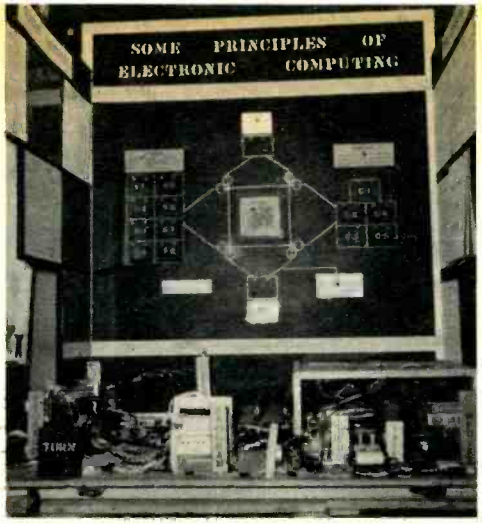
EDITORIAL AND ADVERTISING OFFICES: 67 West 44th Street, New York 36, N. Y.

ADDRESS ALL MAIL: Subscriptions, change of address, Form 3579 to Circulation Dept., Fawcett Bldg., Greenwich, Conn.; and all editorial and advertising to Fawcett Publications, Inc., 67 W. 44th St., New York 36, N. Y.

Second-class postage paid at Greenwich, Conn., and at additional mailing offices.

Subscription price $3.00 per year in the U. S. and possessions and Canada. All other countries $6.00 per year. Foreign subscriptions and sales should be remitted by International Money Order in U. S. funds payable at Greenwich, Conn.

Printed in U.S.A.



Here is one of many computer projects at National Science Fair. For candid comments on projects, see editorial.

A Message From the Editor

HI-FI music lovers who listen to FM stations often get annoyed at frequent spot commercials which detract from the proper atmosphere for good listening. One FM station in the East has recently decided to cut down on the number of spot commercials during the day. They have begun to realize that too many commercials can be detrimental to the station and its sponsors. Here's hoping others follow WQXR's example.

Up until this issue we have been running the ABC's of Electronics, a series on fundamentals. A new series on learning electronics by building projects starts in our next issue. In every article you will be shown how to build a specific electronic circuit, how it works and why it was designed as it was. These circuits have been designed so that they will plug into each other and give you a complete AM-FM-phono system when you finish the first part of the series. The first article will describe a power supply.

Our editors recently attended the National Science Fair in Hartford, Connecticut. This was the culmination of the individual regional and state fairs held during the past year. Many of the displays and papers dealt with electronics. There was no question but that the youngsters who built the exhibits had spent long hours in investigating the basic principles that made the devices work and then in building the devices. But the wiring and the chassis

Next month—a metal locator you can build.

layouts in many instances were sloppy and did not reflect an awareness of how critical wiring and component placing can be. We realize that most of the students who enter Science Fairs are young and have not had much experience in building devices such as they displayed. However this was the National Science Fair and as such should represent the best in scientific ability among our high school students. Also, and even more important, all of these students supposedly worked under the supervision of a school instructor or other supervisor. We suggest that part of the emphasis in Science Fairs be placed on enrolling more expert and knowledgeable supervisors to help our youngsters in their scientific endeavors in and out of fairs. This may be a great opportunity for electronics engineers and technicians to work a little more closely with our high schools in transmitting some of their knowledge and ideas to the more advanced and ambitious students.

For our lead story this month we installed a radio controlled door opener in a typical garage. The particular unit we used is the latest type, with an all transistor transmitter which requires no antenna and no connection to the auto. Read how easily you can install it on page 27 and be the envy of your neighbors.

Next month we will present a round-up of thermoelectricity. For the shortwave listener we have a very interesting story on how to get QSL's from the many transmitting stations which do not normally respond to letters from shortwave listeners. We also describe how to build a new inexpensive metal locator designed especially for us. We guarantee this one, having used it ourselves. If you have a TV set in a cabinet which you'd like to expand to contain your hi-fi equipment we'll show you how to build the cabinet and connect the components. See you next month.

Charles Tuffer

BIG REWARDS

for the most-wanted men in Radio-TV-Electronics

General Electronics Technician | Radio-TV Engineer | Radio-TV Service Manager | Industrial Electronics Technician | Electrical Engineering Technician | Electrical Draftsman

That's right! There *are* big rewards for the most-wanted men in Radio-TV-Electronics.

You can be one of these men. With the right training you can qualify for a big-pay job in a vital industry. You can start yourself on an exciting, rewarding career in a field that offers unlimited opportunities.

But you must be thoroughly trained. You must know more than wires and tubes. You must *think* in electronic terms.

There's no short-cut to success in Radio-TV-Electronics. But there is a simple, sure way . . . the I.C.S. way.

I.C.S. is the world's oldest and largest technical training school. Sixty-seven years of experience in training 6½ million students have made the I.C.S. system a success-proven method of home study. Today, there are more trained men from I.C.S. in supervisory and management jobs than from any other school.

Up-to-the-minute I.C.S. Courses make electronic fundamentals clear, easy-to-follow. *Personalized* guidance helps you through each step.

You study at home — in your spare time — at your own pace. Everything you learn is practical, usable. Courses are prepared by experts who know what *you* need to know to go places.

Join the ranks of the most-wanted men in Radio-TV-Electronics. Your first step is to send for your free I.C.S. Career Kit. You have nothing to lose. You can gain an exciting career in the fastest-growing industry of all time.

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

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

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

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

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

Send the coupon below for your *free* I.C.S. Career Kit!

1. "How to Succeed," 36-page guide to advancement.
2. Opportunity handbook for the field of your choice.
3. Sample lesson (Math) to demonstrate I.C.S. method.

For Real Job Security—Get an I.C.S. Diploma! **I.C.S., Scranton 15, Penna.**

Accredited Member, National Home Study Council

INTERNATIONAL CORRESPONDENCE SCHOOLS

ICS

BOX 02423G, SCRANTON 15, PENNA. (Partial list of 259 courses)

Without cost or obligation, send me "How to Succeed" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):

RADIO TELEVISION ELECTRONICS
- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Practical Telephony
- ☐ Radio-TV Servicing

BUSINESS
- ☐ Cost Accounting
- ☐ Managing a Small Business
- ☐ Purchasing Agent

DRAFTING
- ☐ Electrical Drafting

HIGH SCHOOL
- ☐ High School Diploma
- ☐ Good English
- ☐ High School Mathematics

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Elec. Engr. Technician
- ☐ Elec. Light and Power
- ☐ Practical Electrician
- ☐ Professional Engineer (Elec.)

LEADERSHIP
- ☐ Industrial Foremanship
- ☐ Industrial Supervision
- ☐ Personnel-Labor Relations
- ☐ Supervision

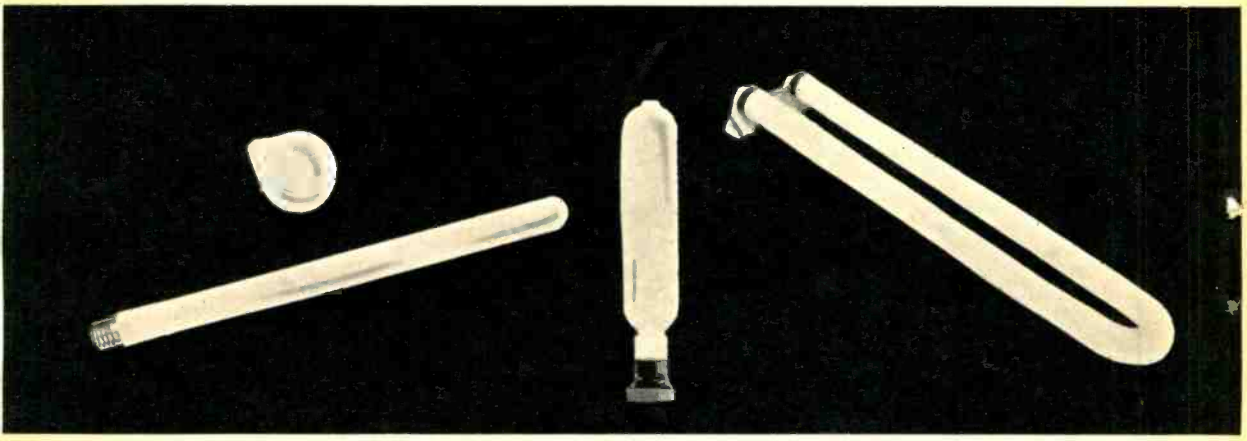
Name_____ Age_____ Home Address_____

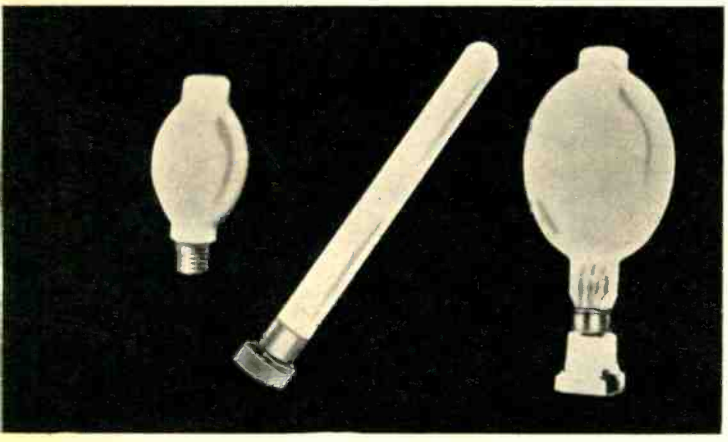
City_____ Zone_____ State_____ Working Hours_____ A.M. to_____ P.M._____

Occupation_____

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.

Electronics in the News





Three new concepts in the field of fluorescent lighting are in the experimental stage at Westinghouse. As you can see, most of the bulbs shown above and at the left are single ended and may be plugged or screwed into a socket for operation much like a conventional incandescent light bulb. These new lights do not require external ballasts or starters. The U-shaped bulb (above right) is the second new idea. This also has the wiring at one end.

Unlike the fluorescent tubes we use today, Westinghouse has designed a rectangular glass plate no more than 1 inch thick which produces a fluorescent light. These unusual lamps consist of a labyrinth or maze of passages sealed in a thin glass block. The electric discharge travels through this maze and illuminates the glass. The lamp shown at the left is made with a reflector on one side so that all the light is reflected through only one side of the lamp as opposed to the fluorescent tube where the entire bulb is illuminated. The waffle-like bulb at far left is a 1946 model showing how far we've come.

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.*
- ✓ *R.F. Signal Generator for F.M.*
- ✓ *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 pattern 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

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

Model 70—UTILITY TESTER
Total Price...$15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- 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).

As an Automotive Tester the Model 70 will test:

• 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

SHIPPED ON APPROVAL

NO MONEY WITH ORDER—NO C.O.D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied **then** send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanotion necessary.

MOSS ELECTRONIC, INC.
Dept. D-622, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name .....

Address .....

City ..... Zone..... State.....

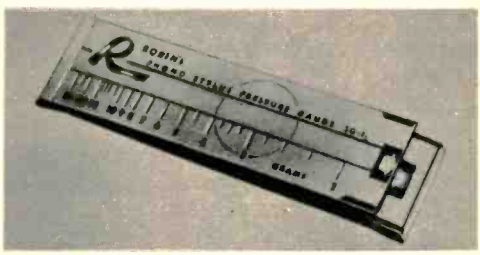
All prices net, F.O.B., N. Y. C.

- ☐ Model 77 ..... Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ 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

. . . News

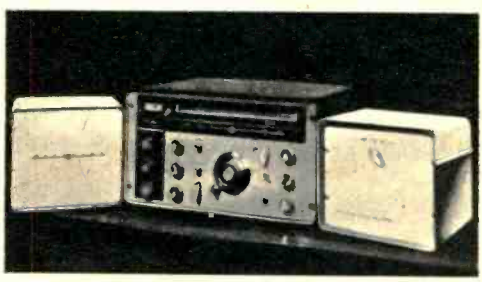
A communications system that would enable a ground station to communicate with up to 500 aircraft every two minutes is being designed by RCA. The system would use push buttons. Any one of 32 pre-conceived messages such as "Climb to 11,000 feet" or "Report reaching New York" may be transmitted by merely setting a dial to the desired message and pushing the button. Information about altitude and identity of the aircraft will be transmitted automatically, without any action by the pilot. In an emergency, either party may push a button for voice communication. The system, called AGACS, will be used to prevent collision paths of aircraft and is scheduled for mid-1961 delivery.

—o—



Robins Industries has designed a stainless steel gauge to measure the stylus pressure of your monophonic or stereo cartridge. SG-1 is priced at $1.00.

—o—



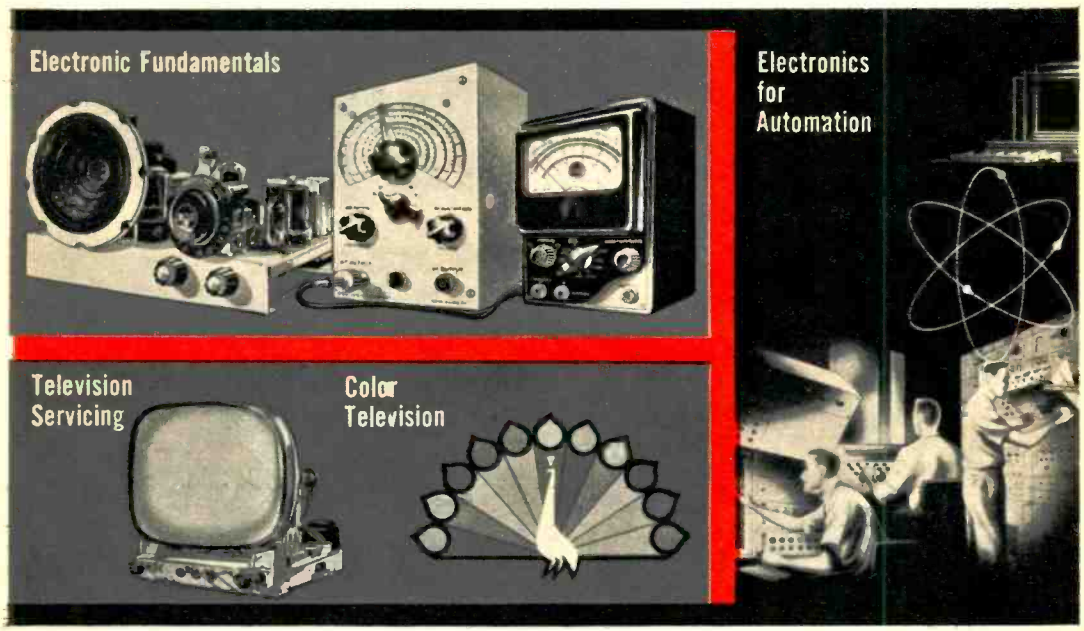
Speakers and crystal calibrators to match the National NC-303 ham receiver have been made available by the National Company. The speaker NTS-2, is priced at $21.95, crystal calibrator model XCU-300—$23.95 and the deluxe crystal/WWV calibrator is available for $34.95.

LET RCA TRAIN YOU IN ELECTRONICS

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

ELECTRONICS FOR AUTOMATION

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



Send for our 64 page Home Study Catalog FREE!

FOR RESIDENT SCHOOL COURSES SEE AD ON OPPOSITE PAGE

Practical work with the very first lesson. Pay-as-you-learn. You need pay for only one study group at a time.

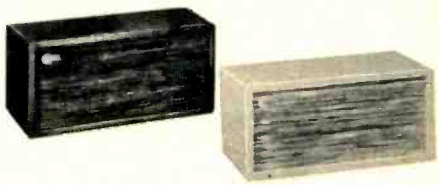
RCA INSTITUTES, Inc. Home Study School, Dept. EI-89
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N. Y.

Without obligation, send me the FREE catalog of Home Study Courses. No salesman will call.

Name .....
Please print
Address .....
City ..... Zone..... State.....
Korean Vets! Enter Discharge Date.....

CANADIANS — Take advantage of these same RCA courses at no additional cost. No postage, no customs, no delay. Send coupon to: RCA Victor Company, Ltd., 5001 Cote de Liesse Rd., Montreal 9, Quebec
To save time, paste coupon on postcard.

. . . News



British Industries Corporation has announced the Wharfedale WS/2 two-speaker stereo system in a sealed enclosure. No auxiliary speakers are needed to achieve the frequency range of 20-20,000 cycles. The system may be operated by a moderately powered amplifier. It measures 11" x 10½" x 24" and is finished on all sides in Birch, Mahogany or Walnut. Priced from $79.50 depending on wood. For further information write to British Industries, Port Washington, New York.

A new AM-FM tuner in the medium price range ($139.95) has been announced by H. H. Scott. The circuit features include a 2 mc wide-band FM detector without the need for AFC. An electronic eye indicator on front panel shows optimum tuning point on both AM and FM, and functions as a relative signal strength meter to aid in antenna placement. The RF circuitry of the model 320 is heavily silver plated for high sensitivity and to minimize cross-modulation caused by strong local station. Tape recorder and multiplex outputs are included. More information is available from H. H. Scott, Dept. P, 111 Powdermill Rd., Maynard, Mass.

build this great new knight®-kit

A PRODUCT OF ALLIED RADIO

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

COMPARABLE IN EVERY WAY TO WIRED AMPLIFIERS COSTING TWICE AS MUCH

tremendous value at only

$44.50

only $4.45 down

never before such performance... such styling... such quality at so low a price...

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**

EXCLUSIVE **knight-kit** **MONEY-BACK GUARANTEE**

Every KNIGHT-KIT meets or exceeds published specifications, or we refund your money.

ONLY **knight-kits** ARE **CONVENIENCE ENGINEERED** for easiest building—no previous electronic experience needed...

see over 50 other fine knight-kits...write for catalog

HI-FI KITS	HOBBY KITS	INSTRUMENT KITS	
Stereo Amplifiers	Short-Wave Radios	VTVM	Cap. Checker
Stereo Preamp	AC-DC Table Radios	VOM's	R/C Tester, etc.
Stereo Control	Clock-Radio	Tube Checkers	
Hi-Fi Tuners	Radio-Intercom	Oscilloscopes	**HAM KITS**
Hi-Fi Amplifiers	Transistor Radios	Signal Tracer	Receiver
Speaker Systems, and others	Electronic Lab Kits and many others	Audio Generator	Transmitter
		Sweep Generator	VFO, etc.

EASY TERMS ON ORDERS AS LOW AS $20

1959 ALLIED CATALOG FREE

Send for this value-packed catalog featuring the complete KNIGHT-KIT line, as well as the world's largest stocks of everything in Electronics.

WRITE FOR YOUR COPY TODAY

® Registered Trade Mark Allied Radio Corporation

ALLIED RADIO Dept. 133-H9

100 N. Western Ave., Chicago 80, Ill.

☐ Ship Model Y-773 Knight-Kit Stereo Amplifier. $_____ encl.

☐ Send FREE ALLIED 1959 Catalog

Name_____

Address_____

City_____ Zone_____ State_____

. . .News

From Italy comes an automatic 4-speed record changer called LESA CD2/21. The changer may be used automatically, at which time it accepts up to 8 records of any size; or manually with arm returning to place at the end of the record. Any standard cartridge may be placed in the tone arm. The pre-wired plug-in head permits quick switching of mono and stereo cartridges. The changer features minimum rumble, flutter and wow. $39.95 from Electrophono & Parts Corp., 530 Canal Street, New York, N.Y.

—o—

This summer high school students possessing unusually high aptitudes for work in science will have an opportunity to attend an advanced science training program at the University of Maine. The students attending this course are those who have placed in the top 25% at science fairs and the Annual Science Talent Search, and have shown high grades in their high school courses. The program is designed to broaden the student's background in science and develop an appreciation of the interrelationships among the sciences.

—o—

High-speed data-handling systems that "read" print or pictures the same as the human eye, and process the information in the form of coded light signals, may result from new techniques now under study at RCA. The new methods are based upon use of light-sensitive and light-emitting devices to do the coding.

BUILD 16 RADIO CIRCUITS AT HOME

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

Reg. U.S. Pat. Off.

only $22.95

A Practical Home Radio Course

Now Includes

- ★ 12 RECEIVERS
- ★ 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 addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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.
☐ Send me FREE additional information describing "Edu-Kit."

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 514AE, Hewlett, N. Y.

. . . News

The model 1020 completely transistorized DC power supply is now available from EICO, 33-00 Northern Blvd., Long Island City, N. Y. It serves as a universal power supply for operating transistor radios, hearing aids, preamplifiers, instruments and other transistor devices under repair or development. It is also intended for use as a variable bias supply for transistors or vacuum tubes in circuit development, to recharge small storage batteries, or to do light electroplating. The 1020 provides continuous variable output monitored by a dual range voltmeter (0-6, 0-30, VDC). The maximum output current capacity is 150 ma from 0-12V, 200 ma from 12-24V, 300 ma from 24-30V. Kit is $19.95, factory wired model $27.95.

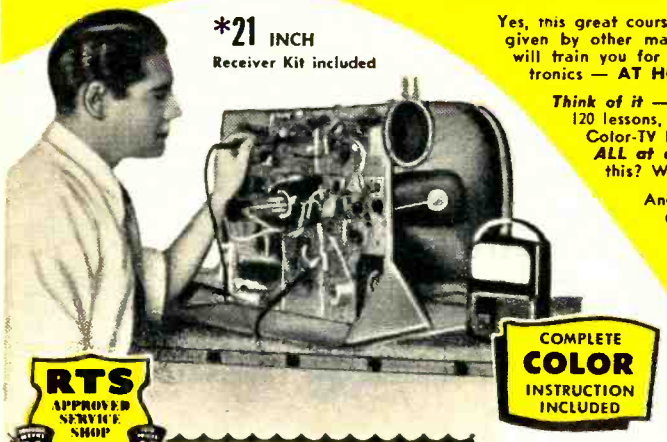
—o—

A new electronic eye radar system for use on military helicopters and low-flying battlefield operations was announced by Bendix Aviation Corp. Designed for night flying, bad weather conditions and navigating between mountains, the "eye" provides the pilot with a television-type view of the ground and is also useful for ground mapping purposes. A 40-inch antenna scans the area around the aircraft at the rate of 60 rpm.

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

....AT A PRICE YOU CAN AFFORD!



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.**

Think of it — a complete training program including over 120 lessons, Fourteen Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . ***ALL at a really big saving to you.*** How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)
OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP

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!

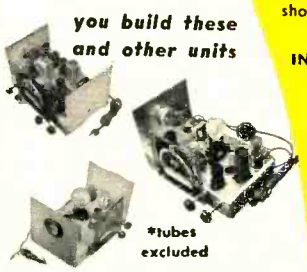
RTS APPROVED SERVICE SHOP

Get your free book on the
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

RADIO-TELEVISION TRAINING SCHOOL
5100 S. VERMONT AVENUE
LOS ANGELES 37, CALIFORNIA

ACT NOW!

ASSOCIATION OF HOME STUDY SCHOOLS

RTS' Membership in The Association of Home Study Schools is your assurance of Reliability, Integrity, and Quality of Training.

ALL THESE FREE!

CUT OUT AND MAIL — *TODAY!*

RADIO-TELEVISION TRAINING SCHOOL
5100 S. Vermont Avenue, Dept. E1-89
Los Angeles 37, California

SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

Name _____ Age _____
please print

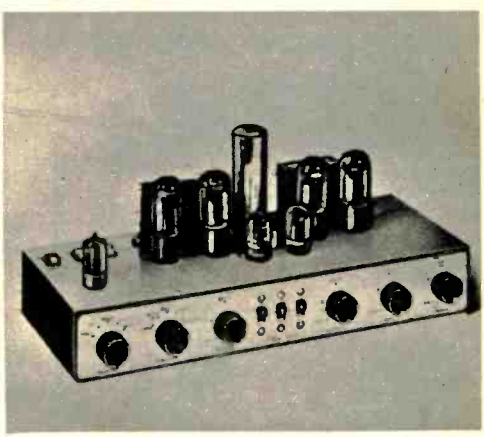
Address _____

City & State _____

300

. . . News

General Instrument Corp. has developed a new capacitor using a "metallic sponge" of tantalum, a rare metal. Primarily for military use, the capacitors will be used in the microminiaturization of missiles gear, communications equipment and other electronics systems. The tantalum powder is compressed, as above, into a spongy pellet with a surface area equivalent to 48 square inches. G.I. says unit is comparable to unit 1,000 times its size.



Arkay Radio Kits announces a new 12-watt amp pre-amp kit priced at $36.95 for stereo and monaural use. The CS-12 operates from any ceramic or crystal phono cartridge, high output tape decks, etc. Power output is normally 12 watts push-pull per channel with 20 watts of peak power. Complete step-by-step instructions included. Address is 88-06 Van Wyck Expressway, Richmond Hill, N. Y.

WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID

RADIO-TELEVISION SERVICE TECHNICIAN

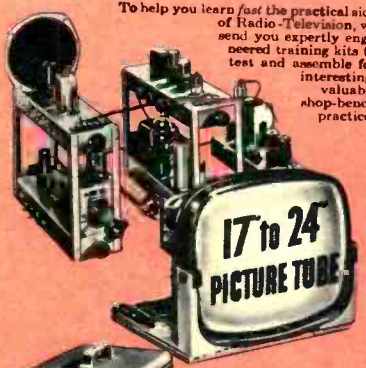
NOW — Just $6 Starts You Training in

RADIO-TELEVISION

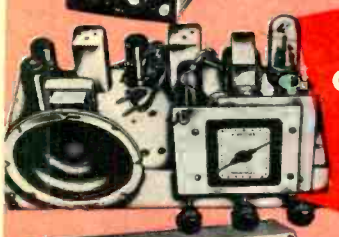
the SPRAYBERRY "Learn-by-Doing" Way . . .

25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!



- The new Sprayberry Training Television Receiver, built and tested in 5 sections.
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.



You build the new Sprayberry tester — a complete 18-range Volt-Ohm-Milliammeter test meter.

Big New CATALOG AND Sample Lesson FREE!

★ ★ ★ ★ **This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!**

Men by the thousands... trained Radio-Television Service Technicians...are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now — *just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need...to step into a fine job or your own Radio-Television Service Business.

Complete Facts Free—Act Now; Offer Limited

Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once...mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free*. No obligation...no salesman will bother you.

HOME STUDY TRAINING IN SPARE TIME

Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today... let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity in store for you!

SPRAYBERRY Academy of Radio-Television

1512 Jarvis Avenue, Dept. 120-A, Chicago 26, Illinois

Mail This Coupon Now—No Salesman Will Call

Sprayberry Academy of Radio-Television
Dept. 120-A, 1512 W. Jarvis Ave., Chicago 26, Ill.

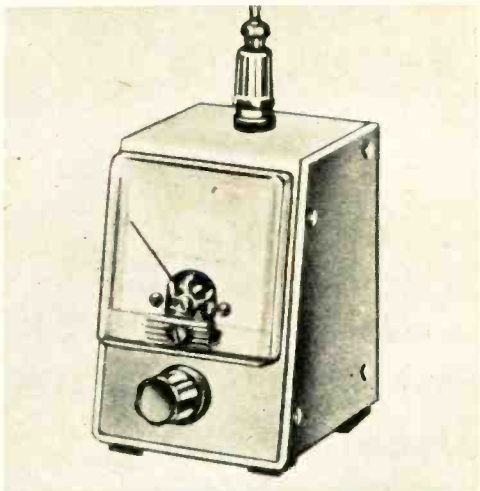
Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME ..... Age .....

ADDRESS .....

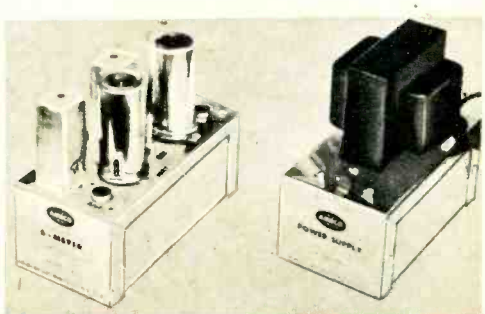
CITY ..... ZONE ..... STATE .....

. . . News



The new Heath Power Meter kit picks up energy from a mobile antenna and indicates when the operator has his transmitter tuned for maximum output. The PM-2 features a variable sensitivity control for adjustment to various power transmitter fields, its own antenna and a sensitive 200 μa meter. $12.95 from Benton Harbor, Mich.

—o—



A 6-meter crystal controlled converter in kit or factory wired form has been made available by Ameco. A Pi-net coil with taps is used in output for hookup to any receiver. Frequency can be changed by replacing the crystal. The power requirement of 16 ma at 117 volts DC and .85A at 6.3 volts AC can be obtained from the receiver or from the Ameco power supply PS-1.

Model DB-6K converter kit is $19.95, $27.50 wired. Power supply kit is $10.50.

F.C.C. COMMERCIAL OPERATOR LICENSE

Training... *for* **Jobs** *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 radiotelephone 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 Communications Electronics Course prepares you for a *FIRST CLASS* F.C.C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F.C.C. license.

CORRESPONDENCE OR RESIDENCE CLASSES

Grantham training is available by correspondence or in resident classes. Either way, you are trained quickly and well. Write, or mail the coupon below, to any division of Grantham School of Electronics. Our free booklet will be sent to you immediately.

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
Ron Taylor, 29 S. Franklin St., Chambersburg, Pa.	1st	12
Berl Moore, P.O. Box 169, Opp, Alabama	1st	15
Donald R. Titus, 270 Park Terrace, Hartford 6, Conn.	1st	12
Robin O. Okinishi, P.O. Box 375, Hanapepe, Kauai, Hawaii	1st	12
Billy R. Kirby, Route #3, Smithfield, N. C.	1st	9
J. H. Reeves, 10621 Ruthelen, Los Angeles 47, Calif.	1st	12
Donald H. Ford, Hyannis Rd. (Cape Cod), Barnstable, Mass.	1st	12
James D. Hough, 400 S. Church St., East Troy, Wisc.	1st	12

FOUR COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains four complete Divisions—located in Hollywood, Calif., Seattle, Wash., Kansas City, Mo., and Washington, D.C. All Divisions of Grantham School of Electronics offer the same rapid courses in F.C.C. license preparation, either by home study or in resident classes.*

Get your First Class Commercial F.C.C. License in 12 weeks by training at

Grantham School OF ELECTRONICS

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

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

KANSAS CITY MO. — 3123 Gillham Road Kansas City 9, Mo. (Phone: JE 1-6320)

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

for **FREE** *Booklet CLIP COUPON and mail in envelope or paste on postal card.*

MAIL COUPON NOW

To: **GRANTHAM SCHOOL OF ELECTRONICS**

1505 N. Western Hollywood • 408 Marion Seattle • 3123 Gillham Rd. Kansas City • 821-19th, NW Washington

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-M

. . . News

New Booklets and Catalogs

Audiotex Mfg. Co. is offering a free catalog showing their new hi-fi accessory line. 3225 Exposition Place, Los Angeles 18, California.

"Phototubes and How to Use Them" a booklet explaining photo emission and spectrum response and other aspects of the phototubes is available from CBS-Hytron, Parker St., Newburyport, Mass. This bulletin, PA-227, also includes circuits illustrating uses.

Another booklet entitled "Why a Ceramic Cartridge?" is available free from CBS-Hytron at the above address. It discusses and compares magnetic and ceramic cartridges.

Electro-Voice is offering two new catalogs: Number 134 tells about and illustrates hi-fi speakers, enclosures and proper placement of equipment. Catalog 120A describes and illustrates professional microphones. Both available on request from distributors or Electro-Voice, Buchanan, Mich.

A folder illustrating and describing Homewood Industries' line of hi-fi and stereo cabinetry available in kits for the do-it-yourselfer may be obtained from the manufacturer at 26 Court Street, Brooklyn 2, N. Y.

Silicon and selenium rectifiers are described in International Rectifier Corporation's new "Short Form Catalog," free from El Segundo, Calif.

A booklet telling about Jensen's line of monophonic and stereophonic high fidelity loudspeaker systems is available on request from Jensen Mfg. Co., 6601 S. Laramie, Chicago 38, Ill. Request catalog 165-C.

A new technical manual has been announced by Sylvania. It contains information on receiving, special purpose and television tubes. Also described are transistors and crystal diodes. This edition of the manual contains a transistor characteristics chart, microwave diode chart, cathode ray phosphor chart and an American-European Substitution chart. Available from Sylvania distributors for $3.00.

FREE!

MONTH AFTER MONTH FROM RADIO SHACK

32 BIG PAGES OF BARGAINS LIKE THIS:

Because Radio Shack is one of the world's largest dealers in hi-fi components, industrial electronic equipment, ham radio, test equipment, tools, optical goods, records and hobby supplies, everything new, every bargain, comes to Radio Shack first . . . and through these Bargain Bulletins . . . to Radio Shack customers. They're free and frequent. To be "in the know," fill in and mail the coupon below.

Spend 35c

Save $100's!

35c

RADIO SHACK'S

1960 GUIDE TO ELECTRONIC BUYING

Completely new . . . completely different . . . and a complete directory of everything in electronics for industry, for the audiophile, for the hobbyist . . . plus everything in hi-fi, ham radio, tools, test and laboratory equipment . . . all presented in 250 big 8½" x 11" pages, big readable type with clear pictures . . . and including latest technical articles written by recognized authorities.

NOW! 2-WAY RADIO STATION WITHOUT FCC EXAMS!

Build It Yourself!

CITIZENS' BAND TRANSCEIVER

NEW CLASS D **KIT**

FCC APPRVD.

AT LAST! Thanks to new FCC rulings, anyone can own and operate a shortwave radio station on the 11-meter band without FCC exams! And this complete Radio Shack — STANCOR kit provides everything you need to build a combination transmitter-receiver exactly as pictured!

Order No. 450X136, Sh. Wt. 11 lbs.

$39.95

$5 Down

$5 Mthly.

RADIO SHACK CORP. Dept. 8P

730 Commonwealth Avenue, Boston 17, Mass.

Please send me:

- ☐ FREE Bargain Bulletins for full year
- ☐ 1960 Guide To Electronic Buying @ 35c
- ☐ Transceiver Kit Order No. 450X136 @ $39.95

☐ Check ☐ Money ☐ C.O.D.

Name _____

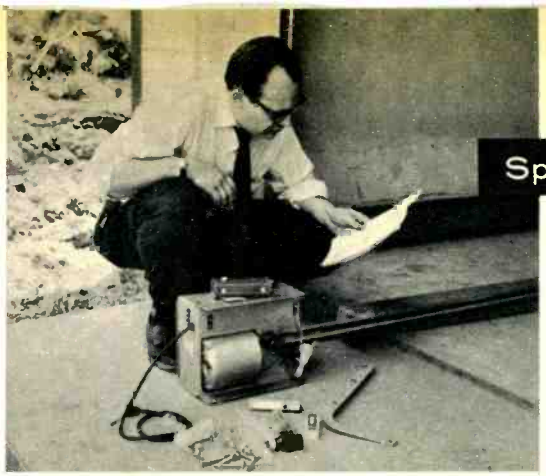
Address _____

City _____ Zone _____ State _____

RADIO SHACK CORPORATION

167 Washington St., Boston 8, Mass.
730 Commonwealth Ave., Boston 17, Mass.
230-240 Crown St., New Haven 10, Conn.

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



Special Project

Unit is unpacked and checked against parts list. Manual gives installation procedure.

how to install a

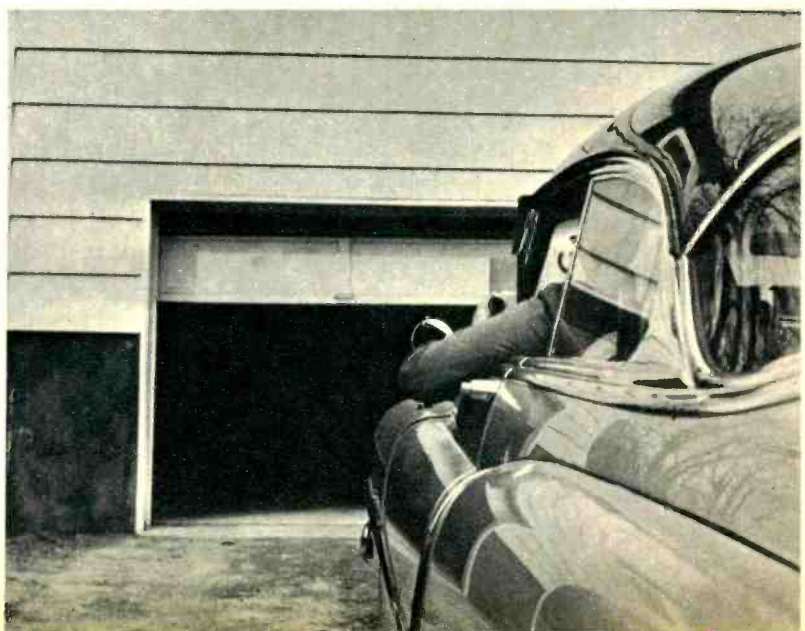
Radio Control Garage Door Opener

By Len Buckwalter
Associate Editor

The new Perma-Power system features a transistor transmitter to greatly reduce installation time.

THREE hours after unpacking the carton, the garage door raised and lowered in response to a pushbutton. Convenience, especially during rainy weather has made the radio control garage door opener an item of continued popularity.

The outstanding feature of the Perma-Power unit described here is the transmitter—a completely transistorized unit that cuts



One push on the transmitter button raises door, the next one lowers it. The portable transmitter is normally clipped onto car's sun visor, activated from there.

Photos by Mike Bonvino

A plywood panel is hammered into wall just above the garage door to provide a firm base.

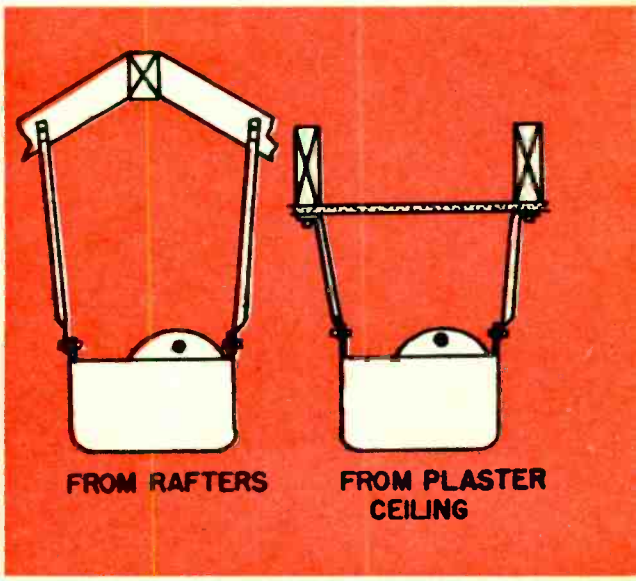
Header bracket is fastened into panel. Lag screws actually sink into beam behind panel.

The long rail of the unit is raised until it reaches the header bracket, then fastened.

Topside view of operator mechanism. Two pieces of angle iron are bolted to its sides.

Operator is mounted to ceiling with long lag screws. Receiver is located inside of this unit.

Various types of mountings are possible with the length of pipe supplied in the kit.



overall installation time virtually in half. There's no need to wire up the dashboard of the car or mount the older tube-type transmitter on the firewall in the engine compartment. Since the transmitter is now self-contained, with internal antenna and battery, it may be quickly transferred to another car.

The system operates on a radio frequency of 27.255 megacycles but no license from the FCC is required. Due to the low power (under 100 milliwatts) the transmitter falls into the category of "restricted radiation" according to Part 15 of FCC rules. Operating range is approximately 75 feet.

The problem of interference from neighboring installations is overcome through the use of tone modulation, with ten different channels available. If your neighbor's transmitter raises your garage door, simply plug in a different channel selector. Our unit was marked Channel 8 which modulated the transmitter with a 3000 cycle tone. A corresponding channel selector is in the receiver.

The receiver is located inside the same housing that holds the ¼-horsepower operator motor. It is a three-tube circuit that reacts only when 27.255 mc, modulated with the proper tone, is received. The final tube is a thyratron to provide positive action in closing a relay that provides power to the motor. One protective feature is a time delay capacitor to prevent transient voltages from triggering off the receiver.

Actual installation of the system is detailed in the photos. It is a one-man job requiring no special tools, but a small ladder and electric drill speed the job considerably. The only delay encountered was during the mounting of the operator unit. This particular garage did not lend itself to the recommended pipe bracket mount. (A length of pipe is supplied with the kit and should accommodate most other garages.) Two short pieces of angle iron were secured, then drilled with the appropriate holes and used to fasten the operator to a wood beam running through the ceiling.

Upon completion the mechanism functioned properly after a brief adjustment of the clutch. This arrangement is a safety feature that cuts the power if anything obstructs the free travel of the garage door.

EI rates the Perma-Power unit, a rig selling for $139.90, a Good Buy.

[*More photos on next page.*]

Door bracket is mounted near top of door inside using long carriage bolts.

The door arm is spaced right distance from door and snapped on bracket.

Manual push button for motor is put in garage for use when car is out.

Before adjusting clutch in motor-receiver the transmitter is tested.

Clutch is adjusted to right tension for pulling door to proper height.

The complete transistor transmitter, including battery, is in this case.

novice hams:

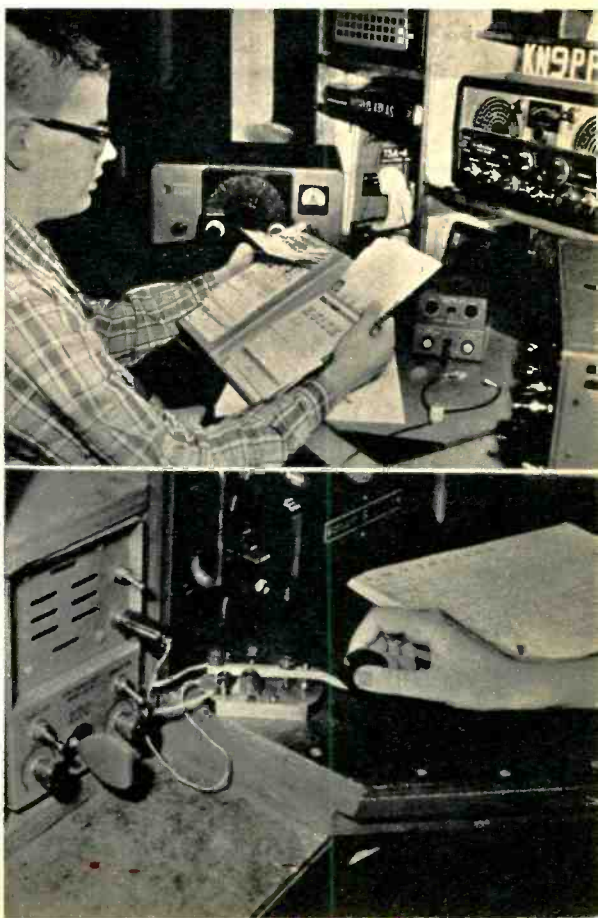
Tips to Boost Your QSO's

By Carole F. Hoover, K9AMD

ALMOST every field of endeavor has its period of apprenticeship, and the fascinating hobby of amateur radio is no exception. Happily, the Novice level in radio can be cut very short if the individual decides to learn what is necessary for a General license in a minimum of time. But just as the student swimmer stays in shallow water until he can float, the Novice "ham" must perform like a real "OM" before he enters "deep water."

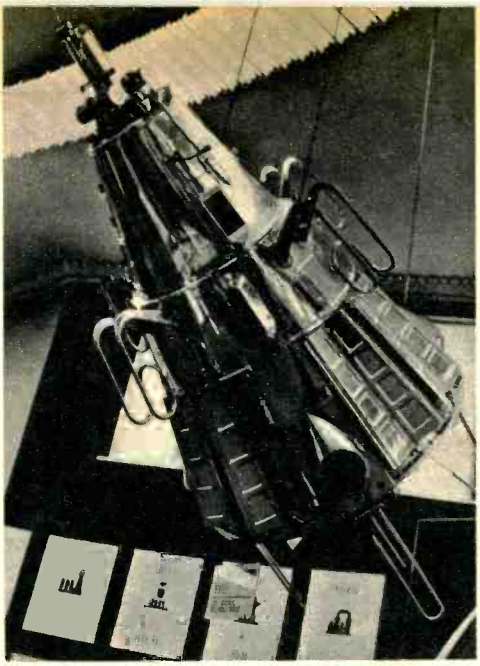
But the "N" that appears in a new ham's call letters is no reason for him to feel timid or hang his head in shame. In fact, a knowing Novice can have as much fun as any other amateur during the period he prepares for his General Class examinations.

"Since the FCC says my transmitter is limited to 75 watts output," a typical Novice complains, "how [*Continued on page* 106]



Scott Millick (right) received many QSL cards from contacts on 15 meters, CW, while still a Novice. He now uses a "bug," but mastered 20 wpm on hand key before taking General Class exam. Brent Greenwood (below) did a lot of listening before sending his first CQ. He found that learning procedure pays off in contacts.

"Lid" is ham terminology for a sloppy sender. Novices can duck this undesirable tag by using hand key and not rushing to use a "bug."



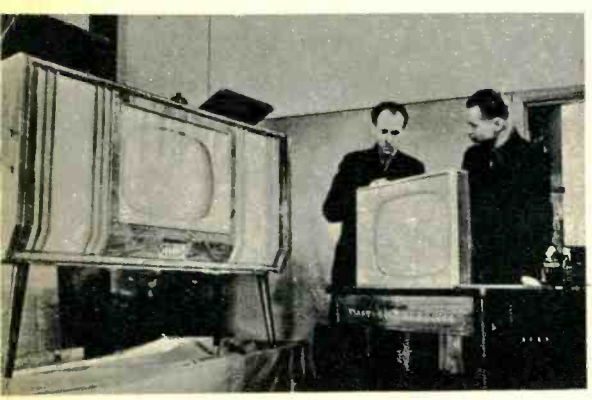
The major attraction, as might be expected, centers around Russian developments in the international race to conquer outer space. Here an instrumented model of Sputnik III greets all.

Soviets Show TV, Missiles and Synchrotrons in New York

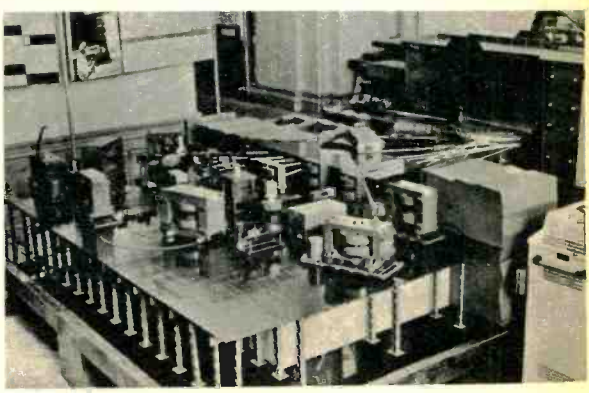
AS the annual onslaught of hot and humid summer weather moved in on New York City, so did the Russians. In the air-cooled corners of the Coliseum, the city's huge exhibition hall, some 80 technical experts, 20 interpreters, and a large administrative staff from behind the Iron Curtain have all settled down (until August 10) to explain what's going on in science, technology and culture in Russia. They are talking about everything —sable coats, folk songs, and especially sputniks.

The latest models of hard-to-get Soviet [*Continued on page* 93]

These exhibition TV sets are said to be Russia's latest. Each has new 110° picture tube, 14" by 19" screen, and can pull in up to 12 channels.



Reds claim to have world's largest synchrotron (680-million electron volts) in operation for peaceful purposes in USSR. Here is model.



Multi-tubed experimental rocket is assembled on the firing range by member of the Forest Hills (N. Y.) Rocket Society. This particular rocket was designed to determine if specially-treated cardboard tubing could withstand heat of burning fuel. Cardboard tubing is not a recommended material. Below, Lt. Col. Charles Parkin helps youngsters set up a rocket launching ramp in front of sandbag bunkers.

Big Boom in Amateur Rocketry

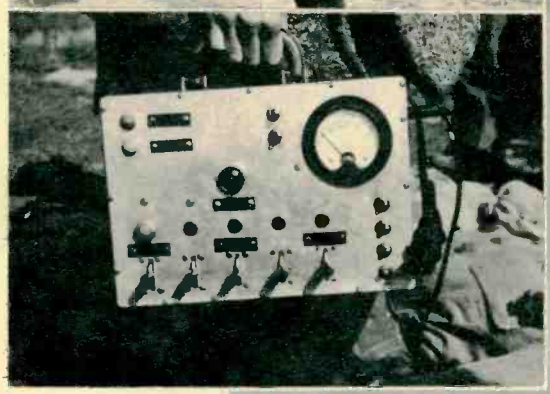
By Ed Nanas
Feature Editor

Teenage missilemen finally get big chance to fire rockets of their own design on a safe Army range.

CROUCHED over a home-made electrical firing box in the semi-darkness of a sandbag bunker, two 16-year-old high school youths started their countdown. Tension mounted as they methodically flipped switch after switch until the final contact was made.

Their moment of truth had arrived. Months of studying rocket

Young radio amateur of the Wakefield (Va.) Rocket Society, helps coordinate firing from bunker area with walkie-talkie.



Here is one firing mechanism that incorporates a land-line communications system between those members of club who are assigned firing duties, and those who will do the tracking. Unit was designed by 16-year-old Richard Kurtz of Forest Hills, New York.

Lou Taylor, of New York City, checks for wobble and friction by moving his rocket, the XR-4, up and down specially constructed launcher and rail. This rocket sports fins somewhat larger than those of most other missiles.

theory and math, deciding on tube size, figuring fuel mixtures, machining nozzles and nose cones, pooling allowances and lawn-cutting cash to buy materials, working out details of the firing mechanism, launching ramps, fin angles, being frustrated in attempts to convince local police and fire officials that their scientifically developed and "safe" rockets did not violate anti-fireworks law—all this is past history. Now the big question:

Would it get off the ground?

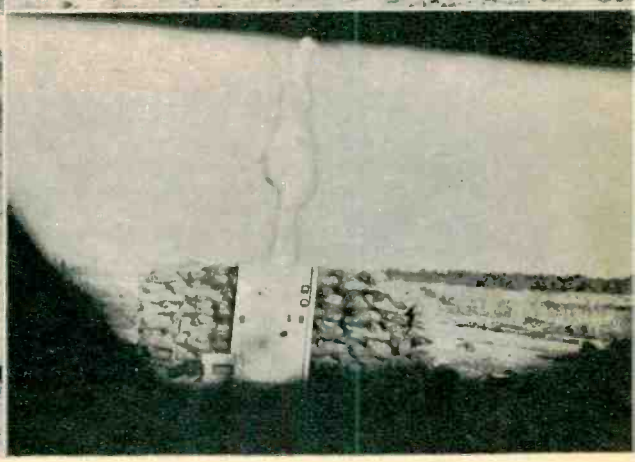
The scene: Camp A. P. Hill artillery firing range in the rolling terrain of Caroline County, Va. The participants: Over 150 young men with a sincere interest in the fastest growing teenage hobby of them all—amateur rocketry. Across the United States there are more than 5000 amateur rocket societies and groups and over 40,000 individual rocket enthusiasts. These are not just a bunch of "kids playing with fireworks." On the contrary, many of them exhibit keen scientific knowledge and a sophisticated approach to rocketry.

"What if it doesn't go?" we asked one

A large delegation from Staten Island, N. Y., listens carefully to safety lecture by the Army's range officer before proceeding to fueling area.

Binoculars, sextants, slide rules, trigonometry tables, cameras—these are the tools of those rocket fans whose job it is to track the missiles.

With an Army firetruck nearby, masked and gloved amateur rocketeer pours fuel into tube. Maximum safety was the order of the day.



This photo was taken through a slit in the sandbag bunker as four-foot rocket of Mount Vernon (Va.) rocket club soared skyward.

busy rocketeer as he set about his final check. As soon as the question escaped our lips, we felt badly about bringing up this one horrible possibility. But his calm answer, typical of the serious rocketeer's outlook, set us straight:

"If it doesn't go, that means something is wrong somewhere. It may be a weight problem, a design problem, a fuel problem, a firing problem. Maybe a combination of problems. I just hope we can find out where the trouble is."

A seemingly universal problem is the lack of success in finding a suitable area near the rocketeers' home bases where they can safely fire their missiles without endangering life, limb, private homes and passing airplanes. In some Mid- and Far-Western areas this is not as big a problem as it is in the East, where these young scientists have to use all the techniques of the public relations industry in order to wrangle an official okay to hold a static (on-the-ground) test.

Here's where the United States Army has stepped into the picture. Realizing

[*Continued on page* 96]

His name is Michael Tate, age 16. With him is Mark II, his 12½' rocket. His career aim: Space medicine.

Outstanding Amateur Missile Carries Radio, Cameras, Animals

SIXTEEN-YEAR-OLD Michael Tate, of Jackson Heights, N. Y., is the young scientist who designed and built the impressive rocket and payload described below.

Tate worked 750 hours on the missile, which he calls Mark II Research Probe. It is his second large rocket and was originally designed for a 50-50 zinc and sulphur fuel. This has now been changed to Galcite 58, a more sophisticated propellant. With the Galcite 58, Tate estimates that his rocket will travel some 20 miles above the launching site. However, late word from Army engineers, received through Capt. Brinley of the First Army (shown below), indicates that with a slight modification of the 6" steel nozzle, Tate's rocket might very well climb to an altitude many times his own conservative estimate.

The propulsion unit and instrument package each measure 5'7"; nose cone 10.5". The body of the rocket is cold punched steel, while the nose cone is an aluminum-cadmium alloy. With the non-critical four-fin design and instrument package, the unfueled rocket is 95 lbs.

The entire instrument package is designed to resist high "G" thrusts and can be recovered. Starting from the bottom, Tate has included a battery power supply; two pressurized aluminum containers, each capable of carrying a hamster; and instruments to monitor altitude, temperature, determine the ejection point of the package, and keep tabs on the pressure inside the airtight hamster chambers.

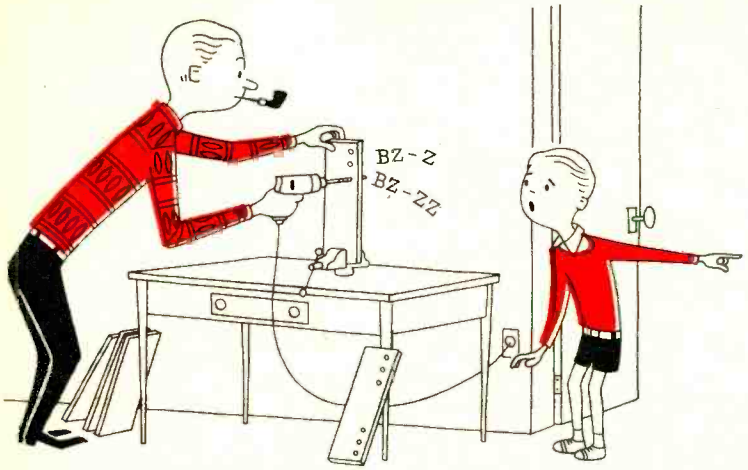
Also included in the payload is a Tate-built telemetering radio transmitter for 27.255 mc (Citizens Band), which will send atmospheric data back to earth. Atop that is a carefully mounted still camera, and at the apex of the payload is an 8mm Bolex movie camera. Then there is the ejection mechanism and parachute.

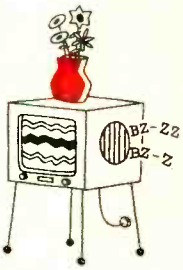
The Army, working closely with Tate on plans to fire the rocket, is having a difficult time trying to find a suitable launching site since Cape Canaveral requires missiles to have a built-in emergency self-destruction mechanism. A possibility exists that the rocket may be launched in the Canadian Northland or from a ship at sea.

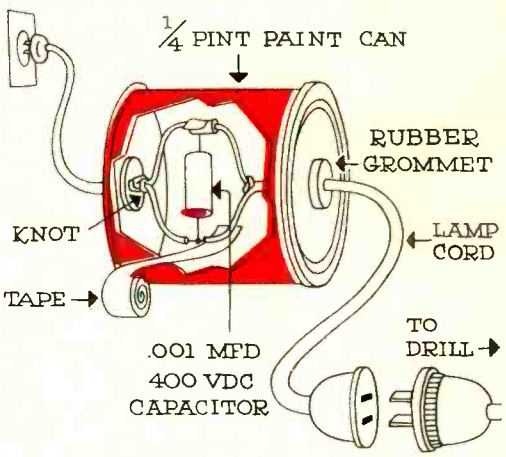
To Michael Tate, the editors of *Electronics Illustrated* extend a hearty "Well Done!"

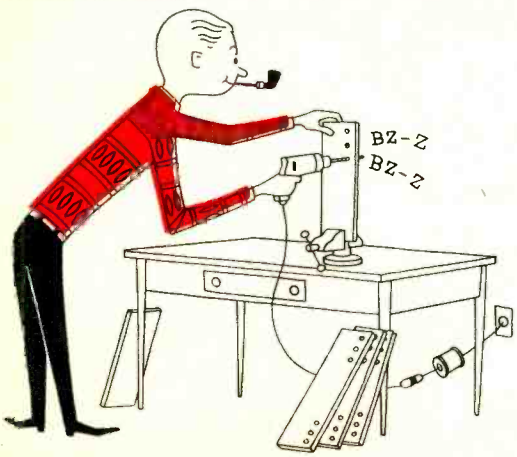
Henry and Me

***EI* will pay $10 for each practical electronic idea used for Henry and Me. Send them to Electronics Illustrated, 67 W. 44th St., NY 36, NY.**



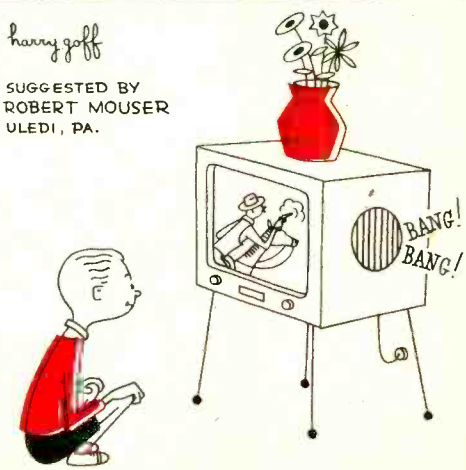






harry goff

SUGGESTED BY
ROBERT MOUSER
ULEDI, PA.



Milt Kiver on

How to Use Meters -1

The VOM will measure voltage, resistance, and current. Here's how to set up its controls.

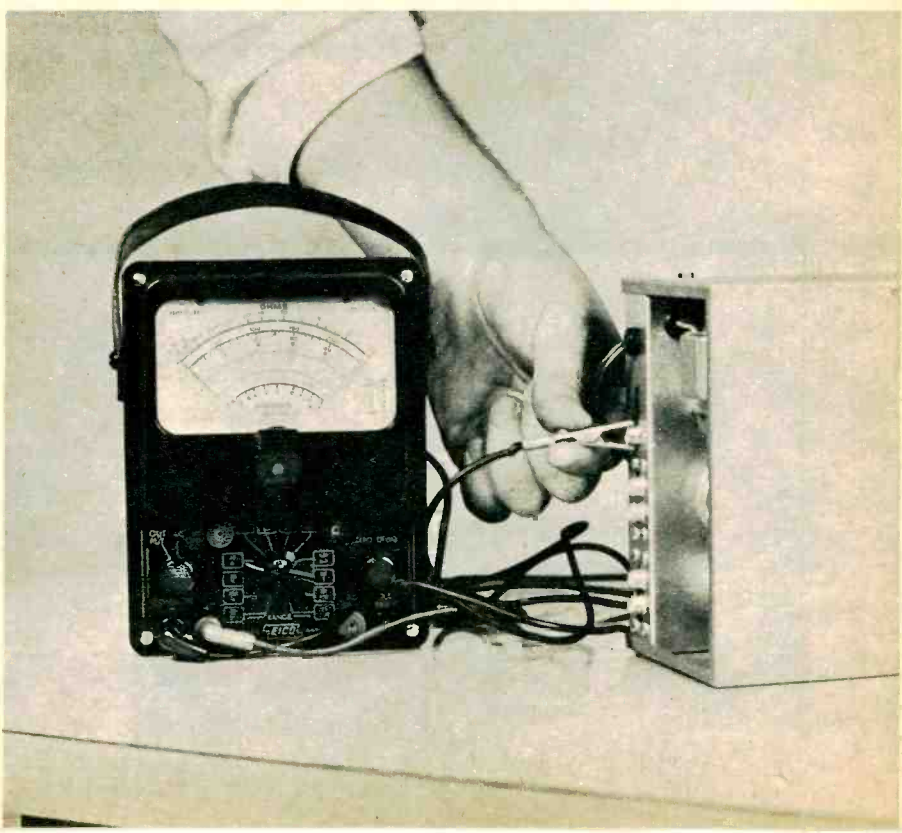
TWO of the most extensively used electronic test instruments are the VTVM and the VOM. These initials stand, respectively, for Vacuum Tube Volt Meter and Volt Ohm Milliammeter. Since it is simpler to use the letters than to pronounce the words they stand for, the abbreviated designations VTVM and VOM are almost universally employed.

Now, what can these instruments do?

They can measure AC and DC voltages and they can measure resistances. In addition, the VOM is capable of measuring direct current. This particular feature is seldom found in the VTVM.

VTVM's and VOM's do essentially the same job, but each does it quite differently. The VTVM uses an electronic bridge circuit for its operation. Due to this electronic circuitry, the VTVM possesses a very high input resistance. For DC measurements, it is on the order of megohms. This feature is particularly useful since it means that when a VTVM is connected across a circuit for a

The negative lead of a VOM often terminates in an alligator clip to permit connection to the chassis (often the ground side) of equipment being tested.



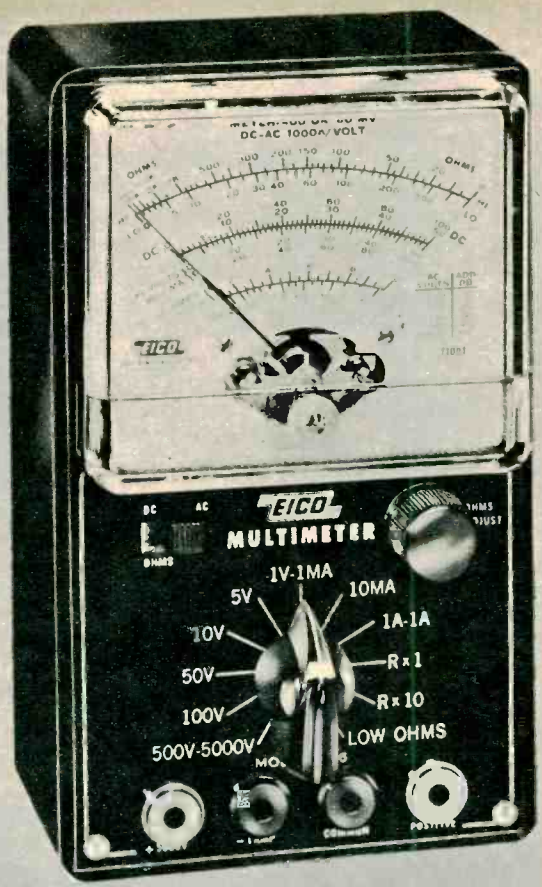


Fig. 1. Controls on this 1000 ohms-per-volt VOM include Function at upper left, Ohms Adjust at upper right. Large Range Selector is at center, probes plug in along bottom.

measurement, it does not disturb the circuit, and the true value of the voltage will be read.

The VOM consists essentially of a meter movement with various series and shunt resistors. It possesses no electronic circuitry in the form of tubes at all. A battery, mounted internally in the meter case, is needed for resistance measurement. For voltage measurement, power is provided by the circuit under test. The same is true when current measurements are made.

VOM's almost always possess lower input resistances than VTVM's. With inexpensive VOM's, on the order of 1,000 ohms-per-volt, voltage readings in high resistance circuits will be low. As a matter of fact, the higher the circuit resistance, the more the voltage will be off (on the low side). However, there are VOM's available with high input resistances and for these units the results will not differ markedly from those obtained using a VTVM.

The resistance range of the VOM is generally much smaller than that obtainable from the VTVM. This stems from the fact that the amount of resistance measurable is largely governed by the size of the battery in the VOM. Since the internal space allottable to a battery is limited, the resistance measurements are thereby restricted.

Now in order to use either one of these instruments two things must be known. First, it is necessary to know how to set the various controls; second, it is necessary to know how to read the meter scale after the controls have been set and a measurement is made. Let us consider the controls first, what names they possess, and how they would be set for a certain measurement. We will start with voltage measurements using the VOM shown in Fig. 1. A test lead,

usually black, is inserted into the pin jack marked COMMON. The other test lead, red, is inserted into the pin jack marked POSITIVE.

The next step is to turn the center selector knob to the proper voltage range. This requires that we have some idea of the amount of voltage we are measuring. Let us assume it is near 80 volts. As we look over the various ranges, we see 1V, 5V, 10V, 50V, 100V, and a final position marked, 500V-5000V. The first figure higher than 80 volts is 100 volts. This is the position to which the control is set. If we have no idea how much the voltage is, we would set the center selector switch to the highest position, 500V-5000V. For voltages up to 500 volts, the meter leads remain plugged into the positions indicated. For voltages between 500 and 5,000 volts, a slight change has to be made. The common lead remains unchanged. However, the red lead, which was previously plugged into the pin jack marked POSITIVE is now shifted to the pin jack at the other side of the panel marked "+5000V."

The voltage measurement may now be made. Touch the COMMON test lead to the low end of the voltage to be measured (usually the chassis of the equipment under test) while the other test lead is touched to the high terminal of the voltage to be measured. The meter needle will now deflect upscale. The figure on the scale where the needle

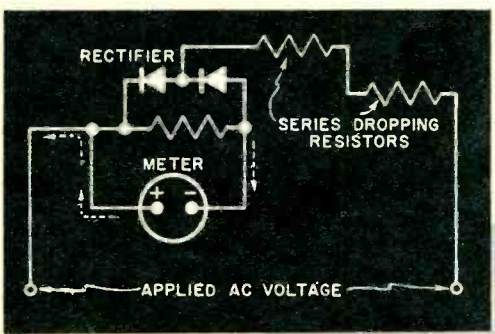
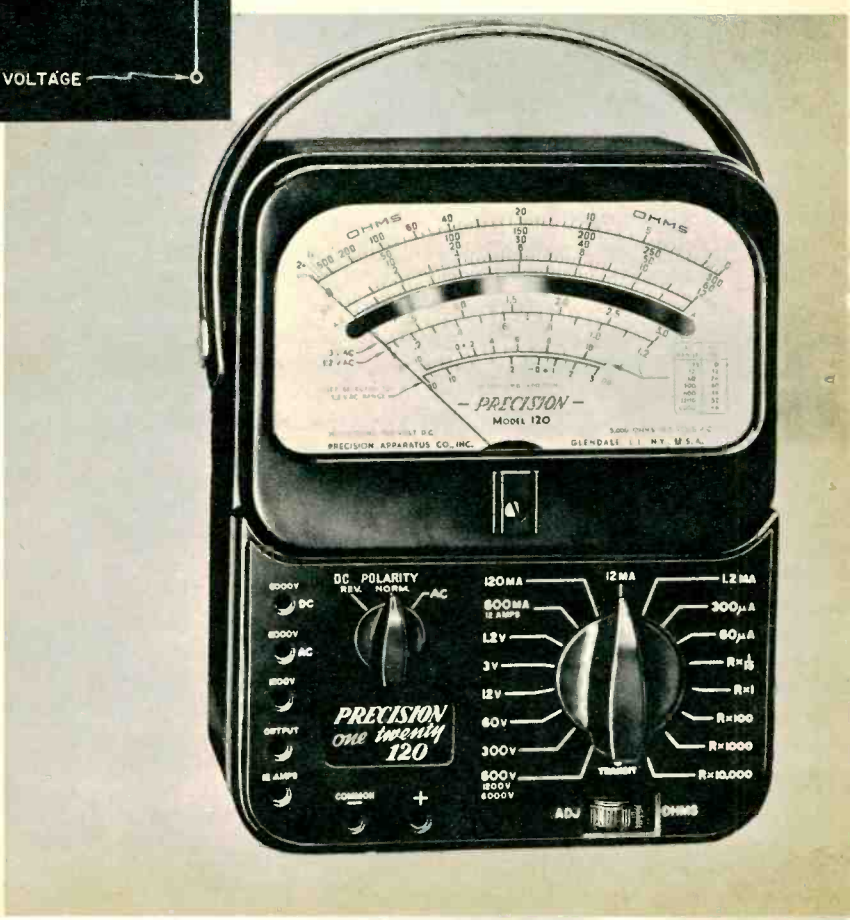
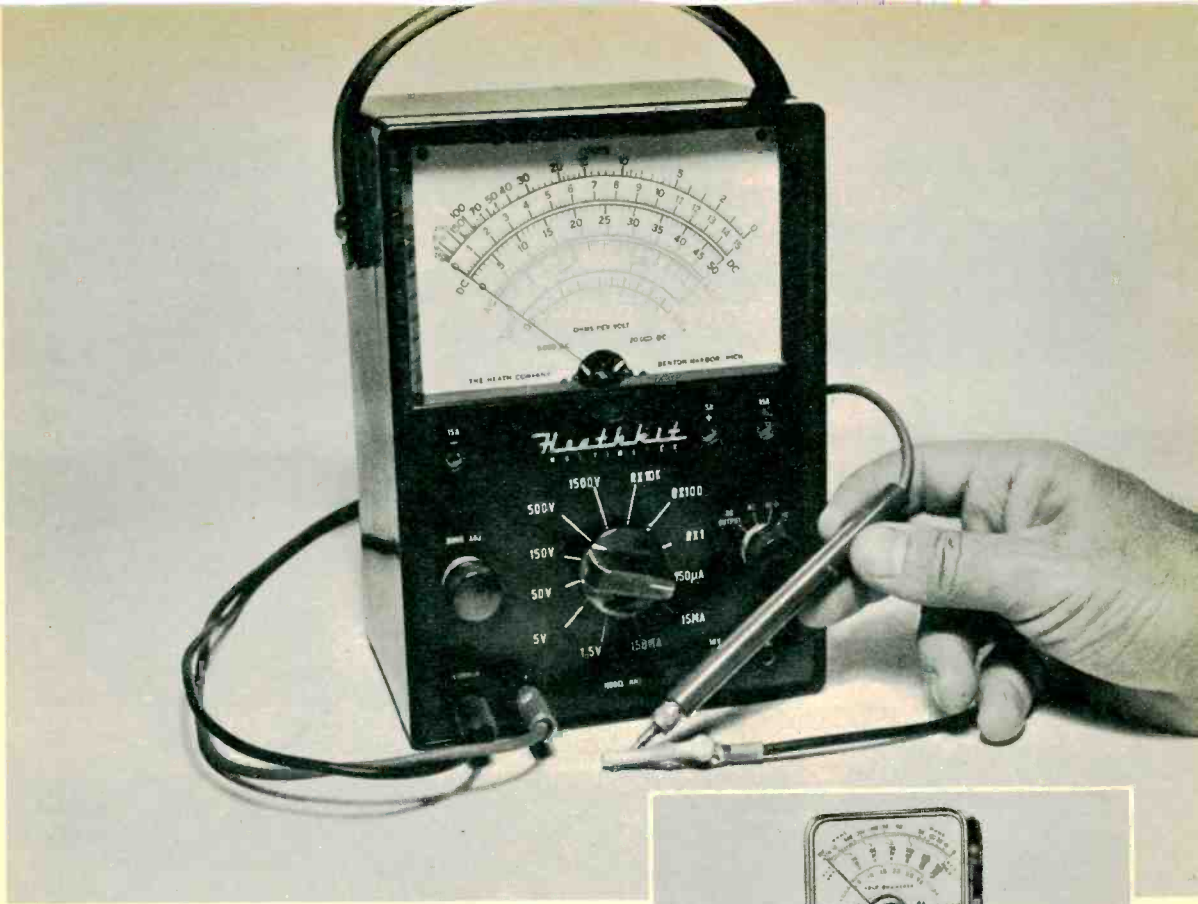


Fig. 2. Simplified VOM circuit for AC voltage measurement. Rectifier is copper oxide unit.

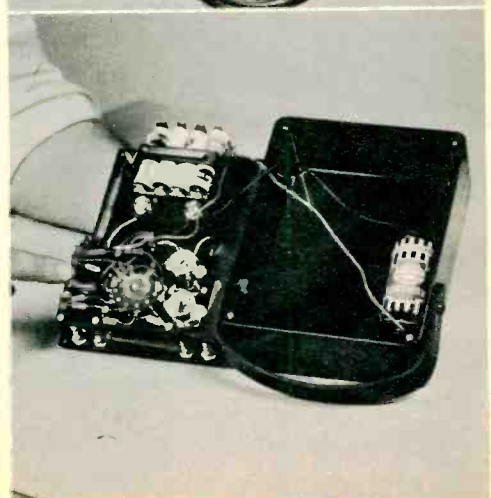
To view the correct reading, a mirror is used on this meter face to correct for parallax.





The positive and negative leads are shorted together while calibrating on ohms scale.

This pocket-size VOM has no Function or Range switch, leads are plugged into proper jacks.



Batteries for ohms scales are visible in case. Finger points to resistors on Range selector.

comes to a stop represents the value of that voltage.

Suppose the meter needle, instead of moving upscale, moves instead to the left. This means that the COMMON lead is touching the highest (or most positive) point of the voltage while the other test probe is at the low voltage terminal. To correct the situation, reverse the terminals to which the leads are making contact.

If the meter needle moves so far that it goes off-scale, this means that the meter has been set for too low a range. Rotate the range selector switch clock-

[*Continued on page* 98]

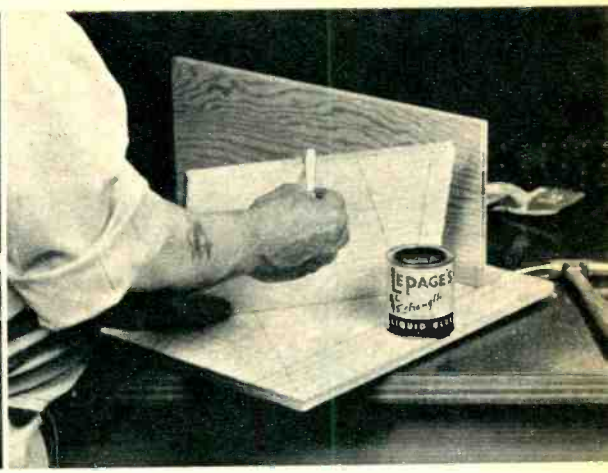
Stereo Hi-Fi Outdoors

Here's an easy home workshop project that yields a good sounding speaker and table; build 2 for stereo.

Spaced about six feet apart and directed, via the doors, to the listener, these speakers create stereo illusion. Individual L-pads control the volume.

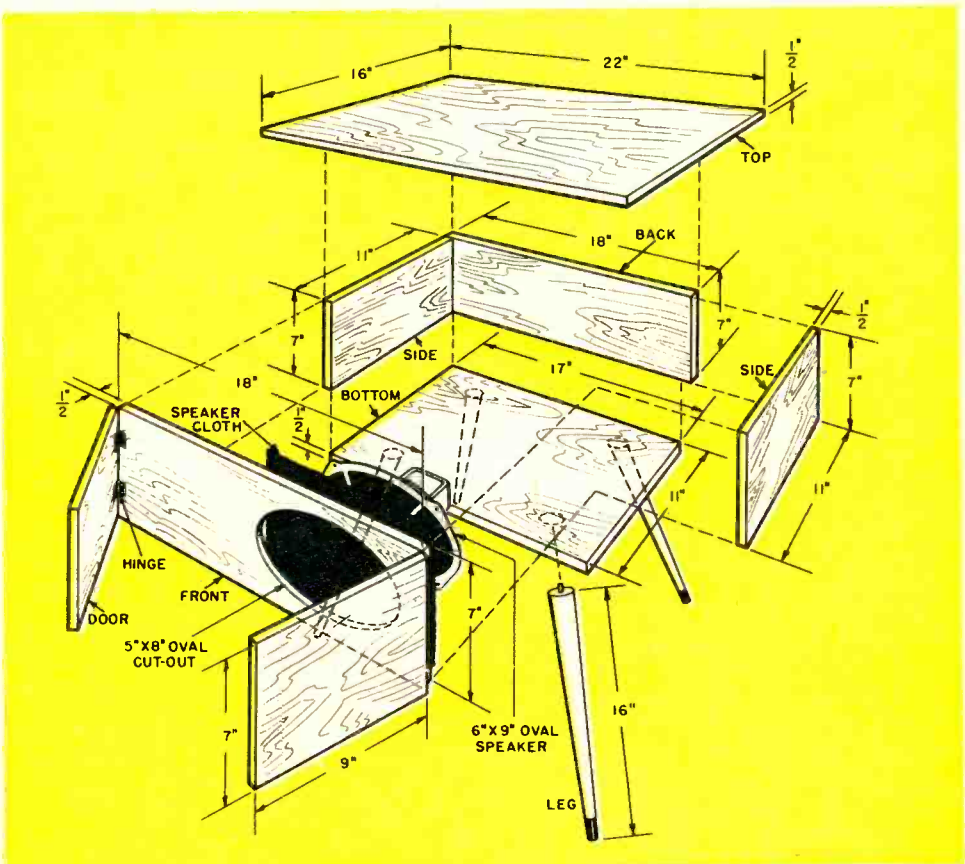
IF you have stereo equipment in your home you probably have not arranged the speakers so that you can enjoy the music outdoors on your terrace or patio. You could carry the speakers outside, but they may be bulky and then what do you do with the wires? Then again, maybe you don't have stereo but would like to have it this summer. Well, *EI* has the ideal solution, build two of the speaker-tables shown here and you too can have stereo (if you get a stereo pickup and amplifier). These speaker enclosures are watertight and use relatively inexpensive auto replacement speakers which include tweeters. The balance-volume controls consist of two L-pads mounted in a small metal box. These are connected to the speakers following the directions furnished with the controls.

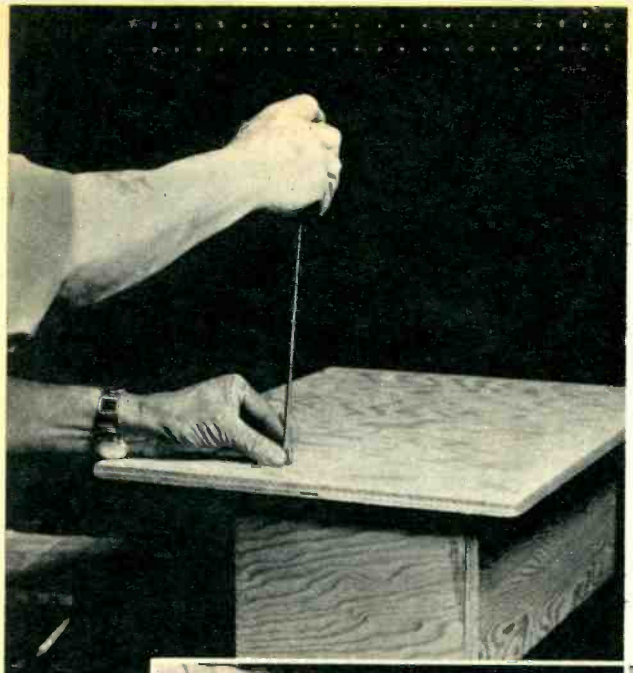
When building the enclosures make certain to use a waterproof glue on all sides and nail or screw securely. The doors covering the front may be used to direct the sound, but should be closed when the speakers are not in use. Be certain to use a spar varnish



All of the parts used for two speaker tables are shown above left. Note that the speakers include separate tweeters. Glue and then nail or screw all parts together, seal all holes.

In this exploded view note that the speaker is off center. This leaves room for a bass reflex type port if more bass is desired. Also use sound-absorbing material inside.

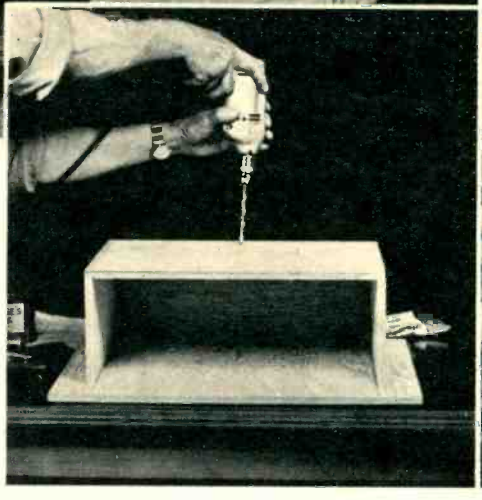


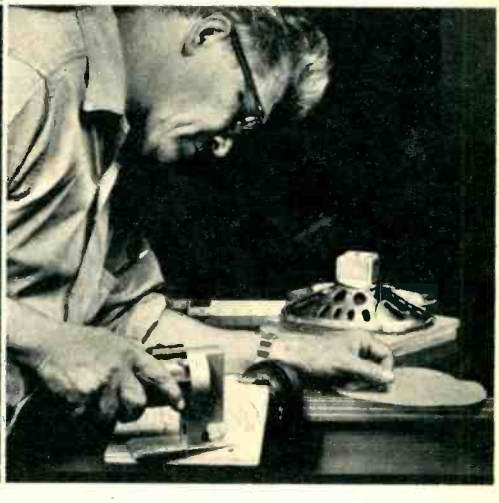


After sides are glued and nailed add screws for greater rigidity. Top overhangs sides as protection against rain damage to speaker.

Drill ¼-inch hole on bottom towards the rear for wires from speaker to amplifier and the remote volume-balance control box.

For 6 by 9 inch speaker make a 5 by 8 inch hole on the front. As template use tracing paper marked along inner rim of speaker.





or other waterproof finish on the tables so that they may be safely left outside at all times.

If this cabinet is made as shown, without a bass reflex type port, padding or some similar sound absorbent material should be stapled to alternate sides in the cabinet to absorb some of the backwave from the speaker. If a port is cut in the speaker mounting board its size may be varied by sliding a piece of plywood over it, gradually closing off part of the hole until the sound is most pleasing (the bass is cleanest with no boom). Then the plywood may be nailed over the hole inside the cabinet leaving the opening previously determined. Use some grille cloth over the opening to match the speaker oval in appearance.

Although wood legs with brass tips were used here, all metal tapered legs are also available. Make certain they are well plated for outdoor use.

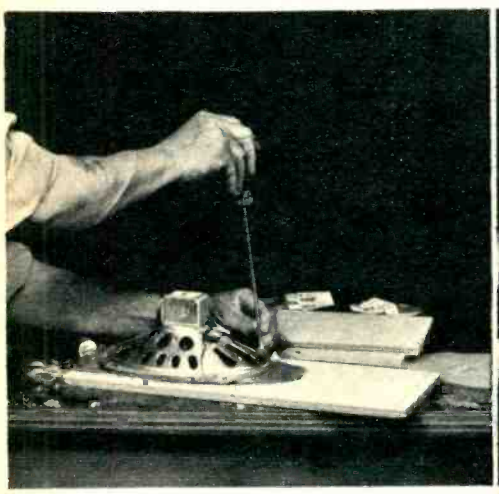
Many good quality auto replacement type speakers are now available at a modest price. Two of these were used in this project. If less expensive ones are chosen tweeters may be added for little extra cost. A wide selection of parts are available through electronics parts mail order catalogues or stores.

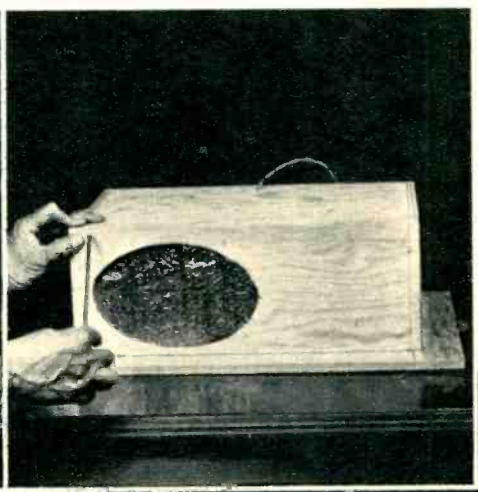
The builder may desire to use a piece of solid wood or Formica covered wood for the top of the table. This should be even more impervious to water and humidity than the plywood specified.

Be certain to follow the directions furnished with the L-pads for connecting these to the speakers as volume and balance controls. The doors also may be used to vary the volume but it is better to use them to direct the sound to the listening area. For stereo listening, space the speakers about six to eight feet apart on a line perpendicular to the listener. To calibrate the volume-balance control for stereo first play a monophonic record through each channel. Select the correct volume on one, mark the setting, and then find the setting for the same volume for the other channel. You may have to reverse the wires going to one of the speakers to get them in phase. You will know they are out of phase if the bass response sounds weak and if you do not get the full stereo effect.

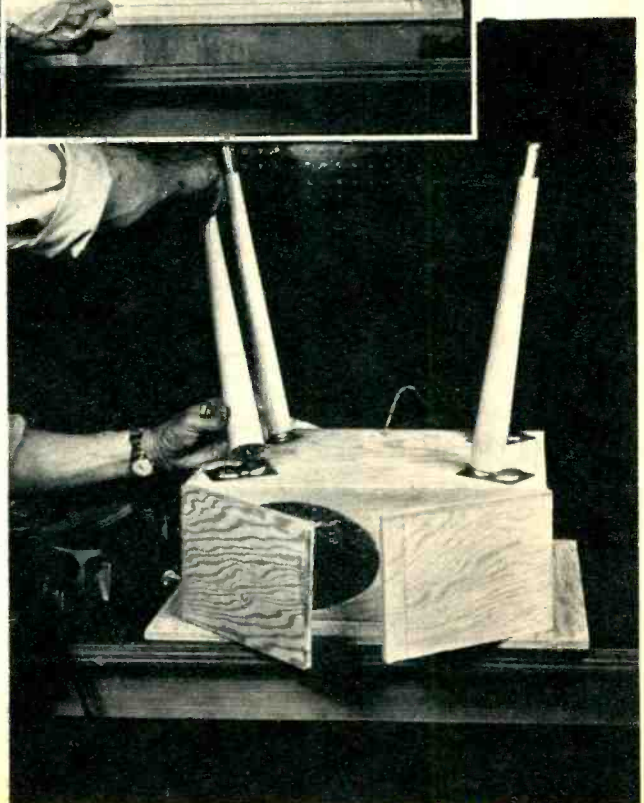
PARTS LIST

4x6 foot sheet ½-inch exterior grade plywood
8—16-inch tapered legs with mounting plates and brass tips
4 sets of small hinges, waterproof
12x9 inch piece of grille cloth
2—Utah SP69DE, 6x9 inch speaker or equivalent
2—L-4 Mallory L-pads, 4 ohm, 4 watt
1—3x2x5 inch chassis box
Waterproof glue, varnish, stain, wire, nails, screws, etc.
Sound absorbent material for inside of cabinet
Knobs for front doors if desired





Any sturdy cloth may be used to cover the speaker, special grille cloths are available. Staple this to the inside of front mounting board.



After screwing the speaker to the mounting board screw the latter into position after soldering the speaker leads to its terminals.

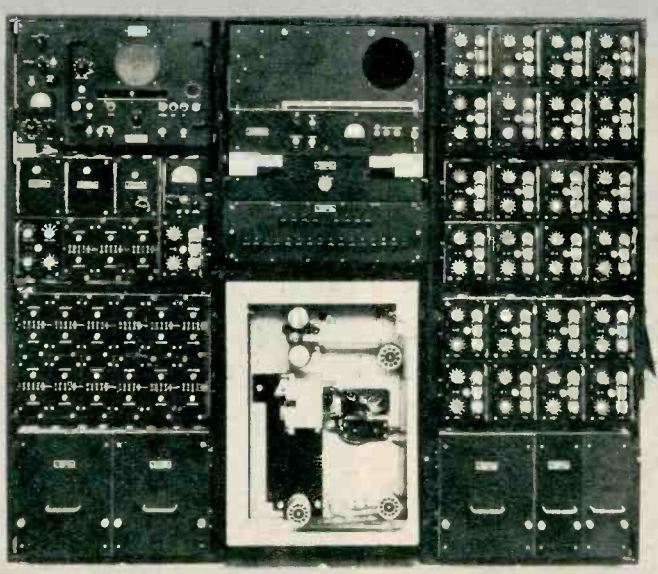
The legs may be screwed into mounting plate at outward angle for maximum stability. Doors protect the speaker when closed.

From wiggles on a seismic chart come clues to oil deep in the Arctic ground. Wiggles form a "profile" of sub-surface layers.

They Find Oil with Electronics

By James Joseph

The great Frozen North is in the middle of a gold rush—the rush for "black gold."



Here's a typical field recording console showing myriad of settings and magnetic tape transport mechanism. Units like these, made by United Geophysical Co., are usually housed in special trucks.

SOMEWHERE across the barren deep-freeze of the Canadian North, a parka-clad oil explorer works the controls of his electronic console with near-numb fingers.

"Ready!" he warns, his voice reaching into the —40°F chill.

At a firing station a quarter mile to the north, another man, wearing a headset, triggers the shot. Deep beneath the wintertime muskegs, there's a rumbling explosion. Shockwaves race deep into the earth toward unseen and uncharted strata. Reflected from limestone, schist and shale, they pound back to the surface actuating some 50 shock-sensitive "microphones."

Hunched at his console, the oil explorer grins as his dials indicate the amplitude of the rebounding waves. Each tiny vibration is recorded on photosensitive paper. Then the muskegs lapse once again into silence.

But during those rumbling moments, deep rock formations—the Mother Lode of oil—have been thoroughly mapped by electronics and dynamite.

A strange alliance—electronics and high explosives? Perhaps, but together they're one of the major fuel-finding hopes of the free world. In the frozen Canadian and Alaskan Arctic lies petroleum's last frontier—and potentially, its richest. Lurking somewhere beneath muskeg and tundra is a black ocean of oil, enough oil, perhaps, to free the Western World from dependence upon Middle East reserves. The experts are wagering a king's ransom—$200 million this year alone—that electronics will find it.

The rush for black gold—oil—is on. And the North Country has seen nothing like it since Klondike days. Already electronics have uncorked Alberta's liquid bonanza (which until recently paid every citizen a $20 annual oil dividend). Within the past

A bearded seismic, right, sets up intricate console in truck for a sounding shot. When ready, he'll call the shooter via special telephone. In very rugged terrain where trucks cannot navigate, portable battery-operated field gear, left, is used for shots. These units are made by Texas Instruments.

Boom! Dynamite, buried some 45' deep, is exploded to create seismic waves which will penetrate through many strata to bedrock. Rig in background drills holes for insertion of dynamite.

At minus-40° F, seismic, far left, strings out one of many geophones. Set firmly in the ground and clamped to cable, they convert reflected waves to electrical energy and send the signals to the recording truck. Seismic cable, on spool, may be worth up to $20,000 for each half-mile. Far right, delicate geophones are placed every 100' or so on each side of the shot-hole.

five years the same team of electronics and dynamite has pulled the stopper from British Columbia's long hidden gas fields, which now fuel homes in the Pacific Northwest.

"But," predicts an American expert, "the big boom and the even bigger bonanza lies yet farther North."

How far North? Clear to the Arctic Circle—and a thousand miles beyond. Only last February, Canada threw open its Arctic to exploration. Ten oil companies, most of them American, rushed to stake claim to 60,000,000 frigid acres. Readying now to jump-off into this bleak no-man's land are oildom's electronic prospectors—the seismologists.

How can electronics lay bare the substrata? Well, step for a chill moment into the seismologist's boots as he stalks the wintertime muskegs.

Typical of winter-tough veterans to Arctic electronics, you're young, rugged and just a few years out of college, where you probably majored in geology. You've come North over new trails with an exploration team, a seismic party. Miles from the nearest Hudson's Bay Post, you've set up camp in trailers. Your orders: Map the subsurface, get down to bedrock.

Your electronic recording gear is complex, but seismic theory is simple. Sound waves reflect just as do their higher-frequency brethren, light waves. When sound waves strike a deep layer that has a different density and structure than the layer immediately above or below it, some energy is reflected and some refracted to the surface.

If, with a sensitive-to-shock electronic device, you can record not only each reflected wave, but also its *travel time* (elapsed time between the original shot and the wave's return to the surface)—and if you know its speed through the earth's various layers—you can map the depth and lay of the unseen strata.

What you've mapped, of course, is the earth's structure—the layers upon layers of minerals, metals and rock laid down through the ages. But as an electronic geologist, you don't guarantee oil. Nobody can. All the client expects for the $1500 he's spending every 24-hours is a subterranean map detailing every deep-down dome, anticline and fault—formations which are the likely lurking places of oil.

So parka-clad, you take to the muskegs. Ahead of you move the bulldozers, blazing grid trail—exploration roads which checkerboard the wintertime muskegs.

Five, maybe six miles behind the dozers work the seismic party's two

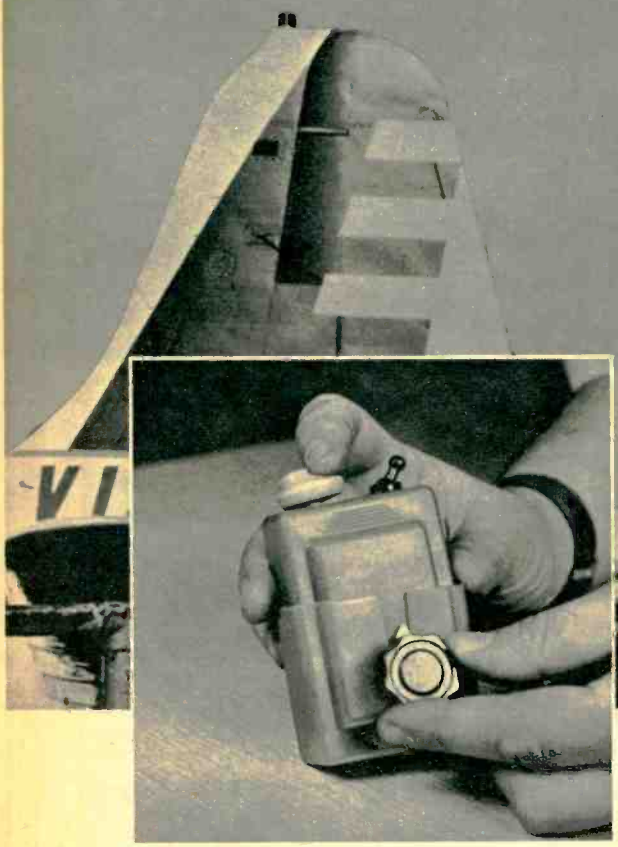
[*Continued on page* 95]

build an

Airport Monitor

By Vin Zeluff

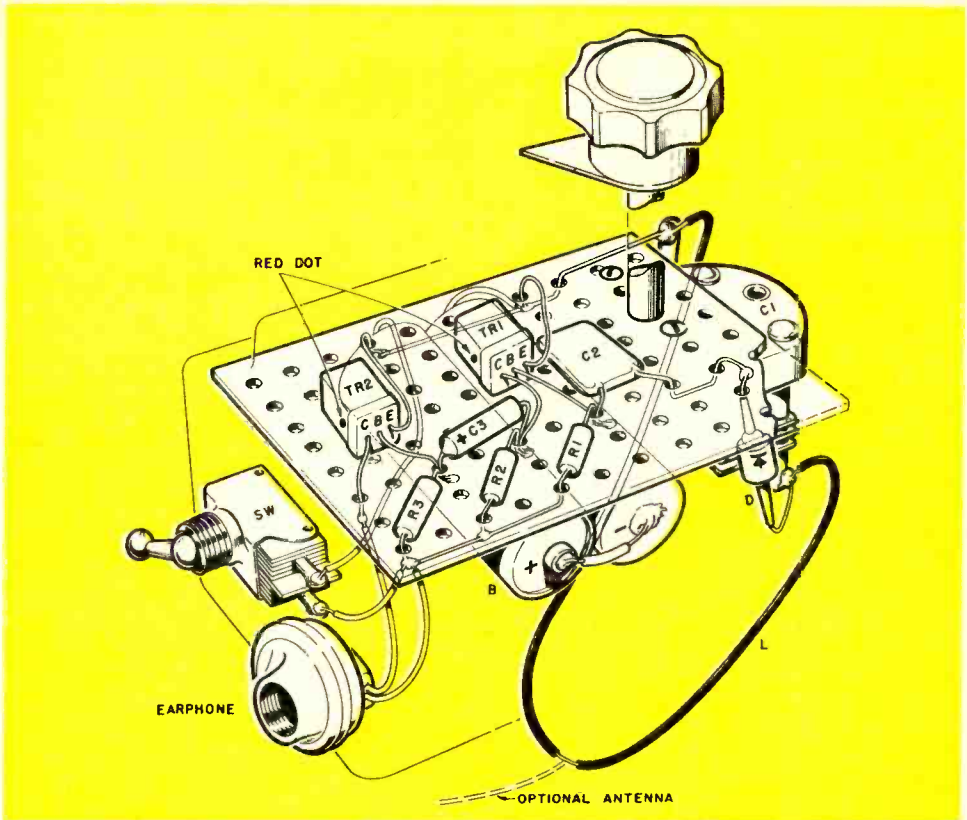
Listen to aircraft radio messages with this receiver. It works while you're in a plane or near the tower.



Above, author tunes receiver on observation deck of airport. Hearing aid earphone is used. Closeup at left shows the earphone optionally mounted on top of plastic case.

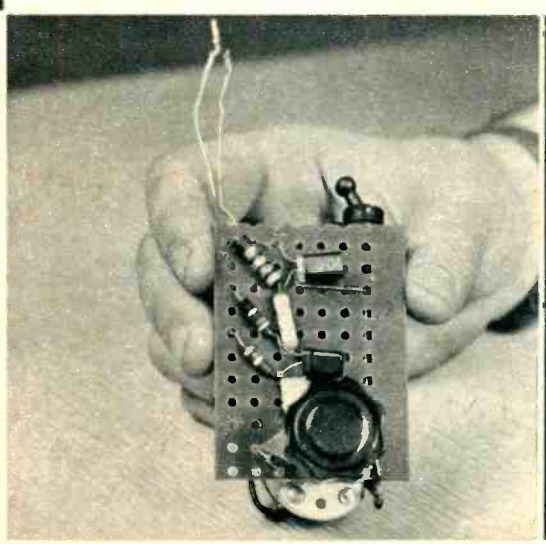
ONLY a very simple receiver is needed to listen in to an airplane's radio transmissions at short range. No antenna is required while inside the plane because the signal from the radio transmitter is quite strong. While on the ground and outside of the airplane fuselage, the transmissions from both the plane and the control tower can be received. If you are near the plane or the tower the receiver operates without an antenna. As you move away from the control tower antenna, you find that the voice gets weaker as the distance increases. You will also find that turning the receiver or moving it a few inches to one side or another will bring the station in louder.

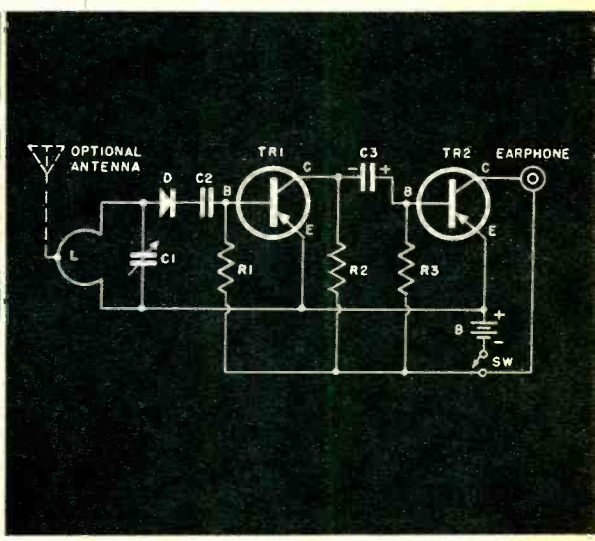
To increase the signal pickup, clip a piece of wire about a foot or two long to the one-turn loop coil. The wire can be moved



In wiring guide above, tuning knob has been raised slightly for clarity. Observe all polarities.

Small parts are threaded through perforations in the board, then soldered. Two leads at top will connect to earphone. Optional antenna in the schematic is described in the text.





around for best reception. Try it up under your coat lapel, extended at arm's length vertically if it is a stiff wire, hold the wire near metal objects, fences or pipes at the airport, or even clipped to nearby metal objects. Some of these will "kill" the signal but others will greatly improve it. Inside a plane, no wire is needed.

The complete receiver is small enough to fit into a shirt or jacket pocket. It could be made even smaller if the new hearing-aid type of cells were used instead of the two penlite cells shown.

The receiver consists of a crystal diode detector and a two-stage transistor audio amplifier. All of the components of the audio amplifier are mounted on a ⅛-inch thick perforated board. The perforations allow convenient holes for the wires of the parts to extend through and provide mounting at the same time. If such a board is unobtainable, any thin insulating sheet can be used, even heavy cardboard. Holes can be made at the points shown in the illustration for wiring and mounting. The board was cut to a width of 2⅛ inches and a length of 2⅞ inches.

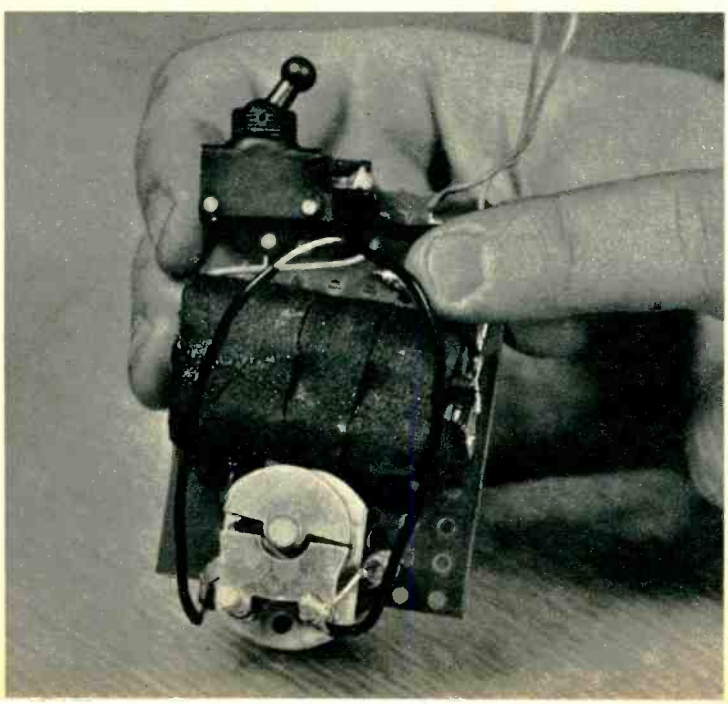
Drill the three holes in the board for the shaft and the mounting screws of the tuning capacitor before any of the other parts are mounted. Mount it temporarily to make sure that the shaft clears the hole and doesn't bind. It will be mounted upside down later, so that the stationary plates extend outward from the board. The terminals are then close to the outboard one-turn coil. The tuning capacitor can be removed for awhile until it is needed later.

Assemble the resistors and capacitors on the board by inserting their leads through convenient holes and bend and twist the leads on the far side of the board so that they are ready for soldering. One lead from each of the three resistors can be bent to overlap the next and soldered so they form a common bus for the battery negative. The battery positive lead is one bare wire used as a bus that extends about an inch from the board and runs in a straight line down one side of the board. Later, the free

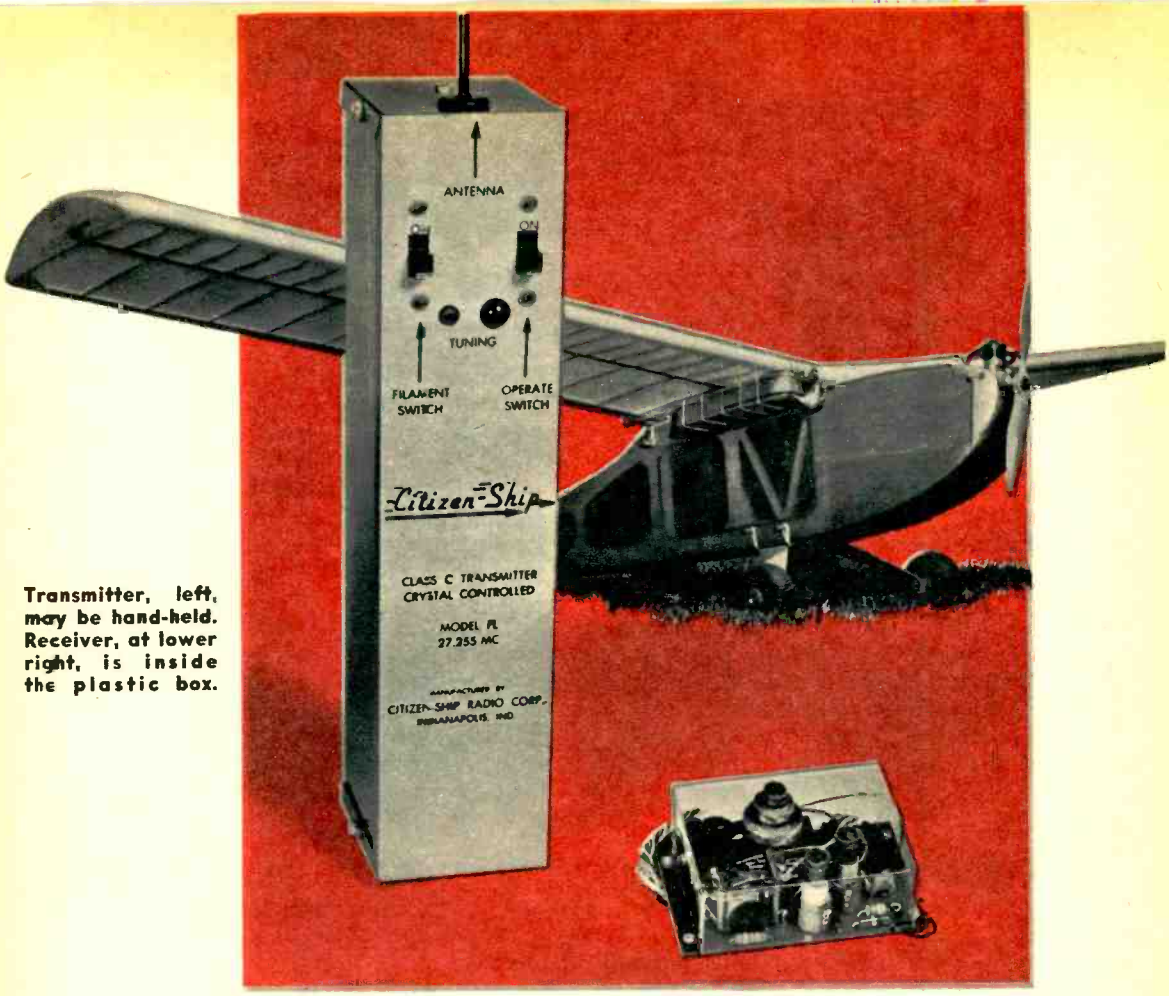
[*Continued on page* 99]

PARTS LIST

C1—Variable capacitor 25 mmfd with ¼" shaft
C2—.03 mfd miniature ceramic capacitor
C3—2 mfd, 6 volt miniature electrolytic capacitor
R1—470,000 ohm ½ watt resistor
R2—4,700 ohm ½ watt resistor
R3—360,000 ohm ½ watt resistor
D—1N34 germanium rectifier
TR1—CK722 transistor
TR2—CK721 transistor
B—Two penlite cells in series
SW—SPST toggle switch
Earphone—High impedance type, 2000 ohms or higher
Misc.—Perforated board 2⅛"x2⅞", length of bell wire or #18 plastic insulated wire, knob, plastic cigarette case 3½"x2¼"x1¼" (approx.)



Finger points to antenna. Two penlite cells are taped together below it.



Transmitter, left, may be hand-held. Receiver, at lower right, is inside the plastic box.

EI assembles an

RC Kit For Model Planes

Receiver, transmitter and escapement are included in this one-channel kit by Citizenship Radio Corp.

LOW cost kits for 27.255 mc radio control can be assembled and operated in just an evening. Factory wired and tested units made by Citizenship Radio Corp. cost $9 more than the kits—$35.90 as compared with $44.90 for both. The kits leave remarkably little work and include such items as relay, tubes, transistor, crystal. The money saved still buys a few hamburgers but other major inducements for putting together these kits are fun for the curious expert or valuable experience for the beginner who'd sharpen his technique in soldering and construction.

If you can stack blocks, you can make these kits with every expectation of having them operate properly. Both kits contain a printed circuit base—referred to in the directions as top (plain side) and bottom (printed circuit side). Each base is already drilled—with eyelets for heavy duty joints. Everything fits. The

idea is to simply bend over the various component leads after inserting them in the diagrammed holes, snip to ⅛ inch overhang, and solder them from beneath. Such parts as tube socket, tank coils, quench coil, press into place in holes provided and automatically make all the proper contacts. A touch of spot solder completes each contact. Transmitter switches are pre-riveted in place on the case.

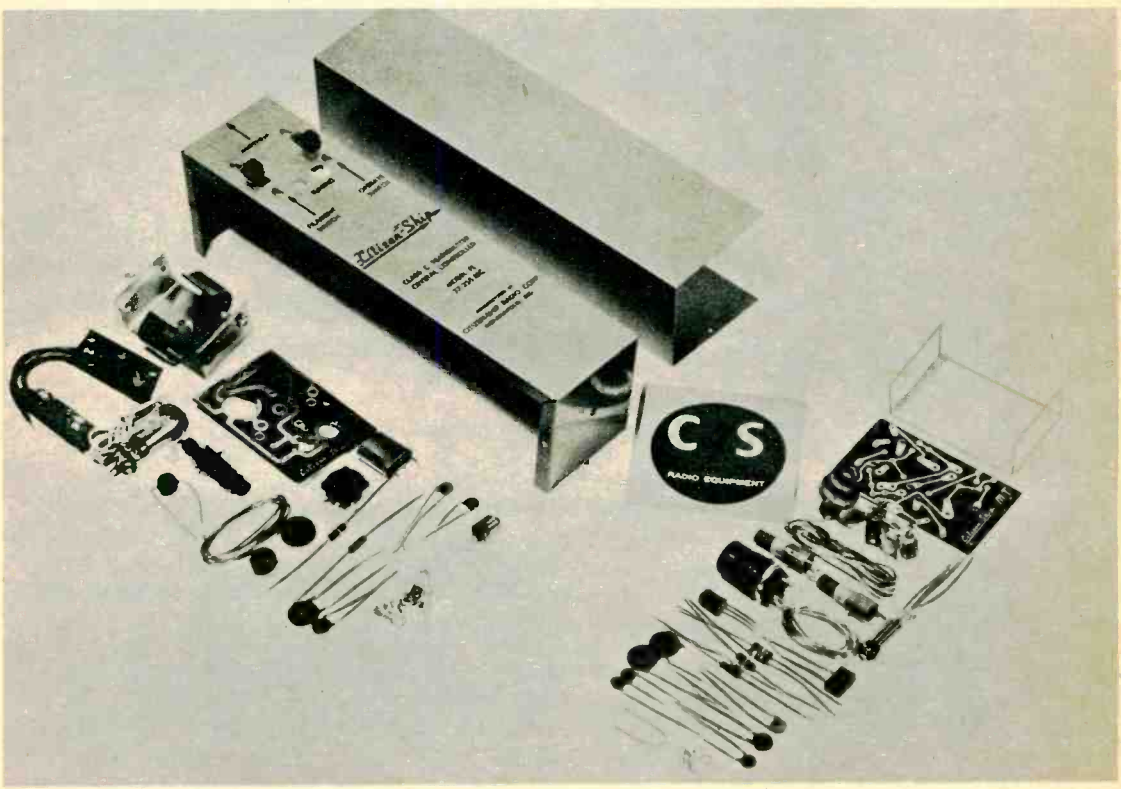
Soldering the printed circuitry is simple. Directions warn against overheating which can burn through or lift the circuitry. We had no trouble. However, the iron should not be much more than 37½ watts, and have a clean, narrow tip, not more than ⅛ inch wide. Do not use a soldering gun. A few connections do benefit from a heavier tip, such as the transmitter base eyelets that slip over the switch soldering lugs—these support the "radio." High grade solder comes with the kit—it is plenty for the job, perhaps enough for wiring the plane or boat. It was found that by carrying a little solder on the clean tip, then touching it to the bent-over leads right at the holes in the board, that the solder instantly took to the circuitry and ran out along the lead ends. Soldering paste should not be used.

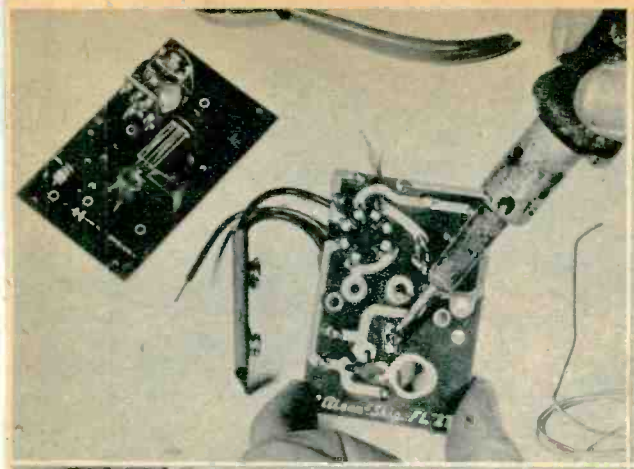
When soldering the transistor in the receiver, grasp the leads with a needle-nose pliers to prevent heat damage to the part.

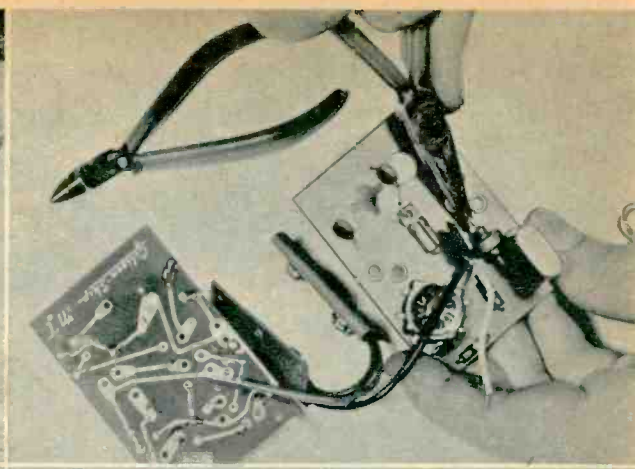
The transmitter uses a small bulb for tuning—when it glows the brightest, tuning is correct. It is suggested that the bulb be tested before assembly because the bulb is soldered in place, necessitating removal of the transmitter chassis for bulb replacement.

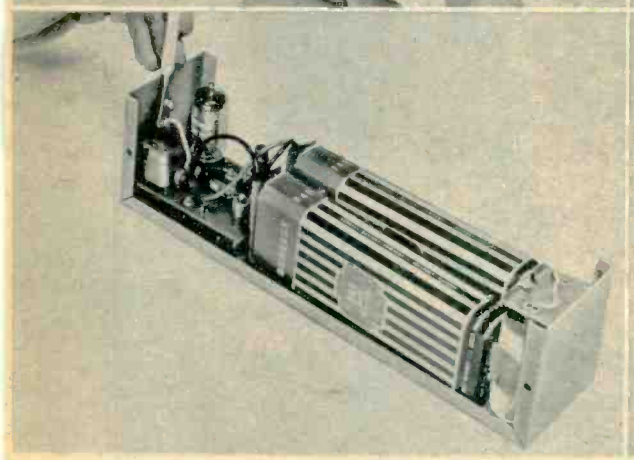
To test and tune, you will need all batteries—see pictures—and a zero to three milliammeter (zero to five will permit relay checking). Also required are two jacks and one phono plug to attach to the

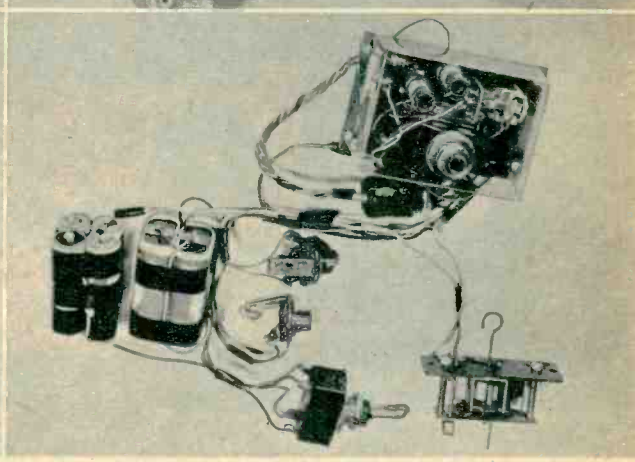
All transmitter parts are to the left, receiver components are at the right, decal at center.











Top left shows pencil iron soldering components to transmitter board. Other board is receiver. Top right photo shows coil being attached to transmitter board. Note the single tube socket.

Above left, transmitter is complete (crystal pointed out). Note large B batteries, small A cells. Right, receiver complete with batteries and escapement at lower right. Meter jacks are at center.

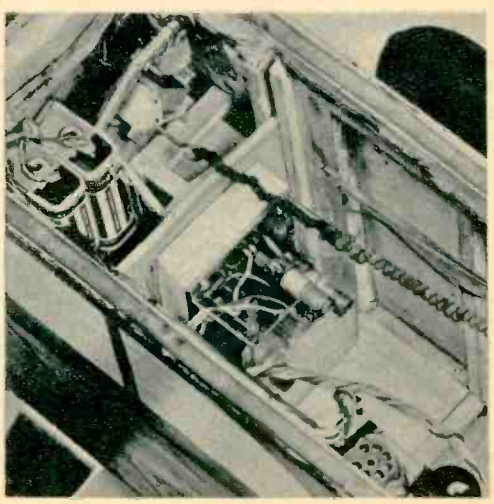
meter, and a single-throw double-pole switch.

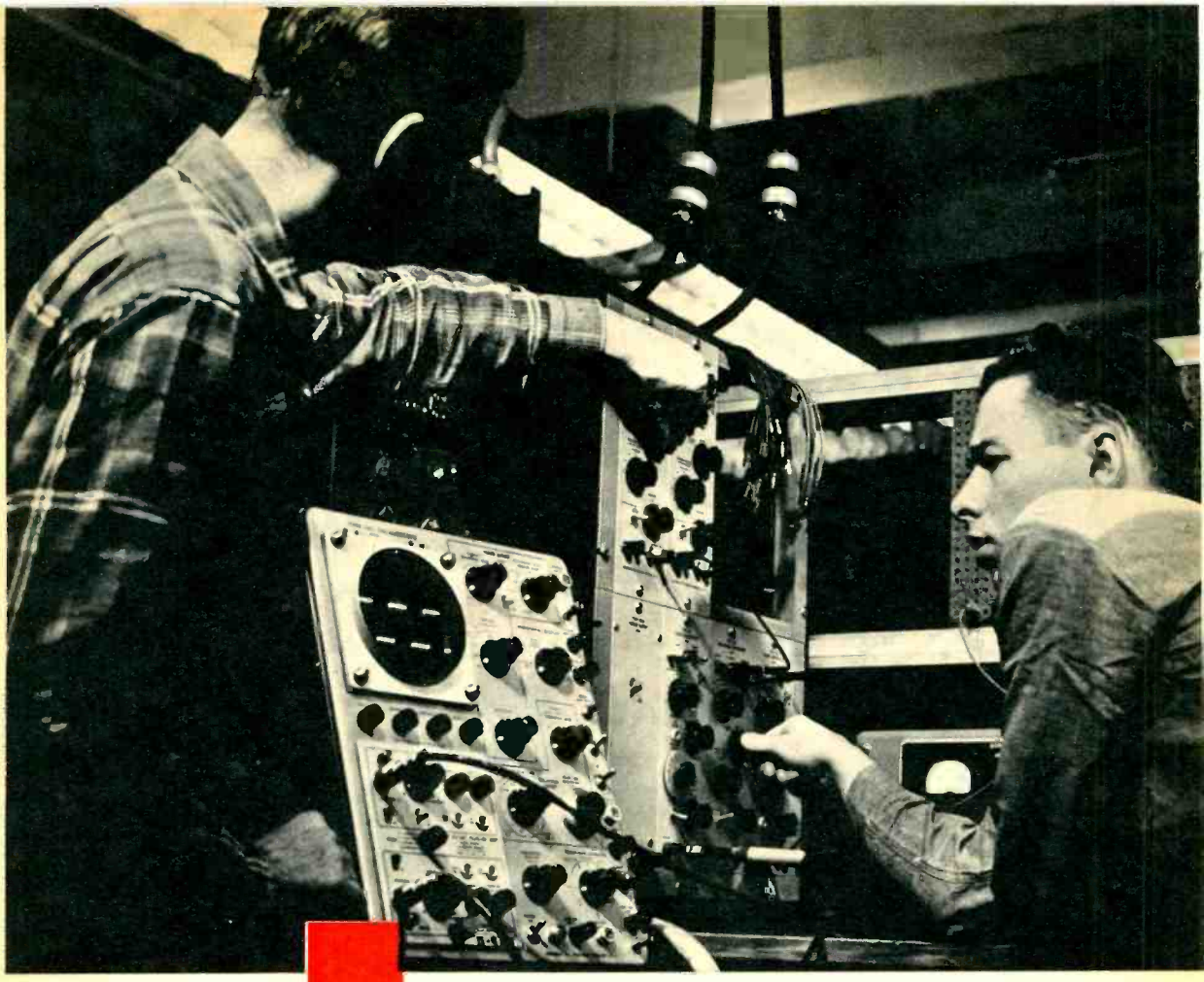
Despite the tuning bulb replacement necessitated in the transmitter, both units operated right off. The receiver was tuned according to directions, then, with transmitter on close by, receiver frequency was tuned to the transmitter. Then we used the receiver itself for a field strength meter to improve the transmitter tuning.

The range of the units may be checked out on the ground. Operate the receiver and transmitter with about 600 feet of separation. Reliable operation at this distance should prove adequate for actual flight conditions, where the range will be greater.

Considering the ease of construction, positive operation, and price, *EI* rates this kit a Good Buy.

Receiver, center, is mounted on foam rubber glued to plywood board, then slid into cabin.





RCA Institutes students calibrate very linear Tektronix scope with signal generator. Scope is used to check computers and automation devices.

nucleonics, computers, featured in

New Technical School Courses

By Norman Eisenberg

ATOM power, huge electronic computers, automation, space-travel, oceanography, atomic physics, medical electronics, solar energy—these are the exciting phrases that describe fields of human endeavor bristling with electronic gear and know-how. Of the many new fields, one of the most significant is the many faceted one known as "industrial electronics." Persons currently working in electronics in the United States number some 1,700,-000. Of this number, nearly half work at servicing home TV and radio receivers. By the most conservative estimates, this doesn't leave enough trained personnel to fill all the other jobs in electronics. It has been estimated that in ten years the electronics industry will employ more than six million workers.

Analog computer problem is worked by student as instructor times performance. This unit, designed for training, has plug-in parts.

Model of Explorer I becomes part of space technology program at National Technical Schools in Los Angeles.

Electronic controls are widely used in industrial automation. The more advanced technical school courses, such as this one at Coyne in Chicago, reflect trends throughout industry.

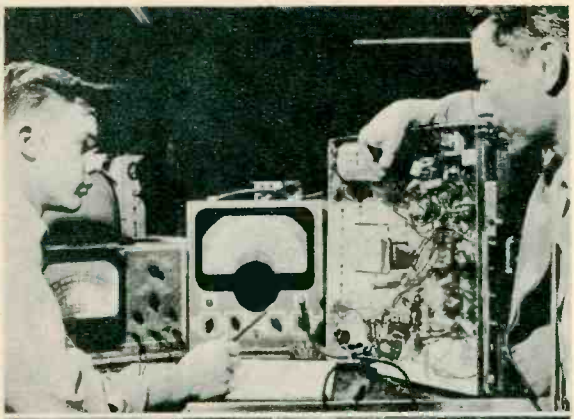
The technical schools, long-time suppliers of skilled labor in the field of electronics, are now "tooling up" to train people for work in the newer areas of electronics. In some schools, new courses are being planned; in others they are already under way.

The training for the new types of jobs in electronics differs somewhat from the training required for radio-TV servicing and ordinary communications. Specific details vary from school to school. One course may try to cover the widest range of subjects in the shortest possible time. Another may concentrate on a few specialized aspects of electronics.

The "Electronic Technician" curriculum at Bailey Tech (St. Louis), for example, tries to touch on all bases. The program includes math and circuit fundamentals, test gear, theory, servicing of equipment, applied physics, antenna theory, FM and TV servicing, advanced circuits, motors, and subjects to cover automation and industrial electronics such as special tubes and electronic controls.

This particular course involves 40 weeks of study. A longer course (104 weeks) is offered by Central Tech in Kansas City. In this course the emphasis is *not* on servicing. The course is more like an engineering curriculum. Math through calculus is taught, as well as communications electronics, physics, pulse systems, test equipment, precision measurements, nuclear energy, UHF and microwave techniques, telemetering, technical report writing, library research, and industrial relations.

A course that centers entirely on servicing is the correspondence course offered by the National Radio Institute. A special feature of the National course is learning to build and use equipment and test units.



Trouble-shooting of basic electronic circuits, such as this TV chassis at Electronics Institute, Kansas City, is still considered by most schools to be a necessary prerequisite to more advanced, specialized electronic study.

Use of large demonstrator panels with terminal points, components and schematic all visible is one of several new teaching methods devised to help students grasp theory and practice in shortest possible time.

Dielectric heating apparatus, used in industry for the bonding of plastics, etc., is checked by advanced students at the Milwaukee School of Engineering, below. Some courses can be applied toward an engineering degree.

A program that omits TV entirely is the "Computer Technology" course offered by the Milwaukee School of Engineering. This 18-month course may be applied toward a BS degree in electrical engineering. It includes much math, test instruments, receivers, industrial electronics and several specialized courses in computers. Subjects such as psychology, social science, technical sales and business law are also included.

Yet another type of course is the one in nuclear engineering technology offered for home study by Capitol in Washington, D. C. This program is designed for those who already possess a technical background, but want to bone up on the new areas of electronics. Among these are atomic physics, nuclear physics, advanced math, reactor physics, circuit analysis, special components and techniques, thermodynamics, servomechanisms, and nuclear reactors.

A training program to turn out rocket technicians has been announced by

[*Continued on page* 102]

WANT MORE INFORMATION?

For a free and up-to-date listing of all technical schools offering courses in electronics, write to:

Electronics Illustrated
67 West 44th Street
New York 36, New York

This list includes names and addresses of schools throughout the country, and indicates whether the courses offered are for home study or must be taken in residence.

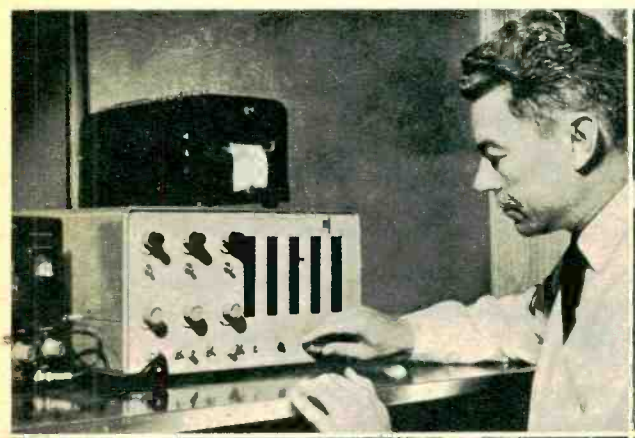
Information on technical schools is also available from the following sources:

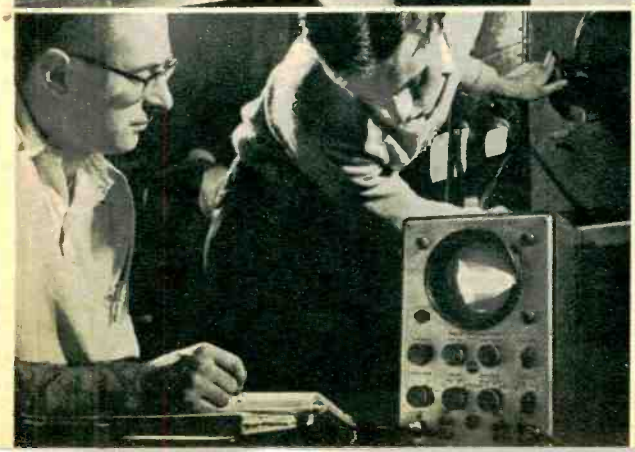
National Council of Technical Schools
912 Seventeenth Street N.W.
Washington 6, D.C.

National Home Study Council
1420 New York Avenue, N.W.
Washington 5, D.C.

Adult Education Assn. of the U.S.A.
743 North Wabash Avenue
Chicago 11, Illinois

Engineers Council for Professional Development
29 West 39th Street
New York 18, New York

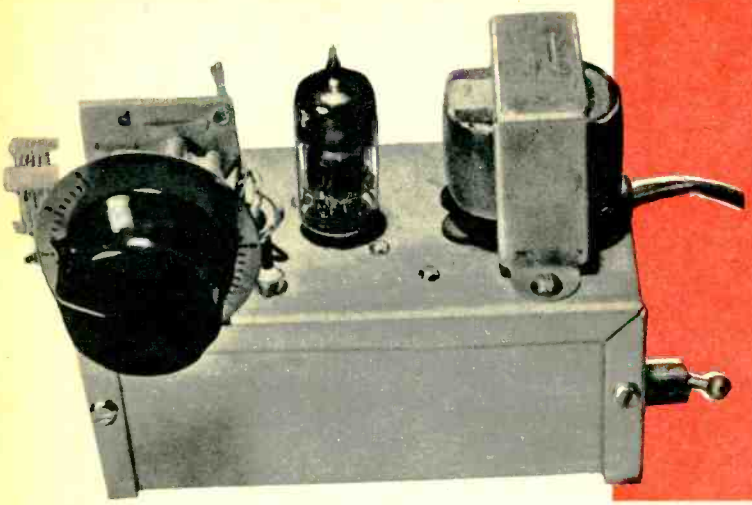




Instructor at Electronics Institute (upper left) examines new piece of gear that is used to make radiation measurements.

Above, recent expansion in the use of single sideband transmission is recognized in course at CREI (Capitol), Washington, D.C.

Mastery of basic fundamentals, such as work with oscilloscope (left), is regarded as very important by technical schools.



Tuning section of completed unit is at left, single tube at the center. Its power transformer is on the right.

Citizens Band Converter

By Joe Doherty

Receive stations on the new 27 megacycle Citizens Band by adding this unit to your home radio.

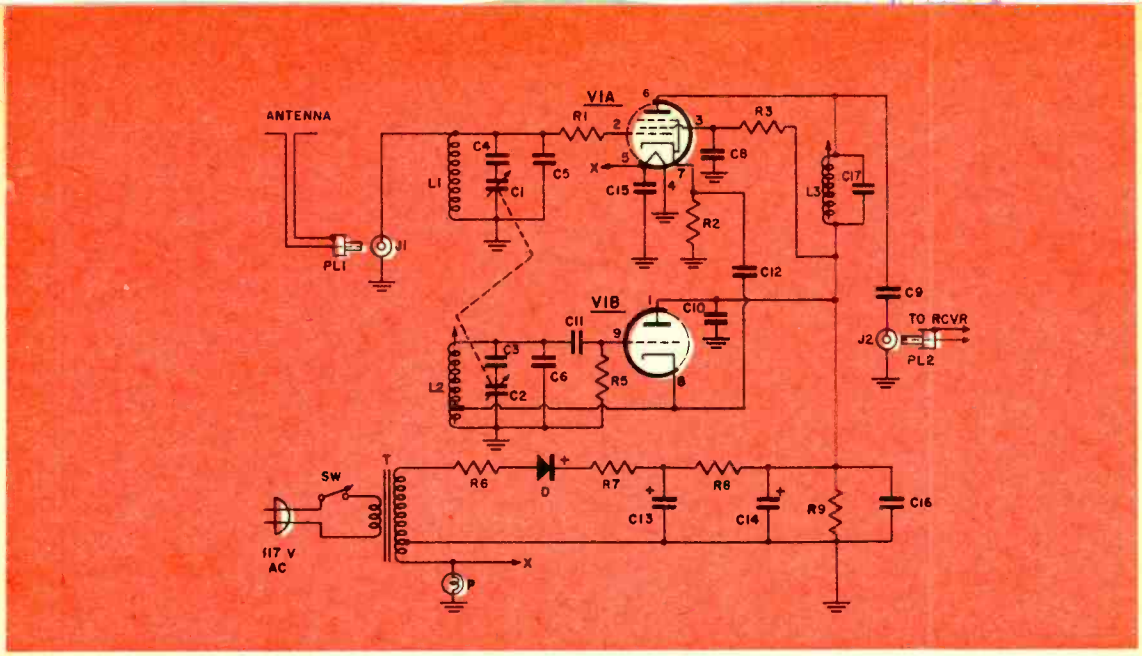
HAVE you heard of the new Citizens Radio Service which the government has recently made available? The unit described here enables you to tune in on the 11 meter Citizens frequency band with your own broadcast radio, plus the 10 meter amateur band as an added bonus. A power supply is included in the unit so there is no need for connections to the broadcast receiver other than the output lead.

It is recommended that all necessary holes be drilled before any parts are mounted. This will simplify the placement problem as construction progresses through the wiring stage. Power supply components are mounted underneath the power transformer, including the switch, pilot lamp and silicon diode rectifier which are mounted on the end plate.

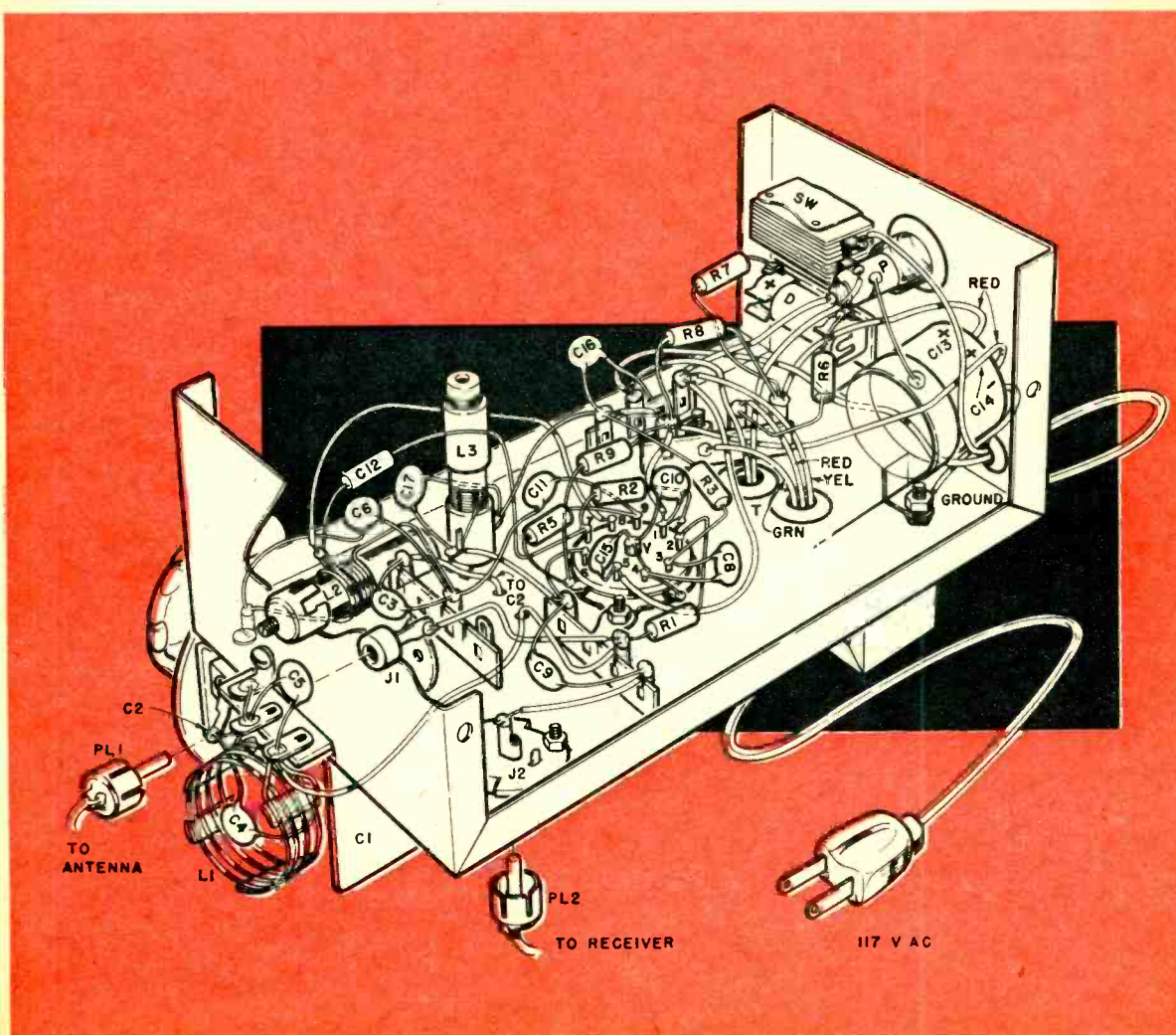
A $\frac{7}{16}$" hole is drilled, a rubber grommet is installed in the hole, and the bulb is then squeezed into the grommet just far enough so the tip of the bulb comes through to the outside. Be gentle, don't use enough force to break the glass. If the tip of the bulb is moistened first, the fitting will be easier. This type of mounting is very inexpensive as compared to the cost of jeweled pilot lamp sockets.

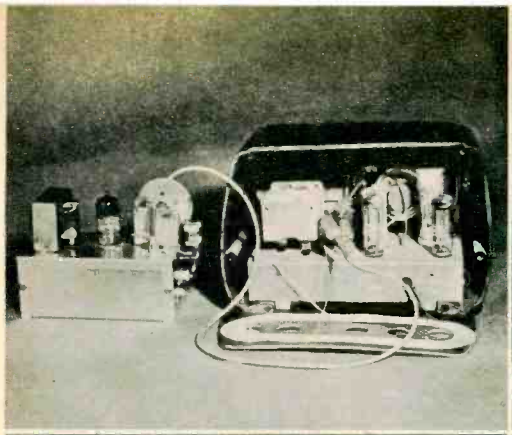
The tube socket is mounted midway between the power supply and the RF and oscillator section providing easy wiring access to both departments.

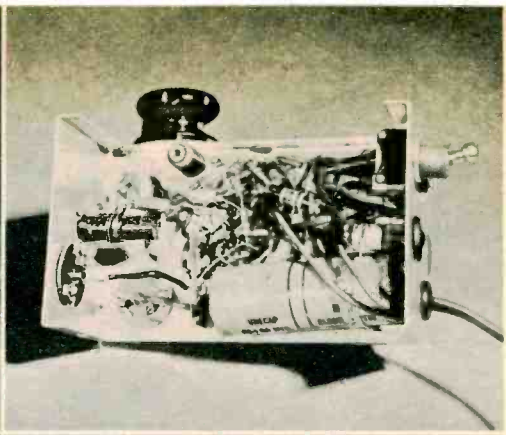
The oscillator coil and output lead are mounted underneath the tuning capacitor proving adequate isolation from the input

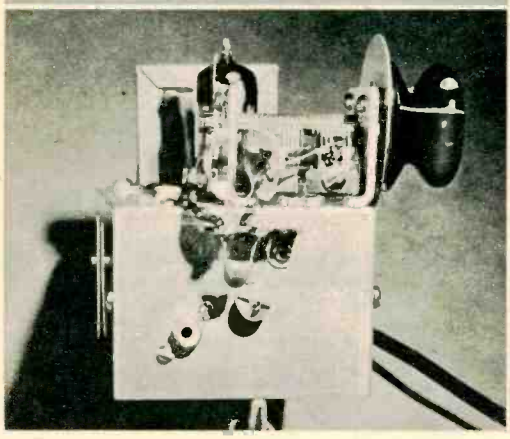


In the schematic above, V1 is a multipurpose tube. The upper half is an RF amplifier, the lower serves as the oscillator. Avoid cold solder joints, particularly troublesome at high frequencies.









At upper left, output of converter is fed into radio by clipping onto tuning capacitor.

Above shows underside of converter chassis. All wires are kept short to avoid losses.

Side view shows mounting of C1-C2, used in tuning. Antenna plugs in jack, lower left.

coil. This is necessary in order to prevent oscillator "pulling."

Coil Construction:

(L1)—The RF input coil consists of 4 turns of a B&W #3011 coil, or equivalent.

(L2)—The oscillator coil consists of 5 turns of #18 solid enameled copper wire, close wound on a ⅜" diameter slug tuned coil form (J. W. Miller #4400). The coil is tapped approximately two turns from the ground end. This is the cathode tap, the coil being the familiar Hartley type.

Alignment and Bandspread:

The oscillator frequency is determined by adjustment of the oscillator coil (L2) slug, and by the setting of the oscillator tuning condenser C2. The adjustment of the slug is not critical. The frequency range of L2C2 is limited by the bandspreading effect of the 50 mmfd fixed capacitor (C3) connected in series with C2, greatly narrowing the capacity range. It is necessary only to adjust L2 so that the center of the 10 meter band falls at the mid range of C1-C2 with the

[*Continued on page* 108]

PARTS LIST

C1,C2—Two-section superheterodyne tuning capacitor, miniature broadcast type (use larger section for oscillator tuning)
C3,C4,C5,C6—50 mmfd disc ceramic capacitor, 400 volt
C8,C9,C10,C11,C15,C16—.001 mfd disc ceramic capacitor, 400 volt
C12—500 mmfd ceramic capacitor, 400 volt
C13,C14—Dual-section electrolytic capacitor, 50 mfd per section, 150 volt
C17—100 mmfd disc ceramic capacitor, 400 volt
R1—56 ohm ½ watt resistor
R2—1,500 ohm ½ watt resistor
R3—120,000 ohm ½ watt resistor
R5—51,000 ohm ½ watt resistor
R6—100 ohm 1 watt resistor
R7—10 ohm 1 watt resistor
R8—3,300 ohm 1 watt resistor
R9—50,000 ohm 1 watt resistor
SW—SPST toggle switch
D—Silicon rectifier 150 ma (Sarkes-Tarzian M-150)
V1—6U8 tube
P—Pilot bulb #47
P11,P12—Phono-type pin plugs
J1,J2—Phono-type pin jacks
L1—¾" diameter coil. Use B&W #3011 (see text)
L2—Slug-tuned coil form. Use J. W. Miller #4400 (see text)
L3—Superex Vari-Loopstick
T—Power transformer (Stancor PS-8415, Triad R-54-X, or equiv.)
Misc.—Bud Minibox CU-3006, five 3-lug terminal strips, rubber grommets ¼" I.D., 9-pin ceramic tube socket

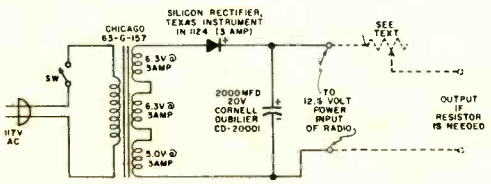
The Electronic Brain

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

AC Operated Auto Receiver

Is it possible to convert a Delco 1958 Buick car radio to 117 volt AC operation?

George J. Moyer, Flint, Mich.



Today, with low-cost silicon rectifiers available at jobbers that cater to the hobbyist, a converter power supply can be made up for under $15.00.

A multiple-filament transformer (Chicago 63-G-157) is connected with all three secondary windings phased so that the voltage is additive for a total of 17.6 volts. The transformer is then connected as shown in the diagram to the silicon rectifier and the high-capacitance filter capacitor. If the output voltage of this power supply is higher than 14 volts at full load with the radio connected, a low value, high-wattage resistor may have to be inserted in the position indicated to protect the radio from over-voltage operation. The easiest way to make up such a resistor for trial is to obtain some nichrome wire from an old, discarded toaster or heating element, insert it in series, then tap down on it until the full-load output voltage is exactly 12.6 volts.

Intercom Amplification

Can an intercom be constructed using only two 5-inch loudspeakers and batteries?

Richard L. Thomas, Chamberlain, S. Dak.

You are probably thinking of sound-powered phones. This type of intercommunication—no batteries required, by the way—is entirely feasible and is now being used by television antenna men for orienting antennas. If this is attempted with loudspeakers instead of special headphones, it will be found that the sound amplitude will be much too small for successful communication. Virtually all intercom sets use loudspeakers as microphones when the switch is in the "talk" position; with the switch on "listen" the speaker acts as a speaker at the sending end. But, at least two stages of vacuum tube amplification are required; some of the newer intercoms utilize three or more transistors as amplifiers.

When it is realized that at least 0.5 watt of sound power would be needed to produce audible speech at a distance of three feet from the speaker, it can be seen that amplifiers *must* be used. The power generated by a PM speaker used as a microphone does not exceed a few milliwatts at the most.

Computers

Where can I find some simple and fundamental information dealing with analog and digital computers?

Bob Bowman, Roanoke, Virginia

A good source of information that deals expressly with digital computers is the three-volume series called "Basics of Digital Computers" by John S. Murphy, published by John F. Rider, Publishers. These volumes may be purchased individually for $2.45 each, or in a complete set for $6.81.

No recent books that are primarily concerned with analog computers have come to our attention in a long time. We might recommend, however, several articles that have appeared in "The Scientific American" during the last few years. For a complete listing of these, plus others, refer to "Readers Guide" and the "Industrial Arts Index," both available in your public library.

[*Continued on page* 94]

Combination of kids and tape recorders spell fun at summer get-togethers. Tape dubbings of favorite records can also keep children amused on trips.

add to summer fun outdoors by taking a

Tape Recorder On Vacation

By Bob Gorman

Out of the house and into the open, tape recording adds to your vacation with "sound snapshots."

WHICH do you pack first when you start gathering your summer vacation gear? Swim suit? Fishing rod? Outboard motor? Tent? Whether your idea of a first-rate vacation calls for all, some or none of these, you should find space on your list—and in your car—for your tape recorder. It can spell the difference between a pleasant trip with the children and an unbearable one, and it can store the exciting events of your vacation while they're still fresh in your mind.

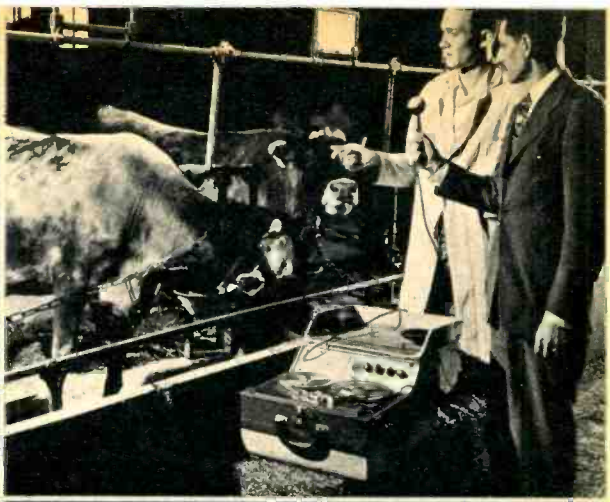
Any portable recorder makes an excellent traveling companion. The standard, AC unit is housebound, of course, under normal conditions. But once you start looking you'll be surprised

An inverter to change 6 or 12 volts DC to AC at 117 volts will permit you to use your normally housebound recorder inside car or boat. An extension cord makes it an easy project to tape anywhere along your vacation route.

Scenes that lend themselves to picture taking, such as this colorful harbor, also rate on-the-scene tape recorded notes. Portable unit is Amplicorp's Magnemite.

Pretty young lady in airplane gets set to record her flight impressions. Inverter turns "home" recorder into a mobile operating unit. This recorder is a Telectro.

With binoculars, Magnemite, and a special parabolic rig to reflect sound into microphone, this man is all set to cdd to collection of bird tweets and chirps.



Looking for unusual sounds? Above left is really one to tell the folks about! But we don't recommend carrying enthusiasm quite so far.

Places of interest, such as experimental dairy farm above, are very likely to have convenient 117 volt outlets for your home tape recorder.

Don't like to write letters? Why not tape record a few remarks, address the reel's original carton, add postage, and drop into mail box.

to find how many convenient 117 volt outlets there are along the way that can supply the power for recording conversations, on-the-spot impressions of the sights you see, as well as interviews with relatives and friends. You'll also save yourself a lot of writing by taping "post cards" for those at home. Wrapped in their own boxes, or in special mailing cartons, tape reels travel like letters, but are a great deal easier to "write."

Your tape recorder becomes a truly versatile instrument when you provide it with a mobile source of power. There are a number of inverters on the market that will change 6 or 12 volts DC into 117 volts AC. In your car and aboard most inboard power boats inverters can be used to operate your recorder *while* you're on the move! Used inverters may be purchased from some surplus and electronics parts stores for under $20.

A recorder that can play while you drive is the perfect solution to the problem of traveling with children. Youngsters are much less likely to get restless on long trips if you tape some of their favorite records before you start, and play them on the way. When the children have run through all their dubbed records, they can make the time go faster and get more out of the trip by describing things they see along the road and playing back their own descriptions.

The dubbing from disc to tape can be accomplished simply by attaching alligator clip leads to the voice coil wires of a phonograph's speaker, and jacking the other end into the high-level input of your tape recorder (radio, auxiliary, etc.).

An in-the-car power supply or battery operated portable recorder extends

[*Continued on page* 104]

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.

Bass Reflex Dimensions

I have a bass reflex cabinet and am using a speaker that has a resonance at 24 cycles per second. What should the dimensions of the port on the cabinet be?

Mark Davidian, Kingsbury, California

The port area can be determined experimentally to match your speaker. This procedure is detailed in an article that appears in the May, 1959 issue of *EI* titled "Build a Bass Reflex."

Stereo Tapes

I am not familiar with stereo tapes and would like to know if they all are 4-track and the same width as standard tapes?

V. E. Elliott, Ottawa, Canada

Stereo tapes may be two or four track but are always the same standard tape width.

Line Voltage Variation

I am stationed overseas and have purchased a stereo tape recorder. Over here the line voltage is rated at 100. There is a switch that enables me to change from 100 to 117 volts. When I return to the States what effect will there be since the voltage in the U.S. is 110 to 115? Will I need any modifications to the recorder?

M/Sgt. R. C. Talley,
APO, San Francisco, Calif.

First we'll assume that your unit is operating from 60 cycle current, not the 50 cycles that is sometimes found overseas. The line voltage in the U.S. is *nominally* 117 volts. This means that equipment designed for 105-125 volts will usually work without difficulty. The 2 volt difference between 115 and 117 in the rating is insignificant.

The most important consideration is the speed of the tape recorder motor which is synchronized with the power line frequency. Small fluctuations in line voltage are insignificant.

Most manufacturers of equipment that operates on 60 cycles provide a simple adaptor for operation on 50 cycles. It is often in the form of a drive wheel that changes the gearing to the motor.

Output Meter

I would like to add two meters to my amplifier for measuring both wattage output and percent of modulation. How would this be done?

Robert Groome, De Land, Fla.

Several of the large mail order houses and electronics supply firms sell Audio Level Indicators which may be hooked up to the speaker terminals of an amplifier to determine the power in watts.

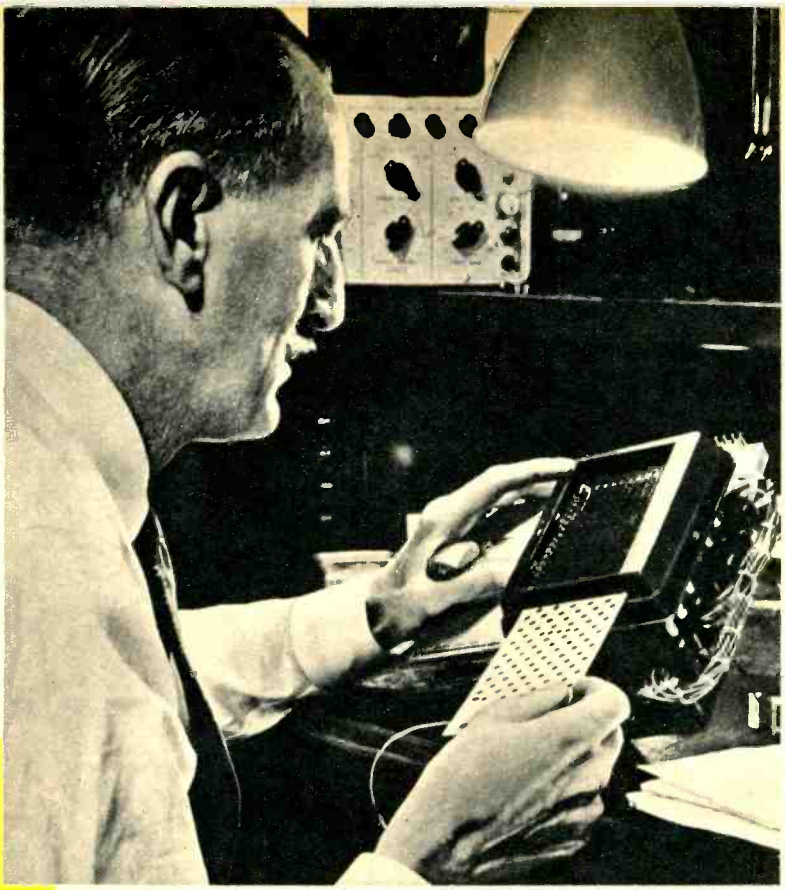
The term "percentage of modulation" is usually reserved for radio transmitters that are modulated by audio tones. It indicates to what extent the radio wave is varied in strength by the voice or music.

Improving Enclosure Response

I recently built a small wooden enclosure for an eight inch speaker and want to extend the bass response. Once this is done, how can I measure what the response actually is?

Stephen Povanda, Garfield, N.J.

I would suggest that you drill a series of close-spaced ¼ to ½ inch holes (about 20 of them to start) in your cabinet either in front, back, or bottom. Adjust the number of holes for the best bass response. Fill the cabinet loosely with fiber glass to kill internal reflections and resonances. The best way to test the system would be with an audio oscillator or a test record. Do not expect much of a clean bass response below 70 cycles.



The punch-card electronic device being worked on by volunteer SAVE engineer Al Petrie is a training aid designed to help students to diagnose cancer cells. It makes it unnecessary for a doctor to check the diagnoses.

Volunteer electronic engineers, technicians spend their spare time in home workshops to provide . . .

New Medical Inventions

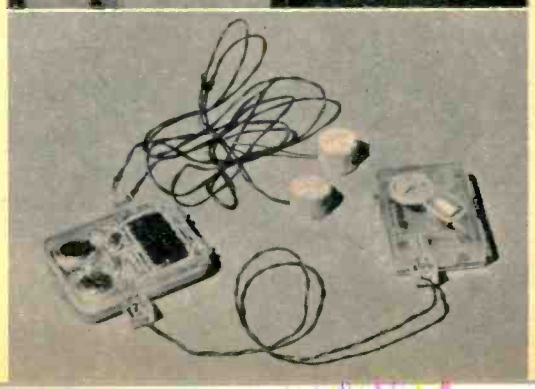
BASEMENTS, garages and home workshops throughout Chicago and its suburbs have been turned into electronic laboratories to benefit humanity. Volunteer engineers of Illinois Bell Telephone Co. have been devoting their spare time to closing the gap between medical knowledge and medical equipment.

Some 40 Illinois Bell engineers and technical people, at the suggestion of their company's president, W. V. Kahler, offered to work on their own time with doctors at the University of Chicago medical school. Each medical researcher outlined his immediate and most pressing need, and the engineers selected those projects most suited to their talents. The broad project was tabbed SAVE—Service Activities of Volunteer Engineers. It has been very successful.

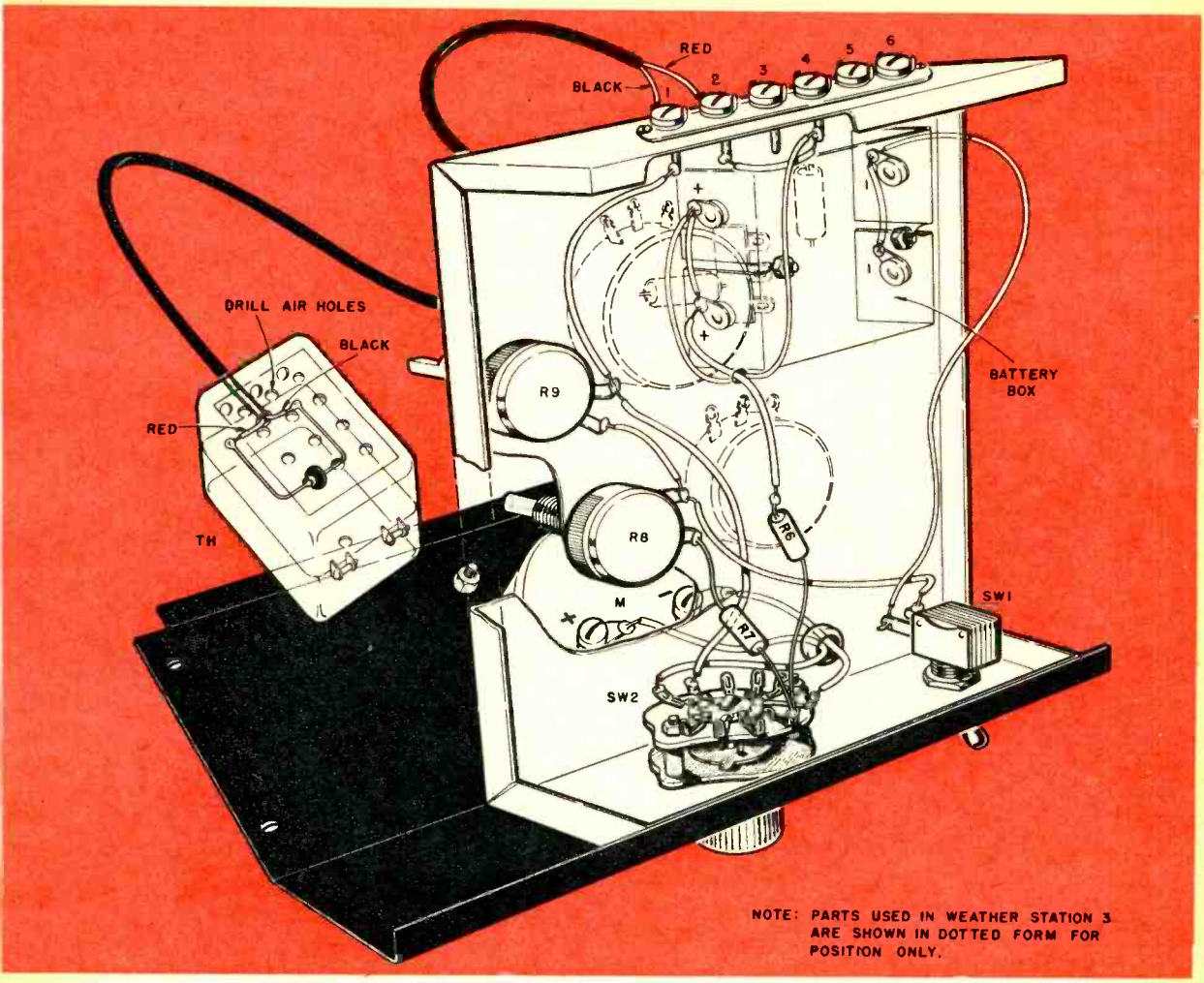
A tiny, three-ounce device to count the human heartbeat during a full day of normal activity has been developed by engineers Lou Harrington, [*Continued on page* 111]

Electronic calorimeter, important in metabolism studies to record changes in body temperature, is the project of engineer Leroy Ryan. At left he is placing clip-held component leads under microscope during design stage. Right, Dr. Seymour Galgov displays completed breadboard.

Electrodes for transistorized heartbeat counter are taped to the chest of Leroy Murphy, who helped develop the device. It can be worn during day of normal activity. Looking on are Dr. R. A. Rowley, left, and William V. Kahler, originator of SAVE project.



The cumulative heartbeat recorder weighs only three ounces. Electrodes are actually dimes inside sponges. At right is watch mechanism, and to the lower left are the four-stage amplifier and miniaturized switching devices.



build your own

Weather Station-4

By Paul Hertzberg

An electronic thermometer to measure temperature concludes this series on the weather station.

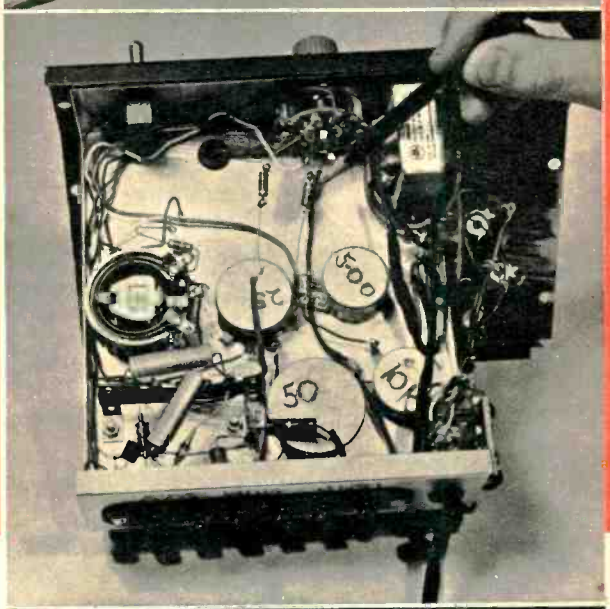
THE only additional parts needed for this month's project are some small resistors and potentiometers together with a simple device which changes its resistance as the temperature rises or falls. It is known as a thermistor. It causes the meter reading to correspond to degrees Fahrenheit. A range of from 10 to 100 degrees was selected for this project as an average temperature

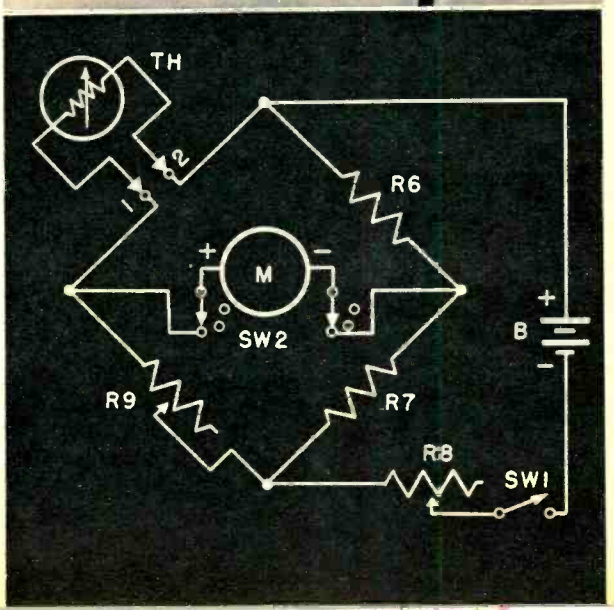
Wiring guide is on facing page and details, parts and wiring required for adding temperature feature.

Meter on front panel shows temperature in degrees Fahrenheit. Thermistor is in plastic case.

Underchassis, pointing out R7. Use this view as a mounting guide for new potentiometers R8 and R9.

Schematic is at lower right. SW1, SW2, M, and B were used in the former weather station projects.





span for most areas around the country.

A set of contacts remain on the selector switch which will connect the meter to the temperature indicating circuit. The remaining space on the chassis is sufficient for mounting the potentiometers. The existing power supply of flashlight batteries will serve for the temperature circuit. A bridge-type circuit is used, with the thermistor in one of the arms. As the temperature rises, the resistance of the thermistor decreases and the current reading on the meter increases. The thermistor has a resistance of 1200 ohms at 77 degrees Fahrenheit, approximately 3500 ohms at 32°F. At 100 degrees, the resistance is about 600 ohms. These figures are important for calibrating the minimum and maximum readings of the meter.

After the circuit is wired, a 10K calibration pot (set to read 6K) is temporarily connected across the terminals where the thermistor leads are normally attached. Set pot R8 at minimum resistance. Turn on the power and adjust R9 pot until the meter reads zero. Then turn off the power and reset the pot across the terminals to 600 ohms. Turn power on again and adjust R8 until the meter reads full scale (1 ma). These two points now represent 10 and 100 degrees.

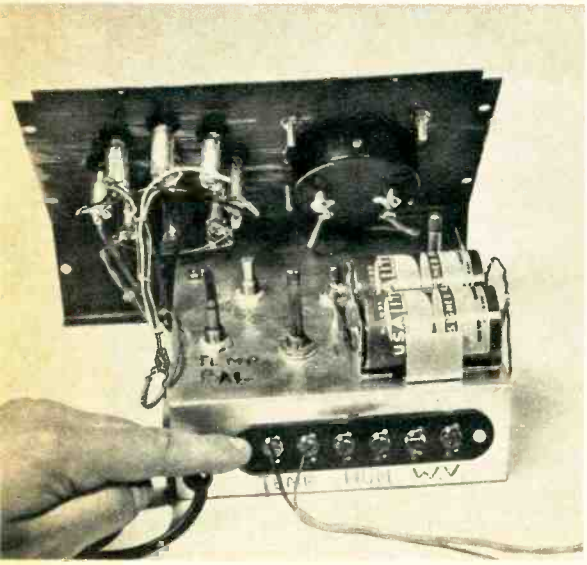
For accurate readings, draw up a chart of the actual temperatures and the readings obtained on the meter. The lower temperatures can be simulated in the freezer chest of your refrigerator and the higher ones taken near a kitchen oven or stove. Reaction time of the thermistor is not quite as fast as the thermometer. The temperature range can be extended by resetting the minimum and maximum points using the manufacturer's temperature/resistance curves available from the Victory Engineering Corporation, N. J.

If desired, the temperature sensing feature of the Weather Station may be built independently from the previous projects.

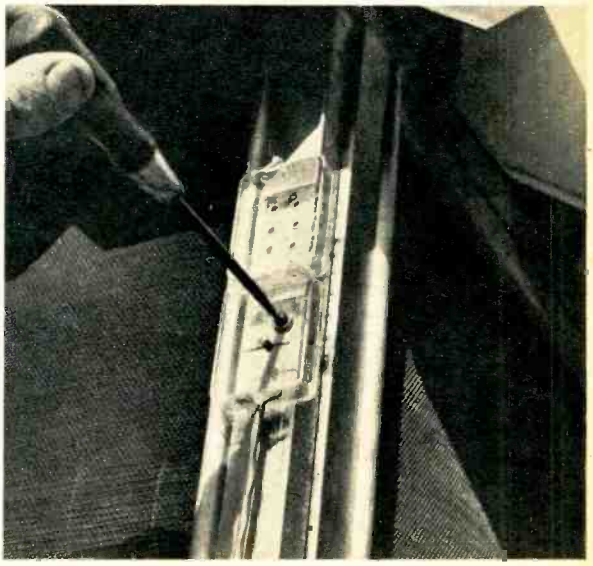
PARTS LIST

New parts
R6—100 ohm resistor ½ watt
R7—50 ohm resistor ½ watt
R8—500 ohm potentiometer
R9—10,000 ohm potentiometer
TH—Thermistor (Veco 31D7)
Misc.—Two-conductor cable, small plastic box
Old parts
B—2 size D batteries
M—Meter 0-1 ma DC
SW1—SPST toggle switch
SW2—Rotary switch 2-pole 4-position

Cable from thermistor hooks to rear apron of unit. Note batteries and balance controls.



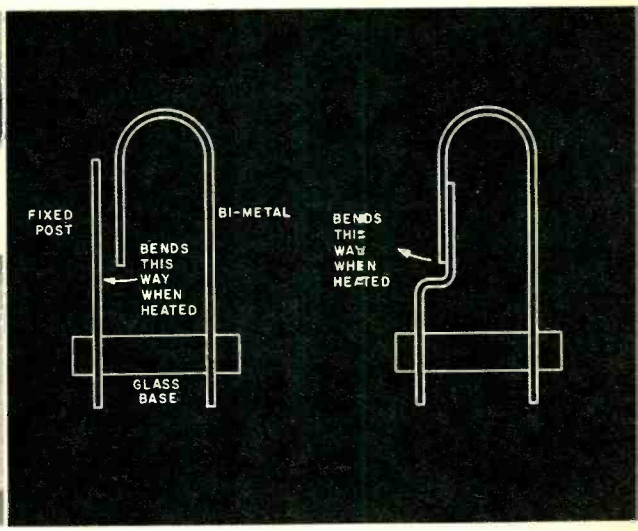
Air holes are drilled in plastic box. Assembly with thermistor is then mounted on house.



Fun with Fluorescent Starters

By Harvey Pollack

Don't throw away burned-out starters! They can be reclaimed for a variety of useful projects.

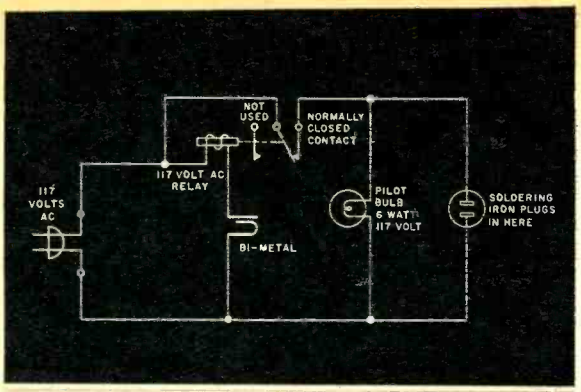


At left, bi-metal electrodes of two typical starters. Drawings show normal condition, left, and modification for normally-closed operation.

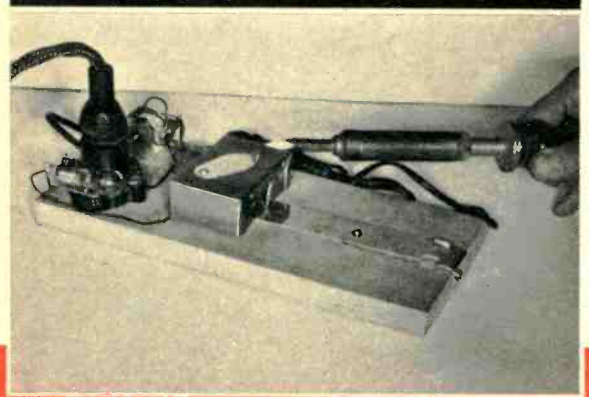
LET'S take a few old fluorescent starters apart to see what makes them tick. Begin by bending back each of the sheet-metal ears so that the phenolic base is freed. The inside assembly can then be lifted out in one piece. Each manufacturer has his own little tricks in fabrication, but essentially all starters are built along similar lines. The principal part is a neon-filled glass bulb wired to the base; inside the bulb is a bi-metallic strip assembly that may consist of a pair of straight wire-like electrodes, or one straight wire and one bowed electrode.

On the outside of the neon tube, wired in parallel with the two inner electrodes, you will probably find either a paper-foil capacitor or a ceramic capacitor, although some manufacturers do not include a capacitor at all. When a starter goes bad, it is generally due to a change in the internal gas pressure due to leakage or to a defective capacitor. In any case, the bi-metallic elements are generally in good shape; these are the parts we shall use, so that we will not be concerned with the gas pressure or capacitor.

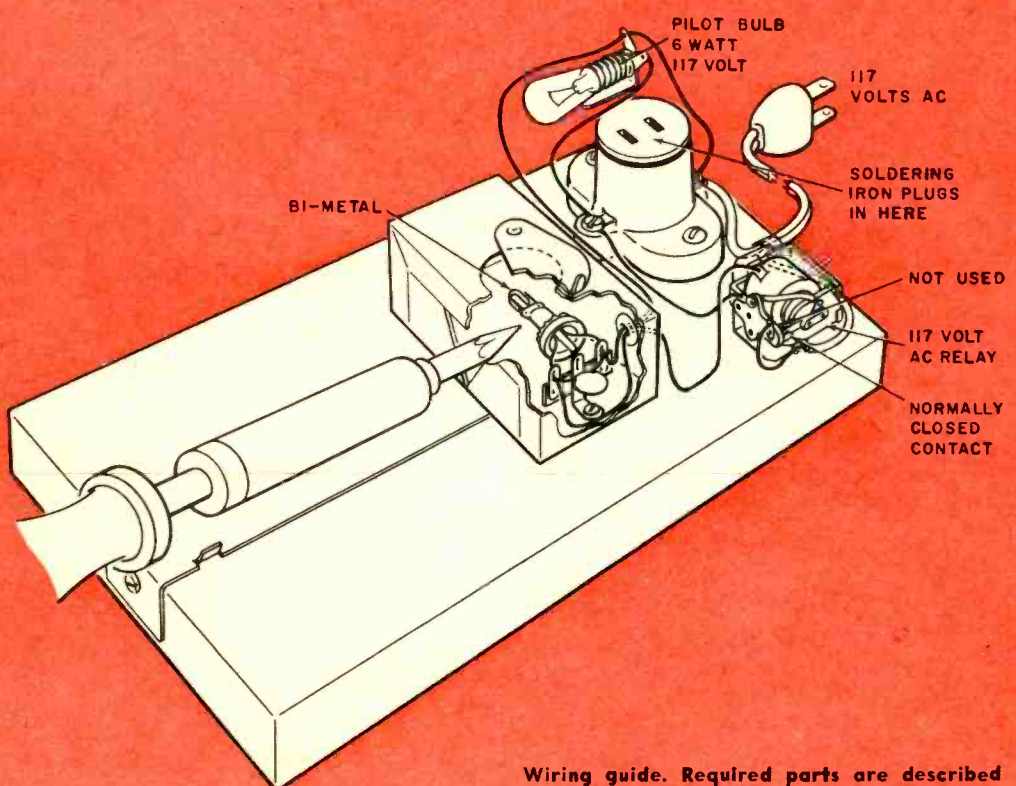
To expose the active electrodes, wrap a few turns of masking tape around the glass bulb and squeeze gently with a pair of pliers or vise jaws. When the glass is broken, the tape is peeled off and carries away the shards of glass without letting them drop around the workbench. Clean away the remaining sharp



In schematic of thermal-controlled solder stand, the bi-metal represents the fluorescent starter electrodes.



Just to the left of the tip of the soldering iron is the swivel cover, adjusted for the desired heat level.



Wiring guide. Required parts are described in text. Bulb lights when power is applied.

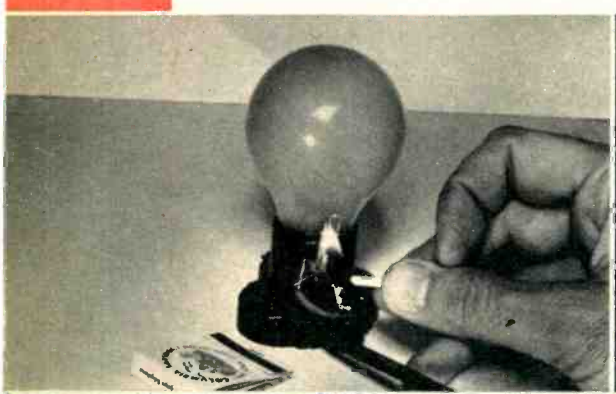
projections with the tip of a longnose pliers, being careful not to damage the elements. Although it cannot be seen by visual inspection, the bowed strip is fabricated of two different metals welded together. One has a greater coefficient of expansion than the other so that the strip bends when its temperature is raised. In all types of starters, the two electrodes are apart at room temperature but come together when heated. You can observe this action by applying a match to the metal and watching it bend.

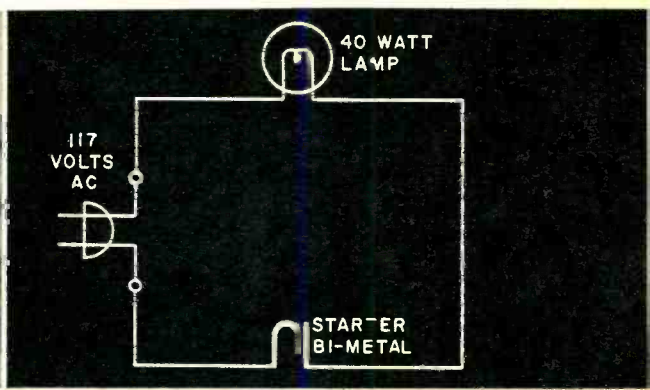
First project is a "Magic Lamp" that you light with a match and blow out with your breath after it is lit! Use either the straight wire or vertical bowed electrodes, but remove the capacitor by clipping it off close to the phenolic base. The bi-metal assembly may be held flat against the glass bulb with a bit of masking or clear tape so positioned that it is completely invisible to anyone standing on the far side of the lamp. The wiring is a simple series circuit in which the bi-metal pieces form the open circuit at room temperature.

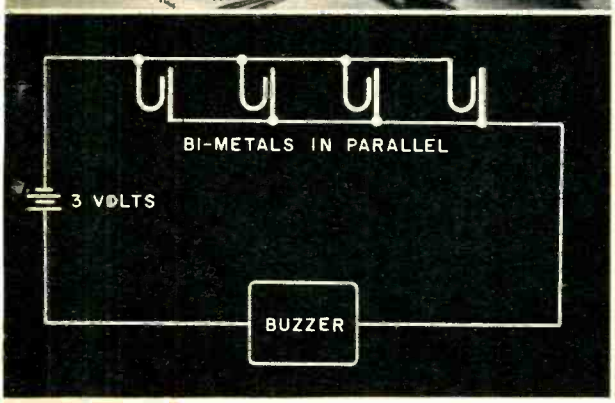
To light the lamp—a 40 watter is suitable for repeated operation—hold the match against the electrodes so that the flame brushes the bowed section. After the lamp comes on, keep the match in position for a few seconds and then remove it. Now blow out the lamp by puffing at the bi-metal to cool it and cause it to open the circuit. Don't wait too long or the contact will open by itself as a result of radiation into the air!

[*Continued on page 97*]

"Magic Lamp" project and its schematic. A match flame applied to the bi-metal turns the lamp on; a puff of breath blows it out. Starter is used in normally-open condition.



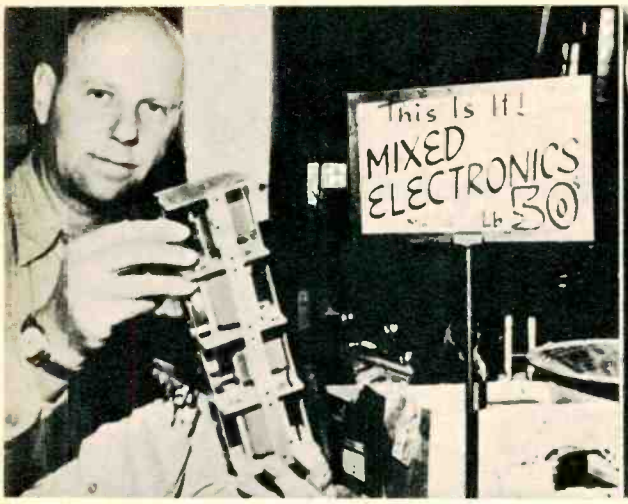




Buzzer, bi-metal electrodes, and batteries comprise a fire alarm unit. Note in schematic that many bi-metals may be wired in parallel, each for a different location.

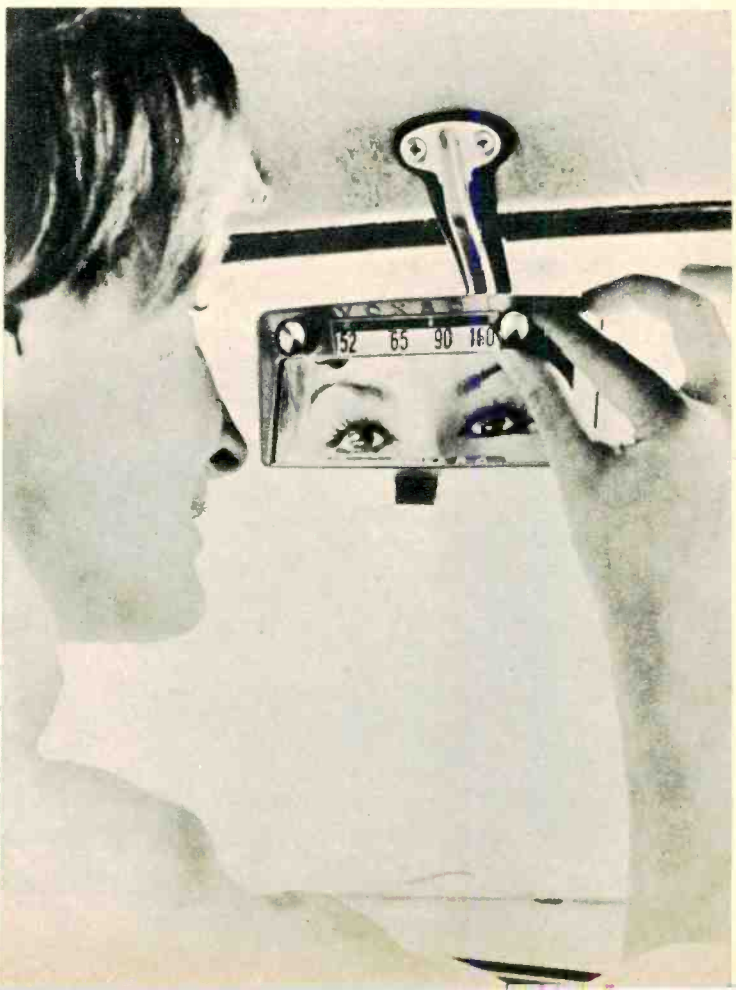
EI Picturescope

Something new for the ham shack: A multi-colored, translucent plastic Great Circle map that indicates the beam direction and width of a rotating antenna by projecting a wedge of light from the rear through the plastic. Maps are centered on East or West Coasts, or in Midwest. For further information contact Hy-Gain Products Corp., 1135 North 22nd Street, Lincoln, Nebraska.



Now you can buy electronics parts the same way the woman of the house buys string beans —by the pound! Rudy Glass, of the Bay Bridge Sales Co., Redwood City, Calif., set up this bargain counter to clear out odds and ends.

Frustration is one way to discourage smoking. Minneapolis-Honeywell engineers built a version of their electrostatic air filter into holder. A 3000-volt punch absorbs smoke, including taste of tobacco, and smoker can't even inhale.



The new look in rear view mirrors for the family auto actually serves more than one purpose. A clever Italian inventor has included a completely transistorized AM radio, with tuning dial on the mirror itself. Called the Vanguard, it is made by Voxson-Faret Co. of Rome.

there's adventure in pulling in

TV Over the Horizon

By Thomas J. Hidley

Stuck with local TV? These happy folk make a hobby of logging distant video stations on their home sets.

SATISFIED with your local TV fare? Happy with three, four —maybe even seven channels? Perhaps you are, but did you know that there is a small army of devoted viewers who receive eighty, ninety, even 300 different stations on their home sets? With a little effort they get excellent reception at 125 air miles, depending on location, and at least one fan managed to bring in a station 5100 miles distant! They call themselves TV DX'ers.

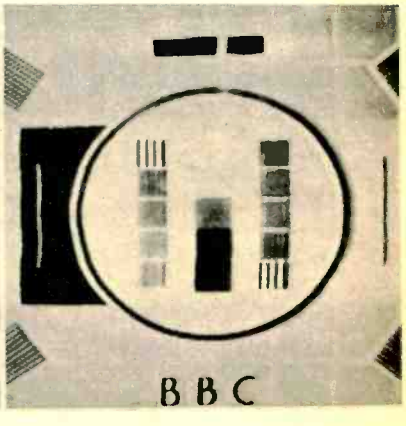
Video reception is normally limited to the line-of-sight horizon. Maximum distance for line-of-sight reception depends on the height of both the transmitting and receiving antennas. What makes reception possible over greater distances—hundreds, even thousands of miles—is what is called the "sporadic-E," a layer of patchy "clouds" of ionized particles that encircle the earth at about 50 miles. These ionized clouds are most common in spring and summer months, and especially in the morning and early evening hours. But the sporadic-E's talent for reflecting television signals may occur (and often does) at any time or season. What's more, "double hops" (earth-to-sporadic-E, back-to-earth, and a repeat of the cycle) are not uncommon.

The American Ionospheric Propagation Association (AIPA) is an organization of persons devoted to the hobby of picking up as many TV stations as possible from one receiver. The ultimate

One DX fan went to the trouble of building this heavy wooden scaffold alongside rotor antenna in order to facilitate servicing.

Carl Lupton, of Shelbyville, Ill., has over 200 television stations logged on his home set. He credits good reception to his crank-up antenna.

Proof positive of reception over long distance is photo of test pattern taken off the screen. Camera must be kept handy, loaded with film.



proof is a photo of the stations' call letters, test pattern, or program. Each picture is inscribed with date and time, and carefully logged. Some TV DX'ers request QSL notes from the faraway stations, and the station engineers are generally happy to hear about their signals' hops.

The typical video DX'er has been an over-the-horizon addict since receiving Steubenville, Ohio, Channel 9, with only a pair of rabbit ears. And his set sat in Syracuse, N. Y.! The only thing that would take the TV monkey off of his back was to receive a new station. So he erected a 50′ tower with double stacked VHF and 12 bay UHF antennas, to say nothing about a rotor for directional tuning.

As he climbed the platform to erect the tower, his wife was sure he would become a basket case. The neighbors were no comfort, shouting that the tower would steal their signals. But his spirit never faltered. He purchased the latest model full four megacycle bandwidth TV set, and soon found himself walking toward it day and night. Once knob twisting and precision tuning entered his blood, he set a goal of 100 stations by New Year's Day. It was hard for him to cry "uncle," but the First of the Year, rolled around and his log showed only 97 stations to his credit. Now he says 200 by the Fourth of July!

Mrs. Doris Dee Johnson of Longview, Wash., has a nine-year-old son who says: "When Mom started DXing it was only a once-in-a-while hobby. Then she got a new antenna, then a rotor for the antenna, then another set for us kids, then she had her set reworked so she could try for BBC. Then she got a tape recorder to tape the DX sound portions. Who knows what next?"

Mrs. Johnson has received KONA, Channel 2, Honolulu, Hawaii, 2700 miles from her home. She has also pulled in San Juan, Puerto Rico, 3650 miles from Longview. She now has over 120 stations to her credit.

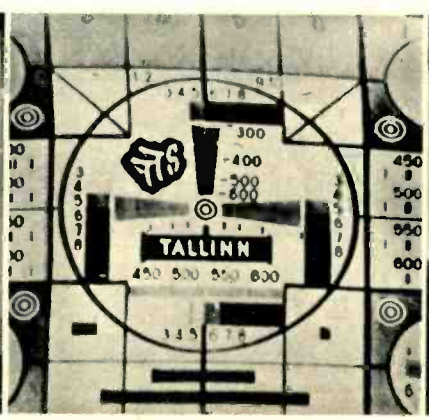
Robert Seybold, president of the American Ionospheric Propagation Association, has 318 TV stations logged. Living in the hills of Dunkirk, N. Y., he has the advantage of a 1200′ elevation. With a 60′ crank-up tower, it's no-wonder his DXing has been a great success. The tower may be serviced at roof level and can be cranked down when high winds are predicted.

Interest in TV DX is not limited to the United States. Behind the Iron Curtain, Heiner Tamment of Tallinn, Estonia, USSR, is an avid long distance viewer and has corresponded with hobbyists in this country. He has received

[*Continued on page* 104]

Pretty girl is Ann Curcer, television personality from Helsinki, Finland. Photo was sent to New Yorker by a DX'er behind Iron Curtain.

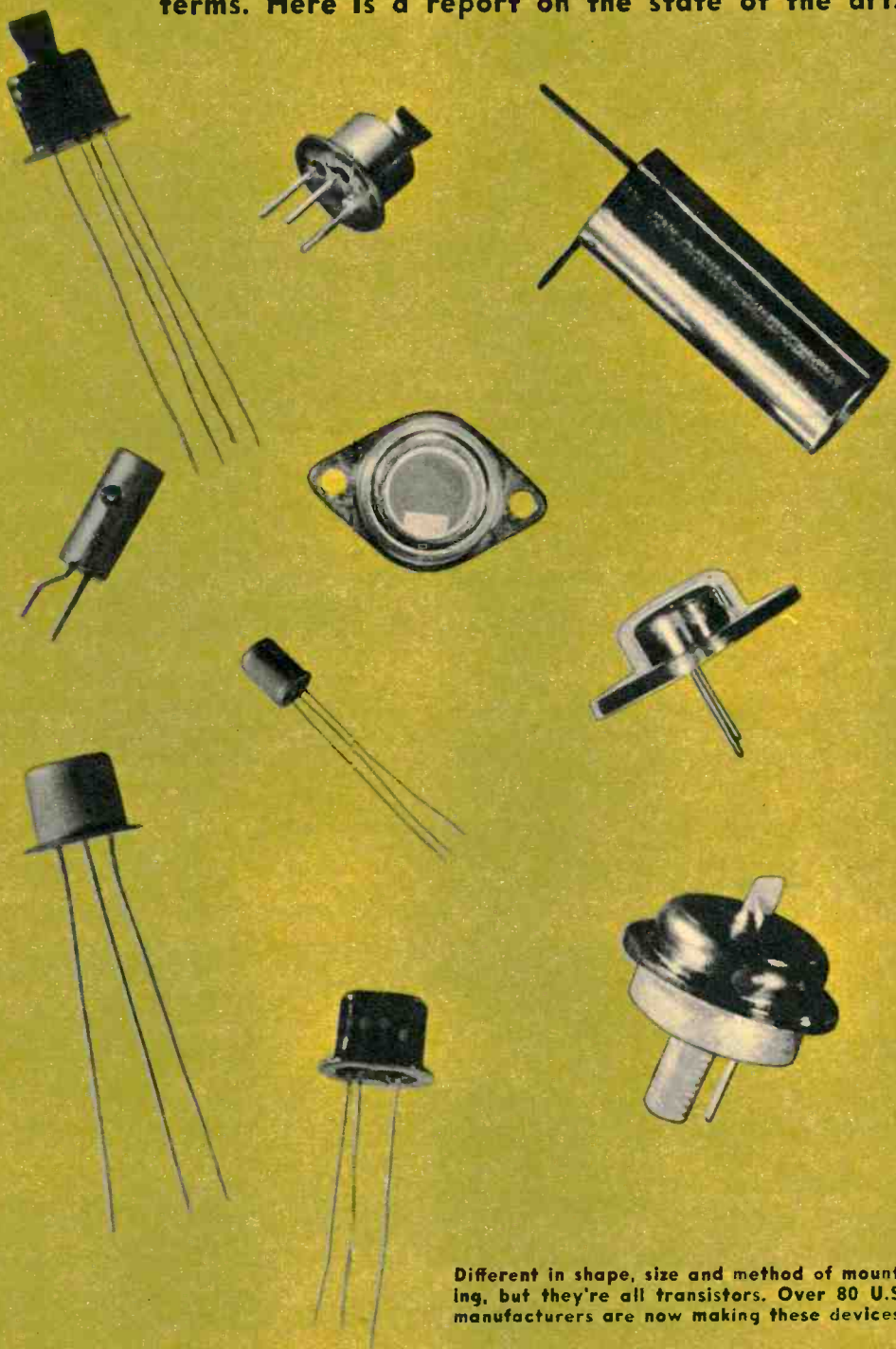
Here's an elaborate test pattern from Estonia, U.S.S.R. Overseas TV varies from country to country in lines per inch, frequency.



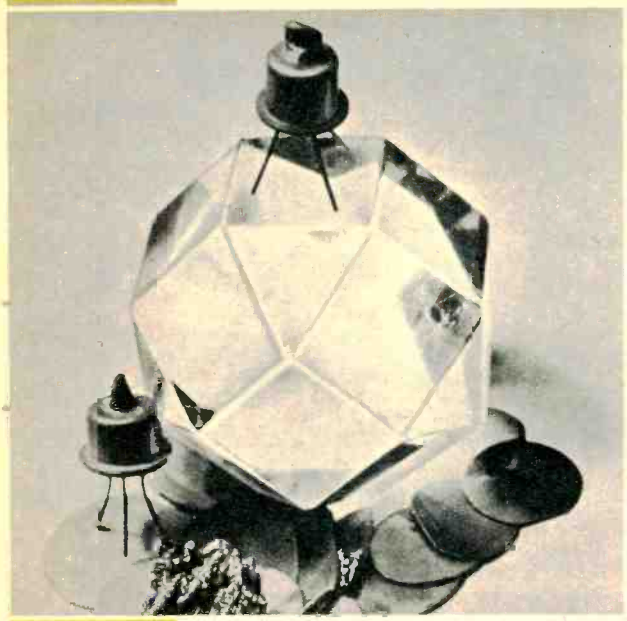
This strictly American test pattern traveled 1060 miles to Dunkirk, N. Y., where Bob Seybold, AIPA president, photographed it.

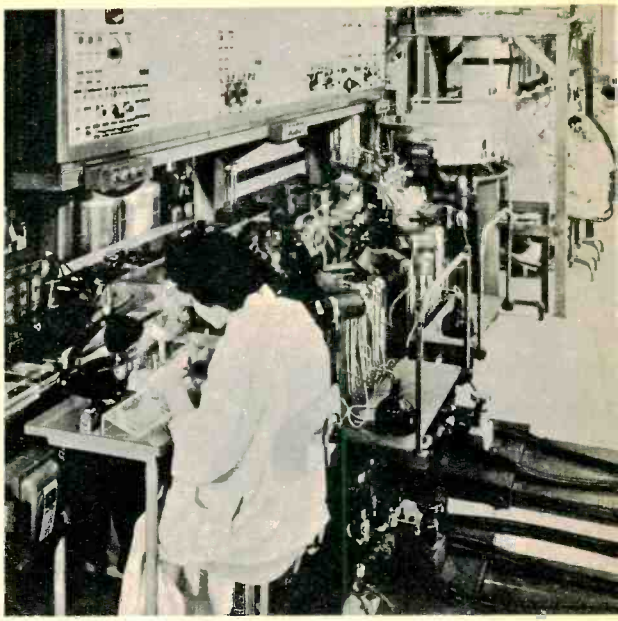
What's New With Transistors

Higher frequencies, higher power, and lots of new terms. Here is a report on the state of the art.



Different in shape, size and method of mounting, but they're all transistors. Over 80 U.S. manufacturers are now making these devices.





Raw silicon (lower left) is carefully refined, "doped" to distribute proper type of atoms throughout crystal, then sliced into wafers less than 1/100" thick. Silicon has become heart of many transistors. Transistor costs are being cut by automatic production facilities such as those at Philco (right).

IT'S BEEN 11 years since the birth of the transistor. No longer a curiosity or mere laboratory plaything, over 80 manufacturers are now making transistors available to the public at large. Having reached a maturity of basic design, we can certainly expect the use of transistors to expand into areas yet unforeseen. But what of the transistor itself? What recent changes have come about?

Ever since the semiconductor device was first announced, designers have been attempting to get it to operate at higher frequencies. They haven't been satisfied with just audio amplifier applications where the transistor has little difficulty boosting signals up to 20,000 cps. They've succeeded in pushing the transistor's frequency handling capabilities close to *one-billion* cps for use in commercial units!

Why all the fuss about frequency? The answer is simple. For years, the vacuum tube has been a fairly reliable workhorse in all frequency ranges. Then along came the transistor with outstanding advantages of small size, ruggedness, no power-drawing filaments, and long life. These advantages were desirable for all applications, not just low-frequency ones. But, for a long time, the transistor was not capable of proper operation, or operation at all, at such high frequencies as the vacuum tube. The reason for this is that the flow of current through semiconductor material depends on "physical" movements. The transit time is simply too slow to accommodate the fast flow demanded by high frequencies. For example, one virtually untapped market for transistors has been in television sets. Here a transistor would have

This transmitter, using only 1/10 watt and two RCA "drift" transistors, beamed a message from California to South Africa on 15 meters.

Magnified over 25 times, this photo takes you inside a diffused base germanium transistor at Bell Labs for a view of its internal structure.

to handle frequencies in the millions of cycles per second. Such transistors are rapidly becoming available at prices comparable to those of vacuum tubes. What will this mean to the consumer? Even smaller TV sets, battery-operated portables. There have been many obstacles in the way of making transistors capable of operating at high frequencies. Almost all transistors depend for their operation upon a junction formed by joining two different semiconductor materials. One, known as N-type, has an excess of negative particles, or electrons. The other, P-type, has more than its share of positive particles, called "holes." If these two materials are joined together, current can pass easily in one direction, but not at all in the opposite direction. This is a semiconductor diode, or rectifier. If a battery is connected to the unit, electrons will flow toward the positive terminal.

If another junction is added, such as another N-type material, we have a device that is capable of amplifying a signal. This is, in fact, the junction transistor. The emitter is the source of electrons; the base controls the current flow, the collector collects electrons.

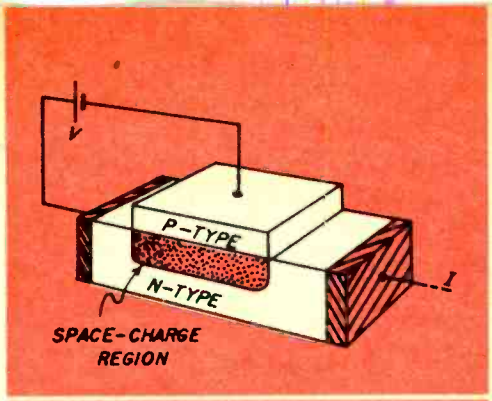
To understand how a junction transistor such as an NPN unit amplifies, suppose resistors are added as the input resistance of the emitter and the output resistance of the collector. With the batteries connected, current flows easily through the emitter junction. We can say that the emitter input resistance is low. On the other hand, with the battery connected as illustrated in the collector circuit, there is a high resistance to current flow through the collector junction. We can say that the collector output resistance is high.

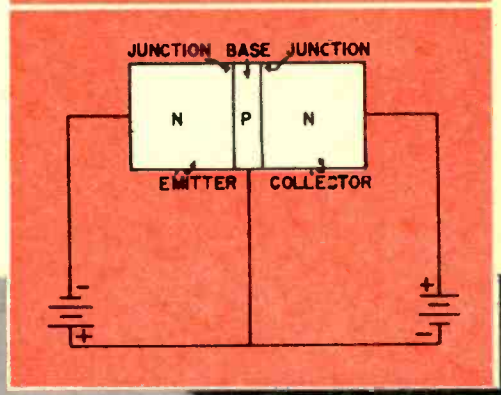
Let us now assume that a varying signal voltage is applied to the emitter. Because the emitter input resistance is low, a slight voltage change at the emitter will cause a large change in emitter current. Since current change in the collector circuit is directly proportional to current change in the emitter circuit, and since collector output resistance is high, the change in collector voltage will be high ($E = IR$). Therefore, for a small change in emitter voltage we have obtained a large change in collector voltage. This is amplification.

It has been found that the high-frequency response of a transistor is limited mainly by the time it takes the

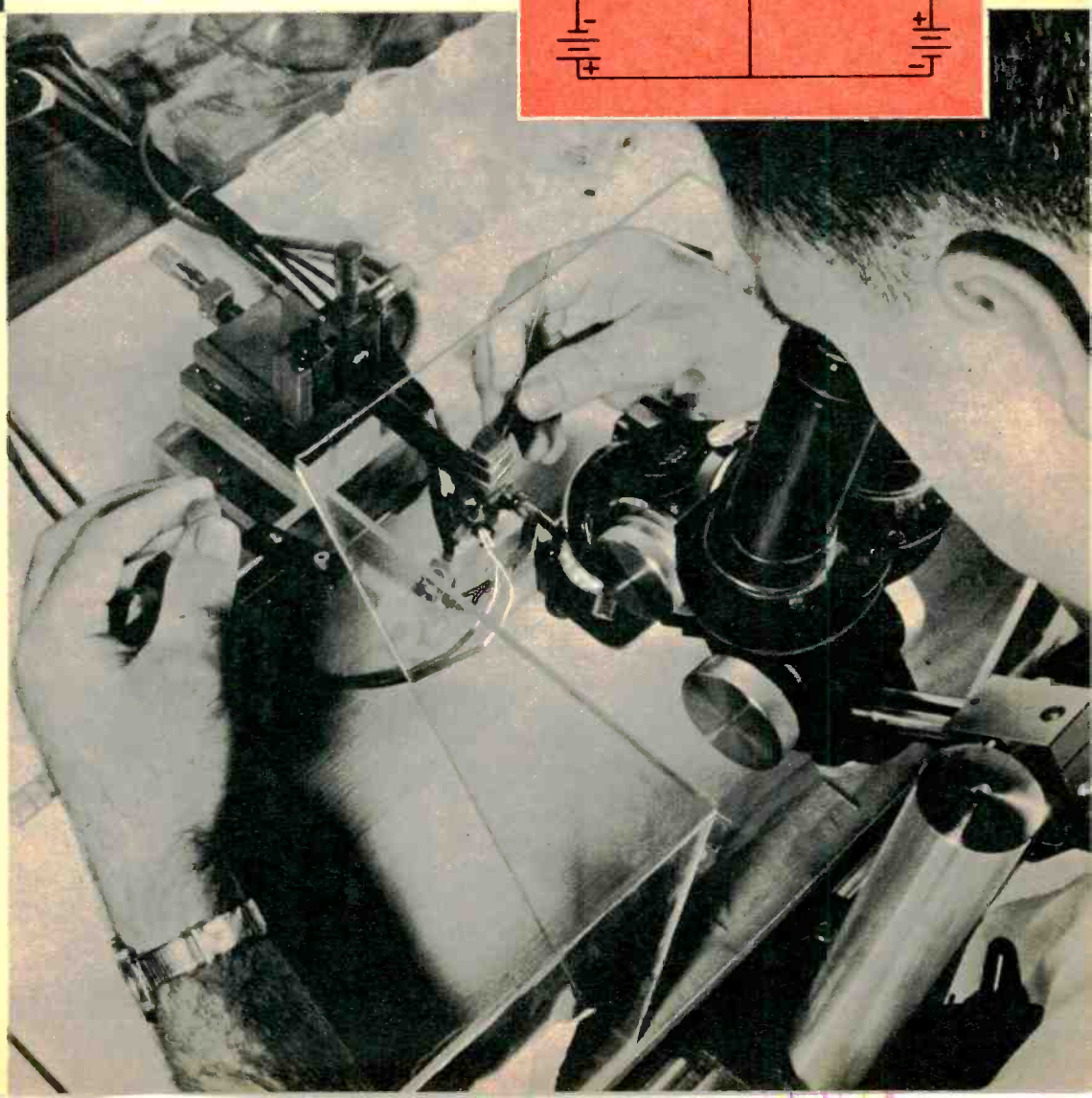
[*Continued on page* 92]

Diagram (lower right) shows basics of NPN junction transistor. New "field-effect" transistor is shown above right. The field-effect is a condition set up within transistor to provide a medium through which electrons may attain greater speeds. By applying proper voltages, a "space charge" region is established in the semiconductor material. It may be compared to a capacitor. The current carriers move through electric field of the "capacitor" with much less transit time than in usual diffusion process. This enables the device to amplify or oscillate at much higher frequencies.

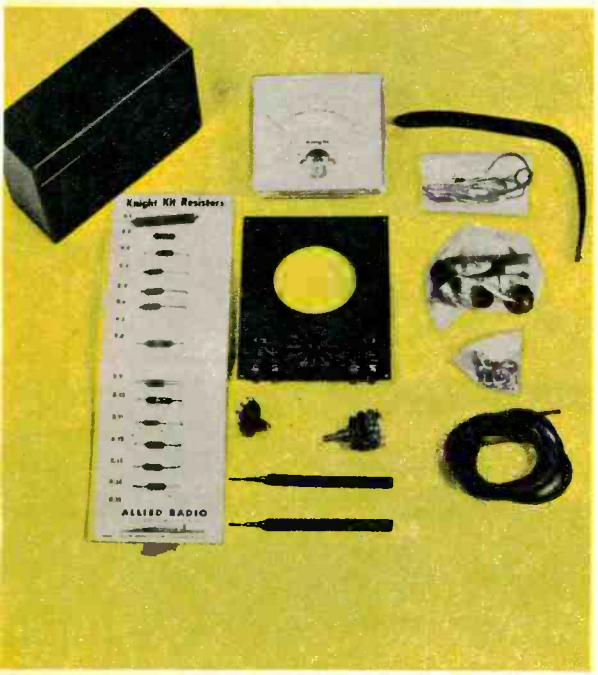




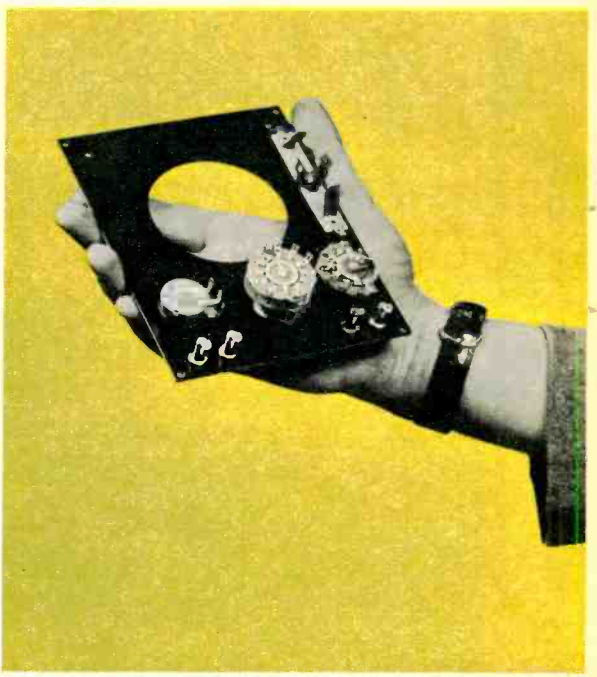
In a move to achieve high frequency transistor operation, researchers at Bell Labs have turned to compression bonding of gold leads to transistor below.



Complete complement of parts supplied in kit. Resistors are easily located on long card at left. Cabinet is made of Bakelite.



Construction proceeds with mounting of main components on the rear of the front panel. The meter will be installed on panel later.



EI assembles a

A Multitester

All the basic voltage, resistance, and current measurements are possible with this Knight-Kit.

COMMONLY known as the VOM (volt-ohm-milliammeter), the multitester is one of the most valuable aids for the experimenter, hobbyist, and troubleshooter. Virtually all types of servicing demand measurements possible with this versatile instrument.

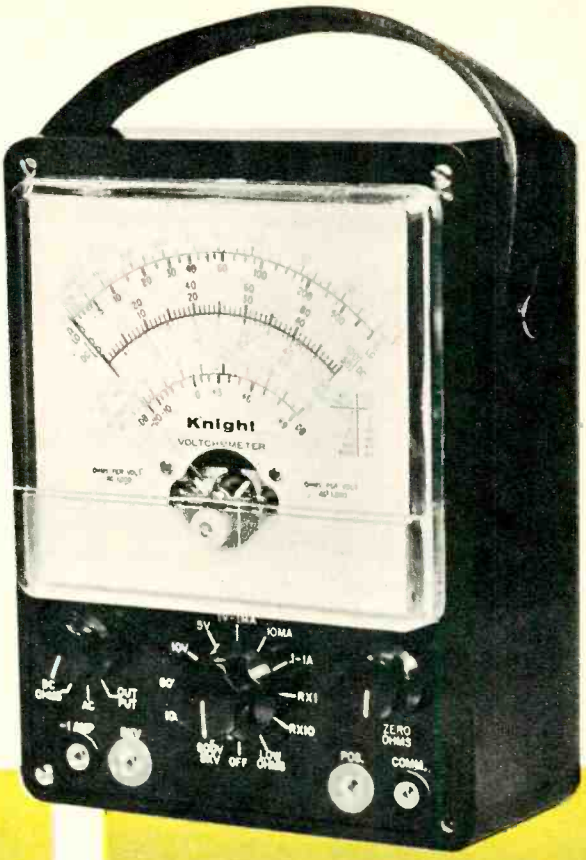
The Knight-Kit VOM from Allied Radio is typical of the units available. It can be assembled in a few short hours and is an excellent project for the beginner, never outliving its usefulness.

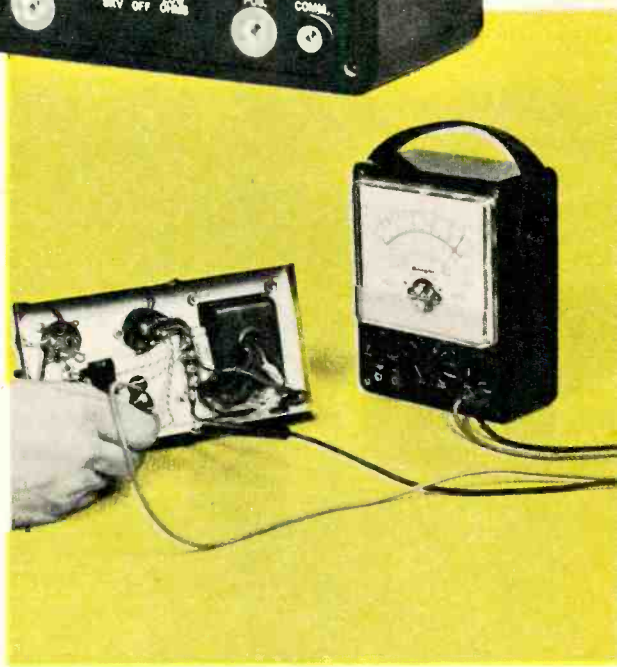
When soldering the resistors their leads should be grasped with a pliers to conduct the heat away from the body of the resistor. Otherwise, these precision parts will change value and ruin the accuracy of the readings.

Once the builder advances to complex servicing, the VOM will be a good companion to the more sensitive vacuum tube voltmeter (which doesn't have the milliammeter feature).

At $16.95 the Knight VOM represents a Good Buy.

Front panel shows, left to right, Function, Range, and Zero Ohms switches. Ranges up to 5,000 volts, 1 megohm, and 1 ampere are scaled on the meter face. Unit needs no external power.



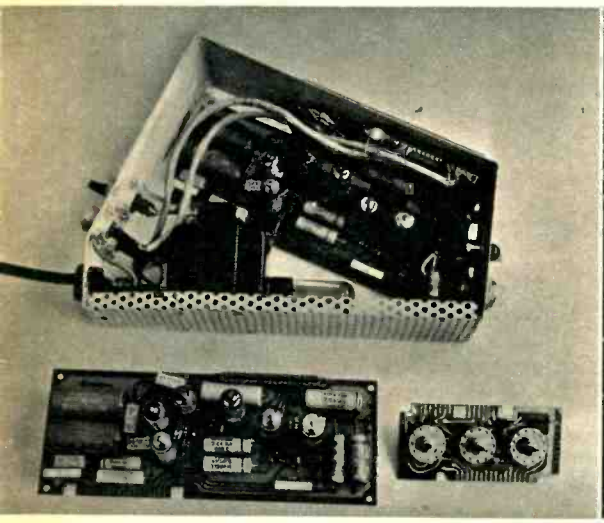


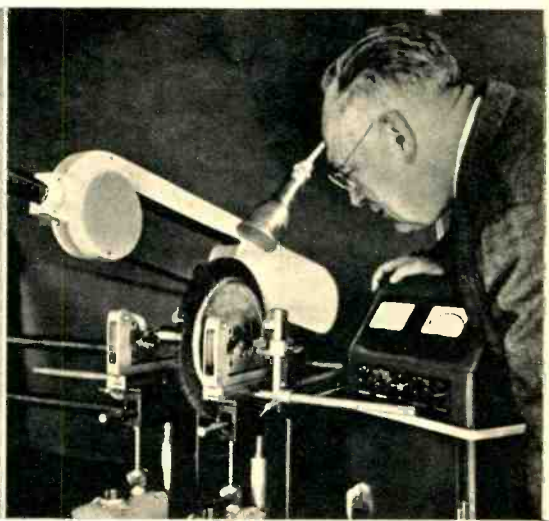
Wiring is complete, including the two probes. Note 1.5 volt battery, used in the ohmmeter section, mounted at upper right of panel.

Always place the meter on its highest scale before checking an unknown voltage or current to avoid pinning and bending the needle.

electronic balancing takes the

Wobble Out Of Car Wheels





Electronic control circuit for balancer is shown at left. It amplifies signal from vibration pickups to synchronize strobe and drive meter. At right, wheel balancing principles are applied to a bladed turbine rotor.

A MAJOR cause of uneven tire wear, low gasoline mileage, and excessive vibration noise is wheel unbalance. Discovering what unbalance is and what to do about it has occupied about 30 years in the life of Marcellus S. Merrill, head of Merrill Engineering Laboratories, Denver, Colo. His pioneering has developed an electronic wheel balancer that can balance a wheel to a tolerance of ⅛ ounce in just 75 seconds. His principles are used in industry to balance anything that rotates: jet engine rotors, turbines, crankshafts, flywheels, etc.

What is unbalance? Well, there is more than one kind and each has to be corrected to make a wheel run true. An unequal distribution of weight around a jacked up wheel tends to rotate it so that the heaviest portion is on the bottom. Kinetic unbalance is static unbalance in motion. This includes distortion of the tire and tube when the wheel rotates at fairly high speeds. This condition can produce depressions in the rubber and uneven wear as heavy portion of tire hits the road with its greater force.

Dynamic unbalance produces vibrations in the lateral plane, side to side. This is due to a coupling action set up in a wheel assembly by two forces working opposite each other in different planes. This condition causes wheel wobble.

The electronic balancer not only has to determine the amount of unbalance, but it has to locate the heavier spot on the wheel. Here's how it works: The wheels to be balanced are raised off the floor. The jack crossarm itself serves as a pivot around which the vehicle can [*Continued on page* 109]

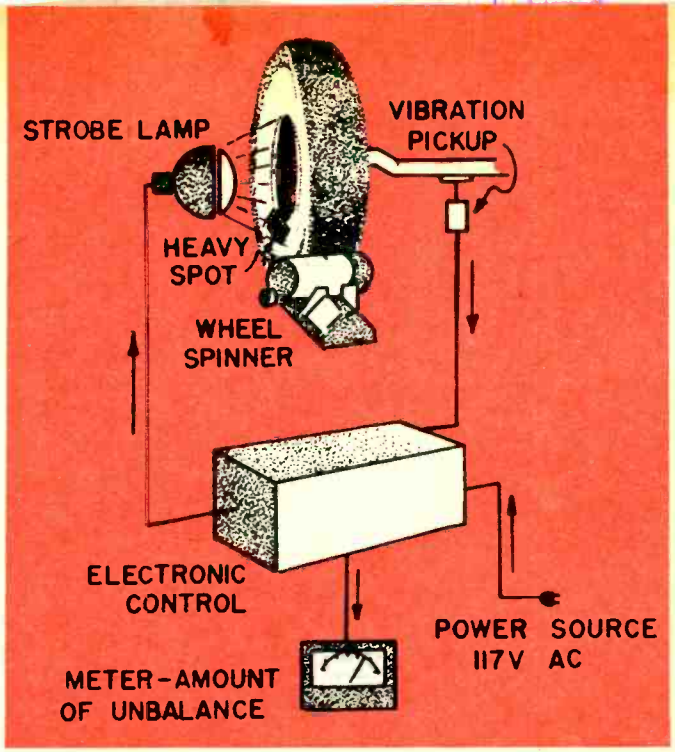
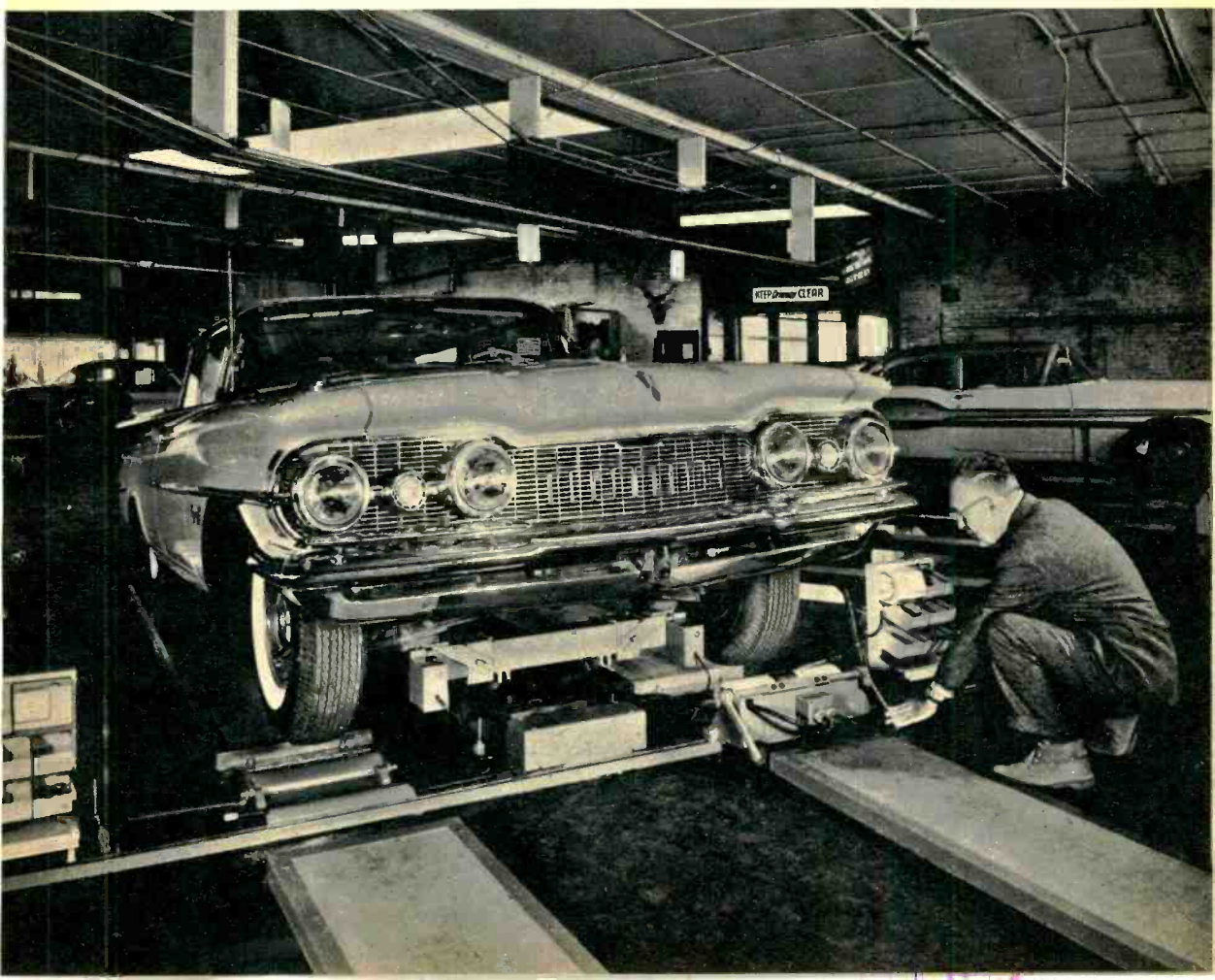
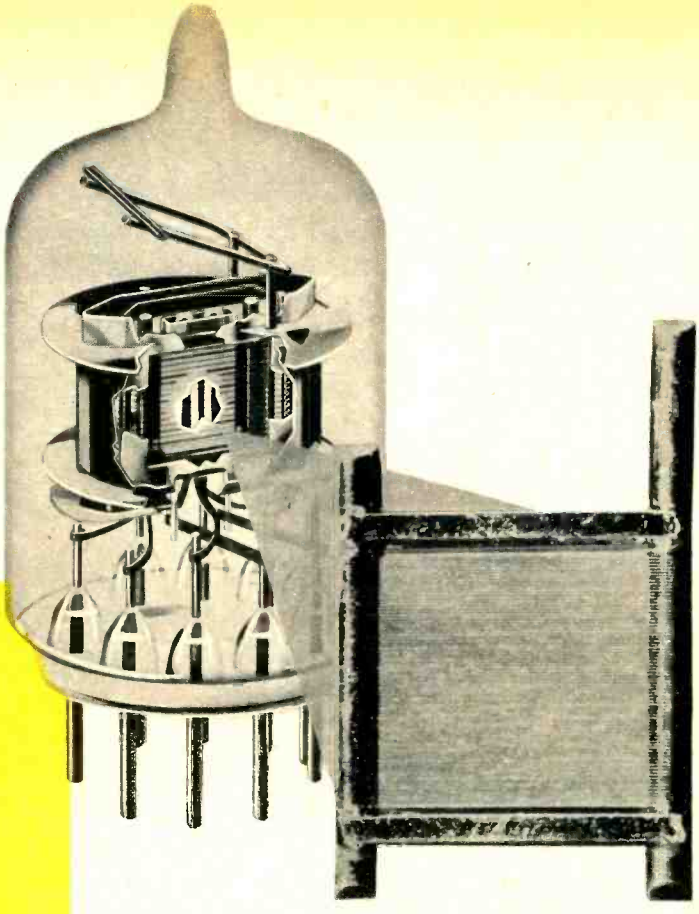


Diagram indicates how a wheel is set up for electronic balancing. At peak meter reading, operator can see the apparent position of the wheel under the strobe light. Heavy spot always appears to be at bottom.

Besides his engineering laboratories, Merrill runs a wheel and axle service in Denver. Below, he is seen adjusting the position of the vibration pickups. Note strobe light at right.

Photos from John Rees, Black Star





A control grid utilizing frame construction is shown removed from an Amperex 6688. Extremely close spacing of tungsten wire results in high gain.

The ABC's of Electronics-14

By Donald Hoefler

Characteristic curves reveal many aspects of tube operation. Here is how to interpret them.

ELECTRON tubes are made in hundreds of different types, each designed with a special set of characteristics to enable it to do a specific job. The four families of vacuum tubes we have discussed include diodes, triodes, tetrodes and pentodes. Within these four families, in receiving tubes alone, we find rectifiers, detectors, voltage amplifiers, power amplifiers and oscillators. When we add transmitting, cathode-ray and special-purpose types, the variety becomes truly vast.

One way of determining if a tube is suited for a given application is to examine its *characteristic curves.* Such curves are sim-

ply graphical representations of the tube's behavior under actual operating conditions. The two most commonly used sets of curves show how the tube plate current responds to changes in grid voltage and plate voltage.

To show this requires two sets of curves, one for grid voltage and another for plate voltage, as shown in Fig. 1. Since there are several other possible variables, these must be established in advance, since a two-dimensional curve can represent only two variable quantities.

The curve of Fig. 1 (A), for example, shows how plate current will vary with grid voltage, *only* when (1) the filament voltage is at the recommended 6.3 volts, and (2) the plate voltage is 250. If either of these conditions should change, the shape and position of the curve on the graph would shift as well. Therefore both the filament voltage and plate voltage are stated right on the curve.

Typically this tube is biased at —8 volts. Following the curve of Fig. 1 (A), we find that when the grid voltage reaches —8, the plate current is 8 milliamperes. Similarly, the recommended operating plate voltage is 250. Then following the curve of Fig. 1 (B), we see that when the plate voltage reaches 250, the plate current is again 8 ma.

Points on a graph, however, only tell us about static conditions. That is, we can only learn about changing, or dynamic characteristics when we consider a section of the curve. Suppose for example that an incoming signal has a 2 volt positive peak. This would drive the grid from its fixed bias of —8 up to —6. From Fig. 1 (A), we see that plate current then goes up to 12.7 milliamperes.

Now let's drop the grid back to —8 and check Fig. 1 (B) to find out what the plate voltage would have to be to force the plate current up to 12.7. We find on the graph that this figure would be 290 volts. Thus a grid voltage decrease of 2

Fig. 1 (A). The effect of grid voltage on plate current flow is shown by this curve.

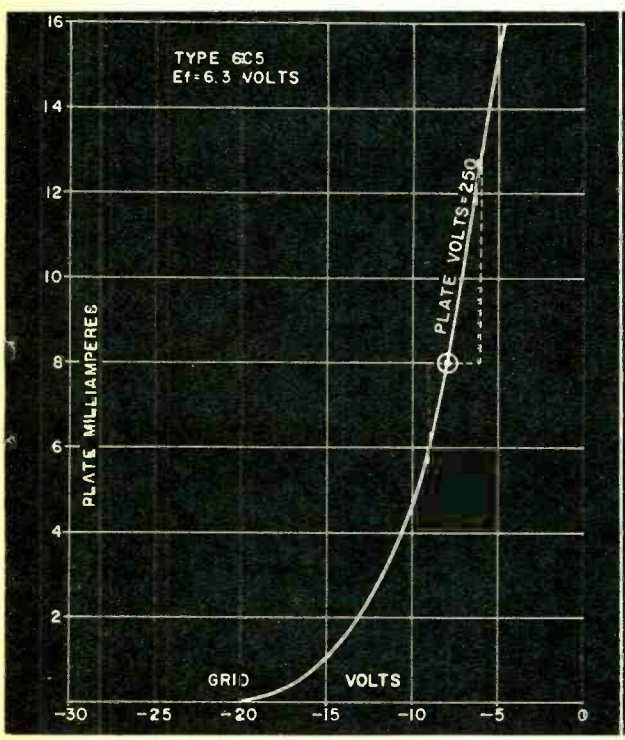
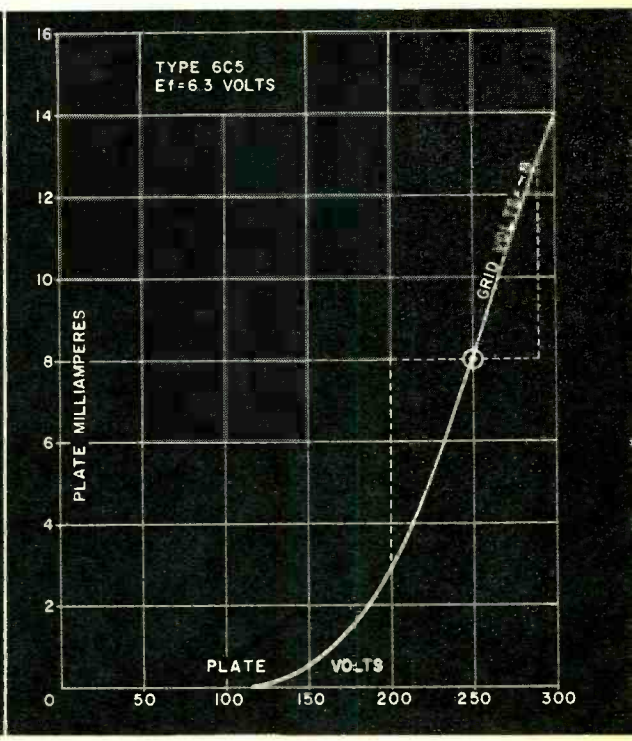


Fig. 1 (B). Plate current flow is changed by varying plate voltage according to this curve.



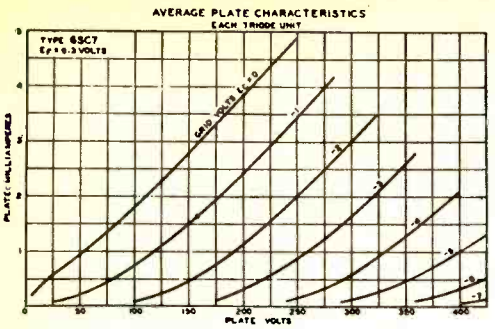


Fig. 2. A typical "family" of plate current-plate voltage curves for a high-mu twin triode.

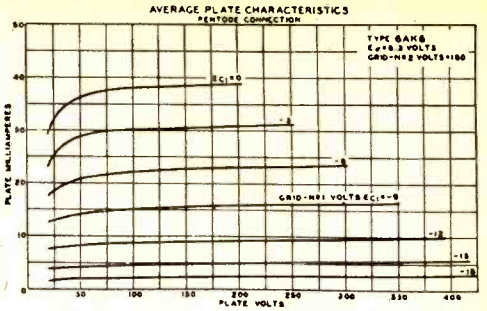


Fig. 3. The power pentode curves are not nearly as steep as those of the triode in Fig. 2.

volts will cause exactly the same increase in plate current as will a plate voltage increase of 40 volts. The grid is therefore exactly 20 times as effective in controlling plate current as is the plate.

This ratio, which expresses the relative effectiveness of plate and grid in controlling tube current, is known as the *amplification factor*. Since tubes having one or more grids are inherently voltage amplifiers, it is to be expected that some such figure of merit would be required, and its symbol is μ (Greek letter *mu*). In mathematical terms, the ratio is expressed as

$$\mu = \frac{\triangle E_p}{\triangle E_g} \text{ for the same } \triangle I_p$$

where $\triangle$ means "a change in"
E_p = plate voltage
E_g = grid voltage
I_p = plate current

It should be understood that the mu of a tube is only a relative indication of the amount of useful voltage which will be developed across the plate load circuit. The actual size of the output signal will depend upon the load impedance, and also upon another characteristic of the tube itself, *plate impedance*.

Referring again to Fig. 1 (B), note the effect of reducing the plate voltage from 250 to 200. The plate current drops from 8 to 3 milliamperes. These two facts are all we need to find the plate impedance, which is expressed mathematically as

$$R_p = \frac{\triangle E_p}{\triangle I_p}$$

The simple calculation is nothing more than an application of Ohm's Law. In this case the plate voltage has shifted 50 (250-200) volts, and the resulting plate current change is 5 (8-3) milliamperes, or 0.005 ampere. The plate impedance then becomes (50 ÷ 0.005), or 10,000 ohms.

Plate impedance is often referred to as plate resistance. Since nearly everyone does it, we won't take issue with the practice, but it should be understood that plate resistance actually has another meaning. This is simply the quotient of the normal operating plate voltage and plate current in the tube. In Fig. 1 (B), for example, under normal operating conditions the plate voltage is 250 and the plate current is 8 milliamperes. Dividing 250 by 0.008, we get a DC plate resistance of 31,250 ohms, a fact which is of very little value in determining the performance characteristics of the tube.

While the amplification factor is purely an abstract number expressing a ratio, plate impedance is an absolute value, expressed in ohms, a definite electrical quantity. Another tube characteristic which is also expressed in an electrical quantity is transconductance or *mutual conductance*.

Returning again to Fig. 1 (A), consider what happens when the grid voltage increases from —8 to —9. The plate current decreases by 2 milliamperes, the difference between 8 and 6. The quotient of these two changes is the mutual conductance, expressed as

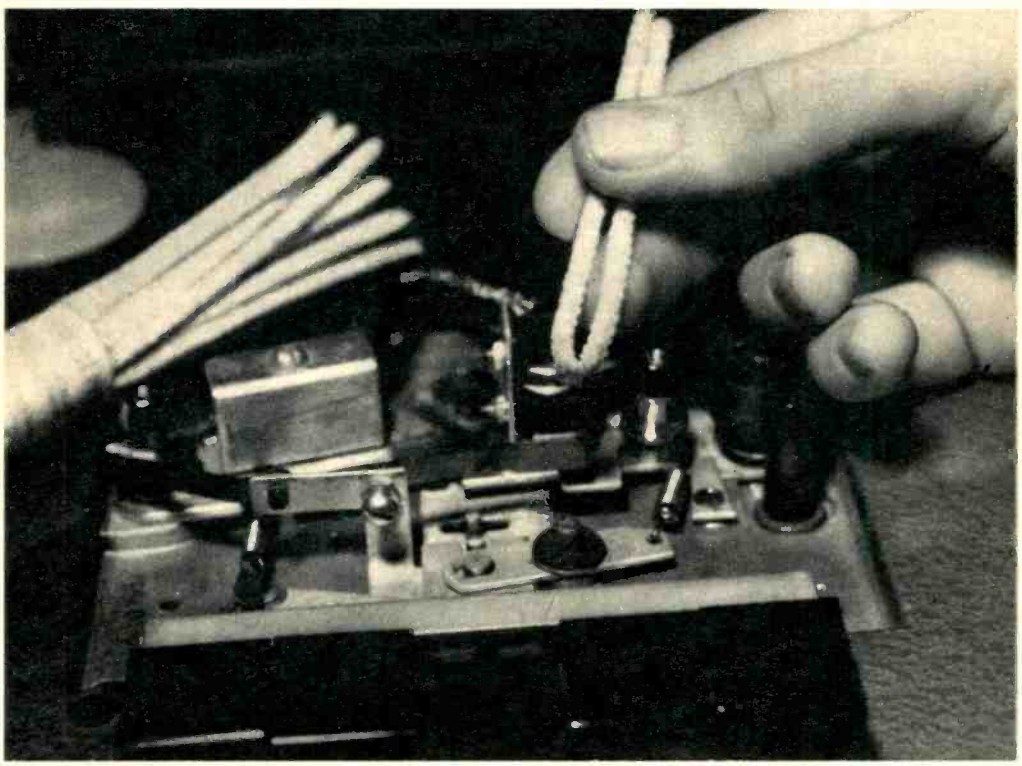
$$g_m = \frac{\triangle I_p}{\triangle E_g}$$

[*Continued on page* 108]

Try These

Pipe Cleaner

Use a pipe cleaner as a brush for removing dust or other accumulations from a tape recorder. It's handy too, for applying cleaning solvent or lubricant. Be sure to clean the heads regularly so tapes seat properly.

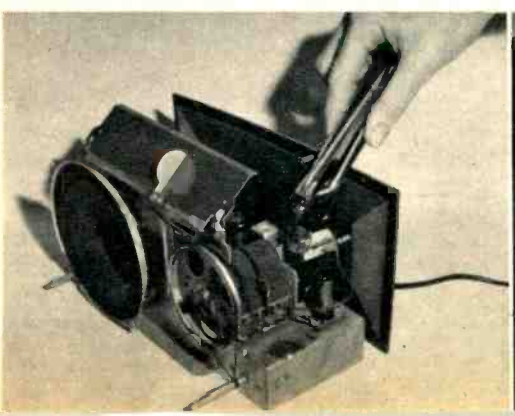


Removing Tubes

A pair of photographic print tongs make hot or hard to reach tube removal a cinch. Rubber electricians tape on the tips give them a no-slip grip.

Slipping Dial Cord

After a period of time, a dial cord will stretch. Wrap the tuning shaft with white adhesive tape for one or two turns to increase the friction.



Continued from page 82

current to flow through the base region. In other words, frequency response goes down as the time for the current to flow through the base region goes up.

Diffused-Base Transistors

Since about 1956, practically all effort on high-frequency transistors has been concentrated on variations of what is known as the diffused-base concept. This term comes about because of the manner in which the junction between the N-type collector and the N-type emitter are formed. The base material and an impurity are sealed together, then heated to a high temperature. The impurity, such as arsenic, changes into a gas which *diffuses* into the base material to form the junction, an extremely thin one for fast electron transit. Also, during the diffusion process the base region near the emitter is given more impurities than at the collector. In operation, the base pulls more electrons from the emitter causing a faster current flow. The combination of both factors goes a long way toward increasing frequency response.

At the present time, there are two transistor types available commercially that are vying for high-frequency honors. These are the "mesa" and MADT transistors, both diffused-base units.

The mesa gets its name from the fact that the base region is etched away to form a plateau, or mesa. The whole object of the etching process is to reduce the total base area and enable higher frequency response.

MADT stands for micro-alloy diffused-base transistor. Micro-alloy describes a combined etching and electroplating process used in manufacturing procedure. It does not contain the plateau of the mesa transistor.

The mesa technique has been adopted by many manufacturers and currently there are about half-a-dozen mesa transistors on the market that operate above 300 mc. The MADT type is patented and licensed by Philco. At the time of this writing, there is one commercially available MADT type that operates above 300 mc.

What Next?

Some experts feel that we have reached a plateau in the state of the transistor art. From now on it will be mainly a process of manufacturing refinements rather than new basic techniques. These refinements may give us commercial units operating at one-billion cps by 1960.

Materials other than the commonly used germanium and silicon show promise for transistor manufacture. Some of those under investigation are silicon carbide, germanium-silicon alloys, etc.

Miniaturization continues to be the outstanding contribution of the transistor, and demands keep getting stronger. David Linden, of the U. S. Army Signal Research and Development Laboratory, announced that the Signal Corp's aim was a complete electronic circuit manufactured and packaged so that it consists physically of an ultra-small module containing up to one million parts per cubic foot!

Another growing area of importance for transistors is in so-called "static devices" (those with no moving parts). A static relay developed by the Walter Kidde Co. for example depends upon a transistor that either conducts or does not conduct, rather than employing contacts that open and close. This does away with the problem of sticky and worn-out contacts.

The automotive industry will soon benefit from transistor science. Already we have seen such items as transistorized ignition systems, mirror positioners, headlight dimmers and hi-fi auto record players.

Power transistors are getting bigger and bigger. Delco Radio Division just announced the 2N1100 series yielding up to 15 amperes.

Many important and unusual things are being done with out-of-the-ordinary transistor diodes such as switching diodes, four-layer diodes, solid-state thyratrons, double-based diodes, unijunction transistors, silicon controlled rectifiers, Dynistors, Thyristors and

Trinistors. These all make excellent switches and have the added ability to remain conductive after the original triggering signal has been removed.

Another switching diode showing great promise for extremely fast switching speeds is one that operates on the "avalanche" effect. Sperry Rand has a diode that switches in 50-trillionths of a second! Current flow is blocked in the diode until it is triggered by a small voltage pulse. This slight increase in voltage accelerates one or more electrons to speeds high enough to knock new electrons into action. These, in turn, knock more electrons and the final result is a current flow carried across the junction by this "avalanche." To turn the switch off, the voltage is reduced. This reduces the speed of the electrons so that they cannot knock other electrons loose.

Field-Effect Transistor

Of great importance in future applications is the unique field-effect transistor. Of all transistors, it is the most closely comparable to the vacuum tube.

Conventional junction transistors such as those we've been discussing have low input—(emitter) resistance and high output—(collector) impedance. But the field-effect transistor, like the vacuum tube, has a high input impedance and lower output impedance.

It has been stated that some experts feel that a plateau has been reached in transistor development. But some quite different techniques allied to transistors are first beginning to be known. Much activity is taking place in "molecular electronics" or solid circuits. This technique is striving to achieve complete circuits and equipment from a *single, solid piece of semiconducting material.* This is done by manufacturing into the single semiconducting piece functions of resistance, capacitance and amplification. Another way of looking at it: Instead of manufacturing individual transistors or resistors or capacitors, any variety of combinations of these are manufactured into one piece of material. Still in its infancy, successful molecular electronics is perhaps the key to new wonders.

Soviets Show TV Missiles

Continued from page 32

automobiles are being examined by American visitors to the exposition, as are various consumer products, medical exhibits and two "typical" Russian schools. But the greatest interest centers around a fully instrumented model of Sputnik III.

Americans visiting the Coliseum may view special closed circuit television in an arrangement similar to the one that proved so popular at the United States exhibit at the Brussels Worlds Fair last year. They can also get a look at the latest television sets sent over by the Kozitsky factory in Leningrad. Designed into large "pieces of furniture," the sets each have a capacity of 12 channels, and some even include a remote control panel for tuning.

Other consumer items on display include tape recorders and hi-fi sets, the quality of which is in question. The editors of *ELECTRONICS ILLUSTRATED* recently tested some of the latest Russian "hi-fi" recordings and found them below American and European standards of fidelity.

An entire radio electronics section includes Russian communications equipment, semiconductor devices, electronic navigation aids and displays on various infrared techniques. Unfortunately, photos of these items were not available in time to include in this issue.

No less than seven computers are on display, ranging from "calculator" units to more complex data-handling machines.

A big move toward automation seems to be in process in the Soviet Union, judging from the exhibition's stressing of automatic machine tools. There are working models of automatic coal-mining machinery, an automatic loading center for coal fields, and an automatic drill for oil wells.

Borrowing a slogan from President Eisenhower, the Russian exhibitors have lumped models of a 680-million electron volt synchrocyclotron and a 10-billion electron volt synchrotron under the banner "Atoms for Peace."

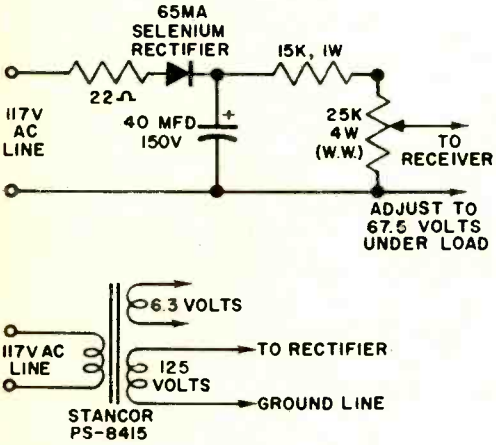
The Electronic Brain

Continued from page 63

AC Power Supply

I am building an electronic door opener for my garage. The receiver calls for a 67½ volt battery which I want to replace with a small AC operated power supply. Can you provide the circuit?

Paul Kucher, Burgettstown, Pa.



Yes, this is relatively easy to do. The simplicity of the power supply in the accompanying diagram is made possible by the fact that the garage door opener receiver must drain very little current from the battery, otherwise a circuit such as this would not have been published at all.

For the sake of safety, this power supply should be built up in a wood case and all leads coming from it should be considered as "live" AC connections. In order to save you some money, we have designed this without an isolating transformer, hence the precaution just given. If you don't mind the extra expense, you might obtain a low-power transformer such as the Stancor PS-8415 and use this to isolate the AC line from the power supply. Since this transformer also has a 6.3 volt secondary winding, you could include a pilot light to show when the receiver is on.

Learning Electronics

Your magazine must number many beginners among its readers who have the same trouble I do in attempting to understand the technical terminology and concepts. Can you provide me with a list of books that might help?

George D. Gillis, Norwood, Man.

ELECTRONICS ILLUSTRATED does attract a large number of readers who are just beginning their study of electronics. We consider our electronics "amateurs" as extremely important citizens because they will most certainly be needed in peace or war after they have learned the field. We are happy to list the books you request and have signified their level of difficulty to help you choose the right ones first.

Marcus and Marcus, "Elements of Radio," Prentice-Hall. Very basic and elementary; excellent for beginners.

Watson, Welch, and Eby, "Understanding Radio," McGraw-Hill. Almost as elementary as Marcus and Marcus.

Keith Henney, "Principles of Radio," Wiley and Sons. For ripe beginners; somewhat more difficult than those above.

Slurzberg and Osterheld, "Essentials of Radio and Television," McGraw-Hill. Technician's level; to be used in conjunction with more elementary texts.

Grob, "Basic Television," McGraw-Hill. About same level as Slurzberg and Osterheld but more practical in nature.

Radio Control for Garage Door

Is there any reason why model plane radio control units cannot be used as control elements for an automatic garage door opener system?

R. J. Uhlenbrock, Florissant, Missouri

The first and most obvious shortcoming is that model plane receivers and transmitters are designed for battery operation. Since the receiver must be on at all times in the garage, this would be a very undesirable approach to the problem. The construction of a suitable AC operated power supply for this equipment would be a relatively difficult task and would be hardly worthwhile. Model plane equipment, furthermore, is not designed for the same kind of reliability and longevity that one finds in garage installations.

They Find Oil With Electronics

Continued from page 49

truck-mounted drill rigs and their youthful three-man crews. Every quarter mile they drill a shot-hole, five inches in diameter augered 45′ deep through muskeg, ice and snow. Into the shot-hole, the shooters pack dynamite, the source of seismic energy and those rumbling shockwaves.

Close by the shot-hole stands the recording truck, an instrumented electronic marvel. From its console, the team's *recorder* calls the signals. The blast, when it comes, jars the strata clear to bedrock, 15,000′ and more underground.

Consider for a moment what happens when a pound or more of dynamite explodes 45′ or so below the frozen surface. Sound energy hurtles outward and downward from the explosion. The higher frequencies travel a few hundred feet. Lower frequencies, however, punch through the strata. The more compact and compressed the strata, the higher velocity. Through limestone, seismic waves may travel 25,000′ per second; salt beds, 25,284 fps; loosely packed surface layers, only 500-1000 fps.

The sound absorption of the surface layers is one reason shot-holes are drilled—to get the dynamite below the earth's velocity barrier, its weathered upper crust.

Rebounding waves are picked up by microphones called *geophones*—delicate galvanometers which convert sound energy to electrical energy (and, in the process, direct current to alternating current). The fist-sized, 5-lb. geophones—perhaps 50 of them strung out a quarter mile either side of the shot-hole—consist of a permanent magnet core around which is suspended a delicate coil.

The geophone's rugged iron case (which also acts as a magnetic shield) is, in reality, a part of the ground itself.

Suppose a 40-cycle sound wave, reflected from miles below ground, causes the muskegs to undulate 40 times a second. The geophone's magnetic core likewise vibrates 40 times a second—40 times cutting the magnetic field, and 40 times inducing a minute dab of current in the coil. Electrical output from a single geophone may be only a few microvolts, though the initial blast may induce up to 3 volts.

Reflected sound, now AC, flows along $10,000-$20,000 worth of winterized cable (a scant half mile of it) to the recording truck and its oscillograph-recorder.

First, the signal is amplified, then recorded on magnetic tape. Finally, it's fed to a sensitive galvanometer which pulls an electronic sleight-of-hand: converts the reflected wave to a beam of light which traces the wave pattern on photographic paper.

Simultaneously, a timing circuit within the seismic recorder clocks the instant of explosion and every 1/100th of a second thereafter.

This final conversion is simple. Involved is a galvanometer (a coil surrounded by a permanent magnet) and a light source. To the coil is cemented a tiny mirror. A light plays on the mirror. When the incoming signal energizes the galvanometer, a strong magnetic field is induced. In this field the coil turns—turning the mirror and tracing a pencil-sharp beam of light on the photographic paper, which itself is moving along from 14-28″ per second.

Developed, the photosensitive paper is a maze of wiggling lines, each traced by a geophone's input signal.

Why the magnetic tape recording? Because it can be played at anytime to reproduce a sub-surface map. A geophysical executive recalls a major oil company who recently wanted a narrow mile-wide section of the Canadian Arctic "profiled" from magnetic tape recorded more than two years before. The resultant sub-surface map—its every detail precisely etched—convinced geologists that, as suspected, a drillable site had been overlooked.

"We won't know for a few months whether their hunch was right and whether there's oil down there," said one seismic, "but the point is, with an assist from electronics, we can remap sub-surfaces from tapes made years ago with no trouble at all."

Big Boom in Rocketry

Continued from page 35

that these high school students represent the professional rocket scientists, mathematicians and engineers of the future, it would be foolish and tragic to let the admittedly inexperienced yet talented youngsters blow their limbs off and wreck property simply because they lack the necessary information to experiment with rockets in a safe manner. Consulting its rocket and fuel experts, the Army published a framework of basic safety rules in which the amateur could develop his design, yet live to conduct further experimentation.

The Army also issued a directive which authorized its area commanders to cooperate with amateur rocket clubs, missile and other scientific groups in the development, making and testing of rockets. That was a year ago. In the Washington, D. C., area, the National Capital Section of the American Rocket Society joined with experts of the Second Army in conducting a 15-week course "The Science of Rocketry" at the Engineer Center, Fort Belvoir, Va. The course was a huge success, attracting up to 175 youths, teachers and parents.

The first big shoot in the East, pictured on these pages, was held on the final Saturday in February at Camp A. P. Hill's range. Many of the youths were from the Washington, Maryland and Virginia area; but a large contingent—two full buses—journeyed from First Army headquarters at Governor's Island in New York Harbor. These were the boys from the New York, New Jersey and New England area.

As the rockets were unloaded from cars and trucks, one could readily see that there was no set formula, no consistent design. Materials varied from polished stainless steel tubing to aluminum, lead pipe, and even cardboard. Some rockets were gaily painted, others plain. Some showed almost professional machining of nozzles and nose cones; others were less professional. They ranged in size from an 11′ two-stage rocket to missiles just a few inches long. The average length was about 18″.

Perhaps the most unusual rocket configuration was the missile pictured on our cover. It took Gerd Nathan, of Baltimore, Md., about a month and a half to construct the three-stage job, with its accompanying launcher. The young man, however, suffered disappointment due to a faulty firing mechanism.

The first order of business was a safety lecture by Lt. Col. Charles Parkin. Then there was a dramatic demonstration of what a poorly made rocket (actually it amounted to a bomb) could do in terms of damage. It blew two paper-stuffed dummies into confetti.

Then the rockets were fueled. According to the size and weight, various combinations of zinc and sulphur (a safe fuel recommended by the Army) were mixed and poured into the rockets. Some rocketeers used combinations of nitrate and sugar.

Group by group, the rockets were set on launching pads and fired from the bunker. Less than a third of 50 rockets were successfully launched, but the major trouble seemed to be in the firing mechanism, not the rocket design. Most rockets had a wire resistance embedded in the fuel. An electric current through the resistance was supposed to ignite the fuel, but too little wire or too much current melted the resistances before they could do the job properly.

The most successful of those that got off the launching pad was the rocket of the Monroe-Woodbridge Central High Rocket Society of Monroe, N. Y. Designed by 16-year-old Bruce Kalloff, it included a transistorized circuit to fire a flare as the rocket tipped over after attaining maximum height. By recording the time between launch and flash, the maximum height could be calculated, after allowing for slippage before the rocket actually tipped over to close the mercury switch and circuit. The Monroe rocket went 6000′ straight up.

Those who failed to get their missiles off the ground generally were able to figure out what was wrong, and are looking forward to another chance. Those who were successful have already drawn up plans for bigger, better rockets to include instrumentation, radio transmitters and live animals.

Fun With Fluorescent Starters

Continued from page 75

To make an inexpensive portable fire alarm follow the diagram on page 75.

A somewhat more ambitious project but one that is well worth the time spent on it, is the thermostatic soldering iron stand. Even if you own a soldering gun, it is desirable to use a standard iron when the job you have to do is a long one. Any iron, left on full heat for long periods of time, begins to develop an oxidized and pitted tip that makes soldering difficult. Also, the life of the tool can be extended indefinitely by running it at a workable but not excessive temperature.

The stand to be described was designed for a 125-watt iron but will work for any model if you change the dimensions to suit the case. This one is built on a piece of pine stock measuring 11½"x5"x¾". The thermal chamber consists of a minibox of hammertone finish aluminum 3¼"x2⅛"x1⅛" (Bud type CU-2117). A triangular hole cut with a tin shears is centered on the little front panel to permit entry for the tip of the soldering iron; the triangle's apex at the bottom also serves to position the tip the same way each time it is inserted in the hole. The bi-metal sensor and its capacitor are both supported by a three-lug terminal strip placed so that the heat element is secured about ½ inch above the tip when it is in place.

A line cord, flush-mounting Edison-base socket, female adaptor, pilot light, and relay complete the complement of components. The relay is an inexpensive 120 volt AC type of the single-pole, double throw variety. (Potter and Brumfield type KT-11A or equivalent.)

In any thermal-controlled system, there are two conditions for which adjustments must be made: (1) triggering temperature and (2) differential temperature. The triggering temperature determines the maximum temperature to which the thermal chamber will rise before the bi-metal sensor triggers the relay to the off position. This adjustment is made by raising or lowering the bi-metal element with respect to the tip of the iron. The farther away they are, the higher must the chamber temperature rise before relay action occurs.

The differential temperature is the range in degrees between the triggering temperature (heat off) and the temperature to which the chamber must drop before the iron comes on again. The differential in this stand is governed by the freedom with which air convection occurs. A 1-inch hole is cut in the top center of the minibox and equipped with a swivel cover that permits the opening to be made any size desired. With the hole wide open, the triggering temperature will be high and the differential small; i.e., the iron will reach full heat before triggering the relay but the "off" time will be short because convection currents can cool the sensor quickly as the iron temperature will be lower. With the hole completely covered, the triggering temperature will still be high but the differential will be much greater; the "off" time will be longer and the average iron temperature will be lower. In-between adjustments will permit you to establish just the conditions that suit you best. There is a ⅜" hole in the rear of the little box and two small holes on either side of the triangular cut-out; these encourage convection when the swivel cover is open.

Remember to save those old starters in the future. The number of things you can do with them is limited only by your imagination. In the foregoing projects, the starters were applied as normally-open devices but there is no reason why the bowed type cannot be bent around to form a normally-closed unit that will open a circuit when it is heated. Using this principle, you can design your own flasher in which an incandescent lamp turns itself off by the heat it generates, then comes on again when it cools. You can make your own thermal time delay relays by locating a little heating coil near a normally-open starter; then, by throwing a switch, the heater will come on but the starter will not key the main circuit until the bi-metal has time to straighten out. Other interesting applications will undoubtedly suggest themselves to you as you experiment with these "something-for-nothing" elements.

How To Use Meters

Continued from page 41

wise to a higher scale until the meter comes back on scale.

All other DC voltage measurements would be made in exactly the same fashion, each differing only in the setting of the range selector switch.

AC voltages are measured by setting the switch at the left side of the panel just below the meter scale to the AC position. (This switch is frequently called the FUNCTION switch.) The center selector switch (known as the RANGE switch), would then be set to the proper voltage value. Note that the same voltage ranges exist for both AC and DC voltages; furthermore, for AC voltages higher than 500 volts we would still shift the red lead from the POSITIVE terminal to the pin jack marked "+5000V." Lead polarity in the measurement of AC voltages is not important; either lead may go to one end of the voltage while the other lead goes to the other end of the voltage to be measured. All AC values are given in RMS voltage, the most commonly encountered method of describing alternating current.

A simplified circuit diagram showing the meter arrangement for measuring AC voltages is given in Fig. 2. The meter itself deflects only in proportion to the average current passing through it. The average value of alternating current is zero since it goes equally plus and minus during one alternation. It is necessary that the current drawn by the instrument be rectified so the meter will read one side of it (either plus or minus). This is done here by a copper-oxide rectifier to obtain an average value of current which is proportional to the applied voltage. The rectifier circuit permits only alternate half cycles of the drawn current to pass through the meter. The remaining half cycles of current bypass the meter; thus, the current through the meter is a pulsating DC which causes a deflection proportional to its average value.

Another facility of this instrument is the measurement of DC current. The first step is to set the small slide switch to the DC position. Next, the center selector knob is set to a current range (1 MA, 10 MA, and .1A-1A) which you feel includes the current value you are measuring. If there is any doubt in your mind, always turn the selector switch to the highest current range before inserting the instrument in the circuit. Failure to observe this precaution may result in serious damage to the meter. If the unknown current is too low for accurate measurement on the highest range, rotate the selector switch to a lower current position until the range is found at which current can be read accurately.

When a current is being measured at any range except the 1A range, insert the test leads in the pin jacks marked POSITIVE and COMMON and place the instrument in series with the component through which the current to be measured is flowing. If the pointer deflects in the wrong direction, simply reverse the test leads. Current in either the .1A range or the 1A range are measured with the selector switch in the .1A-1A position. However, to use the 1A range, insert the test leads in the pin jacks marked POSITIVE and —1 AMP.

AC currents are measured in the same way as DC currents with the following difference in procedure: AC-DC slide switch is placed in AC position.

One of the most frequent jobs that a VOM is called on to perform is the measurement of resistance. The method of setting up the instruments for these measurements differs to a certain extent from the preceding measurements in that now still another control is brought into the operation. This is the control marked OHMS ADJUST and it is located at the right-hand side of the panel just below the meter dial in Fig. 1. How this control is to be adjusted follows.

As a first step in setting up the VOM for resistance measurements, move the slide switch to the DC position. Next, the test leads are inserted, the black lead going to the COMMON terminal, the red lead to the POSITIVE terminal. The center selector switch is set next and if you look closely at the various positions you will find that there are three devoted to resistances. One is marked LOW OHMS, another is

marked R X 10, and the third is marked R X 1. In the R X 1 and R X 10 positions, any readings on the resistance scale would be multiplied by the factor indicated, in this case either 1 or 10. If a resistance less than 100 ohms is to be measured, the selector switch is set to the LOW OHMS position. For a resistance between 100 and 1500 ohms, the R X 1 position is used and for a resistance above 1500 ohms the R X 10 position is used. This information is usually given in the instruction manual that comes with the instrument; however, if you have a VOM and the instruction booklet is not handy, then as a general rule, set the range selector switch to that position which enables you to read the resistance value most accurately.

After the selector switch has been set, the final adjustment to be made is to rotate the OHMS ADJUST control, with the test leads shorted to each other, until the meter pointer is directly over the zero mark on the ohms scale. Now it may happen, as it does in this VOM, that for resistance measurements on the R X 1 and R X 10 scale, the zero mark is at the extreme right-hand side of the scale. On the other hand, when the selector switch is set to the LOW OHMS range, zero adjust is made by rotating the OHMS ADJUST knob until the pointer is at the zero mark of the low ohm scale. This is at the left hand side of the dial. In this case test leads are not shorted together. This procedure happens quite frequently with VOM's. It does not occur with VTVM's, as we shall see later. In any event, it is absolutely necessary whenever a VOM is turned to a new resistance scale, that the instrument be zero adjusted. This is done to insure that when a resistance is introduced between the leads it will produce proper value on the meter. It is to be noted, too, that two entirely different scales are used, one when the meter is in the LOW OHMS position, the other when the meter is either in the R X 1 or R X 10 positions. Other VOM's use one scale for all resistance measurements and may have more resistance selector positions.

Next month our series continues with how to read meter scales.

Airport Monitor

Continued from page 52

end of this bus will be connected to the rotor of the tuning capacitor. Solder the twisted leads and the one used for positive bus.

Put the transistors in place last, so that their leads can be inserted through the proper holes and bent over the twisted leads to which they connect.

Next, you can mount the tuning capacitor on the board. Connect the long lug that goes to the rotor to the extended end of the battery positive bus and clip off the unused portion. Mount the crystal diode by bending one of its leads through a hole in the board and up through another nearby hole. Clip off the unused length. The free end of the 0.03 mfd capacitor connects to this lead. The other diode lead connects to one stator post of the tuning capacitor, along with one end of the one-turn loop. The loop is formed from a 7½-inch length of plastic covered bell wire. Remove about a half inch of insulation in the center of the loop. This allows an extra antenna wire to be clipped on when the receiver is in its case and the loop bent down on the outside of the case. The second end of the loop connects to the battery positive bus where it connects to the rotor lug. This method of assembly allows us to provide short leads in the tuned circuit.

The switch and the two penlight cells are the remaining parts to go inside the box. A plastic box of the type used for cigarettes was bought in a drug store.

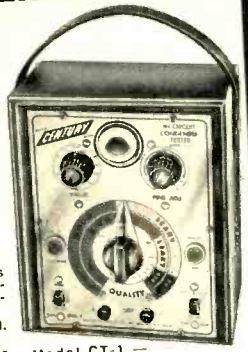
A hole is cut in the bottom of the case for the switch. The batteries are taped together and soldered in series and slid into the case with the chassis. Be sure to feed the earphone leads through a second hole in the bottom of the box before soldering them to the collector lead and the negative bus.

Best reception was had with a foot long clip-on wire held horizontally not vertically as would be expected. Beeps from airport radars can also be heard although their frequency of operation is much higher and not within the normal tuning range of this receiver. Radar peak power is very high.

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

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

SIZE: W–6" H–7" D–3¼"

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

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

❶ DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ 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 entangled 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-7⅛" 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.T.V.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 MEASUREMENTS . . . 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. DZ4s, 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.

111 Roosevelt Avenue, Dept. 408, Mineola, New York

CHECK INSTRUMENTS DESIRED

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

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

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 .....

New Technical School Courses

Continued from page 59

International Correspondence Schools. New equipment, typical of what is used in industry, helps train men in new electronic applications at Chicago's Coyne Electrical School, while the DeVry Technical Institute in the same city has added such courses as telemetering, magnetic amplifiers, computers, transistors, guided missile instrumentation, ultrasonics, and even stereophonic sound. Christy Trades School in Chicago plans to keep its students abreast of developments in automation, space travel, nucleonics, air navigation and seismography.

Regardless of individual variations in courses or training techniques, all the schools seem to agree that there is no overnight short-cut to these new fields. In other words, the fundamentals of radio electronics still form the solid base upon which all the advanced courses are built. This is not mere academic stuffiness. It is absolutely necessary to master basic electronic circuits and test equipment before one can do a successful job with the circuitry involved in computer maintenance, for example.

The approach to the rapidly advancing electronic technology at RCA Institutes is typical of several modern programs. The basic courses in fundamentals remain the same, but new courses are added periodically and introduced with them. It was discovered that a firm hiring a technically trained man to work on computers had to give that man a vast amount of additional on-the-job training. Of course, many industrial firms, in an effort to cut down their costly on-the-job training programs, have asked the technical schools to add more specialized training. But the additional special courses create a problem for both industry and the student. While receiving this extra training, the student's time would not be available to industry, and cost of the courses would be borne by the student.

There is, admittedly, no simple solution to these problems. RCA Institutes, for example, is exploring the idea of setting up a sort of "graduate school" beyond its normal two-years' residence periods for courses in medical electronics, computers, etc. But this would still require additional outlays of time and money by the students. By trying to squeeze the advanced material into the regular curriculum they run the risk of slighting the fundamental courses.

One step in getting around this dilemma is a "computer option" course which adds a "ninth term" to the normal eight terms. This course contains a good deal of technical meat and has helped to reduce the time usually devoted to on-the-job training.

Some schools have separated radio and TV servicing courses from the broader electronics technology course. In the former, they emphasize work on receivers; in the latter they introduce such topics as transistors and pulse circuits. Still another expedient has been the addition of advanced courses for evening students.

With all the new subject matter being undertaken by the technical schools, there are also new training methods. For one thing, the use of large demonstrator models has progressed to new heights. Coyne, in Chicago, has its own closed circuit TV system for teaching applications of video in medicine, industry, and military areas. At DeVry's laboratories, trainees work with the latest servomechanisms housed in a special training aid. By using clip connectors, students can assemble various servo systems quickly, and go from one circuit to the next with a minimum of difficulty. Even the familiar "breadboard" has grown into a huge chassis with all circuit points terminating in external binding posts. The top side of the unit permits many variations to facilitate circuit analysis and the construction of equipment. Underside of chassis is a lesson in model wiring and dressing of leads.

Of course, most of the advanced training methods—demonstrator boards, films, tape recorded quizzes, and so on—are available only at a residence school where the student actually spends his training time. But many advances are

[*Continued on page* 106]

STUDY AT HOME
for a career in ELECTRONICS

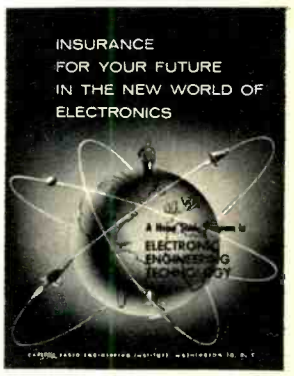
CREI prepares you quickly for success . . . in Electronic Engineering Technology, including Automation, Instrumentation, Industrial Electronics, Aeronautical Electronics, Guided Missiles, Radar, Servomechanisms, Computers, Astronautics, Telemetering, Communications, Manufacturing.

BENEFITS FELT RIGHT AWAY Almost immediately, you feel the benefits of CREI study. Your employer, when informed of your step toward advancement (only at your request), is certain to take new interest in you and in your future. What you learn in CREI Home Study can start helping you do a better job immediately.

CREI HOME STUDY . . . QUICK WAY TO GET THERE Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. CREI can help you, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. Study at your convenience, at your rate of speed.

INDUSTRY RECOGNIZES CREI EDUCATION CREI courses are prepared with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI technical education for their personnel. To name a few: All America Cables and Radio, Inc.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Gates Radio Company; Federal Electric Corp.; The Martin Company; U. S. Information Agency (Voice of America); Canadair Limited; Trans-Canada Air Lines; United Air Lines.

PAYS FOR ITSELF QUICKLY Your very first raise could repay your investment in CREI education, and leave you a profit the very first year. Increases in pay thereafter are pure profit, and you'll be prepared for many more promotions and pay raises. If you have had a high school education, and experience in electronics—and realize the need of a high-level technical knowledge to make good in the better electronic jobs—you can qualify for CREI home study. (Electronics experience is not required for admission to CREI Residence School.) CREI also offers residence courses in Washington, D. C. at the same high technical level. Day and evening classes start at regular intervals. Qualified residence school graduates earn degree of "Associate in Applied Science." Check coupon, or write Capitol Radio Engineering Institute, Dept. 178 F, 3224 16th St., N.W., Wash. 10, D. C.



Get This New Fact-Packed Booklet—It's Free!

Brand New Course: Automation and Industrial Electronics Engineering Technology
Covers all electronic phases of automation. Special emphasis on theory, functioning, and applications of servomechanisms and computers. Also noteworthy: Lessons on machine control, instrumentation, data-processing, and telemetry.

TAKE A MINUTE TO MAIL THIS COUPON FOR FREE BOOKLET!

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula—Founded 1927
Dept. 178F 3224 Sixteenth St., N.W., Washington 10, D. C.
Please send me your course outline and **FREE** illustrated Booklet, **"Insurance for Your Future in the New World of Electronics"** . . . describing opportunities and CREI Home Study courses in Practical Electronics Engineering Technology.

CHECK FIELD OF GREATEST INTEREST
- ☐ Radar, Servo and Computer Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Broadcast (AM, FM, TV) Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology L2
- ☐ Automation and Industrial Electronics Engineering Technology

Name ..... Age .....
Street .....
City ..... Zone ..... State .....
CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

To obtain fast, immediate service and to avoid delay, it is necessary that the following information be filled in:
EMPLOYED BY .....
TYPE OF PRESENT WORK .....
EDUCATION: YEARS HIGH SCHOOL .....
OTHER .....
ELECTRONICS EXPERIENCE .....

Tape Recorder On Vacation

Continued from page 66

your opportunity for collecting interesting sounds and conversations. Portables may be rented from some camera stores. If you use an inverter, you had better be prepared with a long, heavy-duty extension cord since many good opportunities will occur outside your car. Don't try to extend the microphone cable if you are using a crystal, ceramic, or other high-impedance mike. Cables longer than the 6'-12' lengths that come with such microphones may cause a sharp drop in the high-frequency response of your recording.

Whether this limit on microphone "stretch" will seriously limit your use of a recorder depends, of course, on the things you want to tape.

One solution is to get a low-impedance dynamic or ribbon microphone on which you can use cable extensions of practically any length. With such a microphone, however, you'll have to invest an extra $10 or $15 on a cable transformer to match the mike's output to the high-impedance input that is standard on most tape recorders.

With a truly portable battery-operated recorder you virtually have unlimited freedom to make tape recordings anywhere, anytime. You will want to carry it with you when you take photos or movies to make immediate recordings of background information to go with the pictures—as well as notes on lighting and exposure.

Sound doesn't have the same lively bounce out-of-doors as it does surrounded by four walls. Extraneous background noises and wind may also pose a problem. But you can keep these down to a minimum by speaking clearly and distinctly when you record in the open, and asking others to do the same. Hold the mike a little closer to your lips than you would ordinarily, though not so close as to record breathing sounds. The combination of a closer mike and a slightly louder voice allows you to keep the recording volume control turned down so that the mike won't pick up too many undesirable background sounds.

Even a slight breeze may cause the diaphragm of the microphone to move and crackle. But you can minimize this by wrapping a handkerchief over the mike. A thin piece of nylon or silk may be better than cotton or linen, though the difference probably won't be enough to worry about.

Tapes and recorders are pretty rugged, but it's a good idea to shield them from heat as much as possible. Reasonable care is enough. Don't leave tapes on the rear window shelf of your auto, and don't allow them to remain exposed to direct sunlight for extended periods. Reels should be stored flat, preferably in their original boxes or an 8 mm movie reel tin can.

Rewind each tape after you get home to relieve tension that may have built up in the spool from extreme temperature variations.

Rewinding is no problem, however, because you'll undoubtedly play your tapes promptly—and often—after you get home. Vacation snapshots in sound are fascinating while you make them, and they'll keep the fun alive through the winter ahead.

TV Over The Horizon

Continued from page 79

TV programs from Sweden, Finland, Italy and other European countries.

Each year the AIPA holds a convention to exchange ideas on improving antennas, TV sets and tuning techniques. Should you be further interested in this fascinating hobby, you can get a free bulletin on TV DX by writing to Art Collins, 68 Amber Street, Buffalo, N. Y.

The Top Ten of the AIPA

Name	*Home Town*	*Stations Rec'd*
B. Brown, Jr.	Austin, Tex.	334
R. Seybold	Dunkirk, N. Y.	319
A. Collins	Buffalo, N. Y.	270
B. Rauch	Peoria, Ill.	266
C. Rareshide	New Orleans, La.	263
E. Bourgeois	Narco, La.	253
K. Schafer	Kenmore, N. Y.	250
J. D. Burch	Little Rock, Ark.	232
C. Lupton	Shelbyville, Ill.	226
L. Vehorn	Speedway, Ind.	208

New Technical School Courses

Continued from page 102

reported by schools offering home-study courses. ICS, for example, is now teaching drafting via the mail. A correspondence course in automation has been devised by RCA. You can learn about radar by mail from Capitol. And you can prepare at home for qualifying as a professional engineer with the help of correspondence courses from Canadian Institute.

We have seen that the many varied and continuously expanding electronics industries have a tremendous need for trained and specialized workers. For "old hands" who want to ride the boom it may be a matter of learning a few tricks. For those just getting started, technical school training could be regarded as an important investment from which they can get a good grounding in basic electronics as well as more advanced training in the specialty of their choice. Becoming a part of our nation's electronic technology, in all its growing applications, is insurance of a sound, interesting future. —●—

Tips To Boost Your QSO's

Continued from page 31

can I hope to make as many contacts as the fellows who run 1000 watts?"

True, a kilowatt transmitter has its advantages, but the Novice who knows the rules and how to operate his equipment skillfully can't be counted out. One beginner worked over 500 stations during the first five months he held a Novice license, and many of his contacts were choice DX stations.

"Low power doesn't hold me back on 15 meters," Scott Millick, KN9PPX, said, "but I soon found that I had to be a crackerjack CW operator."

By learning to send well-spaced, easy-to-copy letters with a hand key before graduating to an electronic keyer, or "bug," Scott avoided the label of "lid," an embarrassing title given to a sloppy operator.

A good communications *receiver* is a ham's guarantee of successful contacts (QSO's) with other amateurs, and the veterans are first to say "If you can't hear 'em, you can't work 'em." When setting up a station, money spent for a selective receiver that will reject unwanted signals and other QRM (interference) isn't wasted.

Even with a sharp receiver, an efficient transmitter, and a well-placed antenna, the enthusiastic Novice may draw a blank if he lacks old-fashioned "horse-sense." Brent Greenwood, KN9RHL, can vouch that proper operating procedure is as important as tuning up the transmitter on the right frequency.

"I work a lot of stations now," Brent says, "but first I had to learn to call to start a contact and how to sign off properly. Knowing the frequently used abbreviated 'Q' signals helps. For example, QSY means to change frequency, QRS to slow down, and QRT to quit."

Since the two meter band from 145 to 147 megacycles is open to Novices, a first contact might be made there with a microphone instead of a key. However, again you had better learn procedure before you go on the air. Eavesdropping on experienced hams is an easy way for a newcomer to pick up voice and CW operating tips before tossing out the first CQ.

"With so many Novices in such a small range of frequencies," complains another beginner, "there's hardly enough elbow room to talk to anybody."

True, the bands are livelier than ever, but the Novices who gather lots of QSL cards confirming contacts in spite of interference and crowded conditions will soon be seasoned operators ready for their next license exam.

With dependable equipment and a thorough knowledge of the rules, the new ham can have a barrel of fun from the minute his license arrives. Speaking from experience, I'm sure anyone who has had an "N" in his call letters will agree that a Novice, no matter how young or old, should be seen and heard, too. Never feel that the veterans are discriminating against you or ignoring you. Many OM's actually go all out to help Novices improve their skills. —●—

Accredited by the National Home Study Council

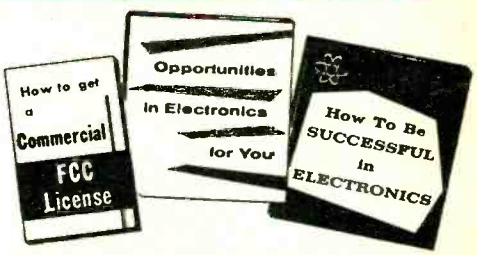
good training doesn't cost . . . it pays!

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 training results in job offers like these:

Radio Operators

TWA has opportunities for radio operators with a 2nd class license or better. Must be able to type at least 35 wpm. Free transportation for self and family. Vacation and many other benefits.

Electronic Technicians

Goodyear Aircraft Corp. has openings for electronic technicians, to work as assistants to engineers on developmental electronics projects such as missile systems, radar, antennas and analog computers.

And our trainees get good jobs

"Investment in training really pays off"

"I am now employed by the Western Electric Company as an electronic tester. My status as a student of Cleveland Institute was an important factor in my being employed. Knowledge gained through the course has proved amazingly helpful and affords me a feeling of complete confidence." T. E. Spence, Greensboro, N. C.

Cleveland Institute of Radio Electronics
4900 Euclid Ave. Desk EI-11, Cleveland 3, Ohio

Cleveland Institute of Radio Electronics
Desk EI-11, 4900 Euclid Ave., 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-11

Citizens Band Converter

Continued from page 62

broadcast receiver tuned to approximately 600 kc.

An alternate method for oscillator adjustment would be to tune in the 10 meter band on a friend's receiver, and adjust the oscillator slug in the converter until its signal is heard at approximately 29 megacycles with C1-C2 at mid range.

The RF input coil (L1) will have the correct inductance to resonate with C1 and C4 and C5 at 10 meters if constructed as described, and mounted as shown in the photograph.

C1-C2 is a dual unit standard broadcast type tuning capacitor, chosen due to its low cost and universal availability. As such, however, its range is too great so it is placed in series with C3 and C4 (50 mmfd disc ceramics) to reduce the effective range. The resultant frequency coverage is from approximately 26 mc to 32 mc when used with the coils described.

The output of the converter is tuned to 600 kc by L3-C17. L3 is a broadcast band coil (see parts list) and C17 is a fixed value. The circuit is tuned by adjusting the slug in L3 for maximum noise in the receiver, the latter of course also being tuned to 600 kc on the dial.

The antenna leadin is connected to the converter at J1. It should be carefully constructed in order to provide as much signal as possible for the converter. A 16 foot dipole with leadin connected at the center, or a vertical antenna 8 feet high should provide good signals. The leadin is connected to a phono plug to fit the input jack J1. If a single wire is used, connect it to the center pin of the phono plug, and ground the chassis to a cold water pipe if available.

The output jack J2 is connected to the antenna terminals of the receiver. If there are no antenna terminals, as on most AC/DC radios, simply connect the center pin of the output plug to the point on the receiver at which the loop antenna is connected. This usually is found on the larger section of the main tuning capacitor. Do *not* ground the output lead to the AC/DC chassis, and do not make any direct chassis to chassis ground connections unless you use an isolation transformer between the AC/DC radio and power line to avoid shock hazard.

To operate the converter, set the broadcast receiver dial to 600 kc, and slowly tune C1-C2 until you hear signals coming through the loudspeaker. Adjust the trimmer capacitor on C1 for the loudest signal.

ABC's Of Electronics

Continued from page 90

The unit in which g_m is stated is the *mho*. This is an electrical quantity which specifies the conductance of any sort of a conductor, whether it be a copper wire or the path between cathode and plate in a vacuum tube. Numerically it is the reciprocal of the ohm. That is

$$\text{mhos} = \frac{1}{\text{ohms}}$$

Since the high vacuum path in a tube is a good deal less conductive than a copper wire, even one mho is far too large for practical use. The unit usually used in expressing transconductance is the micromho, which is one-millionth of a mho. In our problem of Fig. 1(A), $g_m = (0.002 \div 1) = 0.002$ mho $= 2{,}000$ μ mho.

The single curves of Fig. 1 show only the operating characteristics for a single voltage. Since other voltages will shift the entire curve either right or left, usually a family of curves are presented in the tube manuals, as shown in Fig. 2. These curves happen to be for each of two triodes, for this particular tube is a twin-triode type.

Compare the family of curves of Fig. 2 with those of Fig. 3, which are for a power pentode. It is immediately obvious that the latter are much less steep.

But this is also a clue to the plate impedance. We can see from Fig. 3 that all values of $(E_p \div I_p)$ will be exceedingly high. From this we can generalize that the slope of the curve is an indication of plate impedance: the steeper the E_p-I_p curve, the lower the impedance. Thus, a

quick glance at Fig. 2 and 3 tells us that the pentode of Fig. 3 has a much higher plate impedance than the triodes of Fig. 2. This is borne out by the manufacturer's literature, which rates the R_p of the 6SC7 at 53,000 ohms, while that of the 6AK6 is 200,000.

Similarly, the slope of the I_p-E_g curve indicates the transconductance. When varying the grid voltage produces no change in plate current, as at saturation or cutoff, transconductance is zero and the curve is absolutely flat. Conversely, the steeper this curve is, the greater also is the mutual conductance.

This article concludes the purely theoretical approach to basic electronics. Next month *EI* will begin a series of projects you can build while learning the practical application of circuit theory.

Wobble Out Of Car Wheels

Continued from page 87

vibrate freely while an unbalanced wheel is rotating. Vibration pickup units similar to seismic pickups are mounted at each end of the crossarm jack close to the wheel. As the wheel is spun, the unbalance causes the crossarm assembly to vibrate and this mechanical vibration is converted by the pickups into electrical voltages.

At peak meter reading, the apparent position of the wheel is noted under the light from the stroboscope. The peak reading indicates the number of ounces required on the rim of the average wheel to correct the unbalance.

Dynamic unbalance is determined in the same manner except that the signal to drive the meter and strobe comes from the vibration pickup on the opposite side of the vehicle from the wheel that is being balanced. Corrections are made by putting equal weights diametrically opposite each other and on opposite sides of the rim of the wheel. When the wheel is stopped in the position in which it was observed under the strobe light at the peak meter reading, one weight is added at the outside bottom and an equal weight on the inside top of the rim. Result: A true-running wheel.

ELECTRONICS ILLUSTRATED Classified Ads

Your advertisement can reach this mail-buying audience for only 35¢ per word . . . payable in advance (Check or M.O. please) . . . minimum 10 words. Closing dates are the 20th of 3rd preceding month i.e. copy for the November issue must be in our office by August 20th. Mail to ELECTRONICS ILLUSTRATED, 67 West 44th St., New York 36, N. Y. Word count: Zone number free. Figure one word: Name of state (New Jersey), name of city (New York); sets of characters as in key (14-D); also abbreviations as 35MM, 8x10, D.C., A.C.

SAVE MONEY • ORDER BY MAIL

• • • FOR SALE

MONEY SAVING Prices on tubes. TV, Radio, Transmitting and Industrial Types. New, 1st quality, guaranteed. Top name brands only. Government surplus and commercial test, lab and communications equipment in stock. Sell us your excess tubes and equipment. Unused, clean tubes of all types wanted. Send specific details in first letter. Write for "Green Sheet" catalog 25¢. Barry Electronics Corp., 512 Broadway, (Dept. El.), WA 5-7000, New York 12, N. Y.

78 R.P.M. RECORDINGS. Many types. Free lists. Collections bought. P.O.B. 155(EL), Verona, N. J.

• • • PRINTING, MULTIGRAPHING, MIMEOGRAPHING

BUSINESS CARDS, 35 type styles, Envelopes, Letterheads, etc.; also Offset printing, reasonable prices. Write R. Viglione, 180 Maple Street, Lawrence, Massachusetts.

• • • BUSINESS OPPORTUNITIES

WE PAY $4.50 lb. dried. Grow Mushrooms. Cellar, shed and outdoors. Spare, full time, year round. We pay $4.50 lb. Free Book. Mushrooms, Dept. 315, 2954 Admiral Way, Seattle, Wash.

VENDING MACHINES—No selling. Operate a route of coin machines and earn high profits. 32-page catalog free! Parkway Machine Corp., Dept. 33, 715 Ensor St., Baltimore 2, Md.

OPERATE PROFITABLE mailorder business!! Write: Bond, T-1637 West Vernon, Phoenix, Arizona.

• • • EMPLOYMENT OPPORTUNITIES

PRINTING - ADVERTISING SALESMEN. Excellent moneymaking sideline selling Decalcomania Name Plates. Advertising Specialties. Sign letters, Automobile initials. Free Samples. "Ralco"-El, Box L, Boston 19, Mass.

• • • TAPE RECORDERS

HI-FI, RECORDERS. Free Wholesale Catalogue. Carston, 215-G East 88, N. Y. C. 28.

TAPE RECORDERS, Hi-Fi components, Sleep Learning Equipment, tapes. Unusual values. Free catalog. Dressner 69-02 Z, 174 St. Flushing 65, N. Y.

• • • HI-FI

UNUSUAL VALUES. Hi-Fi components, tapes and tape recorders. Send for package quotations. Stereo Center, 18 W. 37 St., NYC.

• • • AGENTS WANTED

RUN A spare-time Greeting Card and Gift Shop at home. Show friends samples of our new 1959 Christmas and All Occasion Greeting Cards and Gifts. Take their orders and earn to 100% profit. No experience necessary. Costs nothing to try. Write today for samples on approval. Regal Greetings, Dept. 44, Ferndale, Michigan.

• • • EDUCATION & INSTRUCTION

ENGINEERING AND Art Degrees earned through home study. Electronics, Electrical, Mechanical, Civil, Physics, Business Administration, Liberal Arts. When writing, specify course desired. Pacific International College of Arts & Sciences, primarily a correspondence school. Resident classes also carried. 5719-E Santa Monica Boulevard, Hollywood 38, California.

CALCULUS, PRACTICAL, First Four Easy Lessons $1. Mathco, 4256-1 Minmor, Cincinnati 17, Ohio.

• • • BUILD-IT-YOURSELF

"AUTOMATIC GARAGE Door Control" book; complete, clear plans, photos, exploded view, instructions, Standard parts, radio/post control. $2.00 (guaranteed). RL Books, 5649D Costello, Van-Nuys, Calif.

TRANSISTORIZE YOUR automobile ignition system for better performance. Complete plans and instructions—$2.50. Technical Services Institute, 5234E Fourth Street N. E., Washington 11, D. C.

• • • RADIO & TV

CRYSTAL RADIO Experimenters. Write to Hulet, 305 Hope, Lakewood, N. J.

DIAGRAMS FOR repairing radios, amplifiers, $1.00; television $2.00. Give make, model. Diagram Service, Box 672-El, Hartford 1, Conn.

15 TESTED ONE tube circuits with Transistor "Radiobuilder" — 25¢. Laboratories, 1131-K Valota, Redwood City, California.

POCKET T-V with picture. Send stamped envelope for info. Ekeradio, 650 N. Fair Oaks, Pasadena, California.

• • • INVENTIONS & INVENTORS

INVENTORS—SEND for free Patent Information book and Inventors Record. Registered Patent Attorney, Associate Examiner, Patent Office 1922-1929; Patent Attorney & Advisor, Navy Department 1930-1947. Gustave Miller, 89El Warner Building, Washington 4, D. C.

• • • MISCELLANEOUS

HYPNOTIZE SUCCESSFULLY! Easily learned, fast, modern methods! Author's "Instantaneous" and "Against Will" methods exposed! Complete illustrated course—including self-hypnosis and "Secret Nerve Pressure Technique" $1.00. Arthur Fowler, 851 Draper Avenue, Schenectady 6, N. Y.

"WINEMAKING; BEER, Ale Brewing." Illustrated. $2.00. Eaton Books, Box 1242-A, Santa Rosa, California.

KITS WIRED and tested. David Goldberg, 1708 N. Vine St., Chicago 14, Ill.

• • • STAMPS & COINS

INDIAN CENT plus Bargain Lists 10¢. Hutchinson's, Box 4747, Philadelphia 34, Penna.

• • • DETECTIVES

DETECTIVES—WORK Home—Travel. Experience unnecessary. Detective Particulars free. Write, Wagner, B-125 West 86th, New York 24.

• • • MUSIC

SONGPOEMS AND Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.

New Medical Inventions

Continued from page 69

Leroy Ryan, Leroy Murphy and communications maintenanceman Watson McCreary. Strapped to the chest, it may provide clues to how coronary heart disease differs in office workers and laborers, men and women, smokers and non-smokers.

Basically, it uses a noise-free pulse pick-up to detect the actual electrical microvolt signal developed each time the heart beats. This signal is fed through a four-stage transistor amplifier, and the pulse output of the amplifier is used to mechanically operate a watch adapted to count heartbeats instead of time.

Cytology is the medical art of checking for signs of cancer and other ailments by studying cells under a microscope. Training badly needed cytology technicians to recognize cancer cells is a long process which calls for a doctor to stand behind each student and score each example.

Engineers Alfred Petrie and Len Helke decided to devote their efforts to perfect a training machine which would save the doctors' time. Housed in a suitcase, complete with keys and lamps, a punched card is prepared for each specimen slide and then inserted into the tester. The student cytologist evaluates the slide, then keys his diagnosis on the tester. The equipment automatically indicates whether or not the diagnosis is correct. Another key indicates the correct answer.

To aid in studies of metabolism, an electronic calorimeter is under development. This instrument would measure changes in body heat and record them. To obtain such information over a 24-hour period by means of an electrocardiograph, doctors would have to examine a cardiograph record more than a mile long.

These men are using their technical skills unselfishly beyond the scope of their day-to-day work and are thereby making important civic contributions to medical research, and humanity as a whole.

this man is

SAVING MONEY

the EI way

There are many reasons why the do-it-yourself craze is sweeping the country. A man takes pride in doing things for himself; it's a fascinating and constructive hobby; and, very important indeed, it's a way of saving money while acquiring the things you want.

ELECTRONICS ILLUSTRATED, understands all this. That's why it brings you top-notch do-it-yourself projects in every issue. EI readers have already had a chance to build: hi-fi stereo pre-amplifier; walkie-talkie 2-way radio; 1-transistor FM pocket radio; a fine hi-fi turntable; an exposure meter for an enlarger; and even home-built rockets and missiles.

Every EI do-it-yourself project is fully tested by the editors before it is brought to the readers. And every one of them is a real bargain! So get in on the savings and fun enjoyed by do-it-yourselfers all over the country. Get every issue of ELECTRONICS ILLUSTRATED. Subscribe now.

get your subscription blank in the mail today!

Mail to
ELECTRONICS ILLUSTRATED,
Circulation Dept.,
Fawcett Building, Greenwich, Conn.

Make sure you never miss an issue of ELECTRONICS ILLUSTRATED

☐ ONE YEAR: $3.00 ☐ TWO YEARS $5.00

In U. S., possessions and Canada. All other countries $6.00 per year.

NAME _____

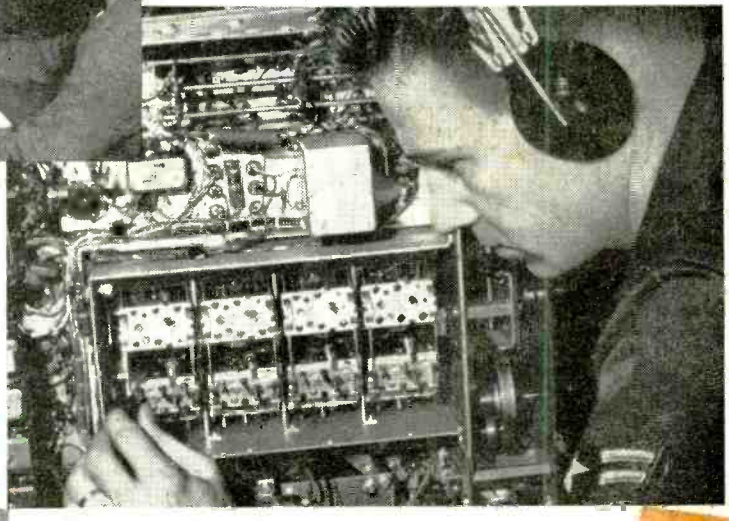
ADDRESS _____

CITY _____ **ZONE** _____ **STATE** _____

'MEN WHO DO-IT-YOURSELF'

YOUR SKILLS CAN MEAN AN IMPORTANT FUTURE IN THE NEW AGE OF SPACE

If you like to build transmitters... or hot rods... or models... you can also build a real future for yourself by training in the U. S. Air Force. For in today's new Age of Space, it is the man with technical ability who will be the important man. *Only in the Air Force,* however, will you find so broad and complete a range of Space Age specialty training. In the Air Force, *the Age of Space* is now. For full details on your training opportunities see your local Air Force Recruiter now, or mail the coupon.



TRAIN IN THE U. S. AIR FORCE

PASTE COUPON ON POSTAL CARD AND MAIL TO:

Airman Information, Dept. ME-98
Box 7608, Washington 4, D. C.

Please send me information on my opportunities in the U. S. Air Force. I am between the ages of 17-34 and reside in the U. S. A. or possessions.

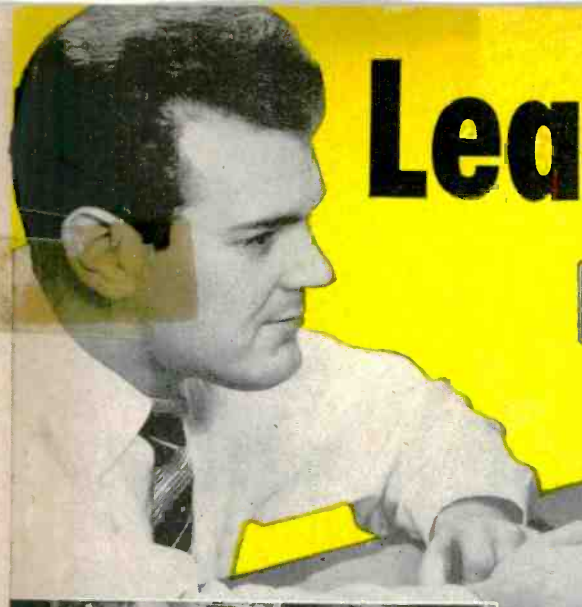
Name_____

Address_____

City_____ Zone____ State_____

Learn Radio-

Servicing by Pra



Jobs Like These Go to the Radio-Television Technician

Fast Growing Field Offers You Good Pay, Success, Bright Future

J. E. SMITH
Founder

Bigger than ever and still growing. That's why Radio-T has special appeal to men not satisfied with their earn ings. More than 4,000 Radio and TV stations on the ai More than 150 million home and auto Radios. 40 millio TV sets. Training PLUS OPPORTUNITY is the ide combination for success. Plan now to get into Radio-T National Radio can train you at home in your spare tim NRI is the oldest and largest home study Radio-T school. Easy to understand, well illustrated lessons teac you basic principles. And you LEARN-BY-DOING, by practicin with kits of equipment NRI sends.

Start Soon to Make $10—$15 a Week in Spare Tim

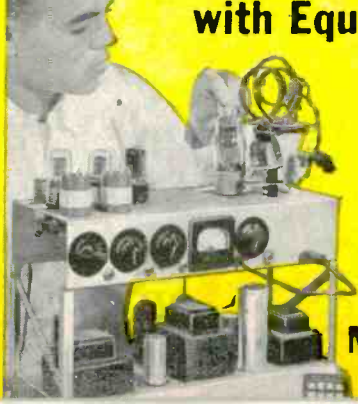
Soon after enrolling many NRI students start to earn $10, $15 week extra fixing sets in spare time. You get the benefit of NRI more than 40 years' experience training men. Make a move toda toward becoming one of that select group—a Radio-TV Technicia Send Postage-Free card today for actual Lesson and 64-page Catalo BOTH FREE. NATIONAL RADIO INSTITUTE, Dep 9HK, Washington 16, D. C.

NRI Trained these Men

"I knew practically nothing about Electronics. After 15 les- sons I started repairing sets. My future looks bright." D. B. ACKERMAN, Minneapolis, Minn.

"Thanks to NRI. I operated a successful Radio Repair shop. Then got a job with WPAQ; now I am an engineer for WHPE." V. W. WORKMAN, High Point, N. C.

"Have good job in a TV repair shop plus a small business in my home. In one year I went from lowest paid to head bench- man." V. BARR, Toronto, Ohio.



You Practice Communication with Equipment NRI Send

Nothing takes the place of practi experience. As part of NRI Com munications Course you build thi Broadcasting Transmitter; train fo FCC License.

You Practice Servicin with Equipment Sent

As part of NRI's Servicing Cour you build AC-DC Superhet Receive Vacuum Tube Voltmeter, man other pieces of equipment for prac tical experience.

MAIL POSTAGE FREE CARD