Largest Circulation of any Electronics Magazine

POPULAR ELECTRONICS

JANUARY 1961

35 CENTS

HI-FI · HAM & CITIZENS RADIO · SWL

AUDIO ANALGESIA
Can It Revolutionize Painless Dentistry?

BUILD "SWEET 16"
New Idea in Hi-Fi Speaker System

LISTEN
Directly to News Broadcasts from EUROPE

Station and Time Listing on page 41

LIGHTNING
Plan Now To Protect Your Home

PLUS: 40 More Pages of PLANS, IDEAS and NEWS

only for those who really need them...

CADRE

Only a short time ago, the FCC opened 22 channels for Citizens Band operation. Licensing was radically simplified. Where formerly two-way radio licenses were granted only to public safety agencies and certain other special groups, SUDDENLY, EVERYBODY COULD HAVE 2-WAY RADIO!

... providing, of course, he could afford the bulk and cost of the equipment that was then available.

Yet in spite of the bulk and the cost, nearly two million Citizens Band transceivers have been purchased to date! A tremendous demand has developed!

You can imagine what will happen now that compact, professional-quality instruments like the CADRE '500' and the CADRE '100' are available!

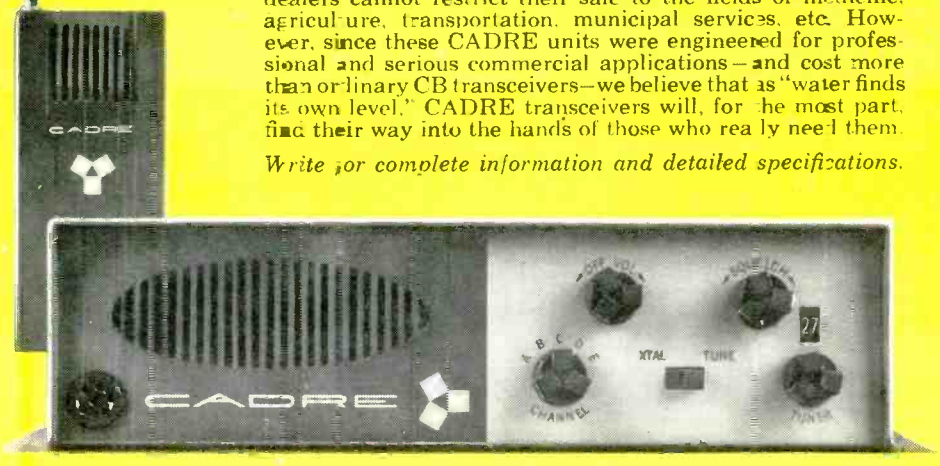
These CADRE units are built to the highest standards of the electronics industry, by a company that has been long established as a prime manufacturer of precision electronic research equipment and computer assemblies. CADRE transceivers are 100% transistorized—compact, lightweight ... engineered for unparalleled performance and reliability.

The CADRE 5-Watt Transceiver, at $199.95, for example, for offices, homes, cars, trucks, boats, aircraft, etc., measures a mere 11 x 5 x 3", weighs less than 6 pounds! Nevertheless, it offers 5 crystal-controlled transmit/receive channels (may be used on all 22), and a range of 10 miles on land, 20 over water!

The CADRE 100-MW Transceiver, $124.95, fits into a shirt pocket! Weighs 20 ounces, yet receives and transmits on any of the 22 channels ... efficiently, clearly ... without annoying noise. A perfect "pocket telephone"!

For the time being, it is unlikely that there will be enough CADRE transceivers to meet *all* the demand. Obviously, our dealers cannot restrict their sale to the fields of medicine, agriculture, transportation, municipal services, etc. However, since these CADRE units were engineered for professional and serious commercial applications—and cost more than ordinary CB transceivers—we believe that as "water finds its own level," CADRE transceivers will, for the most part, find their way into the hands of those who really need them.

Write for complete information and detailed specifications.



CADRE INDUSTRIES, CORP., Endicott, N.Y.

Prices appearing in this advertisement are suggested retail prices.

NOW READY

The NEW NRI Home Study Course in ELECTRONICS

PRINCIPLES — PRACTICES — MAINTENANCE

SPECIAL TRAINING EQUIPMENT

No extra cost. In NRI Electronics training especially developed training kits bring to life theory you learn in easy, illustrated lessons. You get practical experience with Thyratron Tube circuits, Multivibrators, Capacitors, Diodes, Transistors, Telemetry, Computer Circuits and other basic circuits and components.

KIT 1 Get practical experience measuring voltage, current, building circuits.

KIT 2 Build d'Arsonval type Vacuum Tube Voltmeter. Test power line frequencies, high audio, radio frequency signals, resistances.

KIT 3 Practice with resistors, capacitors, coils. Work with half-, full-wave, bridge, voltage doubler and pi-type filter circuits.

KIT 4 Build circuits with pentode tubes, selenium resistors, transistors. Build oscillator, check signal phase shift with oscilloscope.

KIT 5 Experiment with thyratron tube circuits. Lissajous patterns. Study basic amplitude detector circuits, modulation, demodulation.

KIT 6 Get practical experience with magnetic amplifiers, learn to use modified Prony brake; determine motor torque. Use strobe disc to measure motor speed.

KIT 7 Learn effects of positive and negative feedbacks (used in analog computers). Practice varying polarizing voltage and illumination.

KIT 8 Experiment with multivibrators used as timing generators in binary counters, and as frequency dividers. Learn to use blocking oscillators, thermistors.

KIT 9 Practical experience in telemetry circuits used in earth satellites, remote control devices. Work with basic circuits used in digital and analog computers.

KIT 10 Assemble circuits in electrical and electro-mechanical systems, make valuable practical electronic circuits.

MAIL COUPON—New 64-Page Catalog pictures and describes Training Kits, explains what you learn.

NRI is America's oldest, largest home study Radio-Television-Electronics school. For over 45 years NRI has been training men without previous experience for success in Radio-Television Servicing and Communications. Now, expanded uses of Electronics in industry, business and defense are increasing the demand for Electronic Technicians. Four to seven Technicians are needed for every engineer. To meet this demand NRI announces a complete, comprehensive course in ELECTRONICS —Principles, Practices, Maintenance.

This training stresses basic fundamentals because so many Electronic devices are built around identical Electronic principles. It is for beginners, or for Technicians who wish to expand their knowledge.

This is the Electronic Age. Electronic Equipment is already being used to count, weigh, control flow of liquids, solids, gases. Control exposure in photography, detect fumes, or fire. Inspect at remote points. Supervise traffic. Survey land areas and ocean contours. Search for oil, miles beneath the surface. Measure radiation and control power levels in atomic installations. Control air traffic. Translate one language into another. The MILITARY applications of Electronics . . . particularly in space rockets and missiles, tracking devices, etc., . . . probably equal all of the uses above. Electronic equipment is used to machine parts through complex cycles. It is used in business to process data, control inventory, prepare payrolls, post, calculate, and in medicine for electrodiagnosis, measure body characteristics, electrosurgery.

Job Counselors Recommend

Right today a career in Electronics offers unlimited opportunity. Job Counselors know the pay is high, jobs interesting, advancement opportunities great. They advise ambitious, aggressive men who want higher pay now and a better future: "For an interesting career, get into Electronics."

Learn More to Earn More

Simply waiting and wishing for a better job won't get you ahead. You have to decide you want to succeed and *you must act*. NRI can provide the training you need at home in spare time. No need to go away to school. You don't need a high school diploma or previous Electronic experience. This course is planned to meet the needs of beginners. You work and train with components and circuits you will meet throughout your Electronics career. You get especially developed training kits for practical experience that make Electronics easy, simple to learn.

Oldest and Largest School

Training men to succeed, is the National Radio Institute's *only* business. The NRI Diploma is respected and recognized. NRI graduates are everywhere throughout U.S. and Canada. Mail the coupon today. New, FREE 64-page Catalog gives facts, opportunities about careers in Industrial and Military Electronics, also shows what you learn, facts about NRI's other courses in Radio-Television Servicing and Radio-Television Communications. Monthly payments available.

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

WASHINGTON 16, D.C., ESTABLISHED 1914

MAIL THIS COUPON NOW

NATIONAL RADIO INSTITUTE
Washington 16, D. C. 1AD4A

Send me full information without cost or obligation. No salesmen will call.
(Please print.)

Name ..... Age .....

Address .....

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

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 434 S. Wabash Ave., Chicago 5, Ill. Second-class postage paid at Chicago, Illinois. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. **SUBSCRIPTION RATES:** One year U.S. and possessions, and Canada $4.00; Pan-American Union Countries $4.50, all other foreign countries, $5.00.

POPULAR ELECTRONICS

JANUARY 1961

VOLUME 14 NUMBER 1

ZIFF-DAVIS PUBLISHING COMPANY

Special Feature

Electronic Construction Projects

Audio and High Fidelity

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

"I Teach MATH a Funny Way"

—says DR. AARON BAKST, distinguished mathematician and lecturer at New York University.

An Amazing New Way To Master Every Phase of Mathematics—The Key To a Better Job, Higher Pay, Security In Today's Technical Age

THE NEW YORK TIMES says of Dr. Bakst's method: "A rich dish, well-stocked with parlor tricks and ingenious problems . . . a new trend toward the humanization of mathematics."

PARTIAL CONTENTS
of this 791-Page Book

A WHOLE LIBRARY IN ONE GIANT 791-PAGE VOLUME

DR. BAKST'S "funny way to teach math" cuts out the learning and memorizing of rules and formulas. In 791 fascinating pages his book, *Mathematics: Its Magic and Mastery*, uses entertaining puzzles, games and tricks to simplify and humanize math for the average person.

Even if you never finished high school math, you'll find this book easy to follow. It explains every basic step in mathematics: shows how to solve all sorts of problems, from adding up everyday bills to short-cut ways of operating giant electronic calculators. And even Einstein's theory of relativity is explained so simply that any layman can readily understand it.

Unsquaring the Square;
How to Figure the Odds;
The Great Pyramid Mystery;
The Game of 999

These and scores of other intriguing solutions to problems (see partial table of contents at left) quickly give you a good grasp of advanced arithmetic, algebra, geometry, and trigonometry.

You learn by *doing*, not by studying. And what you do is made so absorbing that you'll thoroughly enjoy each single "treasure hunt" episode with this gifted mathematician and writer.

Today's Stress on Math

In today's world of science, automation, engineering, and automatic computing, a good knowledge of all phases of mathematics will help *anyone* to advance himself faster and farther. In fact, it is an absolute essential in many fields, for reaching the top positions.

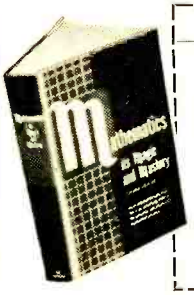
Dr. Bakst's book assures that your new knowledge of math will be of *practical* value to you—because he applies its principles to home life, insurance, business, finance, scientific and managerial problems.

SEND NO MONEY

Examine it FREE for 10 days

There is no need to send any money now. The coupon will bring you this 791-page book for 10 days' free trial. If not convinced that it brings you an interesting and practical way to gain a knowledge of mathematics which will be of great value to you, return it and owe nothing. Otherwise you may keep it by sending us only $1.50 down and the balance in easy payments. Mail the coupon NOW.

D. Van Nostrand Company, Inc.,
Dept. 171, Princeton, N. J.
(Established 1848)



FREE EXAMINATION COUPON

D. VAN NOSTRAND COMPANY, INC., DEPT. 171,
120 ALEXANDER STREET, PRINCETON, N. J.

Please send—for ten days' free examination Dr. Aaron Bakst's MATHEMATICS: ITS MAGIC AND MASTERY. Within ten days I will either return the book or send you $1.50 as first payment and only $2.00 per month for three months until the total price of $7.50, plus a small shipping cost, is paid.

PRINT NAME.....

ADDRESS.....

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

☐ **SAVE:** Check here if you are enclosing $7.50 WITH this coupon. Then WE will pay all shipping costs. Same return privilege: refund guaranteed.
(In Canada: Address 25 Hollinger Road, Toronto 16, Canada. Price slightly higher.)
Foreign and A.P.O.—please send $7.50 with order.

POPULAR ELECTRONICS

World's Largest-Selling Electronics Magazine

Average Net Paid Circulation Over 340,000

Cover Photo and photo on page 78 by Joe Petrovec
QSL cards on cover courtesy Tom Kneitel, James J. Hart

ZIFF-DAVIS PUBLISHING COMPANY, One Park Ave., New York 16, N. Y. William B. Ziff, Chairman of the Board (1946-1953); William Ziff, President, W. Bradford Briggs, Executive Vice President; Michael Michaelson, Vice President and Circulation Director; Hershel B. Sarbin, Vice President; Charles Housman, Financial Vice President; Richard Kislik, Treasurer.

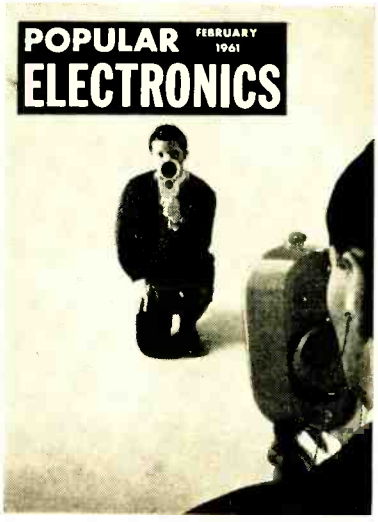
AUDITED PAID CIRCULATION ABC

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC

BRANCH OFFICES: Midwestern Office, 434 S. Wabash Ave., Chicago 5, Ill., Jim Weakley, Advertising Manager; Western Office, 9025 Wilshire Blvd., Beverly Hills, Calif., William J. Ryan, Western Manager.

Foreign Advertising Representatives: D. A. Goodall Ltd., London; Albert Milhado & Co., Antwerp and Dusseldorf.

COMING NEXT MONTH



(ON SALE JANUARY 26)

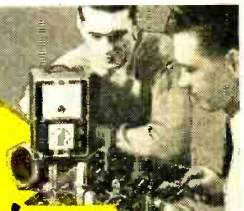
- **INFRARED**
  Invisible infrared light is the secret behind many new products. Next month, infrared theory and some unusual applications will be coming your way—including a two-way infrared walkie-talkie

- **CONSTRUCTION**
  Complete plans for an "in-circuit" low-power transistor tester that checks both p-n-p and n-p-n units, a broadcast-band DX tuned r.f. booster designed to pep up those weak DX signals, plus many others

- **SQUARE-WAVE GENERATORS**
  The next installment on hi-fi testing tells how the square-wave generator works and how it measures phase shift and transient response—both of which are bugaboos of hi-fi reproduction

SUBSCRIPTION SERVICE: Forms 3579 and all subscription correspondence should be addressed to Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois. Please allow at least four weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

We Really Mean It...When We Say



You DON'T Need

A High School Diploma

Previous Electronics Experience

to prepare AT HOME the DeVry way for a job that

Pays REAL MONEY in **Electronics!**

LET US TELL YOU WHY!

OUR INTEREST IN YOU...MAKES THE BIG DIFFERENCE!

In preparing you at home for a profitable job in the billion dollar opportunity field of electronics, DeVry Tech is more interested in your DESIRE TO GET AHEAD than we are in what you know about the field now. DeVry's training is thorough and practical. No previous electronic experience is required. We train you even if you don't know how to splice a lamp cord.

Our thorough training, with its many exclusive features such as home movies, has produced many graduates so well-trained, they have been employed by some of today's best-known firms and by scores of Radio and TV stations across the continent. DeVry Tech graduates are in demand. There are many job opportunities for them.

Becoming a DeVry Tech man in itself is a big lift. We have found during the past 29 years that by understanding a man's problems . . . by encouraging him in every way possible, we usually help him get the break he wants. It helps him do things he cannot do alone.

Another important benefit of becoming a DeVry Tech man is knowing you are part of an institution that not only trains you and helps you get started . . . but an organization that stands behind you on the job. It is such things as these that make DeVry Tech graduates DIFFERENT . . . it makes them PREFERRED men by so many employers.

Why don't you send the coupon below for 2 FREE booklets . . . Mailing that coupon could be a big step forward . . . toward greater heights . . . better pay!

DeVry Sends You Actual Equipment You Need At No Extra Cost!

DeVry Tech, in addition to its exclusive training movies, sends you the practical "Electro-Lab" system which includes 16 shipments of equipment to work more than 300 learn-by-doing projects in your own home. We know of nothing more effective than DeVry Tech's tool-in-hand training.

Exclusive training movies help you learn FASTER!

Send for these 2 FREE BOOKLETS

Accredited member of National Home Study Council

We Have Residential Training for High School Graduates

MILITARY SERVICE	EARN WHILE YOU LEARN	RESIDENT TRAINING
We have valuable information for every man of draft age.	Practical training shows you how to earn good money in spare time.	DeVry Tech has modern training centers in Chicago and Toronto.

WORK IN THESE EXCITING FIELDS WHEN TRAINED!

Radar • Guided Missile Control • Television • Radio
Micro-Waves • Communications • Industrial Electronics
Computers • Automation Electronics • Broadcasting
Remote Control Systems • Your Own Service Shop

DeVRY TECHNICAL INSTITUTE
CHICAGO • TORONTO

DeVRY TECHNICAL INSTITUTE
4141 Belmont Avenue • Chicago 41, Illinois • Dept. PE-1-R

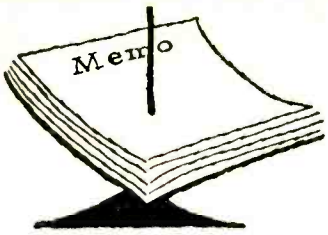
Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

- ☐ Space & Missile Electronics
- ☐ Television and Radio
- ☐ Microwaves
- ☐ Radar
- ☐ Automation Electronics
- ☐ Communications
- ☐ Computers
- ☐ Broadcasting
- ☐ Industrial Electronics
- ☐ Special "Short Courses"

Name_____ Age_____
PLEASE PRINT
Address_____ Apt._____
City_____ Zone____ State_____

☐ Check here if you face military service.

Canadian residents: Write DeVry Tech of Canada, Ltd.
970 Lawrence Avenue West, Toronto 19, Ontario 2078



Notes from the Editor

1961--SOME RANDOM PROGNOSTICATIONS

CITIZENS BAND. Activity will reach the saturation point in the urban areas by September/October .... The 5-watt input level will not be raised to 10 or 25 watts .... At least two manufacturers will offer a single-sideband transceiver claiming that SSB can double the number of available CB channels .... Crystals for "Receive" channels will be eliminated and replaced by push-button tuning .... CB transceivers will incorporate "spotting" switches which use the transmitter crystal to set tunable receiver dial calibration.

STEREO AND HIGH FIDELITY. Three-speaker stereo (derived from two channels) will gain widespread acceptance among those "in the know" ....Reverberation techniques will be improved, but will still remain in the gimmick category .... More FM tuners and receivers will be sold in 1961 than in any other year in the history of FM .... At least one manufacturer will offer a "flexible" speaker enclosure for the home owner who wants to build a system into the walls of his home .... Another manufacturer will stress multiple small speakers for good bass response as opposed to one big speaker.

EXPERIMENTERS AND HOBBYISTS. Tunnel diodes will drop in price and find their way into many home-built projects .... Infrared will attract a lot of interest and will be found in fire and burglar alarms.... There will be a spurt of interest in R/C model control supported by new transistorized circuits, higher transmitter power and better antennas. Long dormant, model control looks like a hot subject in 1961/62 .... G.E.'s "Compactrons," off to a shaky start, will prove that vacuum tubes are not on their way out.

HAM RADIO. There will be a quarter of a million hams by December .... Sunspots will decline and cause a mass exodus from the 10-meter band .... The interest in SSB will continue unabated .... Six meters will become increasingly popular as a "mobile" band, and greater use will be made of the top end of the band .... More manufacturers will follow the trend toward decreasing the cost of ham equipment by offering it in partially assembled kits.

SHORT-WAVE LISTENING. DX on the 25-, 31- and 41-meter bands will be dominant during the late fall and early winter .... The British plan not to report stations operated by the Communists will gain favor--especially stations in those countries that operate jamming transmitters .... In the fall of 1961 one manufacturer will offer SWL's receivers with a special bandspread dial calibrated for the 16-, 19-, 25-, 31- and 49-meter bands.

All-in-all, we think 1961 is going to be pretty interesting.

Oliver P. Ferrell

CREI's extension program in advanced electronic engineering technology offers you...

higher status & better income

The CREI home study program is designed to meet your present and future employment needs and to increase your professional status and earning power. The program—which is comparable in technological content to advanced residence courses in electronics—was developed hand-in-hand with leading companies and Government agencies in electronics, communications, missiles and space exploration.

The courses are presented in easy-to-understand format, and our experienced instructors guide your progress step by step. The program may be completed in 2 to 4 years, depending on how much spare time you can devote to study.

CREI brings you the latest advances and breakthroughs in electronics.

Recent advances and new techniques have placed tremendous importance on how modern and up-to-date the individual's education is. Recognizing this, CREI maintains a large staff of engineers and scientists who occupy prominent positions in government and industry. These men continuously revise the CREI program and incorporate all new technical information and breakthroughs. CREI courses are the most modern you will find . . . anywhere.

This is one reason why the demand for CREI graduates and students at the CREI Placement Bureau has far exceeded the supply for the past several years.

- CREI curricula is accredited by the Engineers' Council for Professional Development.
- U. S. Office of Education lists CREI as "an institution of higher education."
- More than 20,500 students are enrolled in CREI Home Study and Residence Programs.
- More than fifty of America's leading companies and government agencies pay the tuition for their employees studying with CREI.

YOU QUALIFY FOR CREI if you have a high school diploma or equivalent, and if you have had basic electronic training or practical experience in electronics.

NEW 56-Page Catalog Discusses Electronics Industry, Its Dynamic Future, Recent Breakthroughs, Career Opportunities, CREI Courses.

Mail This Coupon Today!

THE CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula • Founded 1927
Dept. 1201-H, 3224 16th St., N.W., Washington 10, D.C., U.S.A.
England: CREI London, Granville House, 132-135 Sloane Street, London S.W. 1, England

Please send me your course outline and FREE 56-Page Book. "Your Future in Electronics and Nuclear Engineering Technology" . . . describing opportunities and CREI home study courses.

Check field of greatest interest

- ☐ Radar, Servo and Computer Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Communications Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology
- ☐ Nuclear 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 of High School_____

Other_____

Electronics Experience_____

By **ROBERT E. TALL**
Washington Correspondent

CB License Problems

THE FCC is upset about statements that have appeared in reputable magazines concerning the supposed "legal" use of unlicensed radio equipment (under Part 15 of the Rules) with CB units. Such statements can cause trouble for people who do not understand the CB Rules and who try to persuade other people to use "unlicensed" equipment for improper purposes.

To set the record straight, if you are licensed in the Class D citizens radio service, *do not* communicate with any station which is not licensed for Class D service. If you are licensed and you do communicate with such stations, the penalties accrue to you and not to the man with the unlicensed equipment.

Some Part 15 equipment can be operated on either a licensed or unlicensed basis. But your Part 15 transceiver must be licensed if you want to communicate with stations that are licensed under Part 19 of the Class D rules. If you have a 100-milliwatt Part 15 transceiver, be sure it meets the minimum CB equipment specifications given in Section 19.51 of the FCC Rules and Regulations.

For the first time since the CB service became a "formality," the FCC has formally expressed its policy on club licensing, and says that it presents a "distinct problem."

The agency has indicated that it realizes CB clubs are "capable of playing an important and useful part in the self-regulation of the service, when they function to promote equitable solution of mutual interference problems." But the FCC feels it is "difficult to visualize" the *need* for a radio club to hold a station license. Presumably, the agency says,

each club member holds a CB license in his own name and, if the Rules are complied with, "any proper substantive messages could be transmitted over individually owned and licensed stations of the club members."

The FCC has further stated that it will not countenance the use of a club station as a subterfuge to avoid the five-minute limitation contained in its Rules on intercommunications between units of different stations. With the unexpected volume of citizens radio business that the FCC has on its hands, it's not difficult to appreciate the agency's attitude.

Citizens Band clubs, the Commission says, "often appear to be very loosely held together with little or no control or supervision of the related activities of their individual members." And "serious questions may be raised as to whether adequate control and supervision of the individual radio units can be maintained at all times by the licensee, as required by Section 19.92 of the Rules." Such control, the agency cautions, "must be sufficient to prevent the use of the radio station as a hobby in itself," and must insure that all communications transmitted are in compliance with Section 19.61 of the Rules.

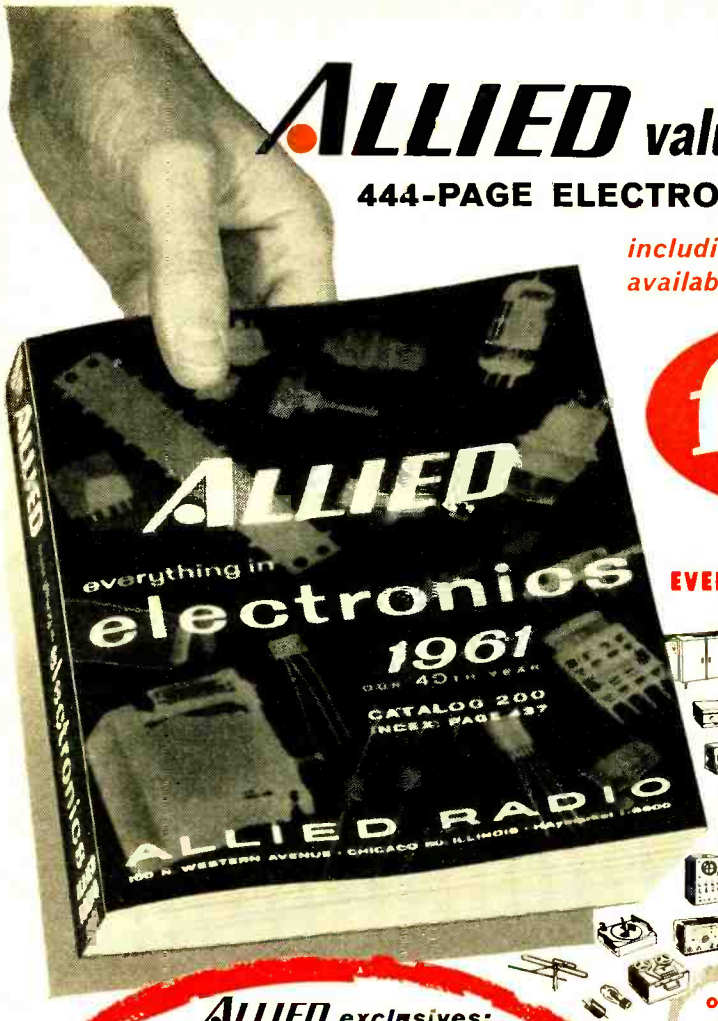
Many private groups organized for emergency or civil defense purposes are also applying for CB licenses. When such groups are actual auxiliaries of civil defense or law enforcement agencies, the governmental agency involved has to indicate its sponsorship and approval of the group if the station license is to be granted. If the group is not officially sponsored and approved, it will be considered as simply another type of club.

The FCC wants club members and officers to "note particularly the provisions of Section 19.12 of the Rules, which specify that not more than one person shall be eligible as a licensee of the same transmitting equipment." Since by definition most organizations are "legal persons," the Commission feels that "individually owned and licensed equipment may not be also operated under a club or other organization license without actual transfer of ownership and control of the equipment in each case." -30-

ALLIED value-packed 1961

444-PAGE ELECTRONICS CATALOG

including special products available only from Allied



free

SAVE MOST ON
EVERYTHING IN ELECTRONICS

- New Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS® for Every Need
- Best Buys in Recorders & Supplies
- Newest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Citizen's Band 2-Way Radio
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

BUY ON EASIEST TERMS
only $2 down on orders up to $50;
only $5 down on orders up to $200;
only $10 down over $200.
Up to 24 months to pay.

ALLIED exclusives:

MONEY-SAVING KNIGHT-KITS®—truly the very best in build-your-own electronic equipment—lowest in cost, easiest to assemble, best for performance. Select from a complete line of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

KNIGHT® STEREO HI-FI—Comparable to the best in quality, styling and performance, yet priced far lower. Select super-value KNIGHT components or complete systems and save most. Also see the largest selections of famous-name hi-fi components and money-saving ALLIED-recommended complete high-fidelity music systems.

Exclusive Allied products save you more

You get every buying advantage at ALLIED: Lowest, money-saving prices, fastest shipment, expert personal help, easiest-pay terms, satisfaction guaranteed or your money back.

send coupon today for 444-page catalog **free**

ALLIED RADIO

Satisfaction Guaranteed or Your Money Back

World's Largest Electronic Supply House

our 40th year

ALLIED RADIO, Dept. 109-A1
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1961 Allied Catalog No. 200

*Name*_____
PLEASE PRINT

*Address*_____

*City*_____ *Zone*____ *State*_____

Hi-Fi Showcase

A GOOD many hi-fi manufacturers are swinging into the new year with some truly noteworthy new products. Space doesn't permit mentioning all of them, but a trip to your local dealer will soon convince you that things are really jumping in hi-fi. For more information on any of the products mentioned here, write directly to the manufacturers (see addresses at the end of this column).

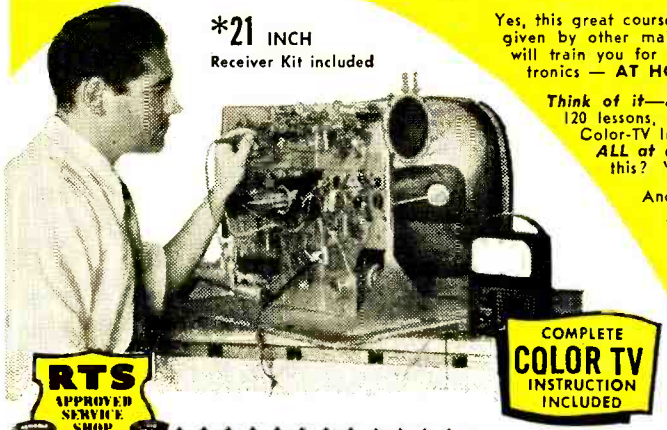
Acro Products, long famous for its output transformers, has put two of these transformers in its new Stereo 120 amplifier. A brute of a unit (it weighs 47 pounds), the Stereo 120 puts out 60 watts in stereo, 120 watts in monaural—enough to make even the most inefficient speaker system sit up and take notice. It makes use of the famous Ultra Linear circuit, which Acro's president, Herb Keroes, patented some years back. The output tubes are EL-34's, but it's a simple matter to substitute KT-88's or 6550's if you prefer the British or American equivalents to the Dutch. Price of the Stereo 120: $159.50 for the kit, $219.50 for the factory-wired model. . . . . If you haven't been keeping up with developments in the arm-and-cartridge area, you may be surprised to learn that tracking pressures of a gram and less aren't unusual these days. ***Audio Dynamics'*** new stereo cartridge, for example, reduces record wear to just about the vanishing point with a tracking force of 0.75 to 1.5 grams in top-grade arms. The ADC-1 is a cinch to mount, since it will fit in almost any arm, regardless of mounting centers, and its four pin connectors can be used with either 3- or 4-wire leads. The cartridge sells for $49.50, with replacement styli priced at $25.00 each.

Simultaneous Bach and bop don't sound very enticing. But divided, and fed into separate rooms, they can be mighty nice—especially when you need only one major piece of equipment for the whole setup. The keystone for such an arrangement is ***Bogen-Presto's*** new 40-watt FM/AM stereo/mono sound cen-

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 38 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

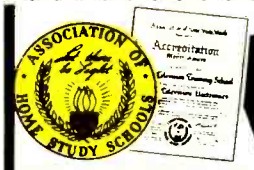
RADIO-TELEVISION TRAINING SCHOOL

815 EAST ROSECRANS AVENUE

LOS ANGELES 59 CALIFORNIA

Est. 1922

ACT NOW!



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
815 EAST ROSECRANS AVE Dept. PE-11
LOS ANGELES 59 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 _____

Address _____

City & State _____

391

Mail This Coupon Now—No Salesman Will Call

Showcase

(*Continued from page* 12)

ter. Dubbed the RP-40, the center has switches controlling each of its four speaker lines, and each speaker switch has a position for channel one, channel two, and "off." Inputs? Take your pick of AM, FM, mono or stereo discs and tapes, TV sound, or mike. Priced at $329.50, the RP-40 can be housed in a walnut or metal enclosure available at slight extra cost. . . . . Working along somewhat more conventional lines, ***Crosby Electronics*** has come up with the first two models in its group of hi-fi/stereo components. Beautifully matched in styling, the Model 690 FM tuner and Model 680 28-watt stereo preamp/amplifier are good basic building blocks for the heart of a component hi-fi system. Both units are identical in size—13½" x 4¾" x 6¾", with price tags of $99.95 and $119.95 respectively.

Alignment, usually a bugaboo with FM tuner kits, is a successful do-it-yourself procedure with ***Dynaco***'s new Dynatuner. An etched circuit so inherently non-critical that it can be completely aligned without test equipment is but one feature of this sensitive FM tuner. Prices are $79.95 for the kit, $119.95 factory assembled. . . . . For audiophiles interested in picking up both AM and FM, ***Heath***'s new stereo tuner offers circuitry and styling to satisfy the most discriminating. The AJ-30's superbly engineered 16-tube circuit retains the excellent performance of Heath's older PT-1, with individual AM and FM tuning meters to boot. And a mar-proof, burn-proof, vinyl covering for the all-steel cabinet makes the unit one of the most attractively housed. Prices are $89.50 for the kit, $145.50 for the factory-wired model. . . . . Another new FM tuner is ***Lafayette***'s KT-650, featuring a low-noise triode mixer with double-tuned dual limiters. A variable a.f.c. control, flywheel weighted tuning, and a front-panel-mounted level control are among the KT-650's other features. Unlike many other tuners, this one is available only in kit form; price is $54.50.

If you're bothered by speaker enclosures that just don't seem to "fit in" with room furnishings, take a good look at ***Leonhardt***'s LH-190 system. Designed

Do you WISH you were EMPLOYED in ELECTRONICS?

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

F.C.C. LICENSE—THE KEY TO BETTER JOBS

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

WHICH LICENSE FOR WHICH JOB?

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

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

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

GRANTHAM TRAINING PREPARES YOU

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

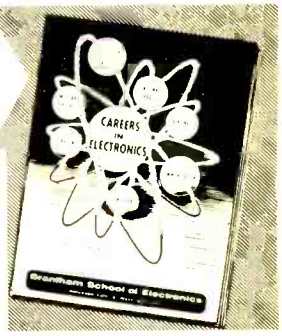
OUR GUARANTEE

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

Learn by Correspondence or in Resident Classes

Grantham training is offered by correspondence or in resident classes. Either way, we train you quickly and thoroughly---teach you a great deal of electronics and prepare you to pass the F.C.C. examination for a first class license. Get details now. Mail coupon below.

This booklet FREE!



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

To get ahead in electronics—first, you need the proper training; then, you need "proof" of your knowledge. Your first class commercial F. C. C. license is a "diploma" in communications electronics, awarded by the U. S. Government when you pass certain examinations. This diploma is recognized by employers. Grantham School of Electronics specializes in preparing you to earn this diploma.

Grantham training is offered in resident classes or by correspondence. Our **free** booklet gives complete details. If you are interested in preparing for your F. C. C. license, mail the coupon below to the School's **home office** at 1505 N. Western Ave., Hollywood 27, California—the address given in the coupon—and our free booklet will be mailed to you promptly. No charge—no obligation.

Grantham School of Electronics

HOLLYWOOD CALIF.
SEATTLE WASH.
KANSAS CITY MO.
WASHINGTON D. C.

RESIDENT CLASSES HELD IN FOUR CITIES

If you are interested in attending day or evening classes mail the coupon for free information to our home office in Hollywood, Calif.

(Mail in envelope or paste on postal card)

To: **GRANTHAM SCHOOL OF ELECTRONICS**
1505 N. Western Ave., Hollywood, Calif.

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

Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Seattle classes ☐ Hollywood classes, ☐ Kansas City classes, ☐ Washington classes

13-A

MAIL COUPON NOW—NO SALESMAN WILL CALL

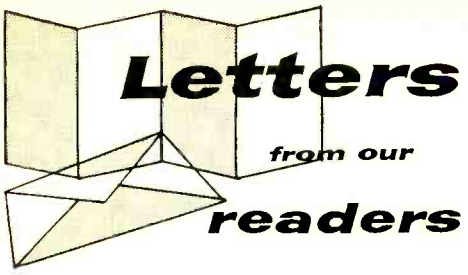
Showcase

(*Continued from page* 14)

specifically for stereo sound, the LH-190's tubular styling makes it right at home in almost any room, regardless of decor. Measuring 10″ in diameter and standing 24½″ high, the LH-190 handles 15 watts over a frequency range of 35 to 18,000 cycles, and sells for $85.00. . . . . Flipping from mono to stereo is sometimes pretty complicated, and so is switching from a standard spindle hole to the big cutouts in 45-rpm discs. ***Lesa***'s new SM5-DU2 stereo/mono manual player solves both problems with a quick-flip switch on top of the pickup and a 45-rpm spindle built right in the turntable. Price is $29.95. . . . . ***Pickering***'s new 381 stereo cartridge, once sold only for lab use, is now available for home hi-fi systems. A professional cartridge originally designed for making precise record measurements, the 381 is produced in both high- and low-impedance models, is flat within 2 db from 20 to 17,000 cycles, and has a tracking force in professional arms of 2 to 3 grams. All units are furnished with an individual calibration test report; prices are $48 to $60, depending on styli.

Featuring an exclusive silver-plated "front end," ***H. H. Scott***'s Model 310D FM tuner also incorporates an interstation noise suppressor claimed to be the quietest and fastest-acting ever offered to music listeners. If you already own other Scott equipment, you'll be happy to learn that chassis styling on this sensitive, wide-band tuner exactly matches that of a good many Scott amplifiers and preamps. Price of the tuner alone, less case, is $184.95. A matching metal case is available for $12.95, and a wooden case sells for $19.95 in a choice of mahogany, limed oak, or oiled walnut finishes. —30—

Acro Products Co., 369 Shurs Lane, Philadelphia 28, Pa.
Audio Dynamics Corp., 1677 Cody Ave., Ridgewood, N. Y.
Bogen-Presto Div., Siegler Corp., P.O. Box 500, Paramus, N. J.
Crosby Electronics, Inc., Syosset, L. I., N. Y.
Dynaco, Inc., 3912 Powelton Ave., Philadelphia 4, Pa.
Electrophone & Parts Corp. (Lesa), 530 Canal St., New York 13, N. Y.
Heath Co., Benton Harbor, Mich.
Lafayette Radio Electronics Corp., 165-08 Liberty Ave., Jamaica 33, N. Y.
Leonhardt Engineering Co., 1300 Railroad Ave., Rockford, Ill.
Pickering & Co., Inc., Plainview, N. Y.
H. H. Scott Inc., 111 Powdermill Rd., Maynard, Mass.



Words of Advice on BCB DX

■ Glen Kippel's article on broadcast-band DX (September issue, page 60) brought back many happy memories of the days when I used to be an active DX'er. The BCB DX'er has a hard row to hoe before he can realize the thrill of receiving veries from distant stations—much harder than his fellow listener on the short-wave bands. Maybe these few words of advice from an old-timer will help.

Don't "cruise" the bands; instead, have a definite objective in mind. Monitor either a certain band, or one particular geographic area, or even a special station. Experiment with different antennas—a long-wire isn't always best for all stations and all directions. A vertical antenna sometimes works wonders.

Monitor "twilight skip" by observing the fading pattern of a station above 1000 kc. at a distance of 40 to 60 miles. If the station exhibits an unusual amount of fading and distortion, you can be sure that good 3000-4000 mile skip is forming. I have logged many Cuban and Central American stations this way.

If you are plagued with what seems to be an all-night disc jockey, write the station and ask when they are off the air. Set your alarm for that time, and behold—a silent channel, probably full

of DX. I did this with WSM in Nashville, Tenn., and received a prompt and courteous reply with the information requested. One night when WSM went off for a few hours I logged a New Zealand station.

CHARLES C. BOEHNKE
Reno, Nevada

BCB DX'er Boehnke did most of his listening after World War II from a QTH in Southern California and was a member of the Victory Radio Club.

"Min-O-Scope" Suggestions

■ The Min-O-Scope, in your August 1960 issue, appears to be a very nice piece of equipment, but I would like to make a couple of suggestions. Wouldn't it be possible to increase the vertical frequency response with peaking coils? They are quite inexpensive and one placed between R_3 and B+ should do the trick.

Wouldn't it also be possible to add a horizontal input to the scope by making S_2 (which was labeled S_1 on the diagram, incidentally) a 6-position instead of a 5-position switch? When the switch was in the sixth position (V_2's grid not connected to any of the frequency-determining capacitors), an input signal could be fed through a suitable blocking capacitor to the high end of R_{19}. The tube (V_2) should then function as an amplifier. This input could be used when you wanted to show a Lissajous figure or something of that nature.

HORACE D. SMITH
Baytown, Texas

Reader Smith's suggestion about peaking coils seems sensible, but the coils would have to be carefully selected and the amplifier gain checked for linearity. As far as adding a horizontal input is concerned, it should work, but may require some experimenting.

Equipment Conversion

■ I have access to surplus electronic equipment—miniature motors and other devices—which, unfortunately, operates only on 24- to 28-volt, 400-

cycle a.c. Can you or any of your readers suggest a simple way to convert to this frequency from 117-volt house current?

DR. F. A. LEMOINE
113 Girard Blvd., S.E.
Albuquerque, N. Mex.

If anyone has any ideas on this subject, please write directly to Dr. Lemoine.

Versatile FM Tuner

■ Congratulations to Robert E. Devine on his fine construction article in your August issue (page 49). The "One-Tube FM Tuner" works better than I ever expected it to, and I can get stations from Buffalo, N. Y., 50 miles away. A friend of mine, who also built one, receives police calls, fire department calls, etc., by adjusting coil L_2. This was a very rewarding project, and it didn't hurt my pocketbook.

JERRY WALD
Toronto, Ont., Canada

Annoyed Listener

■ I have had many a pleasant day at the beach or in the country spoiled by someone else's transistor portable radio playing with the volume turned up full. Some people don't seem to realize that there are others who prefer the peace and quiet of the country. Can you furnish me with a circuit for a pocket-sized noise generator or tunable oscillator that will blot out one or more stations on the

Letters

(*Continued from page* 18)

broadcast band? It should be transistorized and have a range of about 20 feet.

ROBERT D. FREED
New York, N. Y.

Intentionally causing interference in the manner you describe is a violation of the FCC Rules, punishable by imprisonment and/or fine. Why not try to find a quieter spot to spend the day?

Computer Articles in Demand

■ I just finished reading "Russian-English Translating Machine" in the August 1960 issue. Congratulations to Ken Gilmore for his fine interpretation of "How the Translator Works." I've been a P.E. reader since 1955 and particularly enjoy your articles on computers. How about some more of them?

ROBERT G. HEIM
Albert Lea, Minn.

We have a computer article in the works now, which is scheduled to appear in an upcoming issue. Watch for it.

The Good Earth

■ We read your article, "Communicating Through the Earth," by J. C. Fischesser, (July 1960 issue), and we decided to try it. It works very well.

We use tape recorders as the amplifiers—they make a very neat-looking station. By using tape recorders, we can prerecord tapes and play them into the system. Our power runs from .8 to 3.5 watts. We found that 2000-ohm headphones work best in our area.

Our call letters are GTS-71, 72, and 73. The letters stand for Ground Travel Station. The 7

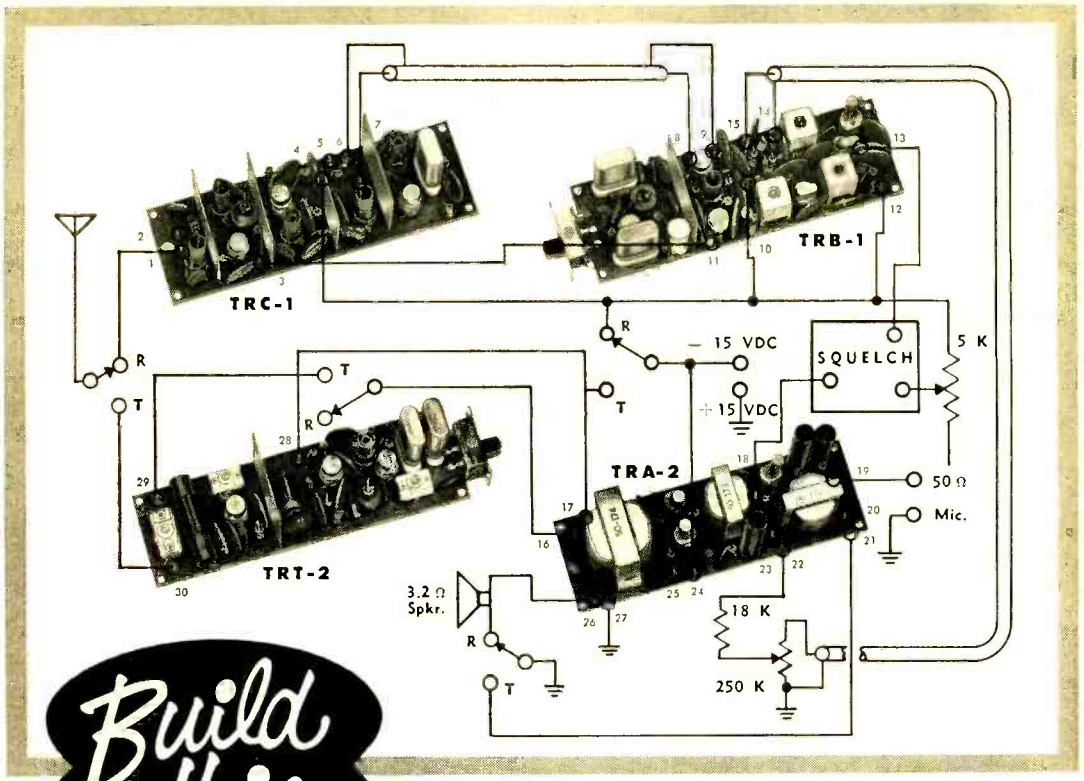
stands for the amateur call district, and the 1, 2, and 3 for the number of the station.

ROBERT FUNK, KN7KZF,
DENNIS HEIDENREICH,
DOUG MOORE
Scottsdale, Arizona

Low-Frequency DX

■ The frequency listed for Thule, Greenland, in Tom Kneitel's "DX'ing Down Below" (July, 1960, p. 51) has been changed. Station XPM50 now operates on 77.15 kc., instead of 98.5 kc. Also, the audio modulation that used to appear on the carrier has been deleted.

M/SGT. ALLEN M. RAYMOND
1933-2 AACS Squadron
APO 864, New York



Build this... ALL TRANSISTOR TRANSCEIVER

Now you can build your own All Transistor, Crystal Controlled, Portable Transceiver for Citizens band or Amateur communications. International sub-assemblies, prewired and tested are "quickly" interwired and ready for operation. Fifteen transistors for transmitting and receiving. Dual conversion superheterodyne receiver. Noise limiter and squelch. International precision crystals and highest quality components throughout. Power requirements: 15 volts dc @ 60 ma average. Positive ground.

TRC-1 CONVERTER
Crystal controlled, 3 transistors for 10 meters or Citizens band. RF amplifier, mixer/oscillator. Double tuned front end. IF output 6 mc. Others on special order. Power: 15 volts dc @ 5 ma. Wired, tested with Crystal. Cat. No. 300-132 ..... $17.95
Special IF (Cat. No. 300-140) $22.50

TRB-1 MIXER IF UNIT
Six transistors, 2 diodes. 6 mc RF amplifier/mixer. Crystal controlled local oscillator. 455 kc IF. Noise limiter/squelch. Input 6 mc. Specify frequency. Wired, tested with crystals. Cat. No. 300-131 ..... $32.50

TRA-2 AUDIO UNIT
Three transistors. Input 100,000 ohms and 50 ohms. Speech amplifier for dynamic microphone. Push-pull power amplifier class B. Output 300 mw. Wired and tested. Cat. No. 400-104 ..... $21.50

TRT-2 TRANSMITTER
Crystal controlled. Three transistors. Output 100 milliwatts minimum with ±1 transistors. Power stage uses special HF transistors. Wired and tested less crystals and transistors. Cat. No. 200-118 ..... $10.00
±1 Transistor Kit (100 mw output). Cat. No. 150-128 ..... $17.50
±2 Transistor Kit (.50 mw output). Cat. No. 150-129 ..... $ 9.00
Crystals FCB for Citizens band (.0025%) ..... $ 4.75
Crystals FA-5 for Amateur (.01%) ..... $ 4.00

ASSEMBLY PARTS KIT makes it easy to interwire subassemblies. Kit includes base plate, squelch control, volume control, transmit-receive switch and antenna connector. Cat. No. 150-136 ..... $9.95

ORDER DIRECT FROM INTERNATIONAL CRYSTAL MFG. CO.

INTERNATIONAL
CRYSTAL MFG. CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLAHOMA

FREE 1961 CATALOG

SEND FREE 1961 INTERNATIONAL CATALOG
NAME _____
ADDRESS _____
CITY _____ STATE _____

83 YX 929. Stereo Tape Record-Play Preamp Kit. $79.95 (less case)

One of the many great Knight-Kit stereo component kits. Professional quality; superb performance with virtually any tape transport; separate dual-channel recording and playback preamps; permits tape monitoring, sound-on-sound and echo effects. Packed with quality features for every possible stereo and monophonic function...

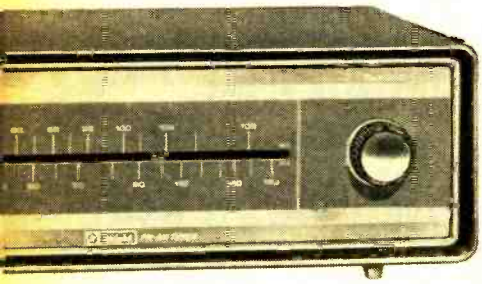
Simply

these and 59

knight

A PRODUCT

a pleasure to build...



83 YX 928. FM-AM Hi-Fi Tuner Kit. $49.95

Typical Knight-Kit hi-fi value—incomparable at the price. With AFC, tuned RF stage on FM, multiplex jack. Straight FM tuner kit also available at $38.95. For deluxe Stereo FM-AM and FM tuner kits, see the Allied catalog...

83 YX 927. 20-Watt Stereo Hi-Fi Amplifier Kit. $39.95

Biggest bargain in quality Stereo hi-fi. Has special clutch-type dual-concentric level control; simplified control facilities; DC preamp filaments. Similarly styled 32-Watt Stereo Amplifier Kit with full frequency center channel available at a low, low $59.95...

The most satisfying do-it-yourself experience awaits you when you build a Knight-Kit! You'll marvel at the sheer ease of assembly, absolutely assured by exclusive "show-how" manuals, wall-sized picture diagrams, step-by-step do-and-check instructions, pre-cut wire, "visi-packed" parts and an engineering perfection that eliminates guesswork. You'll get perfect results. You'll enjoy with pride a true custom-built electronic product, professionally engineered and styled—the best you can own. And to top off your pleasure, you'll save substantially at the unbeatable Knight-Kit price...

83 YU 934. Deluxe 70-Watt Stereo Hi-Fi Amplifier Kit. $119.95

Super-power to drive any of today's speakers, a do-it-yourself stereo masterpiece, featuring: special "blend" control; full-range center channel; tape-source monitor; dual phasing switches; Stereo paralleling switch. For deluxe 40-watt Stereo amplifier at only $76.95, and 60-watt Stereo amplifier, see the Allied catalog...

83 YX 712-2. Superhet Citizen's Band Transceiver Kit. $79.95

Dual-conversion for highest sensitivity and selectivity; crystal-controlled operation on any 2 channels, plus manual tuning. Another Knight-Kit Citizen's Band Transceiver is available at an amazing low $39.95—see the Allied catalog for full details...

Great!

other money-saving -kits®

OF ALLIED RADIO

and you own the best

83 YX 258. 4-Band "Span Master"® Receiver Kit. $25.95

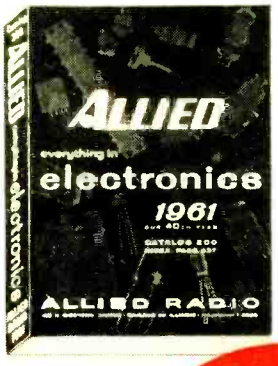
Fabulous performer for world-wide reception; thrilling shortwave adventures, plus fine Broadcast; band-switching, 540 KC to 30 MC; with cabinet. For additional receiver kits, radio-intercom, clock-radio, transistor radios, intercom systems, electronic labs and other great hobbyist Knight-Kits, see the Allied catalog...

money back guarantee

Every Knight-Kit is unconditionally guaranteed to meet our published specifications for performance or your purchase price is refunded in full.

only $2 down

It's easy to buy any Knight-Kit: only $2 down on orders up to $50; $5 down up to $200; $10 down over $200—up to 24 months to pay.



83 Y 125. Electronic VTVM Kit. $25.75

High sensitivity general-purpose VTVM; 11 meg input resistance; balanced-bridge circuit; 4½" meter. One of many fine instrument kits including 5" scopes, AC VTVM, tube checkers, signal tracer, audio generator, sweep generator, and others, described in detail in the Allied catalog...

Featured

IN THIS VALUE-PACKED 1961

444-PAGE ALLIED CATALOG

Send coupon today for the 1961 Allied electronics catalog (the world's biggest), featuring the complete Knight-Kit line. See the best in electronic kits—save on *everything* in Electronics. Send for your FREE copy now!

sold exclusively by

also available in Canada

ALLIED RADIO

pioneer in electronic kit development

our 40th year

free *send coupon today!*

ALLIED RADIO, Dept. 204-A1
100 N. Western Ave., Chicago 80, Ill.

☐ Send Free 1961 Allied Catalog No. 200

Name_____
PLEASE PRINT

Address_____

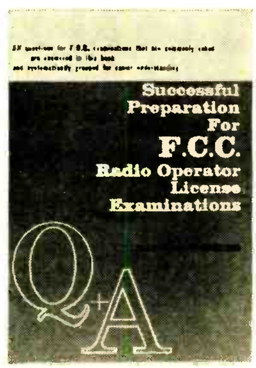
City_____ Zone____ State_____

POP'tronics Bookshelf

"SMITHSONIAN TREASURY OF SCIENCE," edited by Webster P. True. Published by Simon and Schuster, Inc., 630 Fifth Ave., New York 20, N. Y., in cooperation with the Smithsonian Institution, Washington, D. C. Three volumes, 1208 pages. Hard covers. $15.00.

A veritable library of science, this three-volume set contains articles covering almost every field of scientific knowledge and research written by some of the world's foremost authorities. Subjects include astronomy, physics, oceanoraphy, meteorology, engineering, and exploration; authors include W. C. Roentgen ("The X-Rays"), G. Marconi ("Wireless Telegraphy"), J. Edgar Hoover ("Physical Science in the Crime-Detection Laboratory"), and Albert Einstein ("Isaac Newton"). Furnished with an attractive cardboard binder, the set contains 133 full-page photographic plates and 120 text illustrations, including maps, drawings, and woodcuts.

"SUCCESSFUL PREPARATION FOR F.C.C. RADIO OPERATOR LICENSE EXAMINATIONS," by Darrell L. Geiger. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. Hard cover. 689 pages. $9.25.

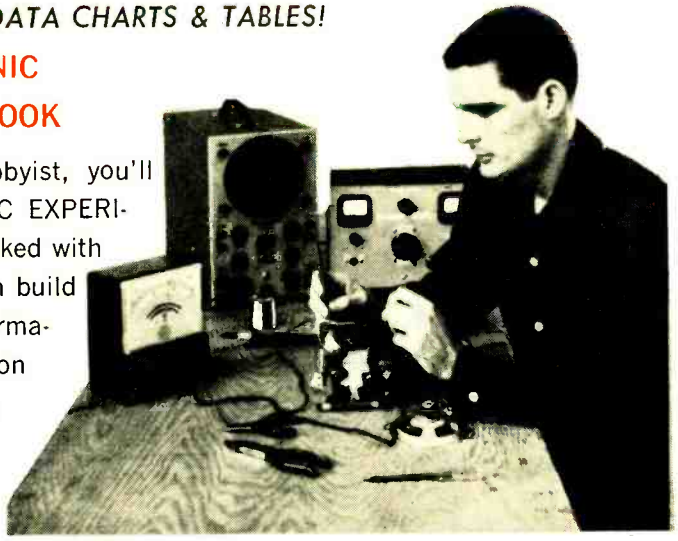


To operate, maintain, or service any commercial radio transmitter in the United States requires some form of FCC license. There are several classes of licenses available, some easier to get than others but carrying fewer privileges. This book describes the various licenses, the nature of the examinations which have to be taken to obtain them, and how to pre-

A DO-IT-YOURSELF GOLDMINE!

40 ALL-NEW PROJECTS! 20 DATA CHARTS & TABLES!

ALL IN THE 1961 ELECTRONIC EXPERIMENTER'S HANDBOOK



If you're an electronics hobbyist, you'll welcome the 1961 ELECTRONIC EXPERIMENTER'S HANDBOOK. It's packed with over 40 all-new projects you can build yourself, plus more than 20 information-packed charts and tables on circuits, resistors, transformers, capacitors, ham and citizens band radio, sound levels, and much more!

THESE ARE JUST A FEW OF THE EXCITING PROJECTS YOU CAN BUILD FROM THE COMPLETE DIAGRAMS AND EASY-TO-FOLLOW DRAWINGS:

PROJECTS FOR YOUR HI-FI & AUDIO SYSTEMS

Speaker Cabinet Designs
Unusual Amplifier
Power Megaphone
Intercom
One-Tube FM Tuner
Speaker Crossover

PROJECTS FOR THE HAM AND SWL

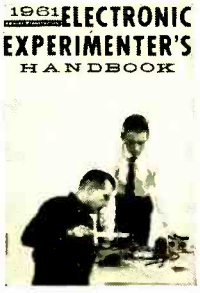
Acoustic Phone Patch
One Transistor Ham Transmitter
Beam Antenna
Mobile Short Wave Converter
Practice Oscillator

PROJECTS FOR YOUR SHOP

Direct Reading Frequency Meter
Grid-Dip Meter
Dual-Meter Transistor Tester
Citizens Radio Tune-up Probe
Field Strength Meter
R.F. Power Meter

PROJECTS FOR FUN

Electronic Music Box
Transistorized Driver Alarm
Auto Safety Flasher
Transistorized Pocket Fence Controller
Transistorized Pocket Radio



The new 1961 ELECTRONIC EXPERIMENTER'S HANDBOOK will be on sale at your favorite newsstand or electronic parts store Jan. 26th. Reserve your copy today —or order now by handy coupon.

Ziff-Davis Publishing Company
1 Park Avenue
New York 16, N. Y.

Please send me a copy of the 1961 ELECTRONIC EXPERIMENTER'S HANDBOOK. I enclose $1.00 plus 10¢ to cover mailing and handling charges. (Canada and Foreign $1.25 plus 10¢ postage.)

NAME_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

EF2200 2017

Bookshelf

(*Continued from page* 24)

pare for the exams. Broad answers to hundreds of typical questions are given which, if studied carefully, will enable the reader to answer any actual exam questions on the same topic correctly. A must for the man seeking a commercial license.

"S-9 SIGNALS" by William I. Orr. Published by Radio Publications, Inc., Wilton, Conn. Soft cover. 48 pages. $1.00.

This latest volume from the pen of the prolific Mr. Orr is one of the most practical paperbacks we've seen in a long time. Although only 48 pages big, it overwhelms the reader with plans for 11 antennas—the likes of which we've *never* seen. Inexpensive to build and simple to install, they undoubtedly can give S-9 signal results simply because Bill Orr believes in proper matching. Recommended for SWL's and hams operating from 2 to 80 meters.

"AUTO RADIO SERVICE MANUAL, Volume 10" published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. 160 pages. Soft cover. $2.95.

Still another volume in the Sams "PHOTOFACT" series covers 31 auto radios produced in 1958 and 1959 under the following brand names: American Motors, Automatic, Buick, Cadillac, Chevrolet, Edsel, Ford, Gonset, International, Mopar, Motorola, Oldsmobile, Pontiac, Riverside, and Vauxhall. It should be a very valuable reference work for the service technician who specializes in auto radio repair.

"MAGNETIC AMPLIFIERS—PRINCIPLES AND APPLICATIONS," by Paul Mali. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 112 pages. Soft cover. $2.45.

The increasing use of magnetic amplifiers makes this book both timely and practical. Presuming a fundamental knowledge of electricity, it starts with a

Accredited by the National Home Study Council

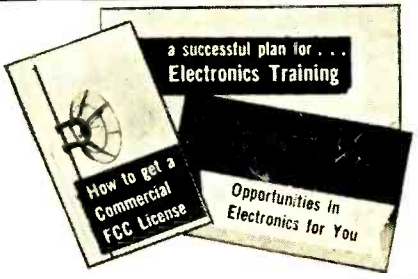
good training doesn't cost . . . it pays!

How To Get an FCC License (Commercial)

Increase Your Technical Knowledge

Get a government license plus an understanding of such electronic applications as computers . . . industrial electronics . . . radar . . . communications . . . and many more.

Get All Three Booklets Free...



An FCC License Or Your Money Back!

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial Radio Telephone License with a Radar Endorsement. Should you fail to pass the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire period of your enrollment agreement.

Get This Handy Pocket Electronics Data Guide Free...

Puts all the commonly used conversion factors, formulas, tables, and color codes at your fingertips. Yours absolutely free if you mail the coupon today. No further obligation.

Cleveland Institute of Electronics
4900 Euclid Avenue Desk PE 73 Cleveland 3, Ohio

Cleveland Institute of Electronics

4900 Euclid Avenue Desk PE 73 Cleveland 3, Ohio

Please send Free Career Information Material prepared to help me get ahead in Electronics and a free copy of your "Pocket Electronics Data Guide." I have had training or experience in Electronics as indicated below:

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

In what kind of work are you now engaged? .....

In what branch of Electronics are you interested?.....

Name.....Age.....

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

PE 73

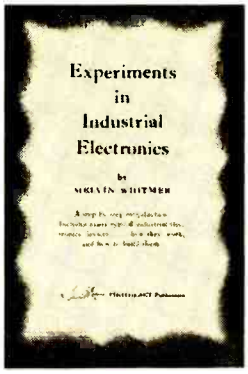
Bookshelf

(*Continued from page* 26)

basic review of magnetism, electromagnetism, and magnetic circuitry, then goes into saturable reactor theory—the key to this field. Gain and feedback in magnetic amplifiers is covered, as well as construction and general uses, maintenance, and trouble-shooting.

"EXPERIMENTS IN INDUSTRIAL ELECTRONICS," by Melvin Whitmer. Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. Soft cover. 94 pages. $1.95.

Experience in entertainment phases of electronics is not enough to allow someone to step into the field of industrial electronics servicing—he needs actual bench experience on industrial equipment. This book is intended to provide such experience through the construction of several projects representative of industrial gear. Diagrams and step-by-step instructions are included for building a photo-electric alarm, an r.f. heating system, an electronic timer, a proximity detector, etc. For those not interested in a career in this field, the book can serve as a source of unusual projects.

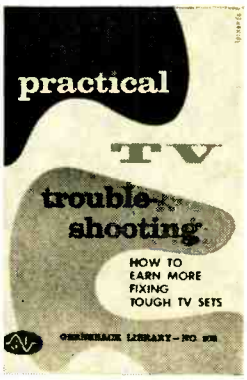


"PRACTICAL RADIO AND ELECTRONICS COURSE FOR HOME STUDY," prepared under the direction of M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. Soft cover. 216 pages. $3.95.

In this book, the beginner in radio and electronics is introduced to the components that make up the ordinary household receiver. Following an explanation of common electronic construction practices, the book advances through meters, circuit properties, test instruments, receivers, transmitters, and non-entertainment (industrial) equipment. It should provide the uninitiated with a basic understanding of a broad field.

"PRACTICAL TV TROUBLE-SHOOTING," published by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. Soft cover. 128 pages. $2.35.

Here is a collection of outstanding service articles by many well-known technician-writers. Intermittents, video i.f. oscillation, horizontal jitter, ghosts, and picture quality control are among the subjects covered. As the title suggests, the emphasis is on the practical side of servicing, but some theory is included (apparently on the assumption that "you can't fix 'em properly if you don't understand 'em"). Recommended for beginners and experienced technicians alike.



Free Literature

Two additions to the regular Heath line of amateur radio, hi-fi, marine, and test equipment kits are featured in the Heathkit Fall & Winter 1960-61 catalog. A new "Science Series," aimed at introducing youngsters to electronics, includes three simple electronic workshop hookups, as well as radios, an intercom, a code practice set, and a portable transmitter. And for the first time in its history, the company has some of its equipment available in factory-wired and tested form. Write to the Heath Company, Benton Harbor, Mich., for your copy.

A six-page folder—"Recommended Circuits for Transistorized Radios"—can be obtained by writing Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J. Four circuits are given, covering units which incorporate from four to seven transistors. -30-

FREE!

LAFAYETTE'S 1961 CATALOG

324 GIANT SIZED PAGES

The Complete Catalog Featuring
"The Best Buys In The Business"

- Stereophonic Hi-Fi Equipment
- Public Address Systems
- Tape Recorders
- Radio and TV Tubes and Parts
- Citizen Band Equipment
- Amateur Equipment
- Industrial Supplies

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

CONTAINS HUNDREDS OF EXCLUSIVE LAFAYETTE ITEMS NOT AVAILABLE IN ANY OTHER CATALOG OR FROM ANY OTHER SOURCE—SEND FOR YOUR COPY NOW!

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist engineer, technician, student, serviceman and dealer.

Our 40th Year

EASY PAY PLAN—the simplest, and quickest way to get what you want when you want it. As little as $2 down . . . up to 24 months to pay.

Communications Receiver
KT-200, Kit HE-10, Wired
64.50 79.95

RK-480 2-Speed
Portable Tape Recorder
49.50

TE-15 Tube Checker
19.95

RW-60 20,000 Ohms Per Volt Multitester
13.50

TN-14
Radio Field Indicator
6.95

4E-800WX
Citizen Band Mobile Antenna
6.95

LAFAYETTE RADIO

Mail the coupon today for your FREE copy of Lafayette Radio's 1961 catalog.

Lafayette Radio Electronics Corp.
Dept. IA-1, P.O. Box 190
Jamaica 31, N. Y.

Send me the FREE Lafayette 324 page 1961 catalog 610

Name_____

Address_____

City_____ Zone____ State_____

NEW products

DEPTH FINDER

PACO Electronics Co., Inc., 70-31 84th St., Glendale 27, L. I., N. Y., has entered the marine-electronics field with the Model DF-90 depth finder. A completely-transistorized unit, the DF-90 serves as both protection against shoals and as a fish-school finder. Its oversize scale is calibrated in one-foot intervals and it

may be powered by the boat's electrical system or by its own batteries. The hermetically-sealed barium-titanite transducer can be mounted on transom or hull. Having a range of up to 120 feet, the DF-90 measures 7" x 5¾" x 6", and is available either as a kit or factory-wired. In kit form, the price is $84.50; wired, $135.50.

CAPACITOR ASSORTMENT

For the experimenter and serviceman, *Pyramid Electric Company* (Darlington, S. C.) has packaged 45 Mylar-paper "Gold-Dip" capacitors in a nine-drawer plastic case. The Type 151 units come in the most popular values ranging from 0.25 μf. (400 volts) to 0.0047 μf. (600 volts). A dab of red paint on one lead and a mark on the body indicate the "outside foil." The case measures 4¾" x 9¾" x 6¼" deep and comes with drawer di-

Learn RADIO, TELEVISION AND ELECTRONICS

by Practicing at Home in Your Spare Time

At No Extra Cost you get specially developed Electronic Training Kits for practical experience. Shop and laboratory practice at home make learning easier, interesting, faster. You do not need a high school diploma or previous experience.

Increasing Demand for Trained Men

This is the Electronics age. Men with Electronic know-how are in demand. They enjoy high pay and growing opportunities for advancement. Satellites, Radar, Automation in Industry, Missiles, Rockets, Planes, Stereo, TV, Radio, Two Way Communications for transportation are a few of the fantastic developments in the fast growing Electronics industry. If you are not completely satisfied with your work; if you are doubtful about your future, investigate Electronics.

High Pay, Prestige, Bright Future

What branch of Electronics interests you? Thousands of successful NRI graduates prove that NRI's learn-by-practice method is the way to success. You start in your chosen career 'way ahead of the man who only learns from books. You do not need to give up your job. You do not need to go away to school. You learn at home, get practical knowledge from training kits NRI provides.

Train With the Leader

NRI is the world's oldest and largest home study Electronics school. You benefit from the experience NRI has gained from training men for 45 years. NRI offers you proven courses of home study in Electronics; Principles, Practices and Maintenance—Radio Television Communications—Radio Television Servicing.

Start Soon, Earn More

Soon after enrolling NRI shows you how to apply your knowledge to earn extra money doing Electronic repairs or servicing Radio and Television sets for friends and neighbors. Take the first step toward success now. Find out what NRI offers you. Mail the postage-free card. No obligation. Cost of NRI training is low. Monthly payment plan available. NATIONAL RADIO INSTITUTE, Washington 16, D.C.

NRI Has Trained Thousands for Success

"I get over twice the salary I made before enrolling. NRI training gave me a thorough understanding." H. ATKINSON, Austin, Tex.

"Now in charge of sound effects for CBC. NRI opened doors to greater opportunity for me." E. TUDOR, Toronto, Ontario.

"Averaged $150 a month spare time before I graduated. Now have my own full time business." F. W. COX, Hollywood, Cal.

NEW COURSE IN ELECTRONICS TURN PAGE

Cut Out and Mail—No Stamp Needed

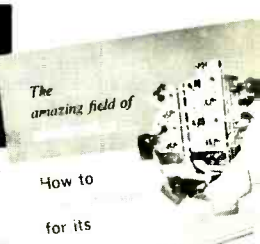
64-PAGE CATALOG FREE

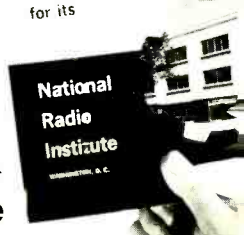
No Salesman will call. (Please PRINT) Dept. 13D-4

Name _____ Age ____

Address _____

City _____ Zone ____ State _____





OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

WASHINGTON 16, D. C.

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

JOB COUNSELORS ADVISE
LEARN ELECTRONICS

SPECIAL TRAINING KITS
NO EXTRA COST

SEE OTHER SIDE

NEW Home Study Course in ELECTRONICS
Principles-Practices-Maintenance
NOW READY

This is the Electronic Age. Electronic equipment is already being used to count and control flow of liquids, solids, gases. Electronics is employed to search for oil, make surveys, control traffic, machine complex parts and in atomic installations. Military uses of Electronics are great and expanding rapidly. In business, Automation with Electronics plays an important part, prepares payrolls, calculates engineering formulas.

Learn More to Earn More

Now, to meet the growing demand for trained Electronic Technicians NRI has developed a comprehensive, complete course in Electronics Principles, Practices, Maintenance. This training stresses fundamentals. It is a course specially prepared for beginners and for Technicians. You get both theory and practical experience in an interesting, exciting way.

Ten Special Training Kits Give Practical Experience

You get practical experience with Thyratron Tube circuits, Multivibrators, build a D'Arsonval type Vacuum Tube Voltmeter (Kit 2); work and experiment with pentode tubes, selenium resistors, oscillators, transistors, magnetic amplifiers; and get practical experience in telemetry circuits as used in earth satellites, digital and analog computers (Kit 9).

NRI Oldest, Largest School

Wishing for success won't bring success. You must act. Get FREE 64-page Catalog from America's oldest and largest home study Electronic-Radio-Television school. It gives facts, opportunities in Industrial and Military Electronics careers, also shows what you learn, tells about NRI's other courses in Radio Television Servicing and Radio Television Communications. Monthly payments plan. Mail Postage Free Card for 64-page Catalog. NATIONAL RADIO INSTITUTE, Washington 16, D.C.

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

National Radio Institute
3939 Wisconsin Avenue
Washington 16, D.C.

POSTAGE FREE CARD
MAIL NOW

products

(*Continued from page 32*)

viders and adhesive labels, permitting its further use after the capacitor supply is exhausted.

R-C TESTER

The latest addition to the NRI "Professional" line of test instruments is the Model 311 resistor-capacitor tester. A bridge circuit is used for accurate measurement of resistance, capacitance, leakage, power factor, opens, and shorts. Four capacitance and four resistance

ranges cover from 0.00001 to 1500 μf. and from 1 ohm to 150 megohms; 1% precision resistors, 5% capacitors, and a 6E5 null indicator insure accuracy. Price: $28.75, wired; $19.75 as a kit. (*National Radio Institute,* 3939 Wisconsin Ave., Washington 16, D. C.)

CERAMIC MICROPHONE

A high-output ceramic microphone available in two models (MK-3 and MK-3L) has been announced by *CBS Electronics,* 100 Endicott St., Danvers, Mass. Frequency response of the MK-3 is 30 to 10,000 cycles. Output is -52 db and the recommended load resistance is 5 megohms. The MK-3L is similar to the MK-3, but is mounted on a 13½" gooseneck that makes it suitable for use in paging systems and language laboratories. Other variations with a push-to-talk button can be had for mobile and CB use.

C.W. TRANSMITTER

Designed for the novice, and for the advanced ham who wants a low-power (60 watts) standby rig, the EICO 723 transmitter is available either wired or as a kit. It covers 80, 40, 20, 15, and 10 meters with single-knob bandswitching. The meter may be switched from the

final's plate to its grid circuit. With an external modulator, the unit can put out an AM phone signal. Other features include: a built-in antenna relay, VFO power take-off, modulator/accessory socket, and effective TVI suppression. Price: $49.95, kit; $79.95, wired. (*Electronic Instrument Co., Inc.,* 33-00 Northern Blvd., L. I. C. 1, N. Y.)

SIGNAL-INJECTION PROBE

The "Noy-Z-Ject" Model D-800 probe, announced by *Doss Electronic Research, Inc.,* Kansas City, Mo., is actually a 1000-cycle pulse generator in probe form. Its output "shock-excites" an r.f. or i.f. tuned circuit to produce a damped-wave output signal at the circuit's resonant

frequency. This excited signal serves as a carrier frequency for the 1000-cycle probe output signal. The long, sharp tip of the probe is handy for getting into tight places and piercing printed-circuit board coatings. Price: $11.67, wired; $8.67, in kit form.

REPAIR SHAFTS

Broken slotted tuning studs on i.f. transformers, width coils, linearity coils, etc.,

ELECTRONICS BOOK SERVICE will send you your choice of the world's greatest electronics books for a 7-DAY FREE EXAMINATION

Here are some of the world's greatest electronics books... chosen carefully by Ziff-Davis Electronics Book Service as among the best in their fields. You'll find top-notch texts and manuals on theory and instruction... important volumes covering radio and TV servicing, electricity and appliances... reference books to help you understand such fields as computers, citizens band, communications, and electronics experimentation.

Each volume is designed to help you get more know-how, greater enjoyment from your electronics specialty—and **each is yours for 7 days FREE!** Simply write your choices on the coupon below and mail it today. When your books arrive, read and enjoy them for seven full days. If, after that, you don't agree that they are everything you want, return them and owe nothing. Here is the perfect way to build the library every man in electronics must have.

THEORY AND INSTRUCTION

Get started in radio, TV, communications, by using these simple basic guides to electronic principles, functions, and operations!

2500. BASIC ELECTRONICS, Grob
An introductory text on the fundamentals of electricity and electronics for technicians in radio, television and industrial electronics. $9.25

2501. ELEMENTS OF ELECTRONICS, Hikey and Villines
This basic electronics text offers an excellent course for training radio and electronics technicians and for students in television, radar and sonar. $6.95

2511. UNDERSTANDING RADIO, 3rd Ed., Watson, Welch and Eby
For those with little or no technical knowledge who wish to know the fundamentals of radio theory and servicing. $8.25

2522. ELEMENTS OF RADIO, Hellman
A thorough grounding in all basic principles of radio and radio communication, with a review of electricity and magnetism. Includes chapter on transistors. $5.50

RADIO AND TV SERVICING

Save time and labor in radio and TV maintenance by referring to professional handbooks!

2407. HOW TO GET AHEAD IN THE TELEVISION AND RADIO SERVICING BUSINESS, Marcus
Shows the way to get started as a TV-Radio repairman, how to earn while you learn, how to get and keep customers. $3.50

2415. MANDL'S TELEVISION SERVICING, Mandl
This standard text book in the T.V. servicing field provides clear descriptions of the fundamentals of T.V., and practical instruction on the diagnosis and correction of typical trouble $7.50

2408. ESSENTIALS OF ELECTRICITY FOR RADIO AND TELEVISION, 2nd Ed., Slurzberg and Osterheld
Provides necessary background of principles for understanding T.V., FM and radio circuits. $8.25

2404. FM RADIO SERVICING HANDBOOK, King
A practical guide to FM V.H.F. receivers, their design, construction, alignment and repair. $5.00

ELECTRICITY AND APPLIANCES

Brush up on electrical theory, repair any electrical appliance by using these simple manuals!

2651. MAJOR APPLIANCE SERVICING, Brockwell
Gives essential information for a career in major appliance servicing. Explains methods of repairing appliances, organizing and managing a service business. $5.95

2650. HANDYMAN'S ELECTRICAL REPAIRS HANDBOOK, Hertzberg
Step-by-step photos and instructions show you how to repair and maintain home power systems, appliances, air conditioners, motors, etc. Also: how to make simple, useful appliance testers. $2.50

2660. BEGINNING ELECTRICITY, Eaton
Principles, construction and operation of basic electrical devices and appliances. A thorough foundation in electricity plus essential details on mechanisms. $6.00

2652. HOW TO REPAIR HOME APPLIANCES, Campbell
For the do-it-yourselfer, a handy, easy-to-read reference book with chapters on all kinds and types of appliances. Concise, thorough instructions with many useful illustrations. $2.50

Construction and Experimentation

Wonderful "how-to" books to help you build and enjoy practical electronic devices simply and easily.

2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay

With a few dollars worth of basic tools and this book to guide you, you can explore electronics experimentation more completely than ever before. 10 big sections. $4.95

2002. ELECTRONIC KITS DIRECTORY, Ziff-Davis Publishing Company

New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi, ham radio, SWL, shop improvement, Citizen's Band, fun and education. $1.00

2351. RADIO PROJECTS, Marcus

10 easy-to-construct radios described in this book cover the field thoroughly and completely, progressing in difficulty from the simple crystal detector to the superheterodyne receiver. $3.85

2001. 1960 ELECTRONIC EXPERIMENTER'S HANDBOOK, Ziff-Davis Publishing Company

40 projects for home and shop, 20 of which are transistorized. Special section on understanding transistor circuits. $1.00; **2009.** cloth, $1.95

Communications and Broadcasting

Here are books which simplify basic and advanced theory — and open new horizons to you in the field of communications!

2901. HAM RADIO, Hertzberg

Tells exactly how to become a "ham"—how to obtain a ham "ticket," how to learn code, how to select receivers and transmitters—everything you need to know is between the covers of this handy guidebook. $2.50

2900. BROADCASTING TELEVISION AND RADIO, Kingston, Cowgill, Levy

A simple, practical introduction to broadcasting, dealing with performance before the microphone and camera. $8.65

2008. CLASS D CITIZENS RADIO, Sands

First complete book on Citizens Radio operation. Covers Class D history, rules, applications, how it works. Many illustrations. $4.95

2907. RADIO OPERATING QUESTIONS AND ANSWERS, Hornung & McKenzie

Presents specific information on radio law, operating practices and theory for those studying to pass the FCC commercial radio operator exams of the various license grades. $6.25

Special Topics

Choose any of these practical books—to take advantage of the growing opportunities in the exciting field of electronics!

2007. COMPUTERS AND HOW THEY WORK, Fahnestock

A fact-filled guidebook to electronic computers. Explains the working of every major computer system. Must reading for all who want a more complete knowledge of this important field. $4.95

2601. TRANSISTORS IN RADIO, TELEVISION AND ELECTRONICS, Kiver

A descriptive, non-mathematical text for radio, television, electronics technicians and for those who want a working knowledge of transistors and circuits. $7.95

2301. ELECTRONICS & NUCLEONICS DICTIONARY, Cooke & Marcus

New! A revised, enlarged edition containing authoritative definitions of terms used in radio, television, industrial electronics, nucleonics, sound recording, etc. Bigger and better than ever! $12.00

2600. TRANSISTORS, Gillie

Describes and analyzes semi-conductors and transistors and how they behave. 300 pages, illustrated. $7.95

See Your Parts Jobber Or Use This Coupon Today!

Leading radio and electronics parts jobbers, hi-fi dealers and salons are making their stores headquarters for books on every electronics subject. You can take this list to your favorite dealer for immediate purchase.

If your local parts jobber or dealer does not carry books, use the coupon for prompt delivery from ELECTRONICS BOOK SERVICE, on a 7-day free trial basis.

ELECTRONICS BOOK SERVICE

One Park Avenue, New York 16, N. Y.

Please send me the book(s) I have listed below for a FREE 7-Day Trial Examination. I understand that if I am not completely satisfied, I may return my selection(s) and I'll owe you nothing. Otherwise, I will send you payment for the book(s) of my choice, plus postage and handling.

NUMBER	TITLE	PRICE
	*TOTAL	

*New York City Residents, please add 3% sales tax.

(If you need more space for other titles, attach a sheet of paper with addl. list.)

☐ SAVE MONEY! Enclose payment in full for the book(s) of your choice and we will pay shipping charges. Same return privileges and prompt refund guaranteed.

☐ Please send me FREE CATALOG, when published.

EF532

NAME _____

PLEASE PRINT CLEARLY

ADDRESS _____

CITY _____ ZONE _____ STATE _____

(7-day free trial offer good only in U.S.A. and Canada. Foreign customers must enclose payment in full. Satisfaction guaranteed or money refunded.)

products

(*Continued from page* 35)

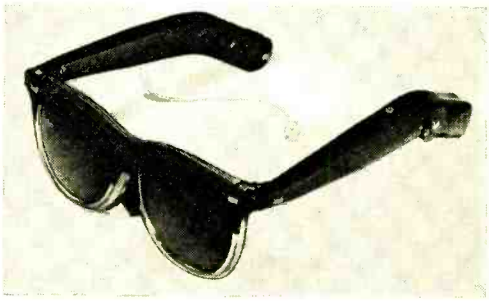
can be easily repaired with a series of repair shafts manufactured by *Superex Electronics Corp.*, 4 Radford Place, Yonkers, N. Y. Both *4-40* and *6-32* sizes are included in an assortment of six popular sizes. Price, 79 cents per assortment.

PRESSURE-SENSITIVE LABELS

Booklets of pressure-sensitive labels to identify small parts containers are available from *Kwikstik Products*, P. O. Box 263, Hicksville, L. I., N. Y. The names of over 450 parts are printed on the labels, including a variety of nails, screws, bolts, and nut sizes. Label size is ½" x 1¼"; price per booklet is $1.00, postpaid.

"SPECTACLE" RADIO

You won't have to miss your favorite radio program if you have one of the tiny, "spectacle" radios produced by the *W. R. Steele Co.*, 7569 University Ave., La Mesa, Calif. The miniature receiver incorporates three transistors and a diode and is completely contained in the temples of a special spectacle frame. A tiny tuning dial is mounted on one temple, a switch/volume control on the other. And the unit's tiny mercury-type battery lasts about 160 hours. Price, $29.95.



TUBE YOKE REMOVER

Now available from the *Walsco Electronics Mfg. Co.* (100 West Green St., Rockford, Ill.) is a solvent which enables a picture tube yoke to be slipped off without breaking the tube. Called "Ez-Off Frozen Yoke Remover Spray," the solvent is packaged in a spray-type can and is priced at 99 cents per can. —30—

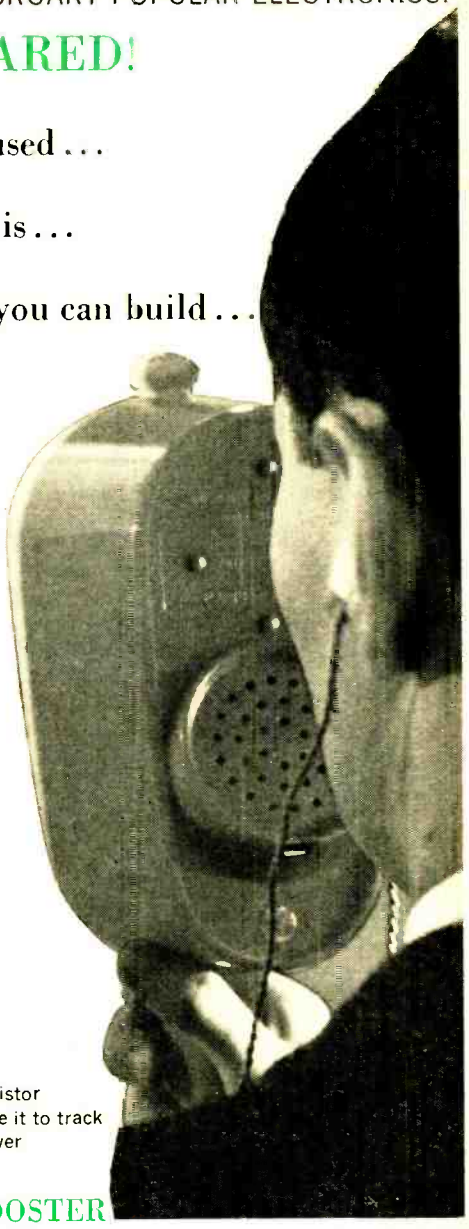
FEATURED IN FEBRUARY POPULAR ELECTRONICS:

INFRARED!

How it's used . . .

What it is . . .

Projects you can build . . .



Once known only as a mysterious invisible light, today infrared is used for such diverse tasks as spotting enemy missiles . . . analyzing molecular structure . . . triggering alarm systems. It's even found in children's toys!

You'll want to find out more about this exciting invisible light and its uses in February POPULAR ELECTRONICS. Learn about an incredible new infrared two-way walkie-talkie . . . how to construct an infrared burglar alarm in this fascinating article.

And you'll also enjoy these exciting February POPULAR ELECTRONICS construction projects:

- **BUILD A FIELD STRENGTH METER**

Here are complete construction plans for an inexpensive one-transistor field strength meter. Tune your transmitter or beam antenna . . . use it to track down troublesome TVI harmonics and r.f. "spill" into adjacent power and telephone lines.

- **CONSTRUCT AN INEXPENSIVE DX BOOSTER**

For under $5.00, you can build a broadcast band DX booster to pep-up those weak DX signals! Boost your communications receiver up to 7 "S" units with the easy-to-follow plans coming your way in February POPULAR ELECTRONICS.

Don't miss the informative, entertaining February issue of POPULAR ELECTRONICS —on sale January 26th at your favorite newsstand.

SUBSCRIPTION RATES:

one year $4 two years $7 three years $10

POPULAR ELECTRONICS, 434 South Wabash Ave., Chicago 5, Ill.

BEST BUYS IN STEREO AND MONO HI-FI

New Stereo/Mono 4-Track Tape Deck RP100
Semikit (electronics in kit form) $289.95 Wired $395.00

New FM-AM Stereo Tuner ST96
Kit $89.95 Wired $129.95
Incl. FET

New 70-Watt Integrated Stereo Amplifier ST70
Kit $94.95 Wired $144.95

New 40-Watt Integrated Stereo Amplifier ST40
Kit $79.95 Wired $124.95

28W Integrated Stereo Amplifier HF81
Kit $69.95 Wired $109.95

FM Tuner HFT90
Kit $39.95 Wired $65.95
Incl. FET Metal Cover $3.95

AM Tuner HFT94 Incl. FET
Kit $39.95 Wired $65.95

Stereo Preamplifier HF85
Kit $39.95 Wired $64.95

Stereo Power Amplifiers

	Kit	Wired
100W HF89:	$99.50	$139.50
70W HF87:	$74.95	$114.95
28W HF86:	$43.95	$ 74.95

Stereo/Mono Changer/Player 1007 with stereo cartridge and dual sapphire styli $49.75

Bookshelf Speaker System HFS1 Kit $39.95 Wired $47.95

EICO

EXCELLENCE IN CREATIVE ELECTRONICS

Over 2 MILLION EICO instruments in use throughout the world. Compare, take them home — right "off the shelf" — from 1500 neighborhood dealers, most of whom offer budget terms.

BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Citizens Band Transceivers from Kit $59.95 Wired $89.95

New 60W CW Transmitter #723
Kit $49.95 Wired $79.95

Transistor Portable Radio RA6
Kit $29.95 Wired $49.95
Incl. FET

BEST BUYS IN TEST EQUIPMENT

New Metered Variable AC Bench Supplies
Model 1073 (3 amps)
Kit $35.95 Wired $47.95
Model 1078 (7½ amps)
Kit $42.95 Wired $54.95

Peak-To-Peak VTVM #232 & Uni-Probe® Pat. #2,790,051
Kit $29.95
Wired $49.95*

VTVM #221
Kit $25.95 Wired $39.95

DC—5 MC 5" Scope #460
Kit $79.95
Wired $129.50

5" Push-Pull Scope #425
Kit $44.95 Wired $79.95

Tube Tester #625
Kit $34.95 Wired $49.95

RF Signal Generator #324
Kit $26.95
Wired $39.95

1000 Ohms/Volt V-O-M #536
Kit $12.90
Wired $14.90

6- & 12V Battery Eliminator & Charger #1050
Kit $29.95
Wired $38.95

Extra-filtered for transistor equipt. #1060
Kit $38.95 Wired $47.95

R-C Bridge & R-C-L Comparator #950B
Kit $19.95 Wired $29.95

Multi-Signal Tracer #145A
Kit $19.95
Wired $28.95

EICO, 3300 N. Blvd., L.I.C. 1, N.Y. PE-1
☐ Send free Catalog describing over 80 top-quality products, free **Stereo Hi-Fi Guide**, free **Short Course for Novice License**, name of nearest EICO dealer. ☐ Send new 36-page GUIDEBOOK TO HI-FI for which I enclose 25¢ for postage & handling.

Name.....

Address.....

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

Add 5% in the West

See Page 38 for the BEST BUYS in CITIZEN TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS

Edward Startz is M.C. for "The Happy Station" program of Radio Netherlands.

ENGLISH LANGUAGE VOICES from EUROPE

Short-wave broadcasts beamed to North America provide hours of informative and interesting listening

THE "Voices of Europe" are broadcasting daily to short-wave listeners in the United States and Canada. And a surprisingly high percentage of the programs are in English. By tuning in on these broadcasts, the listener can obtain a first-hand glimpse of life and customs in each land, gain some understanding of the people and their problems, and hear another side of the daily news.

The tables on the next four pages list the English language broadcasts from European short-wave broadcast stations. Frequencies, call letters, slogans, times and dates, and up-to-date program information are all included. Slight changes in frequencies can be expected, but the programs and times are those which these stations will follow during January and February.

PROGRAMING

Space does not permit a comprehensive listing of all the various and vitally interesting programs on the air, but on page 46 you'll find a few notes typical of European winter programing.

By STEWART WEST

The sound of Big Ben (pre-recorded) is broadcast from London every hour on the hour.

A charming announcer in Switzerland, known as Pamela, can be heard regularly via the short waves.

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
0630-0700 (0330-0400)	*Warsaw, Poland (Radio Warsaw) *News—0630 (0330)*	17800, 15275, 11800
0630-0700 (0330-0400) on Tue. & Sat.	*Helsinki, Finland (Radio Finland) *DX program—1st and 3rd Sat. 0630 (0330)* *Mailbag—Other Sat. 0630 (0330)*	17800, 15190, 11960
0700-0715 (0400-0415)	*London, England (B.B.C.) *News—0700 (0400)*	17740
0730-0830 (0430-0530)	*Warsaw, Poland (Radio Warsaw) *News—0730 (0430), 0800 (0500)*	17800, 15275, 11800
0800-0830 (0500-0530)	Paris, France (This is Paris) *News—0800*	17765
0845-0930 (0545-0630)	Lisbon, Portugal (Lisbon Calling) *News—0910 (0610)*	21495, 17880
0900-0920 (0600-0620) on Sundays only	Oslo, Norway (Radio Norway)	25900, 21670, 17825, 15175
0900-0930 (0600-0630)	*Stockholm, Sweden (Radio Sweden) *News—0900 (0600)* *DX program—Mon. 0920 (0620)*	17840
0915-1315 (0615-1015)	*London, England (B.B.C., North American Service) *News—1100 (0800), 1300 (1000)*	21675, 25840 (from 1100)
0945-1130 (0645-0830)	Berne, Switzerland (Switzerland Calling) *News—0945 (0645)* *DX program—Fri. 1020 (0720)* *Mailbag—Sun. 1030 (0730)*	21605, 17785
1000-1015 (0700-0715)	Vatican City, Vatican (Radio Vatican) *News—1000 (0700)*	15120, 11740, 9645
1000-1030 (0700-0730)	Copenhagen, Denmark (Voice of Denmark) *News—Tue. & Thur. 1000 (0700)* *DX program—Thur. 1020 (0720)* *Mailbag—Sat. 1015 (0715)*	15165
1030-1100 (0730-0800)	Belgrade, Yugoslavia (Radio Belgrade) *News—1030 (0730)*	15240, 11735, 9505
1100-1130 (0800-0830) on Mon., Wed. & Sat.	Vatican City, Vatican (Radio Vatican) *News—1100 (0800)*	21515, 17840
1100-1130 (0800-0830) on Mon. & Fri.	Helsinki, Finland (Radio Finland) *DX program—1st & 3rd Sat. 1100 (0800)* *Mailbag—Alt. Fri. 1100 (0800)*	17800, 15190, 11960
1100-1230 (0800-0930) on Sundays only.	Hilversum, Holland (The Happy Station) *Mailbag—1200 (0900)*	21565, 21480
1140-1210 (0840-0910) on Tue. & Fri.	Copenhagen, Denmark (Voice of Denmark) *News—1140 (0840)*	15165

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
1145-1200 (0845-0900)	Belgrade, Yugoslavia (Radio Belgrade) *News—1145 (0845)*	15240, 9505, 7200
1145-1230 (0845-0930)	Berne, Switzerland (Switzerland Calling) *News—1145 (0845)* *DX program—Fri. 1120 (0920)*	21605, 15315
1200-1220 (0900-0920) on Sundays only.	Oslo, Norway (Radio Norway)	25900, 21670, 17825, 15175, 11850
1215-1300 (0915-1000)	Lisbon, Portugal (Lisbon Calling) *News—1240 (0940)*	17895
1230-1245 (0930-0945)	Athens, Greece (Radio Athens) *News—1230 (0930)*	9605, 6075
1315-1330 (1015-1030)	Vatican City, Vatican (Radio Vatican) *News—1315 (1015)*	15120, 11740, 9645
1330-1400 (1030-1100)	Belgrade, Yugoslavia (Radio Belgrade) *News—1330 (1030)*	9505, 6100
1345-1530 (1045-1230)	Berne, Switzerland (Switzerland Calling) *News—1345 (1045)* *DX program—Fri. 1420 (1120)* *Mailbag—Sun. 1430 (1130)*	9545, 7210
1500-1600 (1200-1300)	*Brussels, Belgium (This is Brussels)	6140
1615-1705 (1315-1405) Daily except Sun.	*Hilversum, Holland (Radio Netherlands) *News—1615 (1315)*	11730, 9590
1615-1815 (1315-1515)	*London, England (B.B.C., G.O.S.) *News—1800 (1500)*	11860, 9510
1630-1800 (1330-1500)	Villa Louvigny, Luxembourg (Radio Luxembourg)	6090
1700-1730 (1400-1430)	Berlin, East Germany (Radio Berlin International) *News—1700 (1400)*	11765, 9605
1715-1845 (1415-1545)	*Cologne, Germany (Voice of Germany) *News—1740 (1440)*	11795, 9605
1730-1800 (1430-1500)	Tirana, Albania (Radio Tirana) *News—1730 (1430)*	7157
1730-1800 (1430-1500) on Mon., Wed. & Fri.	Vatican City, Vatican (Radio Vatican) *News—1730 (1430)*	15120, 11740
1800-2203 (1500-1903)	*London, England (B.B.C., G.O.S.) *News—1800 (1500), 1900 (1600), 2100 (1800), 2200 (1900)*	9510, 6110
1800-0100 (1500-2200)	*Moscow, U.S.S.R. (Radio Moscow) *News—every hour on the hour.* *DX program—2nd & 3rd Sun. 1850 (1550), 2150 (1850)* *Mailbag—Sat. & Sun. 1930 (1630), 2230 (1930)*	9720, 9690, 9660, 9620, 9610, 9570, 7390, 7290, 7210, 7150

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
1830-2000 (1530-1700) on Saturdays, 1900-2000 (1600-1700) on Sun., Tue., Wed. & Thur., 1945-2000 (1645-1700) on Mon. & Fri.	*Brussels, Belgium (This is Brussels) *News—1935 (1635) except Mon. & Fri. at 1945 (1645)* *Mailbag—Sat. 1930 (1630)*	11850, (to Africa on 11720, 9745)
1900-2000 (1600-1700)	*Budapest, Hungary (Radio Budapest) *News—1900 (1600)*	11910, 9833, 7220
1900-1925 (1600-1625) on Sundays only	Oslo, Norway (Radio Norway)	11850, 9610, 6130
1900-2200 (1600-1900)	*Cologne, Germany (Voice of Germany) *English programs—Sun., Wed. & Sat. 2110 (1810)* *DX program—2nd Mon. of the month 2015 (1715)*	11795, 9640
1930-1950 (1630-1650)	*Rome, Italy (Italian Broadcasting and Television System) *News—1930 (1630)*	9575, 6010
1930-2030 (1630-1730)	*Warsaw, Poland (Radio Warsaw) *News—1930 (1630)*	15275, 11800, 9675, 7315
2000-2030 (1700-1730)	*Sofia, Bulgaria (Sofia Bulgaria Calling) *News—2000 (1700)*	9700
2030-2120 (1730-1820) Daily except Sun.	*Hilversum, Holland (Radio Netherlands) *News—2030 (1730)*	9590, 6025
2030-2130 (1730-1830)	*Bucharest, Rumania (Bucharest Calling) *News—2100 (1800)*	11810, 9510, 7225, 7195, 6190, 5980
2030-2215 (1730-1915)	*Berne, Switzerland (Switzerland Calling) *News—2030 (1730)* *DX program—Fri. 2105 (1805)* *Mailbag—Sun. 2115 (1815)*	11865, 9535, 6165
2045-2115 (1745-1815)	*Stockholm, Sweden (Radio Sweden) *News—2045 (1745)* *DX program—Mon. 2105 (1805)*	9725
2100-2130 (1800-1830) Mon. through Fri., 2030-2130 (1730-1830) on Saturdays.	*Copenhagen, Denmark (Voice of Denmark) *News—Mon. 2100 (1800)* *DX program—Tue. 2100 (1800)* *Mailbag—Sat. 2030 (1730)*	9520
2100-2125 (1800-1825) on Sundays only	*Oslo, Norway (Radio Norway)	11850, 9610, 6130
2100-2230 (1800-1930) on Sundays only	*Hilversum, Holland (The Happy Station) *Mailbag—2200 (1900)*	9590, 6025
2130-2230 (1830-1930)	*Warsaw, Poland (Radio Warsaw) *News—2130 (1830), 2200 (1900)*	15275, 11800, 9675, 7315
2200-2255 (1900-1955)	*Prague, Czechoslovakia (This is Prague) *News—2200 (1900)*	11990, 9580, 9550, 7340, 5930

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
2200-2330 (1900-2030)	*Budapest, Hungary (Radio Budapest) *News—2200 (1900)*	9833, 7220
2200-2230 (1900-1930)	*Bucharest, Rumania (Bucharest Calling) *News—2200 (1900)*	11810, 9510, 7225, 7195, 6190, 5980
2200-0100 (1900-2200)	*Cologne, Germany (Voice of Germany) *English programs—Sun., Wed. & Sat. 0010 (2110)* *DX program—2nd Mon. of the month 2315 (2015)*	11795, 9640
2205-2225 (1905-1925)	*Rome, Italy (Italian Broadcasting and Television System) *News—2205 (1905)*	9575, 6010
2215-2300 (1915-2000)	*Madrid, Spain (Voice of Spain) *News—2215 (1915)*	9363, 6130
2215-2245 (1915-1945)	*Stockholm, Sweden (Radio Sweden) *News—2215 (1915)* *DX program—Mon. 2235 (1935)*	9725
2230-2330 (1930-2030)	*Budapest, Hungary (Radio Budapest) *News 2230 (1930)* *2325 (2025)*	11910, 9833, 7220
2230-2300 (1930-2000) Mon. through Fri., 2200-2300 (1900-2000) on Saturdays.	*Copenhagen, Denmark (Voice of Denmark) *News—Mon. 2230 (1930)* *DX program—Tue. 2230 (1930)* *Mailbag—Sat. 2200 (1900)*	9520
2300-2330 (2000-2030)	*Sofia, Bulgaria (Sofia Bulgaria Calling) *News—2300 (2000)*	9700
2315-0000 (2015-2100)	*Berne, Switzerland (Switzerland Calling) *News—2315 (2015)* *DX program—Fri. 2350 (2050)*	11865, 9535, 6165
2315-0000 (2015-2100)	*Madrid, Spain (Voice of Spain) *News—2315 (2015)*	9363, 6130
2330-0000 (2030-2100)	*Bucharest, Rumania (Bucharest Calling) *News—2330 (2030)*	11810, 9510, 7225, 7195, 6190, 5980
0000-0400 (2100-0100)	Vienna, Austria (Radio Austria) *This is an experimental transmission.*	6155
0000-0025 (2100-2125) on Sundays only	*Oslo, Norway (Radio Norway)	11850, 9610, 6130
0000-0055 (2100-2155)	*Prague, Czechoslovakia (This is Prague) *News—0000 (2100)*	11990, 9580, 9550, 5930
0000-0130 (2100-2230)	*Cologne, Germany (Voice of Germany) *News—0025 (2125)*	11945, 9735
0015-0100 (2115-2200)	*Madrid, Spain (Voice of Spain) *News—0015 (2115)*	9363, 6130

* *Strong signals in United States and Canada*

"This Is London." The British Broadcasting Corporation has built up a world-wide following during the three decades it has engaged in short-wave broadcasting. The announcement, "This is London Calling" and the sound of Big Ben striking the hour are known in every corner of the globe. Nowadays, the General Overseas Service includes a variety of unusual programs, and the North American Service is frequently taped and rebroadcast in the United States on AM and FM.

A Youth Forum team is heard on Switzerland's Youth Magazine program.

Horst Krieger is the Short-Wave DX Editor for the Voice of Germany.

During the month of January, the BBC is sure to have something of interest for every listener. Their two best-known world affairs programs are "The World Today" (daily except Saturdays at 2050 EST), and "Serious Argument" (Wednesday at 2115 EST). At 1815 each Friday they will have a special documentary ("Training for the Services" on January 6, 13, and 20; "Solving the World's Food Problems" on January 27).

For sports fans, "Sports Round-Up" is a regular feature Monday through Saturday at 1745. Music lovers will be interested in "The Orchestras of Britain" (Saturdays at 2130 EST), "BBC Concert Hall" (Sundays at 1615), "Famous Churches of London" (Tuesdays at 2130), and "Listeners' Choice" (Wednesdays at 1715).

"The Happy Station." Since 1928 a pioneer short-wave broadcasting station—PCJ—in Hilversum, Holland, has been enthusiastically acclaimed by SWL's. To a very large extent, this endorsement has been credited to Edward Startz and his "International Happy Station Program." But Startz, who originates the ideas and hosts the program each Sunday at 2100, is modest about PCJ's success—he says that it is the inspiration of the listeners that keeps the show so lively.

An example of listeners' participation was scheduled for Christmas Day: a "Round the World Listener Salute" comprising 20 different tapes from as many different countries—all supplied by regular listeners.

"Switzerland Calling." Swiss music enlivens the air at 2050 and 2335 with "Country Dancing Date" on Thursdays and "Jazz Panorama" on Wednesdays. On Saturdays at 2115 there is "Melody Train" with an hour of requests and musical variety. And on Sundays the "Swiss Sunday Special" provides music, information, and fun—including a mailbag section.

TUNING THE BANDS

The SWL tuning for European stations must contend with two problems. One of them is the vicious jamming of Western European broadcasts by transmitters in Soviet-controlled countries. Jamming sounds like a buzz saw and almost always obliterates the broadcast it is intended to cover. To evade such jamming, many stations shift frequencies a few kilocycles, hoping that it may be hours—or days—before the jammer catches on.

The second problem concerns the day-to-day variation in signal strengths. To reach American shores, European stations must beam their broadcasts over the Great Circle path. This means that somewhere along its path the radio signal either passes through or very near the Northern Auroral Zone. When the *Aurora Borealis* is active, there will be severe interference. The signal may lose strength or it may become completely garbled due to rapid fading. Thus, if you find conditions poor one evening and superb the next, don't be too surprised—it does happen.

(*Continued on page* 128)

The Noise that Banishes Pain

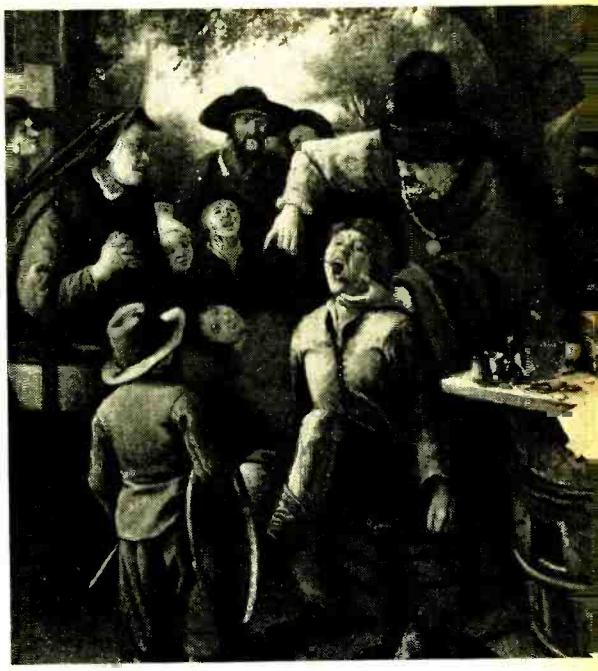
Audio analgesia may revolutionize dentistry

By CHARLES FOWLER

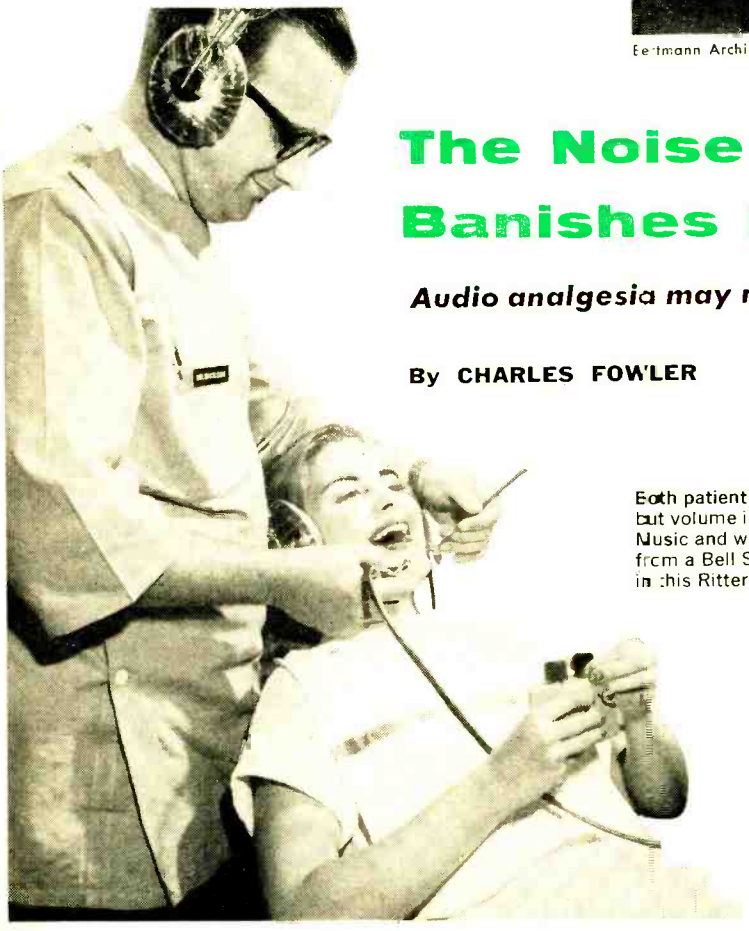
IF your dentist hands you a pair of earphones the next time you visit him, and tells you to dial your own anesthetic, don't be surprised. It is simply the latest evidence that music hath charms and, mixed in the proper proportions with something scientists call "white noise," can suppress even a nagging toothache.

The dentist calls his latest development *audio analgesia,* and he will tell you with enthusiasm that it is completely successful in about two-thirds of his cases. In fact, the dental profession has achieved such success with audio analgesia that doctors in many other fields of medicine are beginning to wonder if they, too, can use it.

Unusual Anesthetic. For successful analgesic action, two ingredients are needed: music and white noise. The latter is quite often called *waterfall*

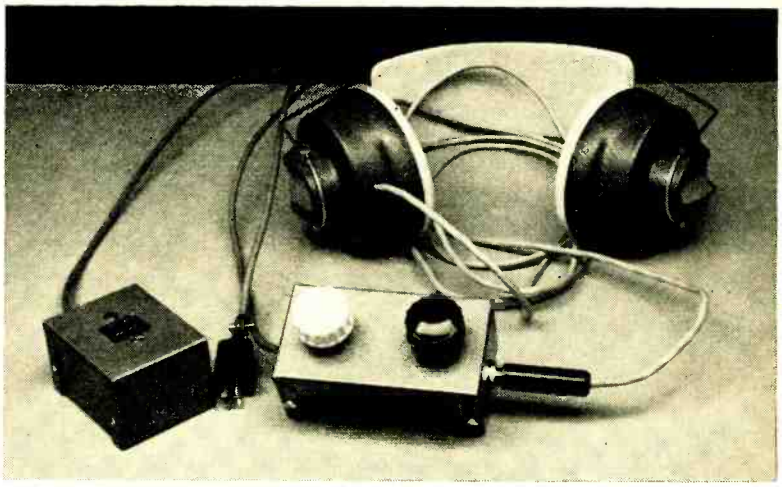


Eastmann Archive



Both patient and dentist wear earphones but volume is controlled only by the patient. Music and white noise are fed to the earphones from a Bell Sound tape-cartridge recorder in this Ritter Audiac installation.

Columbus Dispatch



Audio analgesia setup used by author includes outlet box and connecting cables, control box for patient, and set of Koss stereo earphones. Note different colored knobs on control box.

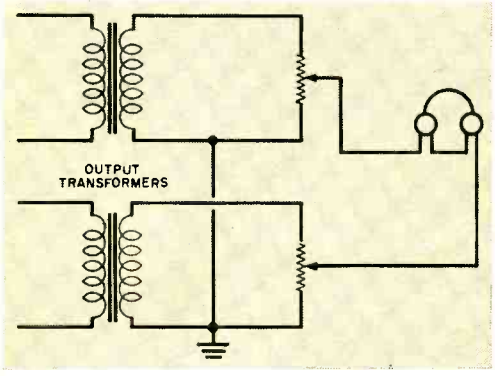


Fig. 1. This circuit was the end result of the author's experimentation with various circuits. Both dentist and patients reported that this one gave the greatest control over music and white noise in earphones.

sound by doctors because that best describes the steady hissing heard by patients.* The primary function of the music is to achieve a state of relaxation for the patient by distracting his attention and giving him something else to think about. Many patients report that the music alone is sufficient to relieve their habitual anxiety and to obscure the fleeting twinges of pain. The real pain inhibitor is the white noise, which is added to the music in whatever proportion the patient wants. If the patient is nervous, or very pain-sensitive, he can turn up the volume to a very high level, until almost any amount of what might be called "dental pain" can be readily blocked off.

And, according to doctors, that is exactly what happens: the pain is blocked off. It is their theory that our nervous system can take just so much stimulation. That stimulation may be in the form of pain or in the form of sound. If the nerve channels are filled up with sound, then relatively little pain can seep through. It will take time and many experiments to confirm or amend this theory; but the fact is that audio analgesia works. With its help, teeth have been extracted and, in recent experiments, babies have been born—all without pain. Audio analgesia may open untold doors, relieving pain in many situations where a more customary anesthetic cannot be applied.

Experiments with audio analgesia, begun a little over a year and a half ago in Boston, grew out of the observation that one of the unpleasant aspects of sitting in a dentist chair is the buzzing noise of the drill. Raising the level of background music played for patients' enjoyment helped to obscure the drilling sound and relieve the nervous tension of the patients.

Further experiments revealed that white noise was more effective than music because, by its very nature, it is all types of sound and thus better able to

*The "sound" of white noise is very similar to the inter-station hiss heard on some FM tuners.

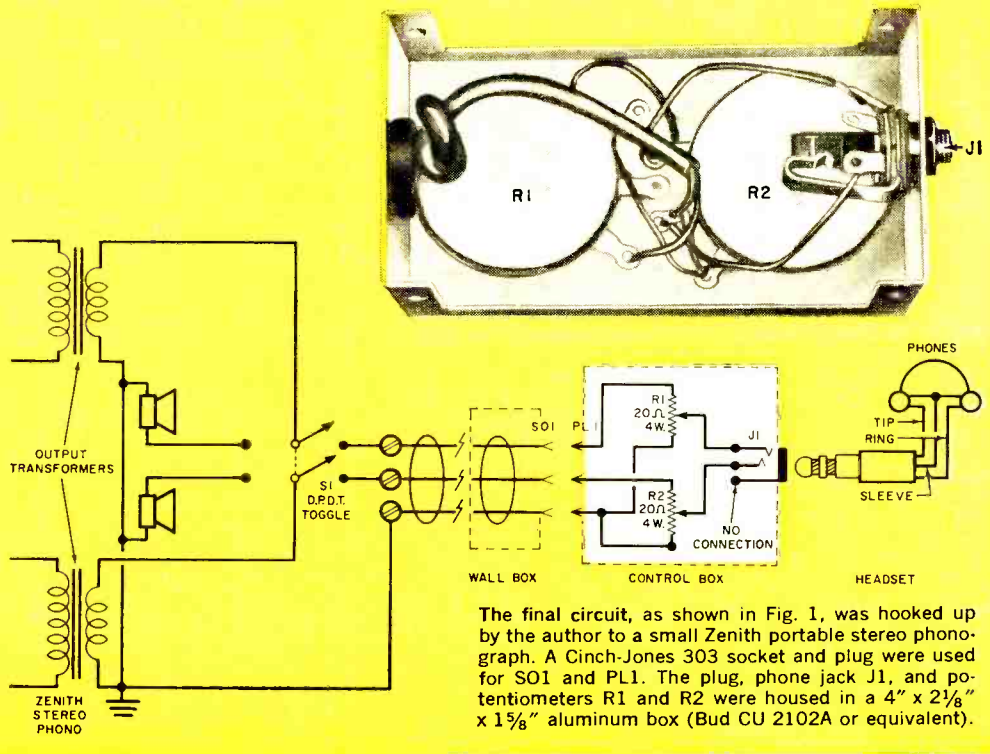
block out other sounds. Music is neither a steady nor a complete noise; other sounds can leak through from time to time. So experiments were continued with white noise as an obscuring agent; then it was discovered that more was being achieved than just relief from annoying noises. The pain threshold was being raised and, in many cases, blocked off completely

Make Your Own. If you have some Emory Cook records, a stereo phonograph and a pair of headphones, you, too, can have audio analgesia. The basic need is for two sources of sound feeding into a pair of stereo headphones through a control box. One sound must be music, the other white noise. The author, with the cooperation of his own dentist and a good many of his patients, has been able to develop a simple arrangement which is inexpensive yet has proven to be eminently satisfactory.

In essence, Cook records are played on a portable Zenith stereo phonograph. The sound is fed to a Koss stereo headset through two 20-ohm, 4-watt potentiometers. (Stereo enthusiasts will be dismayed to learn that this original arrangement is monophonic.) The essentials of the final wiring arrangement are shown in Fig. 1.

Starting with the phonograph, the wires leading from the output transformers to the loudspeakers were disconnected and a d.p.d.t. switch installed. In one position, the phonograph functions normally. In the other, the speakers are cut out and the earphone cables switched in. The switch wires are brought out to screw-type terminal strips and the earphone/control box cables connected to these strips.

The first section of the earphone cable terminates near the dental chair in a small metal box, attached to the baseboard and housing a Cinch-Jones socket. The other end of this cable goes to the terminal strip on the phonograph. This is sort of semi-permanent wiring. The second section of the cable starts with a matching Cinch-Jones plug and termi-



The final circuit, as shown in Fig. 1, was hooked up by the author to a small Zenith portable stereo phonograph. A Cinch-Jones 303 socket and plug were used for SO1 and PL1. The plug, phone jack J1, and potentiometers R1 and R2 were housed in a 4" x 2⅛" x 1⅝" aluminum box (Bud CU 2102A or equivalent).

nates in the control box, which has a standard phone jack to accept the phone plug used on most headphones.

Choice of Wiring. There are many different wiring arrangements possible for the two level controls. Several have been tried in addition to the one in Fig. 1; two others appear in Figs. 2 and 3.

Using the arrangement shown in Fig. 2, music was fed from one channel to one ear, and white noise through the second channel to the other ear. It worked fine, but the patients didn't like it. If they turned the white noise off, and had the music on at low volume levels, then—in spite of the pads on the earphones—they could hear through the "silent" ear.

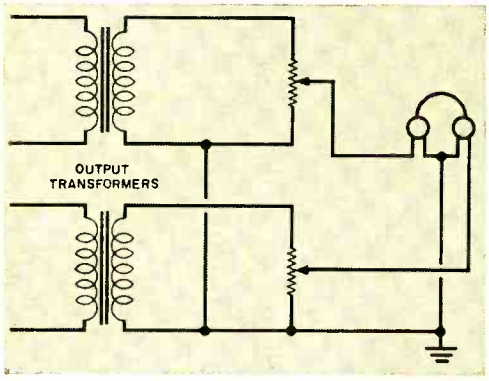
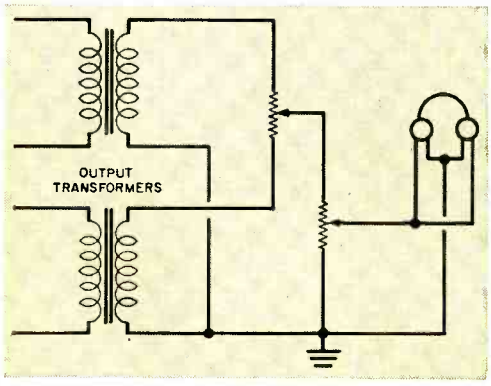


Fig. 2. This hookup, which feeds music and white noise into separate earphones, proved impractical.

Fig. 3. Patients tended to become confused when this stereo blending control arrangement was used.



Also, it gave them what several described as a "split" sensation.

The next experiment provided a blend control, as shown in Fig. 3. This was even worse. Nobody could figure out what to do with the knobs. Despite its growing popularity, stereo has still reached only a small part of the population, and few indeed understood what a blend control was or how it should be adjusted.

The final arrangement (in Fig. 1) has the two earphones in series across the two amplifier outputs. Music reaches both ears and white noise, also going to both ears, blends with it. The loudness level of each is separately controlled and there is no interaction between the two level controls.

Selection of components is not critical as long as the prime requirement of ruggedness is observed. The phones, in particular, are subjected to both physical and electrical abuse, since many patients keep the volume turned well up.

The Koss earphones work well. Use the newer models (SP-3) with a single, well-insulated cable going to one earphone and the connection to the other earphone over the headband. This is a good arrangement from the point of view of both patient and dentist; the fewer the number of wires running around, the better. Other stereo phones may soon be on the market—both Cook and Sargent-Rayment are reported to be in production.

Results Achieved. We have found during the weeks we have worked with audio analgesia, that it is effective with—and well liked by—at least two-thirds of the dentist's patients. This experience is confirmed by the reports of many other dentists now using this latest tool of medical science. The very elderly do not, as a rule, want to try something new. The very young are not able to comprehend how it works or what they should do. But, in between, patient after patient reports finding relaxation from nervous tension and a blanking-out of unpleasant or painful sensations.

One patient even caused a moment of alarm. When the dentist had finished his work and tapped the patient on the shoulder to indicate that he could remove the earphones, the patient didn't respond at all. He had fallen fast asleep. -30-

HI-FI FAN "ROLLS HIS OWN"

John Pritchett is one hi-fi fan who believes in getting something for nothing—or almost nothing. John owns eight recorders, and there's not a commercially pressed LP in the house.

Rather than buy records, John picks his music out of the air, records it, and files it away for future enjoyment. His studio houses three short-wave receivers which pick up broadcasts from around the world. And for hi-fi recordings, there's an FM tuner that pulls in 64 FM stations, providing him with some of the best FM coverage in the United States.

Located in the Appalachians near Boone, North Carolina, John's studio is only part of his hi-fi setup. He has wired all the rooms in his home to receive sound from the setup, so his family and friends can share in his hobby. Listening fare is apt to be anything from hillbilly songs to grand opera—John supplements his income as an education instructor by recording music of local folk artists, and he has recorded all Metropolitan Opera broadcasts for the past eight years. —*John Corey*

3 NEW STEREO/HI-FI BOOKLETS

If you're keen on keeping up with developments in hi-fi/stereo, you'll want to take advantage of three new booklets which manufacturers have made available for only 25 cents each. One booklet, "All About Stereo," is available from Bell Sound Division of Thompson Ramo Wooldridge Inc., Columbus 7, Ohio. A second, issued by Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill., is entitled "The Art of Selecting, Playing, and Preserving Recordings." And a third, "Understanding High Fidelity," is distributed by Bogen-Presto, P. O. Box 500, Paramus, N. J. Be sure to include a quarter with your request for a copy of each of these booklets.

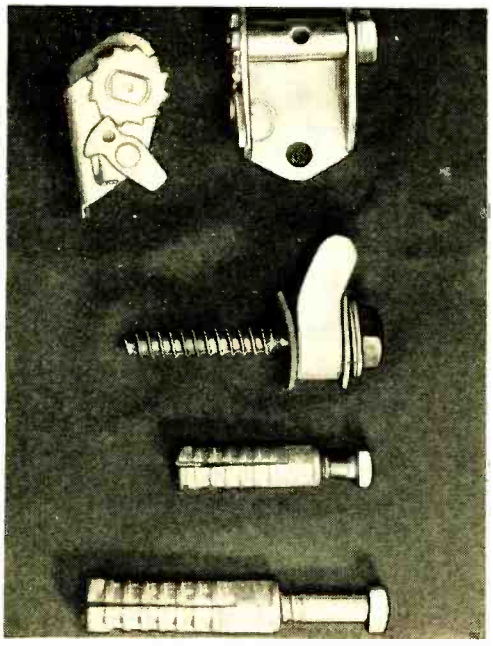
Guying Tips for the Ham Antenna Tower

By JACK DARR

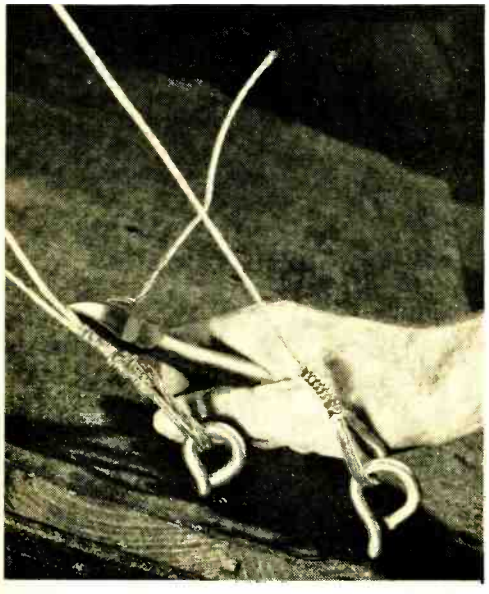
THERE was a time when amateur radio antenna towers were usually homemade affairs. But the widespread use of commercial ham and TV antenna towers has made the homemade tower almost as obsolete as the spark-coil transmitter.

Telescoping masts are ideal supports for light or medium-weight beams and can also hold up the ends of a doublet. For heavy beams, you can buy a mast that is bigger than you need, remove the upper sections, and end up with a tower strong enough to carry the load.

A tower won't carry your antenna for long, though, unless it is properly guyed. Never skimp on the guy wires and



Ratchet take-up anchor (two views, top) hauls in guy wire slack with the twist of a wrench. Another type of anchor (center) is a simple aluminum fitting with an eye for fastening guy wires. Lag screws and lead shields (two views, bottom) secure anchors to concrete; screw expands shield in drilled hole for tight fit.

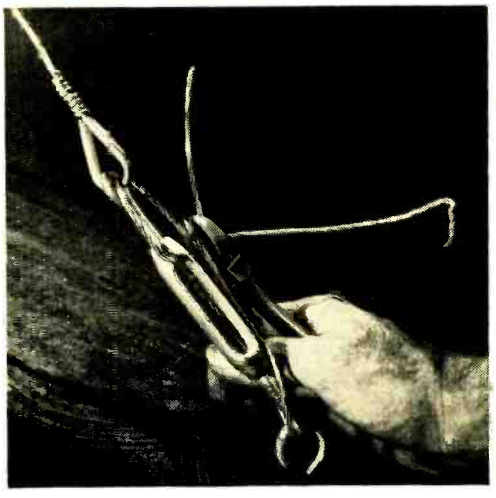


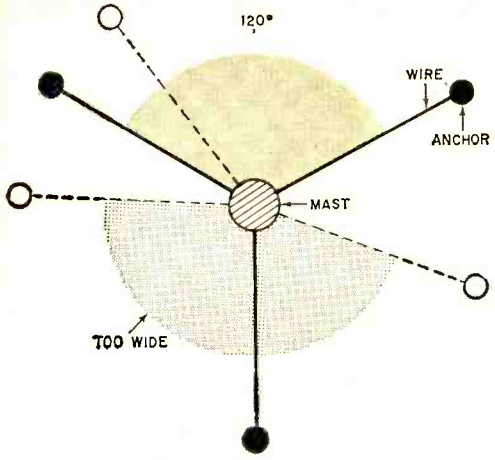
Tall towers and masts require guy wires running to the top and middle sections as well. Two guy wires can be attached to the same ring for medium towers, but high towers should have separate rings to anchor guys.

Always use a metal ring when you attach a guy wire to a metal tower; the sharp edges of the structure would eventually cut through unprotected bare wire.

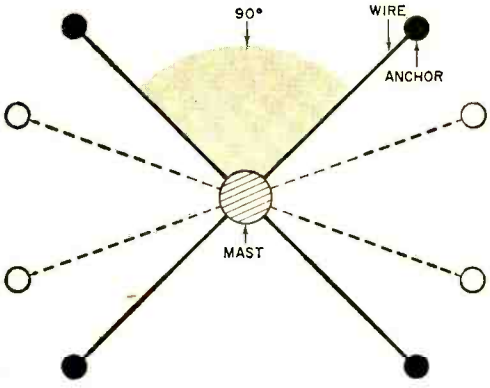
Guy wires can be secured to wooden roofs with a 3" screw eye inserted into the rafter (left). A metal thimble loops the wire through the eye and takes the brunt of wear when metal rubs metal; twisting the wire around itself at least six times will hold it fast. Two poor guy wire fastenings (center and right) are examples of what what **not** to do.

Use a turnbuckle to get the desired tension on the guy wire, with at least a six-turn tie and a thimble at the guy-wire end. Connect the turnbuckle to both the guy wire and the screw eye anchor. Take up any slack by twisting the turnbuckle's body, using an iron rod for leverage. Be sure to safety-tie the turnbuckle with scrap wire to prevent it from unwinding.





In three-wire guy systems, always have the guy wires equally spaced (solid lines) to provide equal bracing against all winds. Unevenly spaced wires (dotted lines) offer less support against strong winds.



Four guy wires offer maximum protection against high winds when spaced 90° apart. Avoid making angles too wide (dashed lines) or the mast may topple during the first big storm.

Not all four-wire guy systems can be spaced 90° apart. A building may get in the way, or your back yard may not have the right dimensions. In such a case, make one wire pull against another (solid lines) for maximum all-round strength.

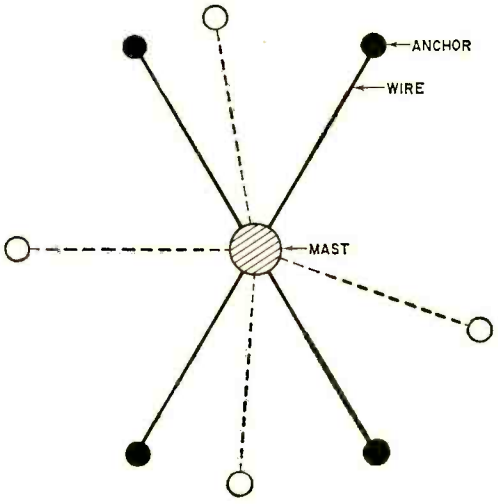
supports—a beam and rotator cost far more than a 50-cent length of wire.

Be sure to ground the tower. For a rooftop job, run a length of heavy solid wire—No. 6 aluminum or larger—from the base of the mast to a ground rod. Don't bend the wire sharply where it goes over the eaves, however. Lightning acts like a high-frequency signal and is "blocked" by such a bend. It may jump to a point several feet away rather than go through a sharp bend in a wire.

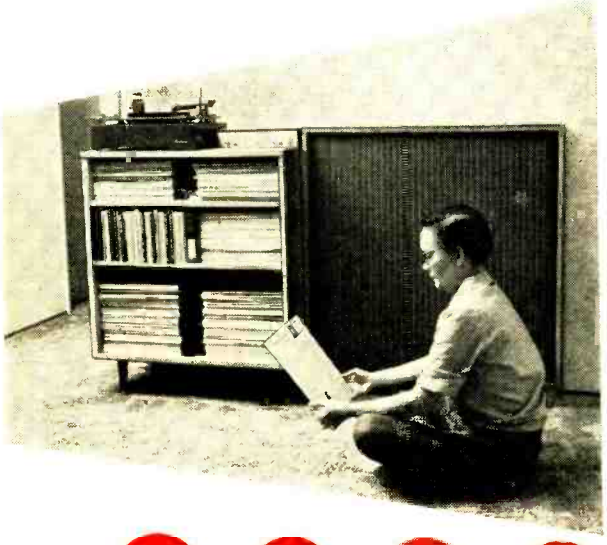
If the mast is mounted on the ground, drive a ground rod near the base of the mast and use a U-bolt to clamp the mast and the rod together.

If you live near the sea, where corrosion is a problem, use aluminum guy wires or very heavily galvanized steel, and spray all joints and fittings with plastic. It's also a good idea to inspect the whole installation thoroughly at least once a year.

Installing your antenna properly, whether it's a 150-foot tower or a 12-foot vertical, is just a series of small jobs: tying guy wires, fastening screw eyes, adjusting a turnbuckle, etc. If every one of these steps is done right, you'll have a tower that will stay up under almost all conditions (short of a wind that blows the house away). If you skip just one step you may wake up one morning and find your tower lying in the yard. To corn a phrase, take care of the little jobs, and the big job will take care of itself. —30—



Sweet Sixteen



Compact enclosure delivers solid sound from sixteen 5-inch speakers

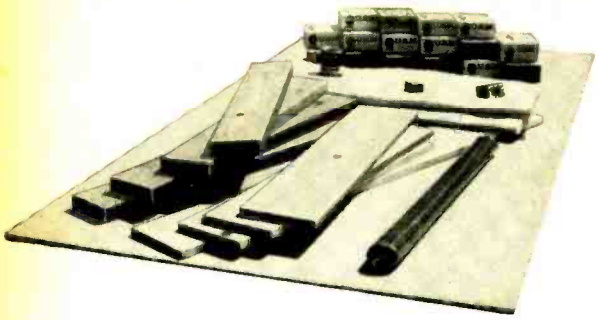
By **JIM KYLE,** K5JKX

CRISP, solid, bass reproduction—a hallmark of highest fidelity—can be yours for a little over $50 and a weekend's work. And there's no catch, even though $250 is a more likely price for a full-range speaker system capable of delivering useful output to 30 cycles and below.

The classic method for providing good bass response calls for big speakers, heavy magnets, low resonant frequencies, and carefully matched enclosures. This approach provides superlative sound in the bottom octaves, but its price tag is pretty super, too.

The performance of the "Sweet Sixteen" system is virtually unbelievable to those who haven't heard it. Coloration of sound—characteristic to some degree of almost every system—is conspicuous only by its absence. Measured response extends to 20 cycles—well below audibility—and is reasonably flat from that point up to just below 10 kc.

Unlike many hi-fi systems, this setup requires little driving power. Five "clean" watts applied to the system will drive all but the most hardened hi-finat-



Required parts are few, but it's best to gather all of them together in one place before you start to work on the system.

ics out of the room. And the system will handle more than 30 watts without audible distortion!

Multiple Speaker Setup. The secret of the setup is hinted at in a good many reference books, and several similar systems have been built and described. (See POPULAR ELECTRONICS, September, 1960, for one of the most recent and most elaborate systems, built for the Wright Air Development Center.) Yet the idea appears to have been almost completely ignored by most audiophiles.

Here's how it works. Instead of mating a big woofer (to handle the bass) with a specially designed tweeter (for mid-range and treble), a large number of small speakers are made to work in unison. At low frequencies, the small cones acting together move the air just as if they were one huge unit. In the mid-range, their low mass and high efficiency produce results not attainable with a single larger speaker.

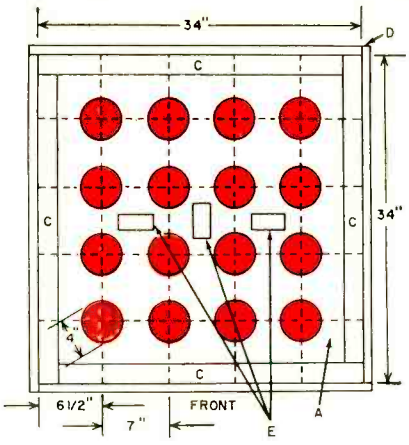
By using many speakers together, the peaks and valleys in each individual unit's frequency response tend to be statistically averaged into a smooth characteristic, difficult to attain with a single unit. The price tag is kept down, surprisingly enough, by the use of inexpensive replacement-quality speakers. Operated at extremely low power levels, these speakers are capable of hi-fi response even though the output from each speaker is so low that it can barely be detected at close range in a quiet room.

With enough of the small speakers working together, sound output comes up to a more-than-usable value. It's theoretically possible (and based on observations made with this unit, perhaps practical) to build a system which will reproduce frequencies as low as one cycle if you just use enough speakers.

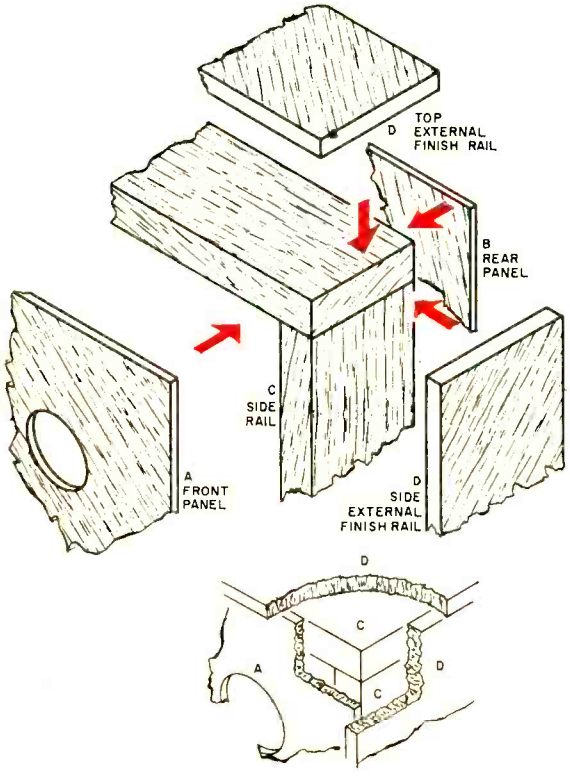
Interconnecting the speakers insures that the power fed to each remains small

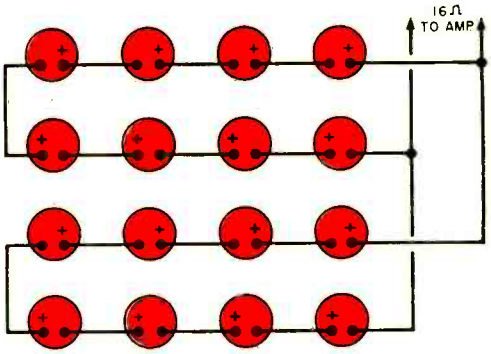
Speaker holes in front panel should be 4" in diameter and can be drilled most easily with a circle cutter mounted in a large electric drill. Side rails are intentionally designed to overlap at corners so they can be trimmed off to size.

Front panel (A) is drilled following layout at right before side rails (C) are attached. Spacers (E) can be cut to fit from pieces sawed off from side rails.



Final assembly is easy following pictorial below. External finish rails (D) hide joints in side rails (C); finish rails are covered with "Contact" material.



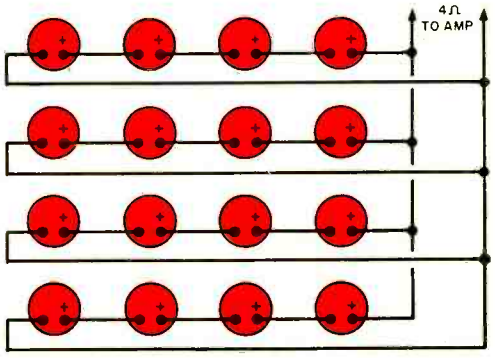


Wiring diagram for use with a 16-ohm amplifier output. See text for instructions on how to phase speakers properly.

BILL OF MATERIALS

2—34" x 34" x 5/16" plywood sheets (cut from a 5' x 6' sheet)
4—2" x 6" x 38" side rails
4—1" x 8" x 38" external finish rails
5 doz.—No. 8 flathead wood screws, 1¼" long
64—No. 6 sheet metal screws, ⅜" long
1 sq. yd.—Grille cloth
1 sq. yd.—Acoustic padding or Fiberglas insulation material
16—5" PM speakers (Quam 5A07 or equivalent)
6 ft.—No. 18 hookup wire
1 sq. yd.—"Contact" table-top material
Misc.—Black screen enamel, staples or tacks, solder, lamp cord, etc.

Speaker hookup for 4-ohm amplifier. Other series/parallel hookups are possible and should appeal to experimenters.



Connecting individual speakers is easy once you know the impedance you require. Simply use ordinary hookup wire and follow the appropriate schematic on page 57.

Decorative touch for finished system is furnished by wood-grained covering material purchased from a department store. Cut material to size before applying it.

—each cone's movement is in the neighborhood of only 0.01" at top volume. Even loud drum passages reproduced at 30 watts cause no visible cone movement.

Simple Enclosure. Resonance problems and tricky enclosures are automatically eliminated in this approach, since they are important only when a speaker is being operated near its power limit. The baffle used with this system is a simple padded box to enclose the sound radiated from the rear of each speaker cone.

Two items are of prime importance for good results with this system. The speaker box must be solid, so don't try to skimp on the side braces or internal supports specified. Important, too, is speaker phasing—individual units must be connected with one another in such a way that all the cones move in the same direction at the same time.

If all of the units are identical, you'll have no trouble. But if you must mix models and manufacturers (and it's sometimes hard to find 16 of these speakers in stock at the same supply house), you'll have to check the phasing before making connections. This process will be described later.

Layout and Construction. The first step, naturally, in building the system is to gather all the materials and components called for in the bill of materials. The only tools required are conventional ones —a ruler, saw, hammer, screwdriver, and soldering iron—but a ¼" electric drill equipped with an adjustable hole cutter and with woodscrew speed bits will simplify construction.

Begin by laying out and cutting the front and rear plywood panels (*A* and *B* in the diagram) to size. Mark the location of the 16 speaker holes on the front panel (*A*) and cut them out. The hole diameter will be exactly four inches for a 5" speaker.

If you're using a hole cutter in an electric drill, check the setting by cutting a hole in scrap lumber first. Then drill the hole halfway through the panel from one side, turn the panel over, and complete the cut from the other side. This will prevent the plywood from splintering when the cutter breaks through.

The next step is to attach the side rails (*C*) to the front panel. Note that the rails are overlapped at the corners in

(*Continued on page* 122)

Lightning

Nature's mysterious display of pyrotechnics

By ART ZUCKERMAN

AFTER putting the finishing touches on a guy wire, Bill Robbins climbed down from the roof. Once back on the ground, he looked proudly at the several antennas rising up from the roof of his new suburban home. With all that stuff up there, Bill thought, this is one house that doesn't have to worry about lightning!

But a week later the granddaddy of all thunderstorms struck. One colossal bolt made a direct hit on Bill's house, starting a roaring fire in the wood-frame structure, and at the same time knocking out the phone. A grimy Bill watched dazedly as his home went up in flames. And he dumbfoundedly asked, "How could it happen? Those antennas . . .

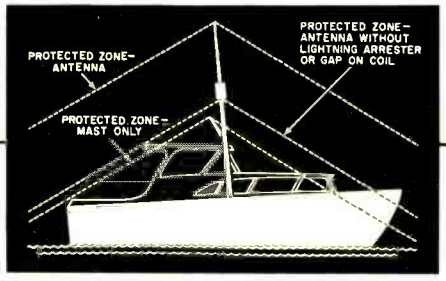
If anything, those antennas had probably guaranteed that the house would take a damaging lightning strike. Their presence on a building that was already the tallest thing for miles around provided a natural pathway for lightning. And the fact that the antennas weren't tied in with a good lightning protection system meant that the lightning, once

it struck, had nowhere to go but into the radio and TV gear and into the non-conducting structure of the house.

Actually, had the antennas been connected to a protection system—or at least been properly grounded—they could have made a very effective contribution to the safety of the house.

What Is Lightning? Just how lightning is generated we can't say for sure. But we know that it's the world's most colossal spark, created by the discharge of stupendous amounts of static electricity. It can carry a punch of hundreds of millions of volts, a current of 1000 to 100,000 amperes or more.

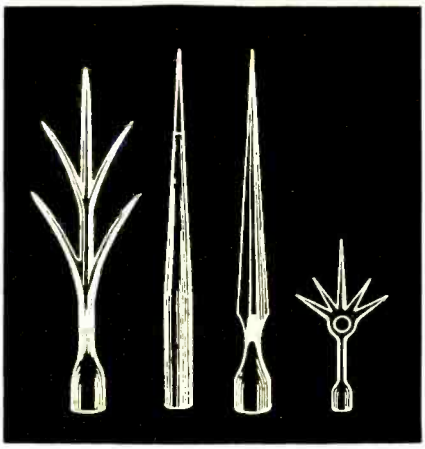
We also know that there are two basic types of lightning. The so-called "cold" variety has extremely high voltages, combined with relatively low amperages. It hits and disappears within 1/10,000th of a second. It doesn't often start fires, but the enormous pressure of its passage can literally explode whatever it hits. "Hot" lightning, on the other hand, has extremely high amperage but relatively low voltage. With a core path temperature as high as several thousand degrees, this is the type that almost invariably starts fires.



LIGHTNING PROTECTION AFLOAT

If you're a boating enthusiast, you'll be concerned with lightning protection afloat. The marine radio antenna of a small boat, if it's a metal rod type, can generally be depended on to do a bang-up protection job—provided that it's linked to a metal hull or connected to a ground plate in a wooden hull by No. 8 copper cable. If a wooden hull has no ground plate in contact with water, the cable can be run over the side of the boat, into the water.

A word of caution: the above does **not** apply to a non-conducting antenna mast with a spirally-wrapped conductor. But any mast can give protection if you put an air terminal on top and link it with No. 8 copper wire conductor down to ground.



Air terminals, commonly called "lightning rods," are an important part of a protection system. Properly installed, they are the highest points on protected structures, wired to dump thousands of amperes of static electricity harmlessly into the ground.

Like all electric sparks, lightning results when the potential between negative and positive charges becomes great enough to cause arcing. In some cases, the arcing goes through a barrier of air between the negative charge in a storm cloud and the positive charge of earth. While we don't know the exact mechanics by which this potential is built up, we do know the rough sequence of events.

A thunderstorm is generated when a layer of cool air overruns a mass of low-lying, moist, warm air. The warm air tends to rise through the cool air, causing its moisture to condense into water droplets. This movement of air current against air current—and possibly of droplet against droplet—generates staggeringly large quantities of static electricity.

For some reason, negative charges tend to collect in the lower layers of a storm cloud and positive charges in the upper layers. One theory is that raindrops falling through the cloud pick up negative ions and deposit them as they pass through the lower layers. In any event, the massive negative potential of the lower cloud layers induces a matching positive potential in the earth below.

As our highly-charged thundercloud scuds across the skies, the corresponding positive charge on the earth follows

along below, chasing after the airborne source of negative potential. The attraction between the opposing charge causes corona-like negative streamers, or stroke leaders, to descend from the cloud. As they approach the ground, these negative streamers become the focal point for the earth's positive charge.

Any elevation or structure that will tend to shorten the gap between stroke leader and ground is climbed by this positive charge. Reaching the top, it sends positive streamers up from the elevation. The take-off point for these positive streamers can be anything—an antenna, a flagpole, a silo, a house, or—if he is out all by himself in open country— a man.

When negative and positive streamers meet, a tremendous current flow occurs at the meeting place, and a huge return stroke races back up the path created by the descending streamer. At the same time, an immense quantity of raw electrical power is released into the earth. Whether damage will result depends on what physical objects this power must pass through to reach the earth proper.

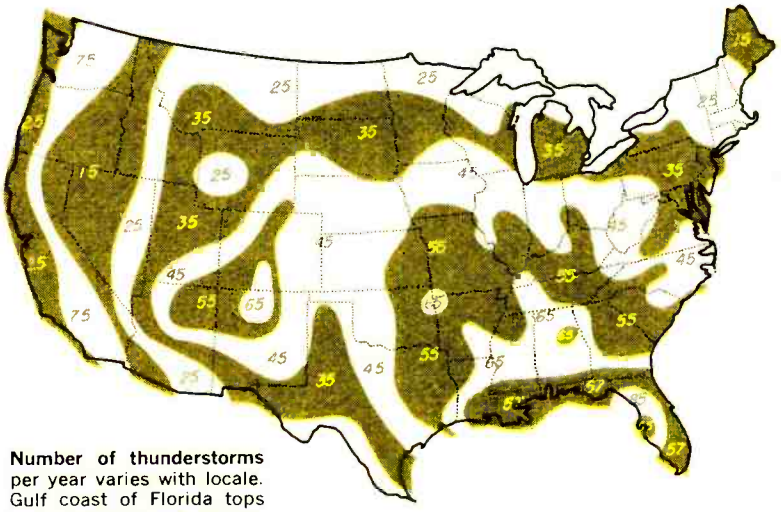
Obviously, lightning going through such non-conductors as wood or brick meets with tremendous electrical resistance. But the massive electrical energy contained in the lightning will not be denied; it smashes through this resistance. In the process it generates enough heat to set fire to—or perhaps even melt—the structure it hits.

Protection System. If the lightning hits a good electrical conductor, however, it takes this path of least resistance, and its energy is carried harmlessly into the ground. In essence, a lightning protection system is nothing more than a good conductor, designed to provide the most likely target for lightning and offer a safe pathway to ground for the lightning when it does strike.

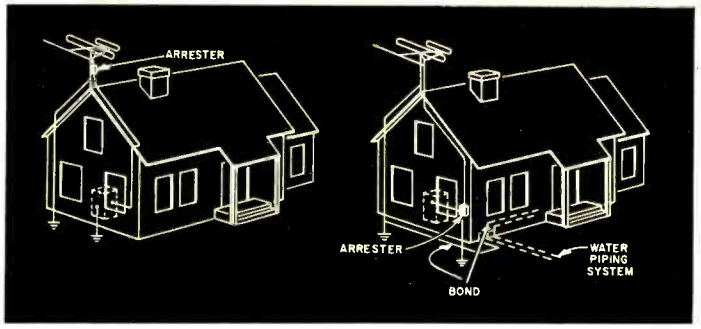
Since objects which shorten the gap between the descending negative stroke leaders and the earth's positive potential are the most likely lightning targets, they form the ideal basis for a protection system. In fact, the obvious thing to do is to make part of that system the highest point on the house.

This highest point is familiarly known as the lightning rod. The modern version of Benjamin Franklin's invention is a far cry from the large, often ornate creations of earlier days. It even goes by a different name—the air terminal. Today's air terminal is pencil-thin and pointed, deliberately designed to be as unobtrusive as possible.

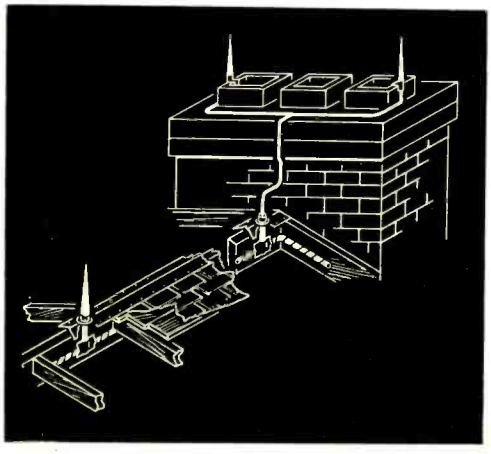
An air terminal by itself is a pretty useless item. In fact, as the initial point on an electrical conduction system, it is a hazard, an open invitation for lightning to pay a visit. The vital part of the sys-



Number of thunderstorms per year varies with locale. Gulf coast of Florida tops rest of nation with 85-95.



Any antenna can serve as an air terminal in a protection system. The antenna mast should be grounded directly if a high-impedance lead-in is used; lightning arrester should be mounted at same level as radio equipment as shown in drawing at right above. Additional air terminals should be installed as shown below, left, if antenna is not centrally located.



tem is a network of cables terminating in a ground rod, buried deep in moist earth.

How About You? Is it really necessary to have a full protection system? That depends primarily on where you live. If your neighborhood is heavily built up and there are a lot of tall objects in your immediate vicinity, danger is greatly reduced. But if you're out in the relatively wide-open suburban or rural spaces—in an area that gets a lot of storms—then it's a good idea to make the investment.

As a rule of thumb, for every thunderstorm that occurs within a square mile of your home, you can figure on one or two lightning strokes hitting within said square mile. If this adds up to, say, 50 storms a year, you have to reconcile yourself to accepting 50 to 100 strokes annually within half a mile of your house.

Though lightning invariably strikes the tallest object handy, it is a temperamental phenomenon and has been known to hit a small house sitting smack between two tall buildings. This is so much the exception, though, that there isn't much point in worrying about it. Actually, if you're near a tall, grounded metal structure, you will benefit from the umbrella of protection it provides. A 100-foot grounded steel tower, for example, should give complete protection to everything within a 50- to 100-foot radius. If your house is no farther away than twice the height of a grounded, conducting structure, you should be fairly secure.

A good, properly-engineered protection system costs between $300 and $400 to install, and there are good reasons for this seemingly high price tag. Let's examine a properly set-up system in detail.

Air to Ground. The air terminals at the top are usually made of copper for maximum conductivity, and it generally takes several of them to do the job. They are installed at intervals along every single high point of the house, such as gables, roof peaks, and chimneys. In fact, a chimney whose diagonal measures more than four feet requires two air terminals. On ridges, air terminals should be spaced no more than 20 feet apart.

The conductor cables are usually heavy affairs of copper—they weigh 187½ pounds per 1000 feet, are made up of 17-gauge strands, and interconnect the air terminals. Each air terminal must also have at least two down conductors, so

(*Continued on page* 120)

The Intermodulation Distortion Analyzer

Continuing our series on test instruments for hi-fi equipment, we move on from the harmonic distortion analyzer we discussed last month to take up another popular testing device—the intermodulation distortion analyzer.

IF music for the solo flute happens to be your favorite dish for an evening's hi-fi fare, intermodulation distortion in your hi-fi system is among the least of your worries. But if you're like most audiophiles in your musical tastes, you prefer other instruments (more likely, even, groups of instruments) to the solo flute. And in this case the IM ratings of the various hi-fi components are important, since they have a lot to do with how your setup sounds.

Intermodulation distortion will occur when two or more separate frequencies are fed through an amplifier (or a speaker,

By G. H. HARRISON

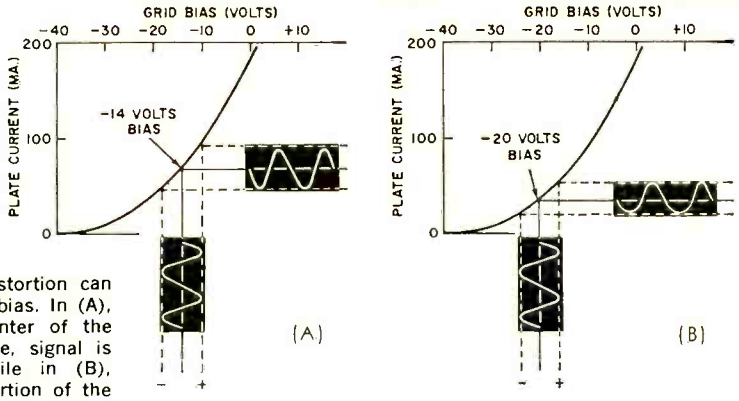
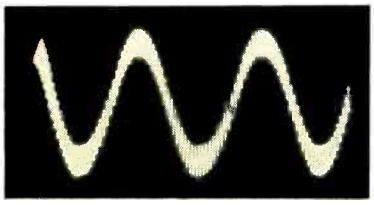


Fig. 1. Intermodulation distortion can be the result of improper bias. In (A), with grid bias at the center of the linear portion of the curve, signal is relatively undistorted, while in (B), operation on non-linear portion of the curve distorts the signal as shown.



Oscillogram of output waveform using combined 60- and 4000-cycle signals, −14 volts bias. Note its symmetry.

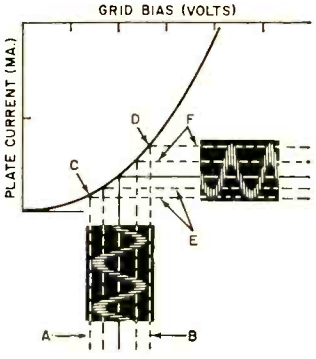
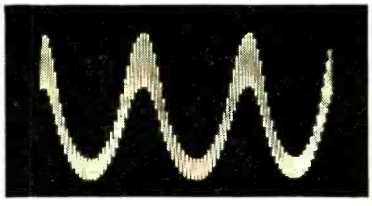


Fig. 2. High-frequency component of combined high- and low-frequency signal is distorted as in Fig. 1(B) above—see text.



Oscillogram showing distortion of the high-frequency component. Tube was overbiased, as in Fig. 1(B) and Fig. 2.

a tape head, a phono cartridge, etc.). Because no piece of equipment has a perfectly linear response, some interaction takes place between these signals, causing them to change—i.e., distort—each other slightly. To put it another way, one *modulates* the other, in much the same way that an AM transmitter modulates the r.f. carrier.

A flute note, for example, could easily be modulated or distorted by a cello tone or a drum beat. And since most music is played not only on flutes, cellos, and drums, but also on violins, trumpets, and many other instruments, the intermodulation problem can get very complicated in a poorly designed amplifier or other component. The resultant sound can be just as unpleasant—perhaps even more so—as that caused by the better known and more generally understood harmonic distortion. (See the December, 1960, issue of P.E. for more on this subject.)

What IM Is. Before we get into the matter of measuring intermodulation, it might be a good idea to talk a little more precisely about what it is. And perhaps the easiest way to understand IM is to see how it can develop in a component such as the ever-present vacuum tube. First, let's review a little basic vacuum-tube theory.

As you know, several kinds of curves can be drawn to illustrate any tube's operating characteristics. Figure 1(A) shows one such curve, the so-called I_pE_g curve, which plots changes in the tube's plate current as the grid voltage is varied. In the case of this particular tube (a 6L6), no plate current flows when the

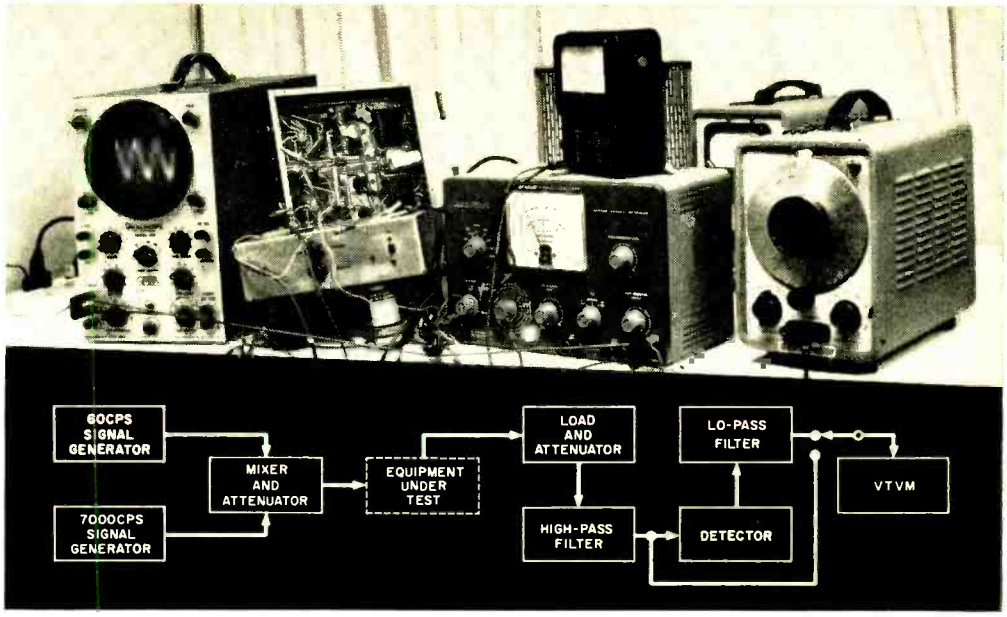


Fig. 3. Setup used to obtain oscillograms on opposite page and block diagram of equipment required; IM analyzers, such as the Heath AA-1 shown here, combine all blocks above except dotted box.

grid voltage is about -40 volts. With -30 volts bias, there is a 10-ma. current flow; with -20 volts bias, a 35-ma. flow.

As the curve shows, one portion is considerably straighter—more linear—than the rest. If the tube is biased to operate in this portion of the curve, then a 4-volt change, either positive or negative, on the grid causes a change of about 25 ma. in the plate current. (In this example, the tube is biased at -14 volts, standard for a pentode-connected 6L6 with 250 volts on plate and screen. Under these conditions, no-signal plate current is about 70 ma.)

Figure 1(B) shows what happens if the same tube is biased at -20 volts, shifting the operating point to the non-linear portion of the curve. Now a 4-volt *positive* signal swing will cause a 20-ma. change in plate current, but a 4-volt *negative* swing will cause the current to shift by only about 15 ma. Figure 3, above, shows the various instruments as well as the breadboard circuit we set up to operate under these conditions.

The unequal amplification of positive and negative grid swings in this case is responsible for intermodulation distortion. Let's see how this comes about. Suppose that instead of a single-frequency sine-wave input signal such as the one used in Fig. 1, we now apply two simultaneous signals (Fig. 2) to our tube operating in the non-linear portion of its curve. One is 60 cps, the other about 4000 cps. With the 60-cycle signal at 8 volts, peak-to-peak, and the other at 2 volts, we get a 4:1 voltage ratio between the two frequencies, which is standard for IM tests. (Actually, the frequencies usually used in standard IM test equipment are 60 and 7000 cps. We used 4000 cycles for these waveforms because a signal at this frequency can be seen superimposed on the 60-cycle signal in the oscillograms far more easily. In addition, the exact frequency of the signals is not at all critical.)

The low-frequency signal will make the plate current swing from about 20 to 55 ma., while the high-frequency signal will cause smaller variations across the path of this swing. Now here's where the intermodulation distortion comes in. Although the high-frequency signal injected into the circuit was of constant amplitude, it is far from constant in the output circuit. When the low-frequency signal is negative, as shown at (A) in Fig. 2, it swings the tube into the portion of the characteristic slope where amplification is least, as shown at (C). On the

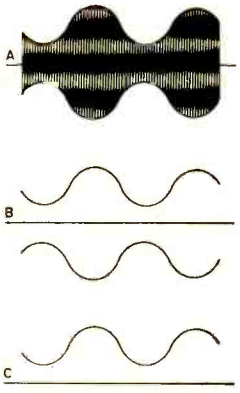


Fig. 4. Original high-frequency signal (A) used in intermodulation distortion test has been visibly modulated by 60-cycle input signal. Signal (A) is demodulated (B) and rectified (C). Signal (C) is distortion component.

positive swings, on the other hand, (B), the tube operates on a steeper part of the slope where amplification is greater (D). Thus the low-frequency signal modulates the high-frequency component, causing its amplitude at (E) to be less than at (F).

This effect—one signal affecting the gain of another—is known as intermodulation, or, more correctly, intermodulation distortion. Since no tube made has absolutely linear characteristics (although some come so close that the difference isn't worth quibbling about), all of them produce some intermodulation distortion.

And tubes aren't the only offenders. A curve similar to the tube's characteristic curve can be drawn for any component—a transformer, an amplifier, or even a complete record playing system from cartridge to speaker. Such a curve is known as the I-O (input-output) characteristic. Since it will always be slightly curved, some IM will always take place.

A speaker cone, for example, may be more sensitive at the center of its excursion than at the outer limits of its travel. If it is being driven back and forth by a low-frequency signal, a superimposed high-frequency signal would be reproduced with greater amplitude at one part of the cone's excursion than at another. Microphones suffer from a similar malady.

Measuring Amplifier IM. Now, since we understand IM, let's get down to the business of measuring it, and take a look at the instrument designed to do the job. The block diagram in Fig. 3 shows the Heath Audio Analyzer AA-1, a typical intermodulation distortion analyzer.

Two signal generators feed their outputs to a mixer-attenuator circuit. (The 60-cycle "generator" is simply a network which taps the 60-cycle line frequency from the filament transformer winding and applies it to the attenuator.) The oscillator has its own separate level control so that the standard ratio of high-to-low signal voltage (4:1, as mentioned earlier) can be adjusted.

The two signals are fed into the equipment under test. The amplifier output is fed back into the IM meter, where it is terminated in the proper load. The signal appearing across the load is channeled through a series of hi-pass filters which completely eliminate the low-frequency component and leave only the high-frequency signal—see Fig. 4(A). Although the major swings of the 60-cycle signal are gone, the variations in the amplitude of the high-frequency signal are clear.

The next stage in the IM unit is a detector, just like the one in your radio receiver. It takes the modulated signal shown in Fig. 4(A) and demodulates it, leaving only the wave envelope in Fig. 4(B), then rectifies this remaining signal to isolate the 60-cps modulation signal as in (C). This 60-cycle signal is routed through a low-pass filter to strip it of any remaining traces of the high-frequency signal, and its amplitude is then read on a VTVM.

As with harmonic distortion, we express IM as a percentage. In our example, the remaining 60-cycle signal, which represents intermodulation, is measured as a percentage of the entire high-frequency signal.

Incidentally, you don't need external load resistors to measure IM distortion with the Heath AA-1—it has 4-, 8-, 16-, and 600-ohm load resistors built in. With the amplifier output connected to the AA-1 input, you can select the proper load resistor and automatically switch it into the circuit with the front panel knob. The vacuum-tube voltmeter which measures the percentage of IM can also be used separately, as an audio VTVM or a wattmeter—the front panel is calibrated for both.

Obviously, an intermodulation analyzer—actually a combination of instruments arranged in one case—is the most convenient device for measuring IM. But

(*Continued on page* 116)

CB Under $100

Lafayette's HE-20 provides top value at new price level

FLEXIBILITY is rapidly becoming the most desirable feature to be sought for in CB equipment. In the larger cities where crowding on a few channels has reached serious proportions, multiple transmit and receive positions (all crystal-controlled) are the only solution. A tunable receiver has numerous advantages in spotting clear channels or working cross-channel. POP'tronics was pleased to see all of these features built into the new HE-20 (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.) which sells for $99.50.

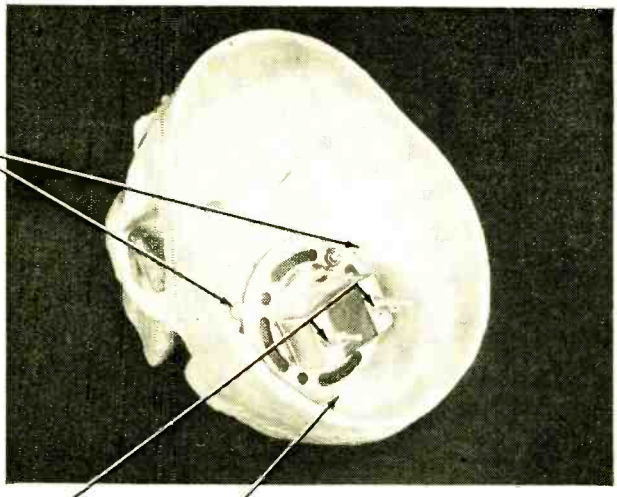
BOX SCORE

	Excellent	Good	Fair	Poor
Talk Power	✔			
Selectivity		✔		
Sensitivity	✔			
Squelch	✔			
Noise Limiting		✔		
Stability	✔			
Operating Ease	✔			

The HE-20 also has a built-in combination S-meter-milliammeter which can be switched over to check the transmitter's plate current. Eight-tube performance of the single-conversion receiver is possible due to triple functions of a 6T8 in the noise limiter, second detector and first audio stage. The noise limiter is a series gate type that is left in the circuit at all times; its effect on voice is negligible. The HE-20 is normally supplied with channel 9 crystals and a ceramic microphone.

The dial of the HE-20 is calibrated in CB channels. Four crystal-controlled transmit and receive positions may be selected by the switch in the lower left-hand corner of the panel.

By LOU GARNER



Loudspeaker is held in place by two mounting screws and scrap plastic rod. Chassis mounts on studs projecting from rear of speaker; spacers prevent the chassis from shorting against the speaker frame.

Thinking Man's Radio

Looking for an off-beat project?

Here's one that's sure to attract attention!

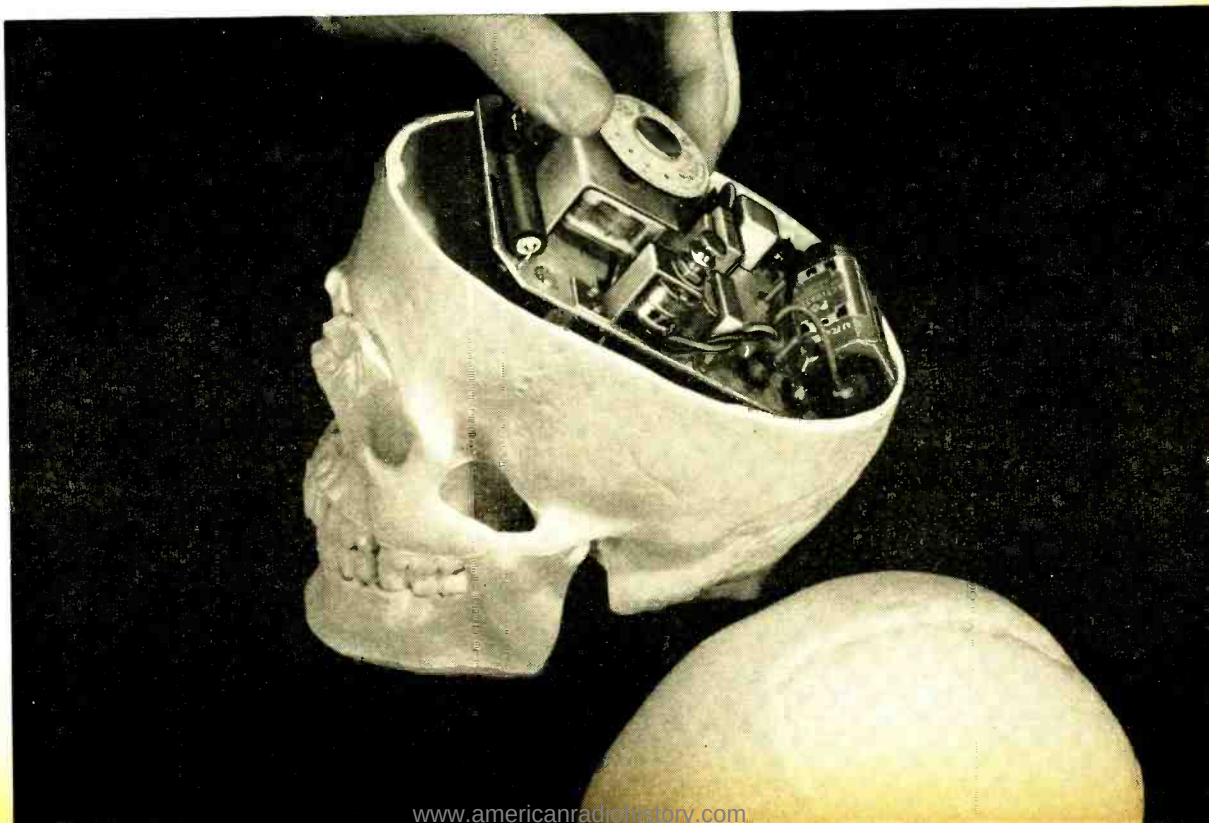
EASILY ASSEMBLED in one or two evenings, the "Thinking Man's" radio is an ideal off-beat project for the electronics hobbyist. Its unique appearance makes it a superb gift for "the man who has everything"—or you might want to keep it for your own office desk or den.

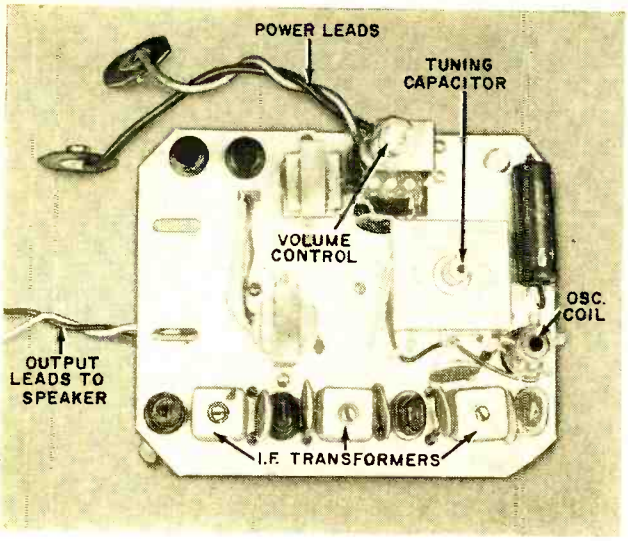
Basically, the radio is a battery-powered six-transistor broadcast set. But its cabinet is a life-size model of a human skull! The chassis is mounted where the brain would normally be, and the speaker is placed so that the sound seems to come from the vicinity of the jaw.

Construction. The skull comes in a moderately-priced kit ($4.95) made by Superior Plastics Inc., 426 N. Oakley Blvd., Chicago 12, Ill., and sold in toy and hobby shops. It is assembled with plastic cement. Don't cement the top of the skull—you'll want to remove it to get at the receiver's controls.

The receiver itself is adapted from a Lafayette kit, No. KT-119A. The parts could be purchased separately, of course, but with the kit there is no chance of the parts not matching or not working properly. Assembly instructions are in the manual that comes with the kit.

The chassis supplied is too large to fit in the skull and must be cut down to about 3 9/16" x 4½"; the antenna must also be replaced with a smaller version. Either Lafayette's MS-329 or MS-299 antenna can be used, but you'll have to remove several turns from the "299" so it will match the kit's tuning capacitor. If you decide to cut a new chassis out of sheet aluminum rather than cutting down the one supplied, it's best to follow the





Follow parts layout at left if you cut a receiver chassis from sheet aluminum. The two slots shown at extreme left of chassis fit on speaker mounting studs.

same parts layout. The receiver is fairly sensitive and another layout might cause oscillation.

When the wiring is finished and double-checked, connect the output transformer's leads to the speaker. Trim the transistor leads to about $\frac{3}{8}$" long and place them in their proper sockets. Connect a 9-volt battery (such as the Burgess P-6) to the power leads and turn the set on.

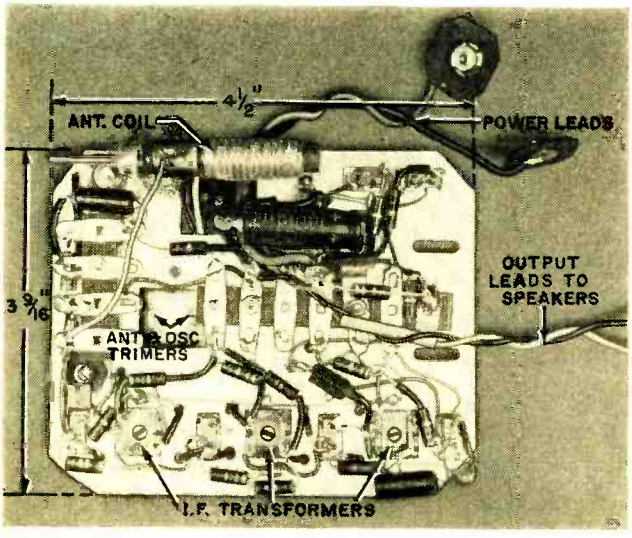
With the volume turned up full, a few stations should be heard as the tuning capacitor is rotated. Don't worry if the set seems to be lacking in sensitivity—like all superhets, it has to be aligned for best performance.

Alignment. Your local service shop can put the set in tip-top shape; or, if you have an r.f. signal generator, you can do the job yourself.

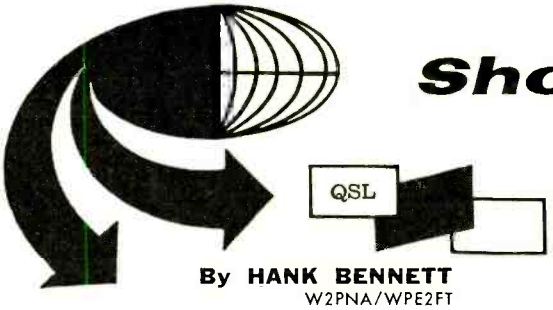
Make up a 3" to 4" loop of 10 to 15 turns of ordinary hookup wire and place it near the receiver's antenna coil. Connect the loop to the generator's output cable and set the generator to produce a modulated 455-kc. signal.

Turn on the set and, using an insulated

(*Continued on page* 121)



Use extra care in soldering to the terminal strips. Both of the strips are so close to the chassis that a blob of solder could very easily cause a short.



Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

MANY SWL's inquire about the work performed by Your Short-Wave Editor. Just what do we do? How is the column prepared? When is mail answered? These questions, and others, are often asked—we'll do our best this month to answer a few of them.

The task of preparing a monthly column is not easy although it is, in many respects, an enjoyable one. The hardest work is performed by the listeners, who devote countless hours to monitoring, recording, logging, and reporting. Without these reports, this column would cease to function. They come in daily, are sorted from the general mail (such as requests for leaflets and letters asking for specific data), and are checked out for accuracy and information value. A few are put aside immediately due to incompleteness (times heard and/or frequencies not given). Very rarely, reports are discarded for being obviously false.

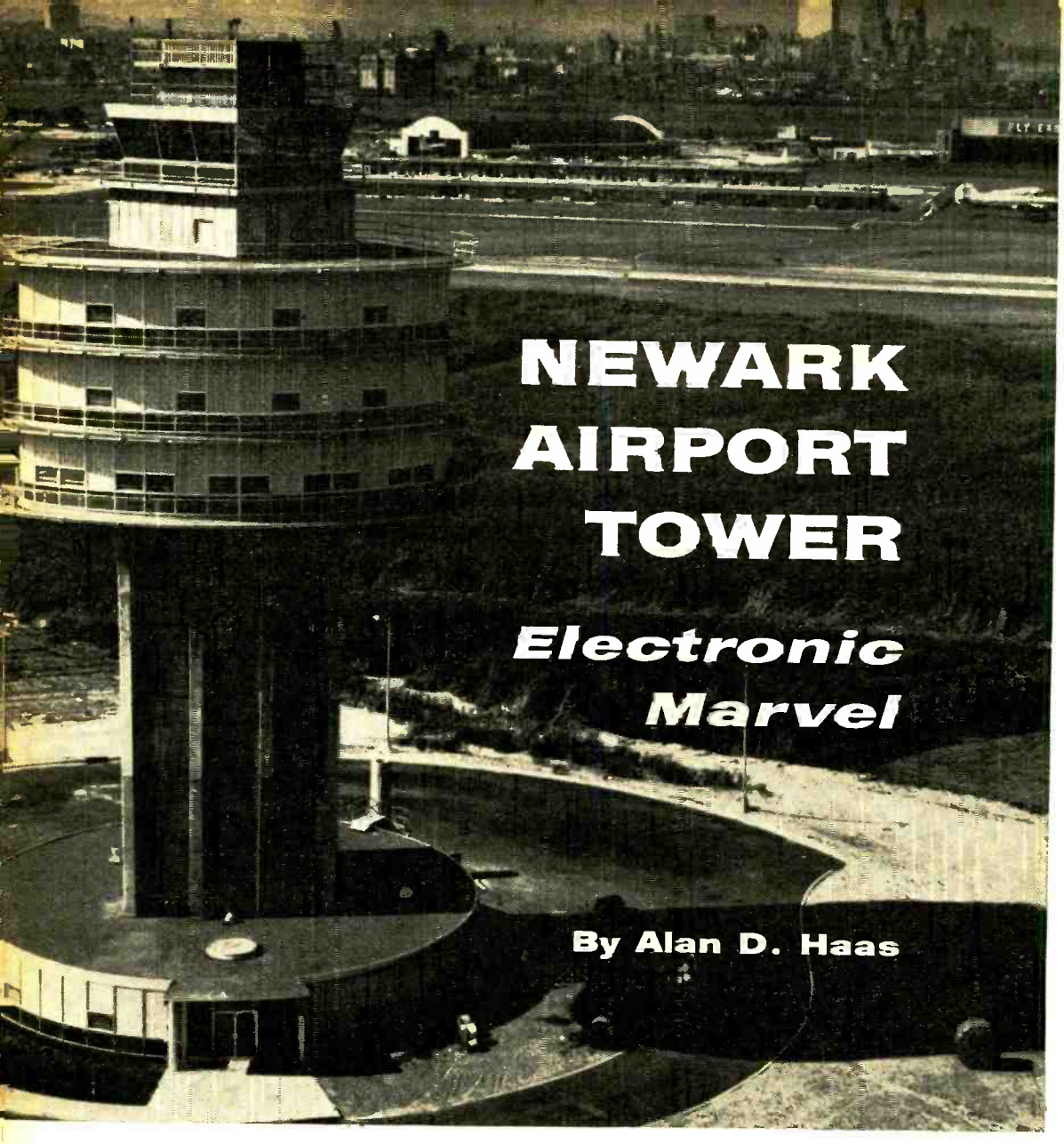
Checking out a total of several hundred reports each month accounts for the greatest share of the time devoted to the preparation of the column. Then, the reports are screened in a search for the most valuable ones. Due to space limitations, we can use only a small percentage of them although we do try to include reports from as many DX'ers as possible. The best ones are rechecked and edited for their "meat"; many personal observations must be omitted to conserve space.

After the best items are chosen and alphabetized, the writing of the column itself takes but a few hours. The actual column (as you see it in print) is held up until the last moment to insure inclusion of any late frequency or schedule changes.

Afterwards, the listening post here has to be put back in order. The reports are sorted and filed, and certain ones selected for immediate answering. *All* reports are acknowledged. In the case of new reporters, we try to ackowledge items at once; our regular contributors hear from us periodically.

General mail is answered whenever we have a few spare moments. Your Short-Wave Editor, with the able assistance of a most patient wife, answers three to four hundred letters monthly. Requests go out to stations for new operating schedules, and information we feel will be of interest is sought. In all, some 50 to 60 hours per

(*Continued on page* 123)



NEWARK AIRPORT TOWER

Electronic Marvel

By Alan D. Haas

WITH air traffic growing increasingly more complex in the metropolitan New York area, airports serving the city are stepping up their electronic control systems to direct incoming and outgoing aircraft. One of the three major airfields in the area, the Newark (N. J.) Airport, has just been brought into the jet age with a recently completed control tower.

Airport taxiways and runways appear on radar screen of surface detection instrument. Screen gives the operator a comprehensive view of the entire field at a glance.

Maintenance and testing are routine operations at the Newark Airport. Engineer at right checks all tower equipment to prevent operating failures.

Traffic control position, located in control cab, is the key spot for guiding both incoming and outgoing aircraft. Cab surveys all field operations.

The tower at Newark offers the last word in jet-age equipment to the 80-odd Federal Aviation Agency specialists who staff the building. And it does everything but sit in the pilot's lap during take-offs and landings. An electronic maze of safety controls, the 150-foot ultramodern structure contains about a million dollars worth of air-traffic-control equipment—including radio transmitters and receivers, direction finders, air surveillance radar, two instrument landing systems, and a telecommunications network.

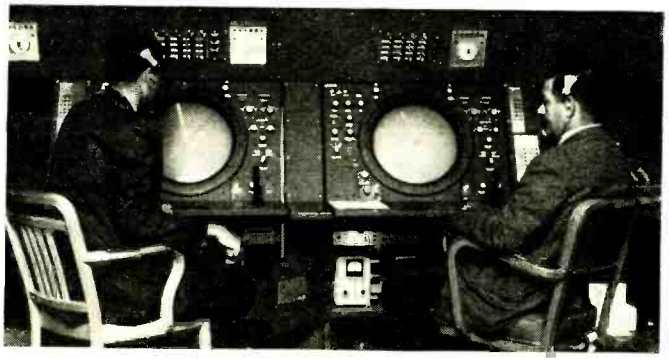
Located near the center of the 2300-acre airport between the two main runways, the tower can virtually reach into the sky and gently waft aircraft onto its runways. Once safely on the ground, the airplanes again rely on the tower to guide

Control tower at Newark stands 150 feet high and cost 1½ million dollars to build. Federal Aviation Agency offices occupy ground floor; electronic control equipment is located on upper floors.

them back into the air en route to their next destination.

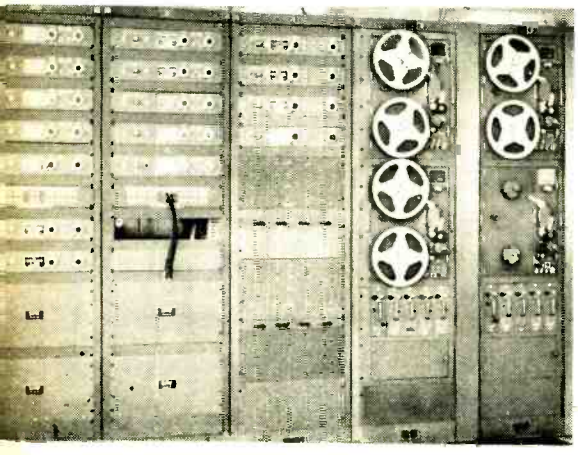
The FAA tower is as accident-proof as human electronic knowledge can make it. There are 16 radio transmitters and 13 receivers, with two separate sources of electrical power to insure continued operation in any emergency. Six different air-traffic-control radio positions are available—two in the control cab and four in the radar scope room. Located below the control cab and the radio equipment, the four radar scopes are in operation 24 hours a day.

Two of these radar scopes are used for guiding aircraft from outer fixes or holding patterns to the final approach course on the active-instrument runway. When an aircraft is about ten miles from the airport, it is picked up on a third scope which shows the craft's position on the glide path as well as its course to the



Radar scopes at right guide aircraft to final approach on instrument landing strip.

Devices in electronic equipment area include tape recorders for recording conversations with aircraft.



runway. The fourth scope is used to direct departing aircraft to a point where they have reached a specified altitude and are well on their way.

The Port of New York Authority, which operates Newark Airport, has already invested some 38 million dollars over the past ten years to improve and enlarge its facilities. And this would seem to be money well spent. During the next five years, traffic at Newark—which is the smallest of the three airports in the metropolitan area—is expected to grow from the present 15 million passengers to more than 25 million annually! —30—

POPULAR ELECTRONICS' slant on

Left to right: National NC-109, Hallicrafters SX-110, and Gonset G-43

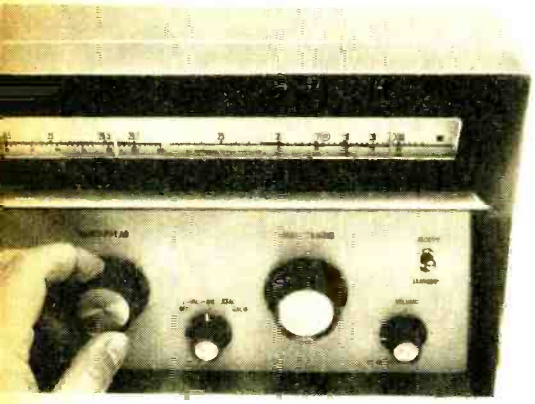
SELECTING a SHORT-WAVE RECEIVER

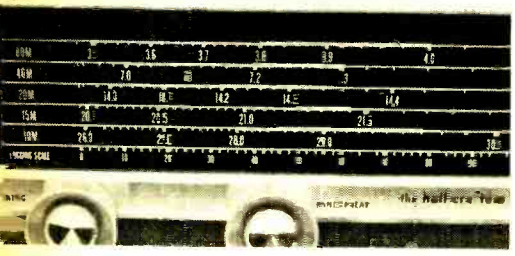
We suggest the SWL investigate advantages offered by medium-priced units

ARE you thinking of buying a new short-wave receiver? You can have a lot of fun and do a lot of DX'ing with a receiver that costs only $60. On the other hand, a very serious-minded SWL will use equipment costing $350 or more —digging for those ultra-weak short-wave stations requires topnotch precision equipment. The staff of POPULAR ELECTRONICS suggests that you investigate three receivers in the price range from $160 to $188—the Gonset G-43, Hallicrafters SX-110, and the National NC-109.

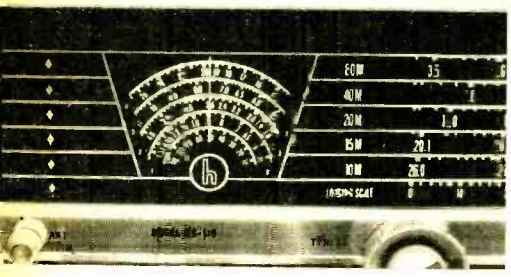
POP'tronics has purposely selected this price category since a good short-wave receiver is an investment. While we are speaking here of the SWL, each of the receivers discussed in this article has special bandspread dial calibration over the five most frequently used ham bands: 80, 40, 20, 15, and 10 meters. Thus, an SWL who later becomes a Novice or General Class radio amateur will have a receiver that is not obsolete—one which he can use for c.w., SSB, or phone operation.

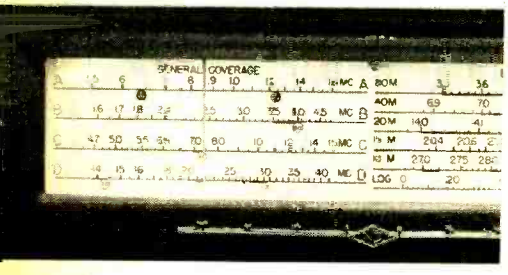
All three of these receivers have been put through their paces by the POP'tronics staff. Each is slightly different in price, circuitry, physical size, feel of the controls, etc. We recommend that, wherever possible, you investigate all of them. (You might also take a look at the Hammarlund HQ-100C, which sells for $213.95 including speaker, and the Hal-





The five most important ham bands are covered on the Hallicrafters SX-110 bandspread dial (above). Logging scale is used on the short-wave broadcast bands to separate stations. Main tuning circular dial (below) is quick-driven.





All three receivers have slide-rule style bandspread scales. The Gonset G-43 also has a slide-rule main tuning scale (left); with both scales mounted on a rotating drum, only one of the six bands is visible.

licrafters SX-108, priced at $142.90 including speaker.) Some radio stores will permit a potential customer to borrow a receiver overnight or over a weekend to try it out.

Gonset G-43. This receiver has a circuit that is comparatively unorthodox when contrasted with the other two models discussed here—it has no r.f. stage for amplification prior to the mixer stage. Instead, it counts on the high gain of three, instead of two, i.f. stages. And since the i.f. is at 1650 kc. instead of the more common 455 kc., there is almost no problem with "images." No crystal filter is used, but 12 tuned circuits in the i.f. strip shape the selectivity curve so that it seems slightly superior to two 455-kc. i.f. stages.

Performance-wise, we were impressed by the extra "length" of the main tuning range which results from spreading it over five high-frequency bands instead of the usual three. The fact that only one tuning range is visible at a time is also worthy of mention. And sensitivity was very good, with the higher frequencies (20-30 mc.) being particularly good, although a crystal filter and phasing control to remove heterodynes was occasionally missed.

A 100-kc. crystal calibrator (Model 3269) is an optional accessory.

Hallicrafters SX-110. The use of multipurpose and high-gain tubes permits the eight tubes in this receiver to do the work of ten. The design is straight-

General-coverage dial of the National NC-109 (at left) extends from 550 kc. to 40.0 mc. The bandsetting positions are marked with small circles. This receiver has a smooth dial drive mechanism.

Important selectivity and sensitivity controls on the NC-109 (right) are conveniently grouped on one panel. The G-43 has an illuminated S-meter (below) and six separate tuning ranges.

forward and devoid of tricky circuits and unnecessary frills. In some ways—the addition of a crystal filter, for example—the SX-110 is a grown-up "big brother" of the SX-108.

Tests on the SX-110 proved that it is a capable receiver with good sensitivity and signal-to-noise ratio on all tuning bands. The main tuning dial is more rapidly driven than in either the Gonset G-43 or the National NC-109, which means that greater dependence must be placed on fine tuning with the bandspread dial. The Hallicrafters people seem to have anticipated this need and have accordingly made the bandspread coverage greater than that in the G-43 and NC-109.

National NC-109. In this receiver, 11 tubes perform the functions of 13. Of particular import is the use of independent oscillator and mixer stages said to provide greater h.f. stability and improved performance above 20 mc.

The NC-109 performed smoothly in our tests and gave the feeling of long-lasting stability. We found the four-step selectivity control in the crystal-filter circuit of great help in separating stations on the crowded 31-meter band. Available accessories for use with this receiver include a 1-mc. crystal calibrator (Model XCU-109) and a narrow-band FM adapter (Model NFM-83-50). —30—

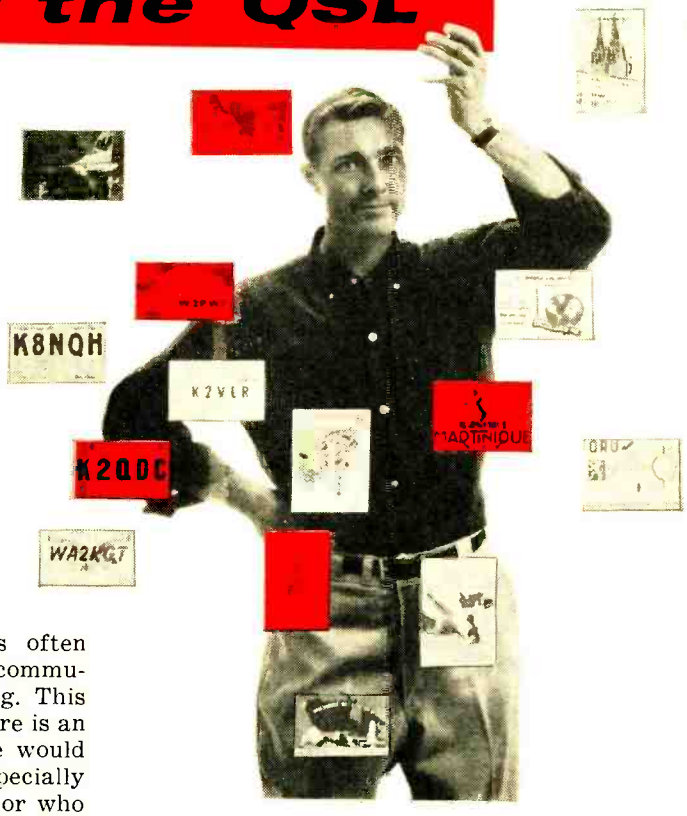
Manufacturer	Model	Price (with spkr.)	Number of bands	Number of r.f. + i.f. stages	Crystal filter	Headset jack
Gonset	G-43	$159.50	6	0 - 3*	no	rear
Hallicrafters	SX-110	$172.90	4	1 - 2	yes	front
National	NC-109	$187.50	4	1 - 2	yes	front

* see text

The ABC's of the QSL

A "reward" for service rendered, the QSL is a colorful memento of an exciting hobby

By HANK BENNETT
W2PNA/WPE2FT



SHORT-WAVE LISTENING is often considered a hobby in which communication is only one way—incoming. This is true to a certain extent, but there is an interesting sideline to it that we would like to tell our readers about, especially those who are new to the hobby or who have not yet become SWL's. This sideline deals with reporting to the stations heard, and receiving their verifications—or QSL cards.

Every day hundreds of short-wave broadcasting stations are on the air beaming programs in a multitude of languages to other countries around the world. Many of these stations—located anywhere from London to Rio de Janeiro, from Tokyo to Moscow—beam regular broadcasts to North America. Some have their own monitoring stations in the U.S.A., but others depend on reports from listeners for information as to whether their signals are being received loud and clear, or poor and weak.

Service Rendered. The newcomer to the hobby may find it interesting and informative to tune in foreign English-language newscasts or to relax to the splendid musical programs offered by many stations. But it doesn't end there—the stations would like to hear from you. They are interested in knowing how well you can hear them and how much you like (or dislike) certain programs. They also want to know whether other stations are interfering with their signals.

The information that you give the stations will help them determine if it is necessary to change frequency in order to avoid interference with other stations. It will enable them to know which of their programs listeners feel are the most interesting. It will also provide them with a definite key as to whether their broadcast times are good or whether they should be adjusted to furnish better reception for more listeners.

Typical Report. To make your report of greatest value to a station, there are certain things you should include in it. First, give the name of the station heard

(either the call letters or station slogan), your location (city and state), and the frequency to which your receiver is tuned.

Then list the exact times at which you heard the station, and be sure to give your time zone (EST, PST, etc.), or give the time in GMT if you wish. List all the program details that you hear with corresponding times for each item, e.g., 0855 news in Eng., 0859 station announcement, 0900 time check, 0900-0915 dance music (and name some of the selections played if you know them.)

Be sure to state how well you hear the station. If there is interference or fading, say so.

You might also mention the make and model of your receiver, the type of antenna you are using, the weather at the time of reception, and your location with respect to some nearby large city.

It is always best to put your report into letter form. Some listeners prefer to send reports on post cards—such reports rarely contain enough information to be of use to stations. Your letter should be thorough and complete, but avoid repetition. Be accurate, though, and be honest in your overall evaluation of the signals.

Verifications. When you want a station to reply to you and to verify your report (many SWL's avidly collect QSL's from stations the world over), enclose return postage and respectfully ask the station to verify if your report is found to be correct. In reporting to foreign countries, your best bet is to enclose an International Reply Coupon (several if you want your reply by airmail). These coupons are available at most post offices for 15 cents each.

Don't be impatient if the stations do not reply at once. Your letter will be only one of many that they receive, and it takes time for them to check the reports against their logs. And do not feel that one report per station is all that you can send; perodic reports will always be welcomed for they will help the stations to know whether their signals are better or worse than before.

Above all, remember that how fast you receive a reply may depend on how much a station values your report. Make your reports informative, and before long those QSL's will be pouring in. —30—

ADDRESSES OF FREQUENTLY HEARD SHORT-WAVE BROADCASTING SERVICES

British Broadcasting Corp.
Broadcasting House
London, W. 1, England

Cairo United Arab Republic Broadcasting Service
4 Sherifein St.
Cairo, U. A. R.

Canadian Broadcasting Corp.
P. O. Box 6000
Montreal, Quebec, Canada

Czechoslovak Radio
Praha-12, Stalinova 12
Czechoslovakia

ELWA Radio Village
Box 192
Monrovia, Liberia

New Zealand Broadcasting Service
P. O. Box 98
Wellington, New Zealand

Nippon Hoso Kyokai (Radio Japan)
No. 2, 2-chome, Uchisaiwai-cho
Chiyda-ku, Tokyo, Japan

The People's Republic of China
Broadcasting Administration
Outside Fu Hsing Men, Peking

Radio Moscow
Pjatnitskjaja ulitza 25
Moscow, U. S. S. R.

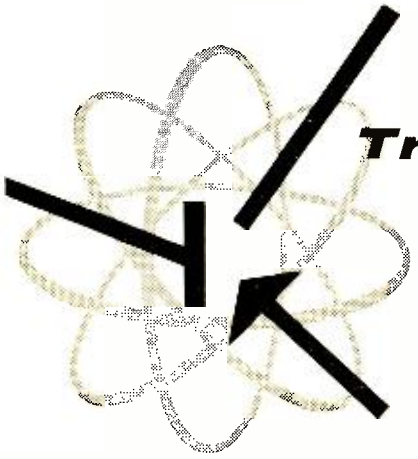
Radio Nacional de Espana
Paseo de la Castellana, No. 42
Madrid, Spain

Radiotelevisione Italiana
Via del Babuino 9
Rome, Italy

Voice of America
Washington 25, D. C.

The Voice of Germany (Deutsche Welle)
Postfach 344
Cologne, Germany

The services listed above are only a few of those on the air. Many others from countries all over the world are listed in the World Radio Handbook, available from Gilfer Associates, P. O. Box 239, Grand Central Station, New York 17, N. Y., for $2.70 per copy.



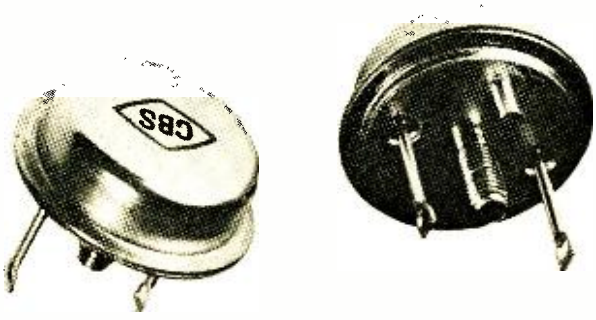
Transistor Topics

By LOU GARNER

ONE of the pleasant tasks faced each year at this time is a guessing game we play with the semiconductor industry. Yours truly attempts to foresee the new developments to be introduced in the coming year. The industry, in turn, creates products which exceed anything conceived in the wildest flights of imagination.

In 1960 blurred images in the crystal ball revealed an American satellite circling the moon and carrying transistorized instrument packages—*negative double-check*—our roman candle experts failed to orbit the moon with a satellite. However, tubes were abandoned after the last few earth satellite shots. Not only are the instrument packages completely transistorized, but the command receiver and transmitter sections use transistors exclusively. Considerable output power can now be obtained from transistors. . . . Two-way radios for foot patrolmen were anticipated—*partial check*—several cities are experimenting with transistor *paging receivers* for their officers. They can hear the police calls on their private radio receivers, and if their services are required, they simply telephone the station house for more information.

The prophecy of a transistorized "hybrid" FM receiver for automobiles registered with a thud, a possible reason being the popularity and acceptance of similar receivers which *translate* the signal from the FM band to the standard AM auto radio. The introduction of many new AM-FM portable radios, including a domestic version by Zenith, may have slowed the production of FM auto radios; many of these inexpensive compact portables are used in place of regular car radios. . . . Transistor ignition systems did not achieve wide acceptance. However, alternator generator systems, using silicon rectifiers to convert the a.c. to d.c. suitable for charging the battery, are standard on several models and optional on almost all other automobiles. . . . The vague outline of a semiconductor picture tube for television receivers was seen in the crystal ball—*check*—Sony of Japan announced experiments on such a device in 1960.



A series of 85-watt power transistors (TO-36) has been introduced recently by CBS Electronics. One such unit can replace two 40-watt or four 20-watt paralleled transistors.

Our prediction of low-priced experimenter v.h.f. power transistors was realized—*check*—the Motorola 2N711 and 2N741 are bargain-priced and go up to

several hundred mc. Texas Instruments "grade out" Types S-065 and R-425 are also extremely popular. In the moderate power class—*check*—Rheem, PSI, and others make two-watt silicon mesa 50-mc. transistors for less than $10.00. . . . Fully transistorized Citizens Band radiotelephone equipment was foreseen—*double-check*—RME, Electra, Karr, Morrow, Globe, Osborne, and many others have marketed "pocket-sized" two-way transistor transceivers which require no license of any sort. . . . Another touchdown was scored in predicting transistorized control devices for the home—*double - check* — garage door openers abound, and several companies, among them F & M Electronics, build an eight-channel completely transistorized model airplane radio-control system.

Things to Come. Moving out on our well-worn limb, saw in hand, we look forward to seeing in 1961 a race among manufacturers of Citizens Band equipment to introduce more powerful, completely transistorized walkie-talkie pack sets. . . . at least one company will produce a CB transceiver with one-watt power input which will operate from rechargeable batteries. . . . more amateur-radio equipment, particularly single-sideband transmitters, will employ transistors. . . . amateurs and experimenters can expect to obtain "grade outs" of silicon mesa two-watt r.f. transistors for three dollars, or less. . . . model airplane radio-control equipment will swing almost completely to transistors, a fact that will permit at least 20 more R/C channels to be added . . . hi-fi equipment will become more dependent on transistors, particularly in low-noise preamplifier applications.

Transistor CB Transmitters. One of the most interesting developments to come out of 1960 is the advent of ultra-compact Citizens Band transceivers. These units are designed to comply with Part 15 of the Federal Communications Commission Rules and Regulations which permits the operation of *unlicensed* low-power radiotelephone equipment in the 27-mc. Citizens Band. The transmitter power amplifier stage must run less than 100 milliwatts input (100 milliwatts is the same as 0.1 watt), and the antenna length cannot exceed five feet.

Many companies have jumped on the "band-wagon" to produce equipment for this short-range (about 1 mile) communications service for hunters, construction workers, traffic controllers, etc. And experimenters can build their own equipment if they are technically qualified to determine whether the transmitter complies with Part 15.

At least one manufacturer, International Crystal Mfg. Co., Oklahoma City, Okla., is producing printed-circuit transmitter kits to comply with Part 15. Although the TRT-2A transmitter was originally intended for use in this company's transistor transceiver, experimenters can purchase the transmitter separately, wired or in kit form. The circuit is shown in Fig. 1.

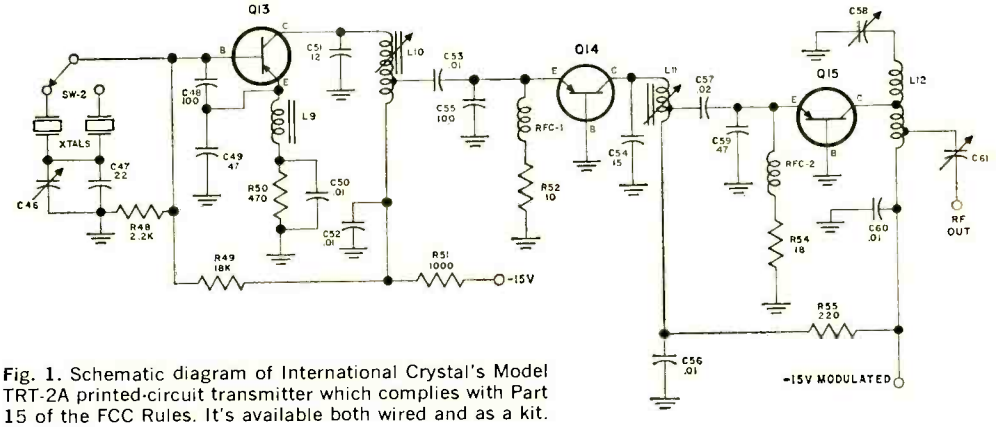


Fig. 1. Schematic diagram of International Crystal's Model TRT-2A printed-circuit transmitter which complies with Part 15 of the FCC Rules. It's available both wired and as a kit.

Model TRT-2A is capable of two-channel operation if you switch the proper

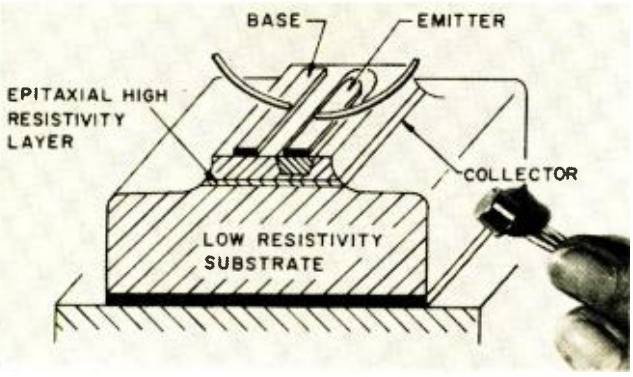


Fig. 2. The addition of an "epitaxial" layer to an otherwise ordinary transistor results in much higher output with increased efficiency. Typical units deliver ½ watt at 70 mc.

crystal into the circuit. A padder capacitor in series with the crystal adjusts the transmitted frequency "on the money." The common emitter oscillator (*Q13*) is a specially selected Texas Instruments Type S-065.

The oscillator circuit is somewhat unusual in that the crystals used are 13.5-mc. fundamental types and the circuit doubles the frequency to 27 mc. The r.f. energy appearing across coil *L10* is coupled to transistor *Q14*, which acts as a buffer-amplifier and is connected in the grounded-base arrangement. The stage receives its forward bias by rectifying some of the r.f.

A grounded-base power amplifier (*Q15*) receives its bias in the same manner, and serves to step the signal level up to the 100-mw. level. Coil *L12* is used to match the power amplifier transistor collector impedance to the antenna or transmission line. If *Q15* is replaced with a Texas Instruments 2N1143, the unit is capable of several hundred milliwatts of power input, and, of course, increased power output.

The International Crystal circuit uses an extra transistor so that it can also be employed in other high-power applications.

Epitaxial Transistor. A radically new method of producing transistors was announced by Bell Telephone Laboratories in June of 1960. Since that time Motorola, Sylvania, Rheem, and others have been producing the "Epitaxial Mesa" transistor in engineering quantities. The devices represent a breakthrough for they are a realization of what has, to now, been only theoretically possible.

Epitaxial transistors consist of thin semiconductor layers epitaxially (derived from the Greek word for "settling on") deposited on low-resistivity substrates or bases of germanium. See Fig. 2. The performance of these units is far superior to conventional germanium mesa transistors.

The epitaxial transistors combine the high reliability, power dissipation, and switching speed of the mesa transistors with the low saturation resistance which has come to be associated with high-frequency alloy-type units.

In amplifier circuitry, the new devices are capable of delivering much higher power output, at higher levels of efficiency. Because they present practically no series resistance in the circuit, there is considerably less power loss in the collector. Typical units are capable of delivering one-half watt of power output with 10-db gain at 70 mc.

The prices for these devices are expected to be substantially the same as for regular mesa transistors. The Motorola Type 2N834 is priced at $18.00 each in original equipment manufacturer quantities. An epitaxial version of the 2N705 germanium mesa transistor is also available at a reduced price.

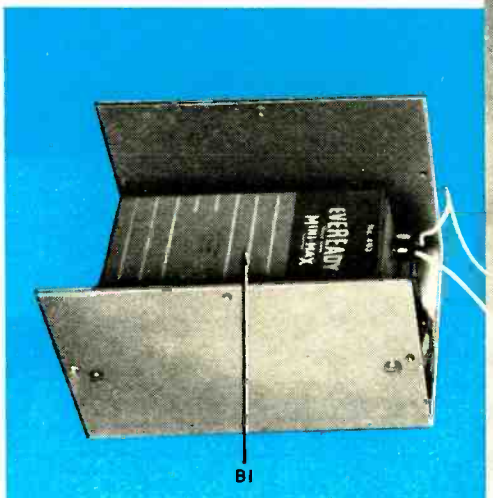
Product News. CBS Electronics' Semiconductor Division (Lowell, Mass.) has announced a new 85-watt *p-n-p* power transistor which saves space and weight and reduces cost. It can be used to replace two 40-watt or four 20-watt paralleled transistors. The nine types in this high-power class are the 2N173, 2N174, 2N277, 2N278, 2N441, 2N442, 2N443, 2N1099, and the 2N1100. These devices can provide 30 watts in Class A, 100

(*Continued on page* 118)

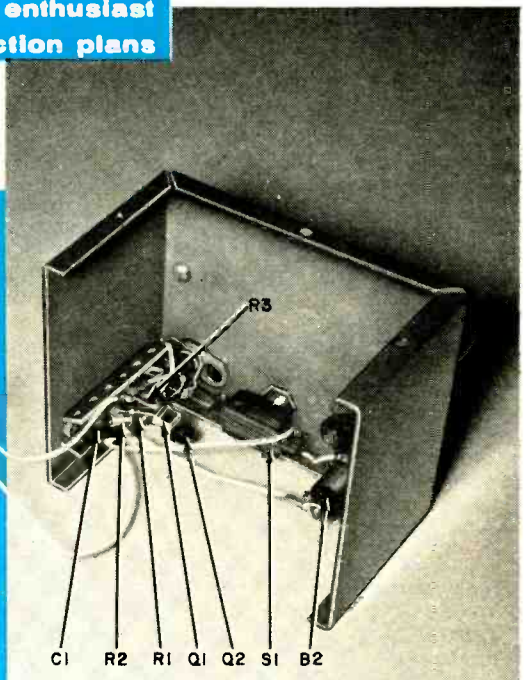
ADVANCED EXPERIMENTERS CORNER

Proven circuits for the electronics enthusiast who does not require construction plans

RADIATION DETECTOR

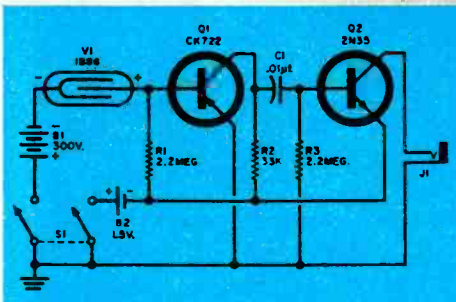


Heart of detector is Geiger tube (V1) mounted behind high-voltage battery (B1). Low-voltage battery (B2) mounts near amplifier circuit in other half of box.



DESIGNED to detect gamma rays, this instrument uses a 1B86 Geiger tube and a transistorized amplifier feeding magnetic phones. Dubbed the "Trans-Geiger," it has built-in high and low voltage batteries, making it completely portable. Current drain is so low that both batteries have normal shelf life.

The pulse amplifier circuit incorporates two transistors (*Q1* and *Q2*) and uses 2.2-megohm base bias resistors (*R1* and *R3*). Thus, the transistors are Class B operated, reducing collector current to less than 50 microamperes. Similarly, drain on battery *B1*, in series with Geiger tube *V1* and resistor *R1*, is well under 1 ma. Switch *S1* is included in



PARTS LIST

B1—300-volt battery (Burgess U200, Eveready 493, or RCA VS093)
B2—1½-volt flashlight cell
C1—0.01-μf. disc capacitor
J1—Open-circuit phone jack
Q1—CK722 p-n-p transistor
Q2—2N35 n-p-n transistor
R1, R3—2.2-megohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
S1—D.p.s.t. toggle switch
V1—1B86 Geiger tube
1—5" x 4" x 3" aluminum box (Bud CU-2105A or equivalent)
Misc—Hardware, terminal strips, flashlight cell holder, etc.

the circuit to protect the batteries should the sun's heat cause *Q1* or *Q2* to develop excessive leakage current when you're out prospecting.

Construction. The Trans-Geiger will fit in a 5″ x 4″ x 3″ aluminum box with just enough room to spare. Mount the 300-volt battery (*B1*) and the Geiger tube (*V1*) in the back half of the box. Be careful when handling and mounting the Geiger tube, since it is extremely fragile. The tube is mounted to the box by gluing it to a pair of ½″ cubes of sponge rubber; do *not* use metal clamps to mount the tube. Since the 1B86 is a gamma-ray detector, and gamma rays are not stopped by thin sheets of aluminum, there is no need to cut a window for it in the aluminum box. Battery *B1* should be strapped in place to prevent it from moving and damaging the tube.

All other components are mounted in the cover half of the box; locate them so that they don't jam against *B1* or *V1* when the box is closed. The pulse amplifier circuit is wired to a pair of 6-lug terminal strips. Mount headphone jack *J1*, switch *S1*, and the battery holder for *B2* on one of the 5″ sides of the box; this puts *J1* and *S1* free and clear of the carrying handle. As a finishing touch, cement a thin layer of sponge rubber to the bottom of the box to act as a shock absorber.

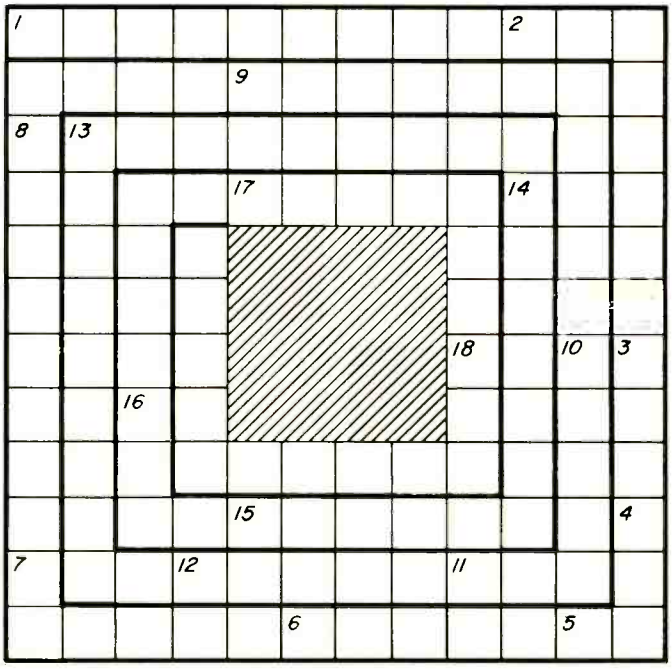
Operation. Plug in a high-impedance magnetic headset and flip on switch *S1*. You will hear some random clicks due to an occasional spurt of cosmic rays hitting the Geiger tube; natural background radiation might also contribute a few clicks. Now lower the bottom of the Trans-Geiger to a radium dial watch; the clicking rate will increase, indicating the presence of a radioactive material which generates gamma rays. In checking radioactive ore samples, use the radium dial watch as a standard—the more clicks per minute, the more radioactive the sample.

—*J. E. Pugh, Jr.*

ROUNDWORD PUZZLE

By Leonard I. Kindler

Here's a puzzle to warm the heart of any electronics experimenter. If you're up on your theory, this one should be a cinch! If you're not, there may be some rough going in spots. Just start in the upper left-hand corner and work clockwise until you reach the center. The last letter of each word is used as the first letter of the next word, and the first word begins with a "T."



1 Detects temperature changes.
2 _____ impedance is caused by load on other side of transformer.
3 Capacitor construction type.
4 Interconnecting wire.
5 _____ waves progressively decrease in amplitude.
6 Unit for expressing power ratio.
7 Wave pattern seen on oscilloscope.
8 Wire joint.
9 Detects static charges.
10 Part of a tube.
11 Switch design type.
12 Capacitor discharge curve type.
13 Piece of transformer core.
14 _____ voltage is fed in 180° out of phase with r.f. signal.
15 Band between adjacent FM channels.
16 Speaker or mike type.
17 Oscillator using parallel-tuned tank.
18 Superregenerative detector type: hyphenated word.

(Answer on page 115)

On the Citizens Band

By TOM KNEITEL, 2W1965

READERS often write to ask why we don't run technical gems in this column. The reason is simple—a lot of space is needed to do justice to most technical subjects, and until recently we didn't have it. But now, thanks to our expanded CB coverage, we hope to present not-too-involved technical items with some frequency (no pun intended). This month we'll start out by talking about mobile antenna mounting, and we'll wind up with some tips on antenna impedance.

The most practical place to locate a mobile antenna on a car is on the left rear fender at about bumper level. Unfortunately, though, the most practical antenna location isn't the spot where you're going to radiate the best non-directional signal.

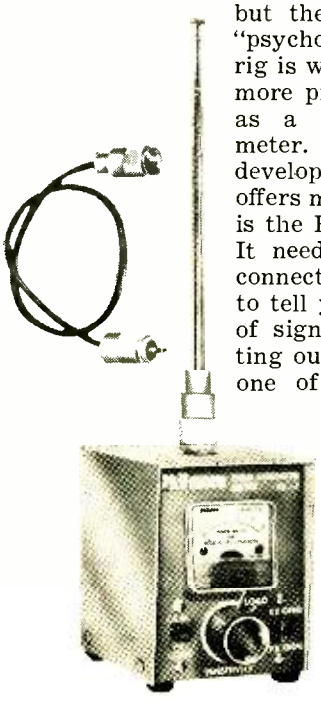
When you mount your antenna on the rear of the car, you are in effect, using the car as a counterpoise, or ground plane, which gives you a 6-db signal gain in the area in front of the car on the side opposite the antenna. (A 6-db gain means that your signal is increased almost four times.) On the side where the antenna is located, you'll have a 6-db attenuation, however, or one-fourth the signal you would have with a non-directional antenna. An improvement of 50% in range and signal strength is possible when the body of the car lies between the antenna and the stations contacted.

Obviously it will be to your advantage to mount the antenna so that portions of the car will extend in all directions around it, i.e., in the exact center of the roof. Where a bumper-mounted antenna might give, say, 5 miles range towards the rear of the car and 7½ towards the front, a roof job would presumably give up to 7½ miles in all directions.

Don't be too concerned about the height of roof-mounted antennas, incidentally—some of the shorter units do just as well as the longer ones and give no trouble with trees, garage doors, and the like. A spring base is usually provided on roof-mounted jobs, and shorter Fiberglas whips, like the "Heliwhip," are often used to cut down on height. A "Heliwhip" for CB is only 48″ long, compared to 108″ for a standard steel whip. But don't confuse these whips with the base-loaded "portable" whips (40″ long, metal, with vinyl covered coils at the bottom), which do not give full range.

Station efficiency is something dear to the hearts of all CB'ers. It should be, because unless your station is efficient, you won't stand much chance of plowing through the 11-meter garble.

But how do you know how well you are "getting out?" Your friends can give you their opinions, but the best way to "psychoanalyze" your rig is with an "FSM," more properly known as a field strength meter. One recently developed unit which offers more than most is the Philmore FS-1. It needs no physical connection to your rig to tell you what kind of signal you're putting out, and a flip of one of the switches



on the front panel turns the unit into a wattmeter for measuring the actual output in watts at your transmitter's antenna jack. Another switch selects either a 52- or 75-ohm load, and the device is furnished with a special interconnecting cable for use in the wattmeter hookup. The FS-1 sells for only $17.50 in easy-to-build kit form.

Many hundreds of mobile units throughout the country are now sporting the snazzy red, white, and blue Five Watt Wizard decals. These 3½" decals are available only to Five Watt Wizard members from club headquarters (P. O. Box 203, Forest Hills 75, N. Y.) for 50 cents each. There's a space on the bottom of the decal for your call sign.

Incidentally, the Wizards recently accepted an application from the "Jersey 5 Watters" (a New Jersey club) to become an independent affiliate of their organization. Other clubs, as well as individuals, are welcome to write to the Wizards at the above address for information on affiliation with the nation's largest nonprofit CB organization.

Letters from CB'ers all over the country are asking "What's this 'impedance' nonsense with antennas?" Actually it's far from nonsense, so let's take a good look at it and see what antenna impedance is all about.

Every antenna has a characteristic "impedance" which must be borne in mind when putting it to use. Most CB antennas have impedances of 50 to 53 ohms or 73 to 78 ohms, and the coaxial cables which feed the signal from the rig to the antenna must be rated at the same impedance as the antenna to insure maximum signal transfer. Therefore, the coax feeder lines most commonly used by CB'ers are the inexpensive RG-58/U (53.5 ohms) and RG-59/U (73 ohms).

One interesting fact many CB'ers seem to be unaware of is that the longer the stretch of coax between rig and antenna, the weaker the signal by the time it reaches its destination. On a 100' cable run using RG-58/U or RG-59/U, you lose about half of your output power by the time it gets to the antenna.

The remedy is to use a larger diameter cable of the same impedance, assuming you have a long cable run. While large-diameter coax is more expensive than small-diameter cable, it has considerably lower loss than its smaller brothers. A good substitute cable for 52-ohm antennas is RG-8/U, which will dissipate only 22% of your signal power every 100 feet, or RG-17/U which will cut the loss down to 15% every 100 feet. For 75-ohm antennas, RG-11/U is best—like RG-8/U, it has a 22% power loss.

As an example, let's say your transmitter operates at 80% efficiency (and I'll bet a penny that it's even less). At 80% efficiency, you're probably getting about 4 watts *output* at your rig's antenna jack. With 100 feet of RG-58/U cable, you would have about 2.2 watts delivered to the antenna. With RG-8/U, you'd have 3.1 watts, and with RG-17/U there would be 3.4 watts. An extra watt and a fraction can mean a lot on the Citizens Band. Of course, there are better cables to use than RG-17/U, but you'd have to be King Midas to afford 100 feet of the stuff.

The table below lists types of cable suitable for CB use, together with their characteristic impedances, db losses, and % power loss per 100 feet. Values are approximate since slight differences occur in manufacturing and between different manufacturers' units. —30—

COAXIAL CABLE	IMPEDANCE IN OHMS	DB LOSS PER 100'	POWER LOSS PER 100' (%)
RG-8/U	52	1.1	22
RG-8A/U	52	1.1	22
RG-11/U	75	1.1	22
RG-11A/U	75	1.1	22
RG-17/U	52	0.7	15
RG-17A/U	52	0.7	15
RG-58/U	53.5	2.6	45
RG-58A/U	50	2.6	45
RG-58C/U	50	2.6	45
RG-59/U	73	2.6	45
RG-59B/U	75	2.6	45

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

ZERO-BEATING AND STABILIZING TRANSMITTERS

HOW OFTEN have you heard a CQ from a state you needed for your WAS, frantically answered his CQ on what you believed to be the same frequency, then waited only to find he was talking to someone else? Similarly, when you're roaming around the bands, you probably often pick up a rare DX station working local stations in sequence on a single frequency, and afterwards hear a number of the locals answering him on different frequencies—sometimes the locals calling the original DX station are so far removed from his frequency that they reduce their chances of being heard to virtually zero.

The culprit is frequently operating technique, but at times your rig may be the offender. If all ham transmitters and receivers were precisely calibrated, transmitting and receiving on exactly the same frequency would require simply matching transmitter and receiver dial settings. As few ham sending and receiving rigs are calibrated with this degree of precision, zero-beating is the best way to hit the right frequency.

How to Zero-Beat. The basic method of zero-beating *phone* stations is to tune in the desired signal on your receiver with the BFO off. Then, without disturbing the receiver settings, turn on the low-power stages of your transmitter and tune the transmitter's VFO until you

Ham of the Month

Rx:DX is the prescription that Harold H. Riker, M.D., Flushing, N. Y., wrote for himself about six years ago. Under the call letters K2JHA, he takes the medicine it specifies—large doses of ham radio—before meals, after meals, and any other time that he can spare from his busy practice.

Dr. Riker's ham station contains a kilowatt transmitter feeding a three-element tri-band rotary beam on 10, 15, and 20 meters, and a trap antenna for use on 80 and 40 meters. On top of the beam is a neat little two-meter vertical antenna which is connected to a Gonset "Communicator" that Dr. Riker uses for local work.

When asked facetiously if all his fancy equipment worked, "Doc" snapped a few switches, and within two minutes was talking to ZS6KD in Johannesburg, South Africa. Then, in rapid succession, G2MA, Yorkshire, England; W2CMM, New York City; and PZ1AX, Surinam, South America, joined in.

Not a man to be separated from his hobby simply because he must call on patients and visit hospitals, K2JHA has a five-band mobile station in his car. He also uses a CB transceiver on the road to keep in touch with his office.

Curt, WV2MZP, (above), occupies the shack of his brother, Doug, WA2JRQ, who is in the Air Force. A third brother, Tom, WV2MZL, also operates the same rig sometimes.

Bill, K7KST, who operates in Seattle, Wash., worked 30 states on 40 meters in only five months as a Novice—all call areas.

hear a high-pitched whistle from the receiver. This whistle is an audio tone resulting from the mixing of the received frequency with your transmitter's frequency. As you continue tuning the transmitter's VFO, the frequency of the "beat" note will decrease to zero and then increase again. At the zero-beat point, your transmitter and the incoming signal are on exactly the same frequency.

To zero-beat a *c.w.* signal, set up the receiver for c.w. reception and tune in the desired signal in the normal manner. Then, turn off the receiver BFO and zero-beat the transmitter to the signal as described for phone operation, above. Now turn the BFO back on. If you have done the job correctly, the beat note formed by your transmitter's signal will have the same pitch as the one generated by the incoming signal.

In order to obtain an accurate zero-beat between two signals, they should be approximately the same strength. Otherwise, the stronger signal will swamp out the weaker one, thus obscuring the exact zero-beat point. A highly selective receiver with good overload characteristics will decrease this effect somewhat, but the real solution is to decrease the strength of the transmitter's signal by turning on only its low power stages. A good operator would do this anyway, because swishing a transmitter across the bands at full power to zero-beat a signal creates unnecessary interference.

Unfortunately, some transmitters don't have any provision for turning on their low power stages without turning on the final amplifier. Our construction project this month shows how this provision can be added to a transmitter.

Increasing Stability. Sometimes, no matter how carefully you set your transmitter oscillator on the frequency of another station, when you switch on the transmitter's final, you discover that you are no longer on exactly the same frequency. One cause of this is poor power-line regulation. The added load of the final decreases the line voltage a few volts, and this in turn reduces the oscillator tube filament voltage, causing your frequency to shift. Check this possibility by observing your VFO frequency when you plug an electric iron into the same line that powers your transmitter. You can sometimes minimize this effect by operating the oscillator tube from a separate filament transformer plugged into a different outlet from the one employed to power the other circuits in the transmitter.

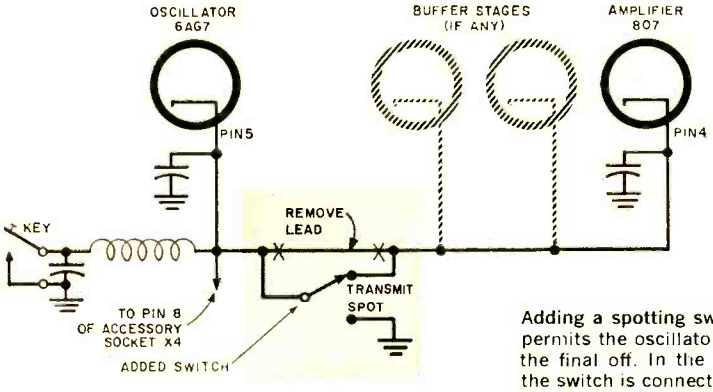
Turning on the buffer, multiplier, or final stages may also pull the oscillator frequency in some transmitters even when all voltages remain constant. This is common in the surplus "Command Set" transmitters (BC-459's, ARC-5's, etc.) that some hams use as VFO's or as complete transmitters. You can overcome this defect by determining how much you have to turn the oscillator dial to compensate for it—usually about half a dial division—and offset the dial this amount after zero-beating a frequency with only the oscillator on.

"SPOTTING" SWITCH

Many low-powered c.w. transmitters incorporate simultaneous keying of both the oscillator and final cathode circuits. Although this type of keying usually works quite well, there is often no way to turn on the oscillator and keep the final off. With the oscillator on by itself, you can get a more accurate "spot" of your frequency on your receiver and have a low-level signal for zero-beating a station calling CQ.

According to Howard S. Pyle, W7OE, it is a simple task to add a frequency-spotting switch to a transmitter. The diagram below shows how to add such a switch to the Johnson Adventurer transmitter, but it should apply equally well to other cathode-keyed transmitters.

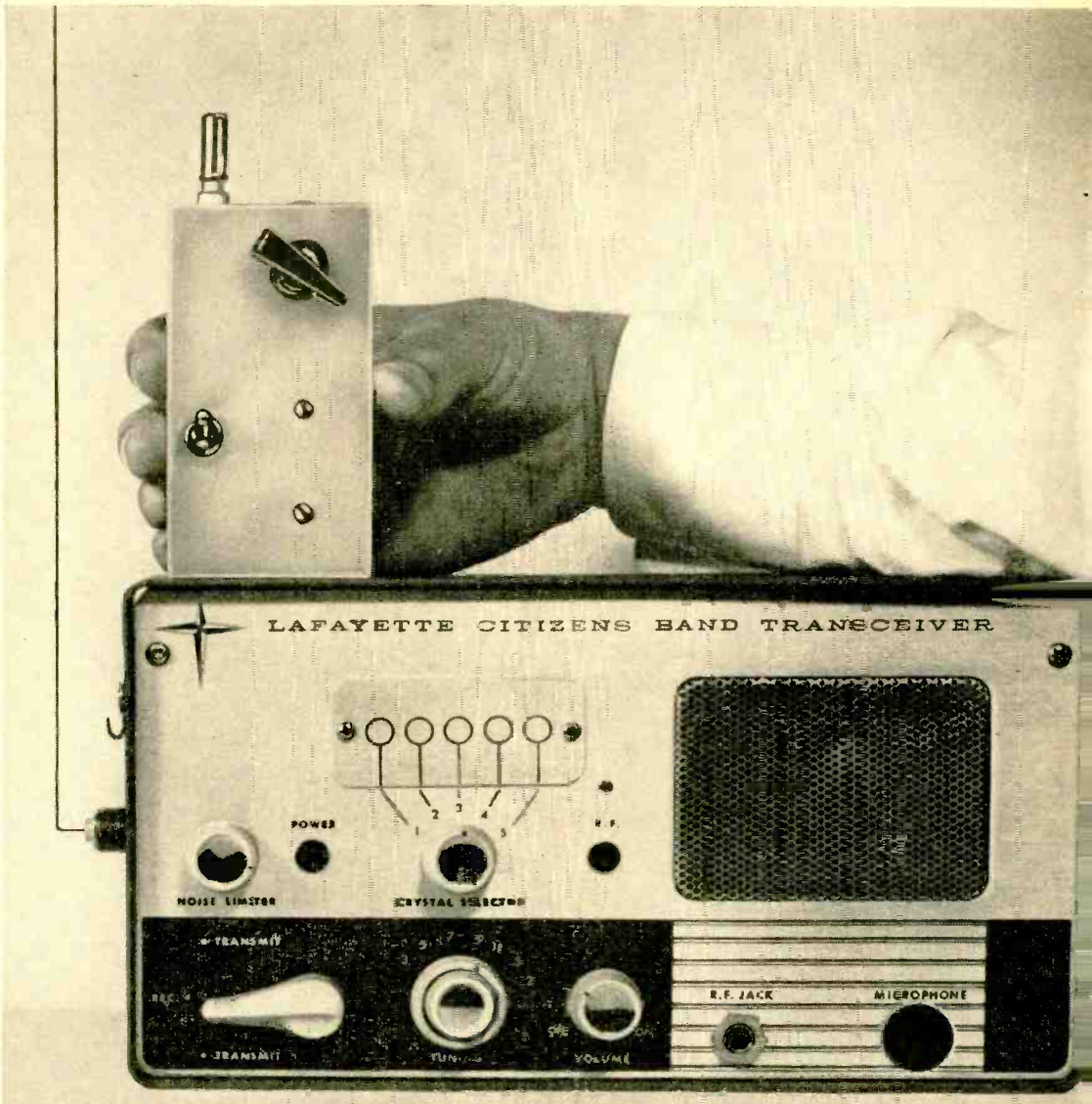
Mount a single-pole, double-throw switch on the transmitter panel in any convenient location. Connect the switch's arm to the key circuit and also to the oscillator cathode. Then connect one fixed switch terminal to the cathodes of the final and any other intermediate stages; ground the remaining switch terminal to the transmitter chassis.



Adding a spotting switch to a transmitter permits the oscillator to be operated with the final off. In the Johnson Adventurer, the switch is connected between the 6AG7 and 807 tubes, as shown in the diagram. With other rigs, insert the switch in front of existing buffer or multiplier stages.

Throwing the switch to the ground position will operate the oscillator alone; the other switch position will provide normal operation of the transmitter. In addition to making it easier for you to zero-beat your transmitter, this switch will win you the gratitude of other amateurs by reducing an unnecessary type of interference.

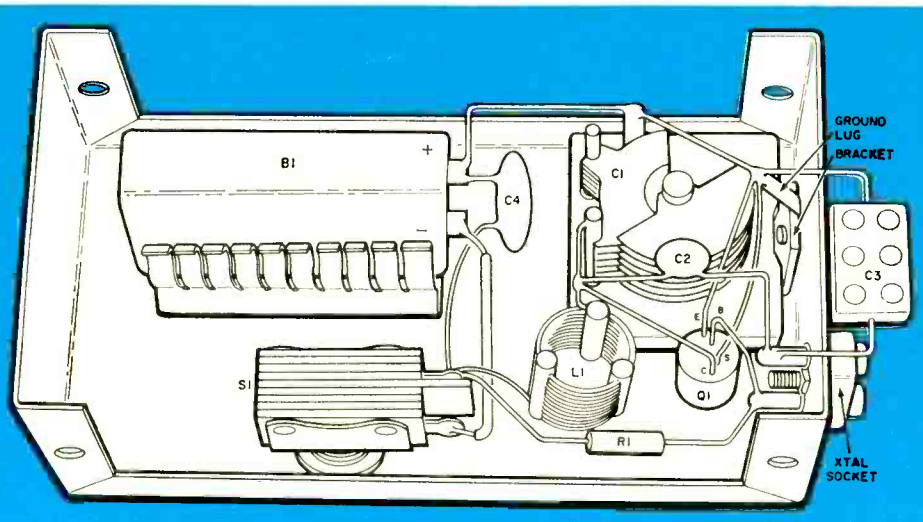
(*Continued on page* 114)

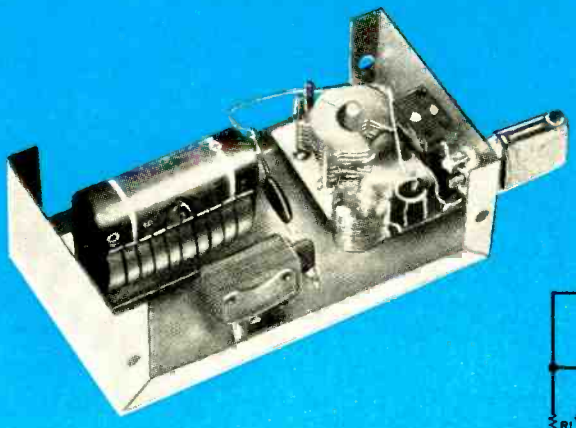


CB CHANNEL SPOTTER

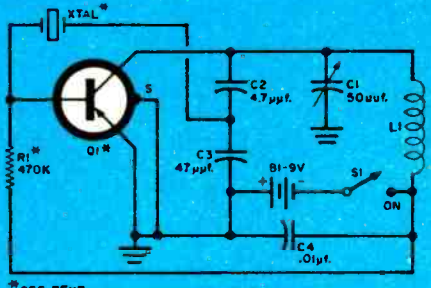
Handy home-built calibrator pinpoints operating frequency on tuning dial

By DONALD L. STONER, W6TNS





Follow the parts layout shown here as closely as possible to minimize changes in stray capacitances.



*SEE TEXT

THE INCREASING USE of tunable receivers in the Citizens Band calls for a device to "spot" your frequency on the receiver tuning dial. Just in case you're not crystal-controlled on the *receive* channel, it's handy to have a gadget that will show the exact setting when the channel is unoccupied.

The "CB Calibrator" will do just that. Essentially, it is a low-power crystal-controlled transistor oscillator for the Citizens Band. When a transmitter crystal for your CB rig is placed in the calibrator's crystal socket, the instrument will generate a signal on the appropriate channel. When accurately calibrated CB crystals are used, the signal should be within the 0.005% limits specified by the FCC for CB equipment.

Using all new parts, you should be able

PARTS LIST

B1—9-volt transistor battery
C1—50-μμf. variable capacitor (Hammarlund HF-50 or equivalent)
C2—4.7-μμf. NPO disc or silver mica capacitor
C3—47-μμf. NPO disc or silver mica capacitor
C4—0.01-μf. disc ceramic capacitor
L1—11¾ turns of No. 18 wire, air core (B & W 3003 or equivalent)
Q1—2N274 drift transistor—see text
R1—½-watt resistor—see text
S1—S.p.s.t. toggle switch
1—4¼" x 2¼" x 1½" chassis box (Bud CU-2116A or equivalent)
Misc.—Crystal socket, battery holder, solder lug

to construct this handy little calibrator for less than $8.50.

Construction. The unit is housed in a 4¼" x 2¼" x 1½" aluminum box. The only other components required are a few capacitors, a resistor, one transistor, a coil, a battery, a switch, and a crystal socket.

Mount the tuning capacitor (*C1*) by its shaft nut and a screw through its bracket. A solder lug placed between the chassis and *C1*'s bracket serves as a common ground for the entire unit. The crystal socket is mounted alongside the tuning capacitor. Transistor *Q1* and coil *L1* are held in place by their leads with no other external support.

Most of the space in the box is taken up by the battery and switch. They may be mounted wherever convenient. The battery is wired directly into the circuit. Also wire in the three fixed capacitors (*C2, C3* and *C4*), keeping their leads as short as possible. Do not wire in resistor *R1* until after the adjustments are made.

Adjustments. There are just two adjustments needed to put the calibrator in operating condition. The first is to set the transistor's collector current at about 0.4 ma.; the second, to set *C1* properly.

The author used an RCA 2N274 drift transistor. Another transistor in the same family (such as the 2N274, 2N370, 2N371, or 2N372) can be used if you wish. Some of these transistors will oscillate while drawing as little as 0.1 ma.; others may need as high as 0.5 ma. With the minimum drain (0.1 ma.), the battery should last almost its entire shelf life. With a drain of 0.4 ma., the battery will last six months to a year under normal service.

Connect a 1-ma. milliammeter in series with one of the battery leads. Substitute a 1-megohm potentiometer (wired as a variable resistor) for *R1*. With the pot at maximum resistance and no crystal in the socket, turn on the switch. The meter should read zero. (Current is actually less than 1 microampere.) Decrease the pot's resistance until the meter reads about 0.2 ma.

Insert a crystal in the socket and slowly tune *C1* while listening for the signal on your CB receiver. If the unit is oscillating, remove the pot, measure its resistance, and place a fixed resistor with the same value (or as near to it as possible) in the circuit. If the calibrator is not oscillating, decrease the pot's resistance a little more and try again. The unit should "take off" with less than 0.5-ma. collector current.

Only third-overtone crystals intended for the Citizens Band are suitable. Fundamental-type crystals will *not* work in this circuit since they operate at a low frequency that is later multiplied to a CB channel frequency.

Operation. To use the calibrator, simply place a CB third-overtone crystal in the socket and flip on the switch. Normally, capacitor *C1*'s plates will be about one-quarter meshed and will need no readjustment (unless crystals for widely separated parts of the band are used).

The calibrator's high degree of accuracy enables it to be used for aligning CB equipment. For example, with suitable crystals, it will indicate the band ends much more accurately than will the conventional signal generator. It can, therefore, be used for setting receiver tracking.

If you normally operate on only one channel most of the time, select a crystal suitable for that channel and place it in the calibrator. Turn the unit on and set it down near your antenna. Adjust the antenna's length and matching network (if there is one) for maximum pickup. When this is done, you can be sure your antenna will deliver maximum performance, both receiving and transmitting, on the band you use most often.

And don't forget the original reason for building the calibrator—it will point out your transmitting frequency quite accurately on your receiver's dial. After operating the unit for a while, you will probably come up with several additional applications for it. —30—

HOW IT WORKS

The calibrator uses a single drift transistor, connected in the common-emitter arrangement as an oscillator. When switch *S1* is turned on, a pulse is fed to the transistor's base through resistor *R1*. The pulse is amplified and appears at the transistor's output—tank circuit *L1-C1*.

Part of the pulse is fed back to the base through the crystal. The crystal sets the operating frequency and acts as a feedback path. Although the crystal is cut for approximately 9 mc., the circuit oscillates at its third harmonic—about 27 mc.

Base bias is determined by *R1*, with the exact value depending on the transistor used.

BUILD 20 RADIO CIRCUITS AT HOME

with the New

PROGRESSIVE RADIO "EDU-KIT"®

ONLY $26.95

Reg. U. S Pat. Off

A Practical Home Radio Course

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ 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, Square Wave Generator and the accompanying instructional material.

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for 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 trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

- ☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
- ☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
- ☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

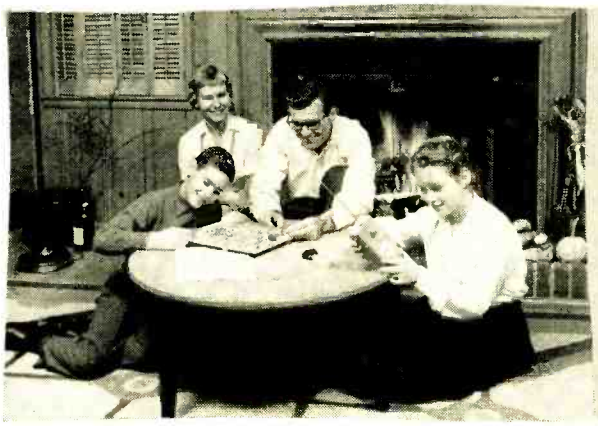
Address .....

.....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 576D, Hewlett, N. Y.

THERE'S A NEW HEATH KIT FOR EVERYONE IN THE FAMILY!



fits both space and dollar budgets!

COMPLETE STEREO-PHONO CONSOLE WIRED OR KIT

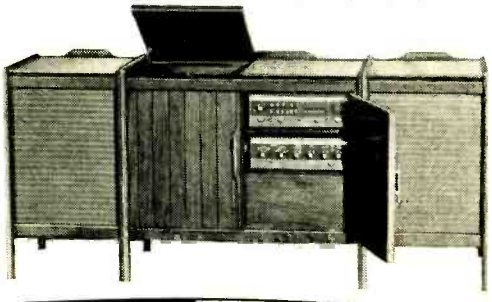
Less than 3' long and end-table height, yet its *six* speakers assure rich, room-filling stereo! Smooth "lows" are delivered by two 12" woofers, "mid-range" and "highs" are sparklingly reproduced by two 8" speakers and two 5" cone-type tweeters mounted at wide dispersal angles in the cabinet. The "anti-skate" 4-speed automatic stereo/mono record changer has diamond and sapphire styli. Concentric volume and separate dual bass and treble tone controls are within easy reach. Superbly styled with solid genuine walnut frame, walnut veneer front panel, and matching "wood-grained" sliding top, the cabinet measures just 31¾" L x 17⅞" W x 26¾" H. Whether you buy the ready-to-play or kit form, the cabinet is factory assembled and finished; to build the kit, just wire the amplifier and install the changer and speakers. 70 lbs.

Model GD-31 (kit)...$13 dn., $11 mo.....**$129.95**
Model GDW-31 (wired)...$15 dn., $13 mo.....**$149.95**

INTRODUCING

. . . a superb new line of Stereo Hi-Fi Consoles . . .

FACTORY ASSEMBLED, *ready to play!*



COMPLETE 28-WATT AND 50-WATT STEREO CONSOLES

Now you can buy Heath stereo components factory-wired and tested with beautiful preassembled, prefinished cabinets . . . ready to plug in and enjoy. The consoles are available in both 28 and 50 watt models, with money-saving optional kit plans. The 28-watt model (HFS-26) contains the Heathkit AJ-10 stereo AM/FM tuner, SA-2 stereo amplifier, AD-50A stereo record changer and two US-3 12" coaxial hi-fi speakers. The 50-watt model (HFS-28) contains the Heathkit AJ-30 Deluxe stereo AM/FM tuner; AA-100 Deluxe stereo amplifier; AD-60B Deluxe stereo record changer and two Jensen H-223F coaxial 2-way 12" hi-fi speakers. Specify walnut or mahogany.

Model HFS-26 (wired)...215 lbs....$47.50 dn.....**$475.00**
Model HFS-27 (kit)...$37.00 dn.....**$370.00**
Model HFS-28 (wired)...264 lbs....$75.00 dn.....**$675.00**
Model HFS-29 (kit)...$55.00 dn.....**$550.00**

Cabinets available separately, write for information.

HEATHKIT® by DAYSTROM

HEATH COMPANY / Benton Harbor, Michigan

NOW ONLY

HEATH

BRINGS YOU

ALL 3!

1. HEATHKIT for do-it-yourself hobbyists.

2. HEATHKIT factory-built, ready to use.

3. HEATHKIT learn-by-doing Science Series for youngsters.

PORTABLE 4-TRACK STEREO TAPE RECORDER KIT

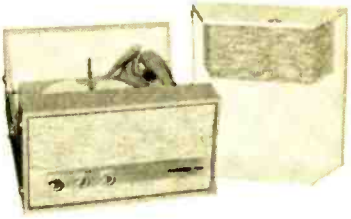
Delight to the vast treasures available to you in popular 4-track pre-recorded stereo tapes . . . make your own 4-track stereo home recordings . . . (you can even use it as a hi-fi center to amplify and control hi-fi tuners, record players, etc.) Has "record," "play," "fast-forward" and "rewind" functions. 2 speeds (3¾" and 7½" per second). Controls include: individual tone balance controls for each channel; level controls; monitoring switch for each channel to let you hear programs as they are being recorded; and a pause button for tape editing. Two "eye-tube" indicators provide control of recording levels. Speaker wings may be detached. Cabinet and tape mechanism are completely preassembled. A storage compartment is provided for tape and accessories. 49 lbs.

Model AD-40...$18 dn., $16 mo.....**$179.95**

STEREO/MONO PORTABLE PHONO KIT

From jazz to classics, the younger set will have stereo wherever they go! Plays either stereo or mono records on its top quality 4-speed automatic changer with diamond and sapphire styli. Has detachable stereo speaker wing and complete tone and stereo balance controls. Record changer and cabinet are factory-assembled, the kit is a "snap" to build. 15½" x 18" x 8⅝". 28 lbs.

Model GD-10...$7 dn.....**$69.95**



ACOUSTIC SUSPENSION SPEAKER SYSTEM KIT

Using the revolutionary "acoustic suspension principle" licensed to Heath by Acoustic Research, Incorporated, the AS-10 meets and surpasses performance of speaker systems three to four times its size. The 10" bass speaker and two 3½" hi-frequency speakers cover 30 to 15,000 cps with fantastic brilliance and fidelity! Use in upright or horizontal position. Cabinets preassembled and prefinished. 32 lbs.

Model AS-10U (unfinished)...$6 dn., $6 mo.....**$59.95**
Model AS-10M (mahogany)...$6.50 dn., $6 mo.....**$64.95**
Model AS-10W (walnut)...$6.50 dn., $6 mo.....**$64.95**

DELUXE AM/FM STEREO TUNER

Exciting new styling and advance-design features rocket this new Heathkit to the top of the stereo hi-fi value list! Featured are: complete AM, FM and simultaneous stereo AM/FM reception, plus a multiplex adapter output; individual flywheel tuning; individual tuning meters on each band; FM automatic frequency control (AFC); and AM bandwidth switch. 24 lbs.

Model AJ-30 (kit)...$9.75 dn., $9 mo.....**$97.50**
Model AJW-30 (wired)...$15.30 dn., $13 mo.....**$152.95**

DELUXE 50-WATT STEREO AMPLIFIER

Look-alike companion to the tuner above, here's two 25-watt channels hi-fi-rated and loaded with extras! Mixed-channel center speaker output; "function selector" for any mode of operation; stereo reverse, balance and separation controls; ganged volume and separate concentric bass and treble tone controls. 5½" H, 15¾" W, 13½" D. 31 lbs.

Model AA-100 (kit)...$8.50 dn., $8.00 mo.....**$84.95**
Model AAW-100 (wired)...$14.50 dn., $13.00 mo.....**$144.95**

8 new, exciting Heathkit® products on following pages

HEATHKIT®... pioneer in do-it-yourself

NOW . . . BUY YOUR HEATHKIT FOR as low as $2.50 DOWN! Yes, under the new, easy Heath Time Payment Plan, orders of $25.00 or more can be purchased for just 10% down . . . and up to 18 FULL MONTHS ON BALANCE for orders of $300 to $600.

So, don't wait . . . enjoy that Heathkit you've wanted so long NOW . . . for just a small amount down, and pay the balance in easy monthly installments!

ANNOUNCING THE ALL-NEW HEATHKIT "WARRIOR" GROUNDED-GRID KILOWATT LINEAR .....ONLY $229.95

Here's news to rock the entire Amateur Radio world! The new desk-top Heathkit "Warrior" matches any unit on the market feature for feature with no quality short cuts and slashes the price in half! *Completely Self-Contained*—amplifier *and* HV, filament, and bias supplies are built in. *Versatile*—drives with 50 to 75 watts, no matching or swamping network required. *Efficient*—stable g-g circuit puts part of drive in output for up to 70% efficiency. *Inexpensive Tubes*—four paralleled 811A's and two 866A's. *Dynamic Regulation*—big oil-filled capacitor and 5-50 henry swinging choke for high peak power output with low distortion. *Design*—special low-capacity filament transformer requires less driving power and eliminates broad-band filament RF choke. *Monitoring*—gives constant output to scope regardless of frequency. *Easily Assembled*—average time 8 hours. *Bands*—80 through 10. *Max. Power Input*—SSB-1000 watts PEP; CW-1000 watts; AM-400 watts (500 using controlled carrier mod.); RTTY-650 watts. *Write for Complete Information.*

Model HA-10...100 lbs....$23.00 dn., $20.00 mo.....**$229.95**

DELUXE SERVICE BENCH VTVM KIT

Greater accuracy and convenience for precision testing. Big 6", 200 ua meter has longer scales plus separate 1.5v and 5v AC scales. Wider frequency coverage with greater precision is made possible through use of 1% resistors and husky capacitors. Other deluxe features include high-visibility meter and controls; recessed thumb-wheel "zero" and "ohms adjust" controls. Measures AC and DC volts to 1500 in 7 ranges; resistance from .1 ohm to 1,000 megohms in 7 ranges. Db calibrations for relative voltage measurements selected to give 10 db steps between ranges. Test leads included. 9½" H x 6½" W x 5" D. 7 lbs.

Model IM-10...$3.30 dn., $5.00 mo.....**$32.95**

NEW ISOLATION TRANSFORMER KIT

The IP-10 presents a significant improvement in isolation transformers. Provides output voltage from 90-130v in 0.75v steps at 300 watts continuous duty, 500 watts intermittent duty, with 117v input—ample power for even color TV servicing. Built-in meter continuously monitors output voltage with ± 1 volt accuracy (linear scale is electronically expanded to cover 90-140v). Power line input voltage can also be measured by operating spring-return slide switch on front panel. Fused primary. Measures 6½" W x 9½" H x 5" D. 22 lbs.

Model IP-10...$5.50 dn., $5 mo.....**$54.95**

NEW FOR THE SIX & & TWO METER VHF NOMADS . . .

The new "Shawnee" 6-meter and "Pawnee" 2-meter Heathkit transceiver kits bring a new definition to *superior performance*. And each offers complete AM and CW facilities with the greatest array of features anywhere! *Single Knob Tuning*—tracked VFO and exciter stages. 10 *Watt Output*—6360 dual tetrode. *Built-In Low Pass Filter. Three-way Power Supply*—built-in for 117vac, 6vdc or 12vdc with separate DC and AC plugs and cables included. *Dual-Purpose Modulator*—10 watts for high level plate modulation or 15 watts for PA operation. *Double Conversion Receiver*—crystal controlled first oscillator. *Voltage Regulation*—on all oscillators. *Complete Controls*—up front on the panel for transmitter and receiver. *Tuning Meter*—auto-switched for signal strength or relative power output. *Slide Rule Dial*—seven inches of spread for receiver and VFO, edge lighted. VFO *or Crystals*—front panel switch of vfo or four crystals for novice, CAP, MARS or net operation. *Spot Switch*—zero in signals with transmitter off. *Complete Shielding*—power supply, final and receiver front end. *Ceramic Microphone*—push-to-talk with coiled cord. *And many more*—*Write for Information.* 34 lbs.

Model HW-10...6 meter, or **HW-20**...2 meter $20 dn., $17 mo.....**$199.95**

HEATH COMPANY / Benton Harbor, Michigan

electronics—always the leader!

now a new improved 6 meter model joins this famous transceiver series

ATTENTION MARINERS!
Keep a "weather-eye" peeled for announcement of a new Heathkit SHIP-TO-SHORE RADIOTELEPHONE . . . COMING SOON!

2, 6 & 10 METER TRANSCEIVER KITS

The new 6 meter HW-29A joins "Tener" and "Twoer" to bring you top transceiver values. Like "Twoer," the new HW-29A multiplies to its output frequency from an 8 mc crystal for greater stability. All models have crystal-controlled, 5 watt input transmitters and tunable super-regen receivers that pull in sigs as low as 1 uv . . . FB for emergency work and "local" nets. Each includes transmit-receive switch, metering jack, ceramic mike and two power cables. Less crystal. 10 lbs.

Model HW-19...10 meter...$4 dn., $5 mo. **$39.95**
Model HW-29A...6 meter...$4.50 dn., $5 mo. **$44.95**
Model HW-30...2 meter...$4.50 dn., $5 mo. **$44.95**
Model HWM-29-1...Converts early "Sixer" to "A" model. 1 lb. **$4.95**

HEATHKIT BASIC RADIO COURSE

Here's a new 2-part series in basic radio for youngsters and adults. "Basic Radio—Part I," available now, teaches radio theory in everyday language, common analogies, and no difficult mathematics. Experiments performed with radio parts supplied result in a regenerative radio receiver. "Part II" of the series, which will be ready March 1, advances your knowledge of radio theory and supplies additional parts to extend your Part I receiver to a 2-band superheterodyne circuit.

Model EK-2A..."Part 1"...8 lbs. **$19.95**

be your own "tune-up" specialist!

NEW ELECTRONIC IGNITION ANALYZER KIT

Checks ignition faults quickly and accurately. One simple hook-up to ignition wiring, and the 10-20 does the rest! No removing plugs, wiring or other engine parts. Checks engine in operation. Switch selection of primary, secondary, parade or superimposed patterns without changing leads to the engine. Detects shorted plugs, defective distributor points, defective wiring, coil and condenser problems, incorrect dwell time, worn distributor parts, etc. Features improved trigger circuit for locked-in patterns without trigger level adjustment; 2-1 vertical and 10-1 horizontal expansion. 8" H x 9½" W x 16" D. 22 lbs.

Model IO-20...$8.95 dn., $9.00 mo. **$89.95**

MONEY BACK GUARANTEE

Heath Company unconditionally guarantees that each Heathkit product, whether assembled by our factory or assembled by the purchaser in accordance with our easy-to-understand instruction manual, must meet our published specifications for performance or your purchase price will be cheerfully refunded.

FREE CATALOG

Send today for your Free Copy of the latest Heathkit Catalog showing over 200 Heathkit items for hi-fi fans, amateur radio operators, students, technicians, marine enthusiasts, sports car owners and hobbyists. Many Heathkit products are now available in both kit and wired form!

ORDER DIRECT BY MAIL OR SEE YOUR HEATHKIT DEALER

HEATHKIT by DAYSTROM

HEATH COMPANY
Benton Harbor 10, Michigan

ORDERING INSTRUCTIONS

Fill out the order blank below. Include charges for parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice.

Please send the following HEATHKITS:

ITEM	MODEL NO.	PRICE

Ship via ( ) Parcel Post ( ) Express ( ) COD ( ) Best Way

( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

Name _____

Address _____

City _____ Zone ___ State _____

Dealer and export prices slightly higher.

A PROPHECY

For men and women with a sincere desire to succeed

"In the years that have passed since my days on the faculty of RCA Institutes, I have become even more firmly convinced that the individual who continues his education . . . particularly his technical education . . . is the individual who profits both as a thinking man and as a working man. Science and industry will reward you for your talents and energy. Out of your efforts may come inventions, new products, processes and services. There is everything good yet to be accomplished in our lives and in our work. What man has done, man can do better."

David Sarnoff

Chairman of the Board,
Radio Corporation of America

RCA Institutes Offers the Finest of Home Study and Resident Training for Your Career in the Rapidly Expanding World of Electronics

RCA Institutes, founded in 1909, is one of the largest technical institutes in the United States devoted exclusively to electronics. A service of Radio Corporation of America, RCA Institutes offers unparalleled facilities for technical instruction . . . tailored to *your* needs. The very name "RCA" means dependability, integrity, and scientific advance.

RCA Institutes Home Study School, licensed by the New York State Department of Education, offers a complete program of integrated courses for beginners and advanced students ranging from electronic fundamentals to automation. All courses are designed to prepare you for a rewarding career in the rapidly expanding world of electronics. *The caliber of the training you receive is the finest!* And you get top recognition as an RCA Institutes graduate!

HOME STUDY COURSES *in*

Electronic Fundamentals · TV Servicing Color TV · Electronics for Automation · Transistors

Pay-Only-As-You-Learn With No Further Obligation. All RCA Institutes Home Study courses are available under the liberal "Pay-As-You-Learn" Plan. This plan affords you the most economical possible method of home study training, *because you pay only for lessons as you order them* . . . one study group at a time! If you drop out at *any* time, for *any* reason, you do not owe RCA Institutes one penny. No other obligations! No monthly installment payments!

RCA Instruction is Personal. With RCA Home Study training you set *your own pace* in keeping with *your own ability*, finances, and time. The Institutes allows you ample time to complete the course. Your lesson assignments are individually graded by technically trained personnel, and helpful comments are added where required. You get theory, experiment, and service practice beginning with the very first lesson. All lessons are profusely illustrated. You get *a complete training package* throughout the entire course.

You Get Prime Quality Equipment. All kits furnished with the course are complete in every respect, and the equipment is top grade. You keep all the equipment furnished to you for actual use on the job . . . *and you never have to take apart one piece to build another!*

* * *

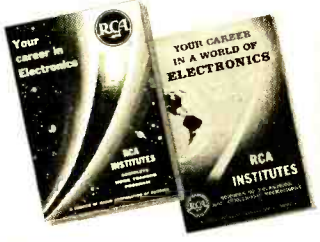
RESIDENT SCHOOLS *in*

Los Angeles and New York City train you for any field of Electronics you may choose!

No Previous Technical Training Required For Admission. RCA Institutes Resident Schools in Los Angeles and New York City offer training that will prepare you to work in rewarding positions on research and production projects in fields such as automation, communications, technical writing, television, computers, and other industrial and advanced electronics applications. Even if you did not complete high school, RCA will prepare you for such training with courses specially designed to provide the basic math and physics required for a career in electronics.

Free Placement Service. RCA Institutes graduates are now employed in important jobs at military installations such as Cape Canaveral, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, and in radio and TV stations all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 92.06% of the graduates who used the Free Placement Service accepted by important electronics companies... *and had their jobs waiting for them on the day they graduated!*

Coeducational Day and Evening Courses. Day and Evening Courses are available at Resident Schools in New York City and Los Angeles. You can prepare for your career in electronics while continuing your normal full-time or part-time employment. Regular classes start four times each year.



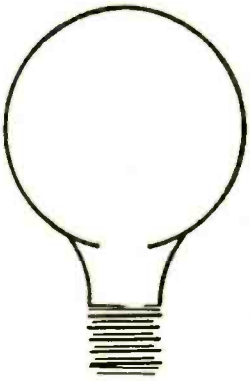
SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY! SPECIFY HOME STUDY OR RESIDENT SCHOOL

RCA INSTITUTES, INC. A Service of Radio Corporation of America 350 W. 4th St., N.Y. 14, N.Y. • 610 S. Main St., Los Angeles 14, Calif.

RCA The Most Trusted Name in Electronics

FERRORESONANT

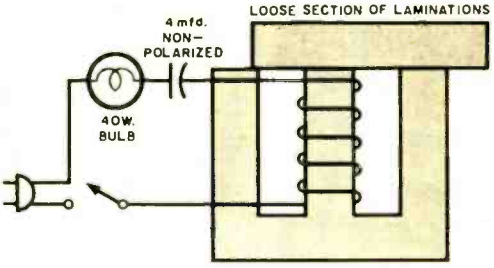
Oscillator Experiment

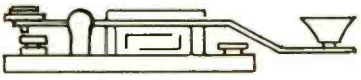


You can put the ferroresonant properties of a choke to work in a relaxation flasher circuit. Simply remove the frame from an old 500-ma. choke having an inductance of at least one henry. Then place a section of loose laminations over the "E" portion of the choke which is connected in the 117-volt a.c. circuit shown.

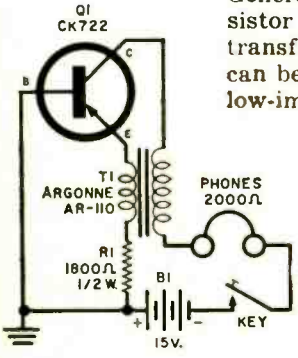
The point of adjustment is quite critical and requires a bit of patience. Start with the stack of laminations completely over the "E" section; under these conditions, the 40-watt bulb should be extinguished. Now slowly move the stack to the point where the bulb lights, taking care to open and close the switch with each adjustment to start oscillation. Near the on-off point—probably within 1/32 of an inch—a resonance setting will be found where the bulb will flash on and off at intervals of a second or so.

—*Martin H. Patrick*





CODE PRACTICE OSCILLATOR



So small that it can be carried in your pocket, this simple code practice oscillator is ideal for building up your code speed to the General Class level. The schematic shows a CK-722 *p-n-p* transistor (*Q1*) hooked up to an Argonne AR-110 transistor output transformer (*T1*), but virtually any transistor or transformer can be used. The transformer impedances aren't critical, but the low-impedance winding must be in the emitter circuit.

If you use an *n-p-n* transistor, reverse connections to battery *B1* so that the positive terminal is connected to the key. Simply reverse *either* the primary or secondary connections if the unit refuses to oscillate. A 15-volt battery is shown in the schematic, but the oscillator will work with voltages as low as 1.5 volts. Crystal phones can be used if they are shunted with a resistor of about 5000 ohms.

—*Wm. Shmigelski*

By
JOHN T. FRYE
W9EGV

Carl and Jerry

A Rough Night

THIS is one time I wish we'd listened to our folks," Carl confessed as he strained his eyes to penetrate the darkness and the ice which was freezing on the windshield despite the efforts of the busy wipers.

"Yeah," agreed his pal, Jerry, who was sitting on the right side of the car but "driving" just as hard as Carl.

The boys had coaxed until their parents reluctantly agreed to let them drive to a town fifty miles from home to see the local team play basketball. The highway had been perfectly clear, and the temperature was in the high 30's when they went into the gym. But when they came out, several hours later, a light rain was falling and the temperature was dropping.

They had started for home immediately; but before they had gone five miles, they knew they were in trouble. The temperature slid down a little more, and the rain started to freeze and become mixed with flurries of sleet. As they crept along the ice-coated highway at a bare twenty miles an hour, they were even too scared to operate their mobile ham radio.

They had reason to be frightened. They passed car after car that had slid off into the shallow ditches along the side of the road and been abandoned. For the past half hour they had not seen another car or even a truck coming in the opposite direction, nor had they seen any headlights on the highway behind them.

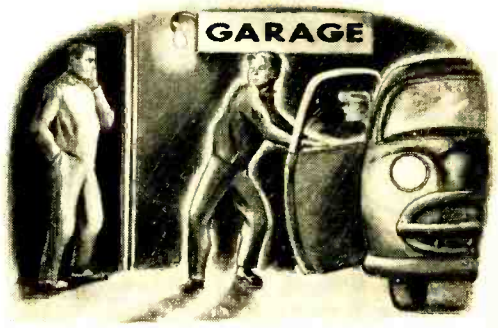
"We'll never make it through those hills a couple of miles ahead," Carl said as he unclinched his right hand from the wheel and wiped his sweating palm on his jacket. "What would our folks want us to do?"

"They'd want us to keep from getting hurt or stacking up the car," Jerry answered promptly; "and I'm with them." He used his handkerchief to wipe the steam from the windshield. "That means we'd better tie up at the first place we can get in out of the weather. If we could just let the folks know—hey, take it easy! See that light ahead?"

Carl lifted his foot from the accelerator and let the car coast. As they came closer, the boys saw that the light came from a bare bulb on the end of a pipe gooseneck over a "Garage" sign on the front of a small concrete block building. Carl touched the brakes, and the car slowly spun around in a half circle and came to rest in the garage drive.

"Whew! That was close!" Jerry gasped as he opened his door and stepped out. His feet promptly slid out from under him, and he had to grab the door to keep from falling.

"How did you two ever get here?" a voice called from the garage. Carl and Jerry saw a short, powerfully-built,



pleasant-looking man with a butch haircut standing in the open doorway.

"You're the first car I've seen on that highway in an hour," he said. "Come on in out of the wet."

THE INSIDE of the small building was cosily warm, thanks to a potbellied coal stove glowing over in one corner. The man introduced himself as Chuck Ray and said that his house was right behind the garage; he had come out to fire the stove so the garage would not be so cold when he went to work the next morning. The boys explained their predicament and asked if they might use his telephone to call home and if they could stay in the garage for the night.

"I think we can do better than that," Chuck said with a friendly grin. "I sort of cotton to a couple of young fellows who've got sense enough to get off the highway when it's not safe to drive. If that phone is still working, you call your folks and tell them the wife and I will put you up tonight."

The telephone was working, and Jerry's call to his home went right through. Mr. Bishop answered, and Jerry quickly explained the situation. Mr. Bishop said he was glad the boys had used their heads and that he would call Carl's folks at once. Before Jerry could reply, there was a click in the receiver and the telephone went dead.

"It's no use," Chuck said as Jerry jiggled the button in the telephone cradle. "I'm surprised the ice hasn't taken the telephone wires down before this, and the power lines, too, for that matter—"

Right in the middle of his sentence, the lights in the garage went out.

"Me and my big mouth!" Chuck muttered as he stumbled around in the darkness hunting for his flashlight. He finally found it and, with its aid, he found an old coal-oil lantern as well.

The three of them were standing there in the feeble yellow light shining through the lantern's smoky globe when there was a loud knock at the side door of the garage. Chuck opened the door to let in two men, one well-dressed and the other in working clothes.

"I'm Dr. Carney, director of the research laboratory across the highway," the better-dressed man introduced himself. "This is Sam Vernon, our main-

tenance man. We're in trouble, and we hope you can help."

Sam placed an object wrapped in a greasy cloth on the bench beside the smoking lantern. He spread back the edges of the cloth to reveal the broken parts of a gasoline-engine distributor.

"That's the distributor from the engine of the auxiliary power plant at the lab," Dr. Carney explained. "This afternoon, of all afternoons, one of our men was moving some pipe on an electric truck in the basement. He misjudged distance and rammed the end of a two-inch pipe right through the distributor. It's imperative we get power back at the lab within the next two hours. Can you fix that distributor?"

Chuck poked around in the broken pieces of metal and Bakelite with a forefinger, then shook his head.

"The only thing that will fix that distributor is a new one," Chuck said bluntly; "and I'm certain you won't find one closer than Center City. The electric company can't do much with the power lines until this is over, and your auxiliary plant won't run without a distributor. Only a woolly worm with a sandpaper belly could travel on this ice, and *he* couldn't make a round trip to Center City in two hours. I'm afraid you'll just have to wait until the lines are repaired or the ice melts off the highway."

Dr. Carney paced nervously up and down the dimly-lit garage as he spoke again. "Let me try to explain how important it is for us to have power at the lab. Over there in a tiny sealed cubicle, an experiment that involves literally years of tedious, painstaking work is coming to a climax. Certain cultures are

growing in that little room under carefully controlled conditions of temperature, humidity, ionization, and radiation. If power can be restored to the various pieces of equipment maintaining the proper conditions within two hours, the experiment can be carried to its conclusion. If power is not restored, the whole experiment, with its hundreds of steps, will have to be started over."

He paused for an instant and then said very slowly and quietly, "I can't be too specific, but let me say this: if that experiment can be carried to a conclusion *now*, and if it turns out as we hope, the restoration of power could mean that victory over one of humanity's greatest scourges would come three years sooner."

A LONG, thoughtful silence settled over the garage. Finally, Jerry cleared his throat and said in a hoarse voice, "We have a mobile radio station in our car outside. Maybe we could get word to Center City and they could manage to send the distributor to us somehow."

Chuck was sliding back the big door of the garage before Jerry finished speaking. "We'll push the car in," he said. "It's worth a try and a lot better than doing nothing."

Once the car was inside the garage, the boys saw with relief that the wooden rafters of the ceiling were well above the tip of the whip antenna fastened to the car's rear bumper.

Jerry turned on the receiver and quickly flipped from one band to another. "Seventy-five and forty meters are out because of static," he observed. "We can't buck the kilowatt QRM on twenty with our flea-power. Fifteen and ten sound dead, but at least there's no QRM or QRN on them. Maybe some of

the boys will be listening on ten for ground-wave contacts."

He switched on the transmitter. After it had warmed up for a minute, he pushed the button on the side of the carbon mike. The motor generator in the trunk compartment whined, but Jerry soon released the push-to-talk button without speaking into the mike. "Something's wrong," he announced as he frowned at the little meter sitting on top of the dash. "I see practically nothing on the field strength meter."

"I bet it's the ice detuning the antenna!" Carl exclaimed, pointing at the quarter-inch-thick sheath coating the slender whip.

Chuck, man of action, had already picked up a propane torch from the bench and lighted it. He carefully played the blue flame up and down the antenna until the ice melted and fell off. Now when Jerry peaked up the transmitter on the ten-meter band, the field strength meter indicated satisfactorily.

"CQ, CQ, CQ Center City with emergency traffic," he said into the mike, and signed his call. He repeated this three times, then cut the transmitter and listened across the band. Not a signal was heard. He tried a longer call, with the same result.

But Jerry didn't give up. After the seventh transmission, the straining ears in the garage heard a very faint and faraway voice repeating Jerry's call. As the operator of the other station signed over, he said he was in Center City!

Jerry went back to him and asked if he had a telephone. There was a long silence, and then the station operator came on and said he could not copy Jerry. Could Jerry do something to increase the strength of his signal just a little bit?

Hurriedly Jerry checked the transmitter tuning, but it was right on the nose and putting out everything it had.

"Let's turn the car so it points toward Center City," Carl suggested. He started tugging at the wheel and pushing on the doorpost. They all helped.

THE OTHER STATION was still calling, and was coming in stronger. When Jerry went back to him, the Center City operator reported that he was

able to read Jerry's signals quite well.

"When the antenna is mounted on the rear bumper, the car acts as a director and puts a lobe of signal out in front," Carl explained in a whisper to Sam.

Dr. Carney took over the mike and told the operator in Center City to call a certain number and explain the situation. Identifying numbers from the power plant and the distributor were passed along.

It seemed as if hours passed before they heard him again, but it was actually less than a half hour by Carl's wristwatch.

"I've got the information," the faint voice said; "do you copy?"

Jerry pushed the button. The relay clicked, but the generator didn't start. "The battery's gone dead!" Jerry groaned as he noted the dimming of the car's dome light.

But Chuck was already busy. He jerked up the hood and snapped the clips of a pair of heavy car-starting cables to the battery terminals. Clips on the other ends of the cables were fastened to the terminals of a battery he took from a charging rack. "Now try her," he said.

The transmitter took right off, and Jerry told the frantically-calling Center City station to go ahead.

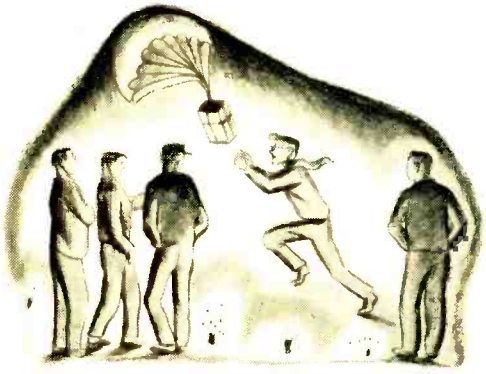
"Your man has located a new distributor," the operator reported. "He's on his way now to pick it up and take it to the airport. The rain isn't freezing here, and conditions are not so bad; so a small plane is going to try to drop the distributor to you on a parachute. Can you arrange some sort of signal he can see to locate you?"

"Can do!" Chuck exclaimed, and he grabbed a handful of red truck fusees from a box beneath the bench.

Arrangements were completed and relayed to the pilot at the airport who said he would take off immediately. Jerry stayed with the mobile station while the other four went outside to arrange the fusees in a big square along the deserted highway.

It was not long before they heard the throbbing of the plane motor. After a couple of passes over the bright red glow cast by the lit fusees, the plane lights came straight toward them down the

highway flying very low. Shortly after the plane roared over, Carl saw a small parachute floating down toward him. He grabbed the carton dangling beneath it the way he would snare a football pass,



while Chuck grabbed up a fusee and waved a signal of success to the plane that roared off into the night.

They all went across the highway to the laboratory, where Sam and Chuck installed the new distributor in jig time and started the generator. Lights came on all over the building, and they trooped upstairs to watch Dr. Carney make an anxious, hurried check of several meters mounted in a big console.

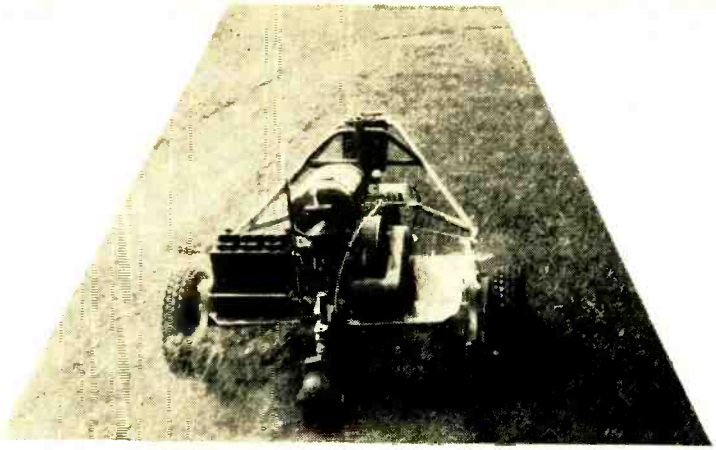
"We made it!" he announced, and then slumped wearily into a chair. "It was close, but conditions inside the cubicle are still within the limits set for the experiment."

WE can hash all this over in the morning," Chuck said with a satisfied yawn, as he headed for the door. "Right now, boys, let's go home and get some sleep. It's been a long, rough night."

Soon Carl and Jerry were snuggled down in a warm, comfortable bed. Just before they went to sleep, Jerry observed:

"Carl, a half dozen times tonight I wouldn't have given a burned-out resistor for our chances. One thing after another kept going wrong. But all of us, working together, jumped on each new obstacle as it reared its ugly head; and everything turned out fine. Don't let me forget this, will you?"

"Uh-uh," Carl agreed drowsily. —30—



ROBOT LAWN MOWER

Child-proof to the nth degree, the lawn mower stops when little tots or their pets cross its path. Gordon Carlson, T. J. Lafeber, and W. C. DeVry (below) of DeVry Tech, inspect with pride this product of their research laboratories.

THE DREAM of many home owners is to build a mechanical man to mow the lawn. Mr. T. J. Lafeber, President of the DeVry Technical Institute, stopped dreaming and came up with a practical design for a robot lawn mower.

The robot's brain is an electronic sensing device which is attached to a standard power-driven lawn mower. The mower is guided over the lawn by a pattern of electric wires imbedded in a shallow slot cut in the sod—which quickly heals over, leaving no visible trace on the lawn surface. Small electric current pulses pass through the buried wire and set up a magnetic field which is used to guide the mower along a predetermined path.

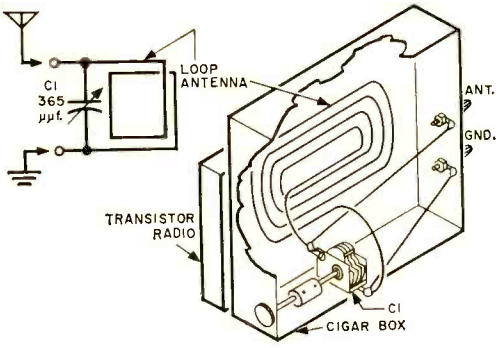
A probe on the front of the mower picks up magnetic impulses around the buried wire and sends them to a small plastic box containing a transistor amplifier. The amplified impulses are interpreted by a directional unit which tells the mower to follow the imbedded wire by means of a simple servo steering system. A safety device instantly shuts off the mower should children, pets, or other objects get in its way.

To send the robot on its tour of duty, the operator starts up the gas engine, flips a few switches to "on," and watches the mower take off on its appointed rounds. There is no reason to wait around because the mower will head back to its storage space when the mowing is done, and put itself away. -30-

Tips and Techniques

RADIATION LOOP ANTENNA

Most transistor portables have no outside antenna jack and are therefore insensitive to weak signals. But, with a radiation loop, an outside long-wire antenna can be used without any connections to the radio. The loop is essentially a tuned circuit which will re-radiate the signal picked up by an outside antenna to the transistor portable. Build the loop in any wooden or cardboard (not metal) box, mounting a replacement-type loop antenna inside the box and connecting a 365-$\mu\mu$f. variable capacitor across the



loop's terminals as shown. Each capacitor terminal should also be connected to a separate binding post; one binding post serves as a terminal for the outside antenna, the other for the ground. To use the loop, place a transistor portable against it and connect the long-wire antenna and a good ground to its binding posts. Then, with a weak station tuned in on the transistor portable, adjust the tuning capacitor in the radiation loop for best reception. In some cases, reversing the position of the portable may boost pickup from the loop.

—*Jerry Carmean*

CAR RADIO SWITCH REPAIR

On many car radios, a d.p.s.t. switch is used to turn the radio on and off and to operate the dial light. Such switches will often burn out on the radio half although

Tips

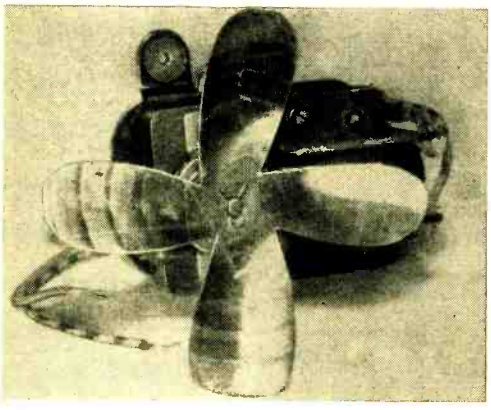
(*Continued from page* 111)

the dial light half will remain operative. To get the set working again temporarily, remove the dial light leads from the switch and solder the radio's on-off leads in their place. The entire switch should eventually be replaced with a new one, however.

—*David Held*

PHONO MOTOR COOLING FAN

If you have an old 78-rpm turntable that is no longer being used, you can make a cooling fan from its motor plus a small fan blade. Since most such motors are of the "shaded-pole" type which cause no radio interference, the fan you make will be fine for cooling communications

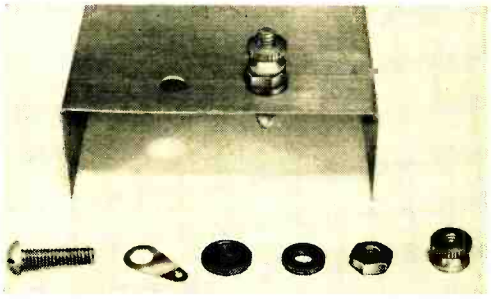


receivers, TV sets, or small transmitters. The turntable motor can usually be dismantled with its shock mounts intact. Make the fan blade from sheet metal or buy a ready-made 4- to 6-inch blade. The completed fan can be mounted at the rear of the equipment to be cooled and should be wired to the set's on-off switch.

—*Terrence Koch*

INEXPENSIVE BINDING POSTS

Insulated plastic binding posts are good-looking, and they lend a professional appearance to home-built electronic equipment—but they're expensive. You can make a low-cost substitute by combining several hardware items found in almost every junk box. Use a ¾"- to 1"-long machine screw, a solder lug, flat and shoulder fiber washers, a hex nut, and a knurled thumb nut for each binding "post" you need. Assemble these parts in order, using the fiber washers to insulate the assembly from a metal chassis. For improved appearance or for color



coding, you can paint the outer surface of the knurled thumb nut with model airplane dope or with fingernail polish.

—*Luis Vicens*

NEON PILOT LAMP

Many electronic kits are supplied without any pilot lights and are inadvertently left on when not in use. You can avoid unnecessary power drain with a neon lamp on-off indicator. All you need do is wire a Dialco 931H neon pilot light assembly to the equipment's on-off switch

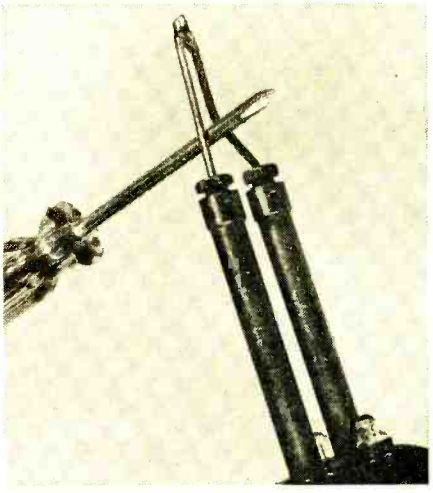
and install an NE-51H neon lamp. The assembly has a built-in 18,000-ohm resistor which is just right for the high-brightness lamp.

—*Clyde C. Cook*

DEMAGNETIZING TOOLS

You can demagnetize screwdrivers or other tools with a standard soldering gun. Depress the gun's trigger and, holding

the trigger down, move the tool through the open loop of the gun's tip, as shown in the photo. Then move the tool slowly out of the loop and away from the gun before releasing the trigger switch—if the trigger is released suddenly while the

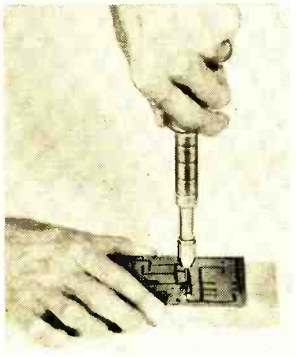


tool is close to the tip, the tool may be more strongly magnetized than it was originally. If the tool is too large to pass through the open loop, simply hold it close to the tip, or near the transformer at the rear of the gun.

—*E. G. Louis*

PUSH-DRILL FOR CIRCUIT BOARDS

When working with etched-circuit boards, you'll find that a push-drill of the type used by carpenters is excellent for making component mounting holes, eyelet holes and so on. These inexpensive tools generally are supplied with a complete set of drill bits and are much easier to use than an "egg-beater" type of drill. In fact, they are often easier to set up than standard electric drills. However, it's best to use a center-punch before drilling.



—*Eugene Richardson*

Across the Ham Bands

(Continued from page 89)

News and Views

Bill Rogers, K3JSV, 38 Vernon St., Uniontown, Pa., got an early start as a ham. After 13 months on the ham bands, six of them as a Novice, he just celebrated his 13th birthday. Bill's record is 474 contacts in 33 states, including a couple of Hawaiian contacts. He transmits via a Heathkit DX-35/VF-1 combination and receives with a Heathkit AR-3 backed up by a QF-1 Q-Multiplier. Bill operates on 40 meters only, c.w. 99% of the time. . . . . **Fred Tich, KN5EIE,** 1092 Christy St., El Paso, Texas, has an interesting call to send on a "bug." Try it. In 2½ months, over 300 hams have mastered his call to give Fred a record of 31 states worked. Of course, there is always one who will not QSL; so his confirmed record is 30 states. Fred excites his 40-meter dipole with a Heathkit DX-20 transmitter, and the antenna excites a Hallicrafters SX-99 when he receives. Check with Fred for a Texas contact on 15 or 40 meters.

Edward K. Wolfe III, KNØYQU, 2755 N. Fernwood, St. Paul 13, Minn., feeds his Johnson Adventurer transmitter into a 7-mc. dipole, and he receives on a 25-year-old RCA ACR-175. His dipole antenna is about 20 feet high. Ed has worked 18 states and has confirmations from half of them—you can guess what he thinks of hams who promise to QSL and never do. Ed was thrilled to receive a phone call from Willie, KØKRT, after their first contact. Willie explained that he phoned all new Novices that he worked in the Minneapolis-St. Paul area to make them welcome to the hobby—a fine example of the true ham spirit. . . . . **Rod Morris, WV2MDZ,** 135 Shepherd Lane, Roslyn Hts., L. I., N. Y., really has been keeping the ionosphere around his antenna stirred up. In two months as a Novice, he has worked 17 countries and 48 states, all confirmed! His transmitter is a Globe Chief 90A running 75 watts and feeding a High-Gain 14AV vertical antenna. He receives with a SX-99 helped along by a QF-1 Q-Multiplier. Rod is another of those hams who have replaced the 6SG7 r.f. tube in their receivers with a 6AC7 as discussed in the March 1960 column—with excellent results. He hopes to pass his General exam soon and offers to help prospective Novices obtain their tickets. . . . . **Neil W. Zimmerman, KNØYDO,** Box 143, Finley, N. D., works 40 and 15 meters with his DX-35 transmitter and SX-99 receiver plus Q-Multiplier. Neil is waiting for his new National NC-270 receiver to arrive. He could use some suggestions from other users of the Gotham V-40 vertical antenna on how to "load" it with his DX-35. Neil is a radar repairman at the Finley, N. D., Air Force Base—he shouldn't have too much trouble getting his General Class ticket.

Lt. Roy C. Hejhall, USN, USS Des Moines (CA-134), F.P.O., New York, N. Y., is WØTRH when he's in St. Paul, Minn. But while serving on the flagship of the U. S.

Sixth Fleet in the Mediterranean, Roy makes his home in Villefranche Sur-Mer on the French Riviera. The French government just issued him a license and the call letters F7BM. When you read this, he will be on 20 meters looking for W's. Roy calls his rig a "French kilowatt." Actually, it's a Knight T-50. but its 50-watt input represents the maximum French ham power limit on 80, 40, and 20 meters. On 10 and 15 meters, the limit is 100 watts. . . . . **Bob Jones, W6EDG,** who listens but cannot transmit, has sent us another list of calls heard in the Philippines in the 15-meter Novice band: W1DMD, K1IVQ, K1LMO, KN1NLW, KN1PIF, KN1PSK; K2DQR, WV2DTK, W2LWH, WA2LYT; KN3LPI, KN3LSS; KN4ZHI; KN5CGU, KN5CWS, KN5EOT, KN5YVQ; WA6CAA, WA6COS, WA6DCG, WA6FCZ, WA6FMF, WA6IJH, WA6IRK, WV6JPS, WV6JRK, WV6KEA, KN6KHT, WV6KNT, WV6KXY, WV6KOJ/MM, WV6KRS, WV6KZI, WV6LHX, WV6LIO, WA6LPF, WV6MBI, WV6MBT, WV6MCI, WV6MDO, WV6MIR, WV6MJG, WV6MFY, WV6MRO, WV6MVZ, WV6MZY, WV6NDD, WV6NPA, WV6NTO, WV6NTQ, K6PKI, K6QPH; KN7JUU, K7KTQ, KN7KZA/5, KN7LHR; KN8TJZ, KN8TRJ, KN8UHB, KN8VAF; KN9AJY, KN9VKF, KN9VLZ, KN9WEP, KN9YKN, KN9YVV, KN9ZCR, KN9ZEJ, KN9ZKA, KN9ZPJ; KNØAUF, KØVVV, KNØZSR; WH6DPB, WH6DNA, WL7DJI, and WL7DQF.

Ron Beitman, KN8VIX, 3729 Oakwood Dr., Amelia 3, Ohio, beat his dad, Irv, KN8WDU, by a few months in getting his license. So Ron has a more impressive record—30 states worked and 22 confirmed. Their station consists of a Globe Chief 90A transmitter, a National NC-183 receiver, and a 180′ long-wire antenna. A new vertical antenna is on the way.

Why not start out the new year by sending us a letter about your activities? Include a picture if you have one available. 73,

Herb, W9EGQ

T	H	E	R	M	I	S	T	O	R	E	F
P	L	I	C	E	L	E	C	T	R	O	L
S	L	A	M	I	N	A	T	I	O	S	E
U	A	M	I	C	O	L	P	I	N	C	C
O	I	A	D					T	E	O	T
J	T	N	E					T	U	P	E
A	N	Y	H					S	T	E	D
S	E	D	C					E	R	L	U
S	N	R	N	E	U	Q	F	L	A	E	A
I	O	A	U	G	N	I	Z	I	L	M	L
L	P	X	E	L	G	G	O	T	N	E	E
E	B	I	C	E	D	E	P	M	A	D	A

Answers to roundword puzzle appearing on page 84.

IM Distortion Analyzer

(*Continued from page 66*)

you can measure IM distortion by setting up two signal generators, the necessary filters, and a VTVM as shown in the block diagram. One tip—most careful workers use the bridge circuit shown in Fig. 5 for connecting the output of the generators to the amplifier input. Since each oscillator is connected across the bridge at a point where the other's signal is at a null, they do not interact with each other to produce an intermodulated test signal. The combined signals—with no intermodulation—appear across *R1* and are applied to the amplifier under test.

The Complete Picture. Generally, when measuring an amplifier for IM, you'll want to get the complete picture by

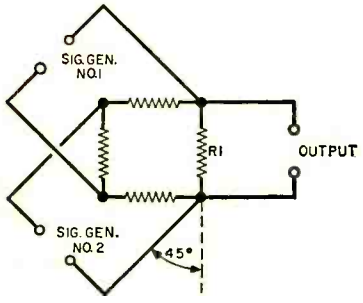


Fig. 5. Standard bridge circuit used for connecting two signal generators to a single audio amplifier. All resistors should be equal in value.

checking the unit over its entire power range. It's a good idea to start measuring IM at the one-watt output level, or even lower, then gradually increase the output power until you reach the amplifier's maximum power rating. At this point, the IM figure will go up sharply as the low-frequency component begins to drive the high-frequency signal into the cutoff region.

Incidentally, there is a trick you might keep in mind when making IM measurements. The meter you use to measure the power output of the amplifier will, of course, read the r.m.s. value of the output signal. In the case of an output sine wave, this is just what we want, because all of our standards are based on r.m.s. readings. But when we add the high-frequency component, this upsets the applecart. The meter will still read something very close to the r.m.s. value of the low-frequency signal. Yet the peak power, due to the excursions on either side of the low-frequency sine-wave signal made by the h.f. component, will be much larger.

All of this means that you may run into severe clipping of the h.f. component while the output meter is still reading within the amplifier's rated power. For this reason, engineers have set up an "equivalent single frequency r.m.s. value" for the mixed output signal. This standard specifies that the mixed signal power is to be calculated as 1.47 times the r.m.s. meter reading.

Let's take an example. To find the sine-wave power output at any given voltage reading across the load resistor, simply use the formula: $P=E^2/R$. But if the signal being amplified is a mixed signal such as we have been discussing, i.e., a signal with a 4:1 voltage ratio, then we use: $P=1.47(E^2)/R$, to get the "equivalent single-frequency r.m.s. value." Thus, if you were feeding a sine wave into an amplifier, and the output meter read 10 volts across an 8-ohm load, the power would be 12.5 watts. But if you read 10 volts of mixed signal across the same load, the equivalent power output would be 18.4 watts.

To find out what voltage will have to appear across the load to give a certain output power—for example, if you want to operate an amplifier to produce 15 watts of power with the mixed signal—a little elementary algebra will turn the formula given in the above paragraph into: $E=\sqrt{PR}\div 1.47$.

Testing Other Components. To measure the IM distortion of a microphone, it's best to use two separate power amplifiers driving two separate speakers, one at the high frequency, the other at the low frequency. With only one amplifier and speaker amplifying both signals, some IM might be introduced in the test signal. Connect the microphone output to the best preamplifier you can find and channel the preamp output into the distortion meter for the reading.

Incidentally, if you have two audio oscillators, you might consider using frequencies somewhere near 200 and 3000

cycles instead of the 60 and 7000 figures we have been using as examples above, since with most speaker systems you can get somewhat purer signals in this range. It's also a good idea to move the experimental setup of speakers and microphones around in the test room and see if the results change. Unless you have a room that is almost acoustically "dead," sound reflections and standing waves can seriously alter your results. One final point: when you're setting up the 4:1 ratio of high or low signals, measure the levels at the microphone preamplifier output.

You can check the IM of your phonograph pickup cartridge by using one of the standard IM test records available. Simply connect the amplifier output to the IM meter and make the reading. Be sure that the test frequencies lie within the frequency range of the instrument. (The Heath AA-1 can accommodate low signals from 10 to 500 cycles, high signals from 2000 to 12,000 cycles.)

If you have a microphone and audio amplifier of known low distortion, you can check the IM of a speaker. Simply feed the two signals through the amplifier to the speaker under test, pick up the sound with the microphone, and measure IM with the meter.

Because of the built-in high-pass filter in the AA-1, it will operate as a very sensitive high-frequency noise meter. One possible application would be bias voltage adjustments on a tape recorder. As you know, the high-frequency noise level rises sharply if the bias is not at the proper level. Set the IM meter test switch to *"Operate,"* and the range switch to *"Set Level."* The tape-recorder output is now channeled through an amplifier and high-pass filter (see Fig. 3) and into the VTVM. The last step is to adjust the tape bias carefully for lowest noise. This adjustment can be made very accurately, since the filter will eliminate all flutter, wow, and other low-frequency signals.

There are many other uses for this versatile "combination of instruments"—measuring flutter, transient ringing, turntable rumble, amplifier hum and noise; the possibilities are almost endless. And, like all test instruments, the better you understand the IM analyzer, the more useful it becomes. 30

Transistor Topics

(*Continued from page* 82)

watts in Class B, and are capable of switching 1000 watts.

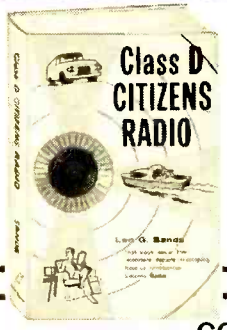
International Rectifier Corp. (El Segundo, Calif.) has announced a new series of high-voltage silicon plug-in rectifiers equipped with tube bases to allow direct replacement of electronic tube types 6X4, 12X4, 0Z4, and 6X5. Rated at 1250 volts peak inverse voltage at 80-ma. d.c. output, the ST-8 rectifier is designed to replace the 0Z4 and 6X5, while providing better surge current capabilities, less noise characteristics and high-temperature operation on vibrator-type power supply applications such as auto radios, military and commercial portable radios, and other communication systems. The ST-8 measures 1.10″ x 1.40″ in diameter. Rated at 1500 PIV at 75-ma. d.c. output, the miniature 1N570 is designed to replace MIL types 6X4 and 12X4 vacuum tubes in a wide range of power supply applications, including radio, television, and test equipment, computers and related data processing equipment. The extremely compact and rugged 1N570 measures only 0.845″ x 0.710″ in diameter and has the same temperature characteristics as the ST-8. For detailed information on the two types, request Bulletin SR-209B.

Don't neglect to obtain a copy of Lafayette's latest catalog #610 (available from Lafayette Radio Electronics Corp., 165-08 Liberty Ave., Jamaica 33, N.Y.). This 322-page "bible" is loaded with semiconductor bargains in both parts and equipment. Of particular interest are the many transistor radios, including the AM-FM types mentioned earlier. Also available is the new Lafayette "Semiconductor and Industrial Catalog," which lists characteristics, design specifications, applications, and circuits for the semiconductor devices represented. Designed for industrial users, this catalog also covers many other devices of importance to industry, and is an invaluable reference guide. When writing for your free copy, ask for BK-1300.

So much for the semiconductor situation. Here's hoping 1961 will be a happy and prosperous year for you.

—Lou

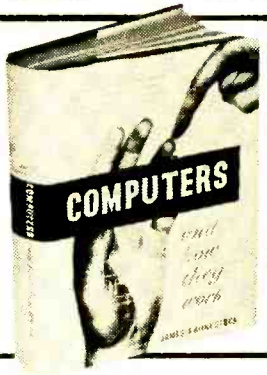
We'd like to send you these important new books for a 7-DAY FREE TRIAL EXAMINATION



CLASS D CITIZENS RADIO — Leo G. Sands

Here is the first complete book on Citizens Radio Operation. Ever since the initial use of 2-way radiotelephone by police departments, this field has been growing in importance and application. Now, with more than a million vehicles equipped for its use, Citizens Radio is a major phase of the electronics field. This important new volume covers every aspect of the field—its history, rules, and everything about how it works—in seven big chapters with one hundred major sections. You'll learn exactly what Citizens Radio is, its applications, what equipment you need, the full story on receiver circuits and transmitters, antennas, installation, and maintenance, full FCC rulings, how to apply for licenses, etc. Many illustrations. **$4.95**

COMPUTERS AND HOW THEY WORK
by James Fahnestock



Here is a fact-filled exciting guidebook to the wonderworld of electronic computers, with more than 120 illustrations and easy-to-follow tables in 10 big chapters. Step by step, you'll see and understand the workings of every type of computer ever used. This important new book illustrates the basic principles of computers in methods that require no knowledge of electronics. You'll learn all about computer memories, flip-flops and the binary counting system. You'll learn the mathematical language of computers where 1 + 1 = 10. Other chapters show you how computers use tubes and transistors to make complex logical decisions in thousandths of a second. COMPUTERS AND HOW THEY WORK is must reading for career minded students and for electronics pros who want a more complete knowledge of this field. **$4.95**

THE ELECTRONIC EXPERIMENTER'S MANUAL
by David A. Findlay

With a few dollars worth of basic tools, and this book to guide you, you can explore the magic of electronics experimentation more completely than ever before. In a few short hours, you'll start your first project. You'll learn about every component used in experimentation, every tool, its function and why it is used. There are 10 big sections, each covering a specific phase of construction. There's a giant section of projects you can build, test equipment you'll construct and use in your future work. THE ELECTRONIC EXPERIMENTER'S MANUAL will give you the professional know-how you must have no matter what phase of electronics is your specialty. **$4.95**

7 DAY FREE EXAMINATION

When your books arrive, read and enjoy their diversity of contents, the thoroughness of their coverage. Then after seven days examination, if you decide that they are not everything you want, send them back and receive a complete refund of the purchase price.

USE THIS CERTIFICATE FOR 7 DAY FREE EXAMINATION

ELECTRONICS BOOK SERVICE •
One Park Avenue, New York 16, N. Y.

Please send me.....copies of CLASS D CITIZENS RADIO and bill me at only $4.95 a copy plus postage and handling.

Please send me.....copies of COMPUTERS AND HOW THEY WORK, and bill me at only $4.95 a copy plus postage and handling.

Please send me.....copies of THE ELECTRONIC EXPERIMENTER'S MANUAL, and bill me at only $4.95 a copy plus postage and handling.

If I don't agree that this is one of the best electronics investments I've ever made, I may return the book(s) wtihin seven days and get a full refund.

$.....enclosed. (SAVE MONEY! Enclose payment with your order and we'll pay the postage.)

Name .....

Address .....

City .....Zone.....State..... EF 533

Lightning

(*Continued from page 62*)

that it will have no difficulty dissipating a heavy lightning charge; generally, the more down-running conductor cables, the better, since a multiple group of parallel paths greatly reduces electrical resistance. All conductor cables must be free of sharp bends that can encourage dangerous arcing; bends can have no less than an 8″ radius and any turn must not exceed 90°.

Down conductors end in ground rods sunk deep into moist earth. These ground rods must be either solid copper or copper clad, at least a half inch in diameter, and 10 feet long. A minimum of two ground rods are necessary, and they should be at opposite ends of the house.

In addition, every metallic object in and on the house—radio-TV antenna masts, metal sidings, or eaves, plumbing and heating pipes, ventilating systems—must be bonded together in the protection system and grounded. This prevents side flashes, and it also guards against charges being induced in these objects by a lightning strike, or even a direct entry by lightning.

Price Factors. Except for the ground rod, aluminum can be used in lightning protection systems in place of copper. Aluminum is cheaper, but because it is less conductive, parts made of this metal must necessarily be heavier and larger than similar copper parts—making it harder to conceal the elements of an aluminum system. In any event, clamps, connectors, and fasteners must be of the same material as the conductor cables.

If you like, you can buy a kit and make your own installation. A copper kit for a roof ridge running 60 to 80 feet costs between $100 and $200. An aluminum kit, generally used only for metal roofs, is available for less than $100.

You'll want to consider the insurance angle. A lightning protection system with a Master Label from Underwriters' Laboratories can earn you a lower fire insurance rate. The only way to get such a Master Label is to have the system installed by a UL-approved contractor. In the long run, this may prove the more economical approach, particularly when you realize that the standard guarantee runs 50 years and covers free replacement of defective parts.

Antenna Protection. Although you may not feel a full investment in a complete lightning protection system is justified in your particular case, you might find it worthwhile to protect your antennas. As a matter of fact, if your antenna mast is spotted in the center of your roof and there are less than 20 feet of roofing running out on either side, an antenna can be rigged so that the entire house is adequately protected.

The rules are pretty much the same as with a regular protection system. A good copper cable should be connected to the mast with an appropriate cable clamp. The cable is then run along the roof ridge in either direction. If you have more than one antenna mast, of course, they should be tied into the roof-spanning conductor. The down-conductor and ground-rod setup is just the same as with a full-scale, standard protection system.

Antennas call for additional protection—a lightning arrester which serves to prevent lightning from entering the house via the antenna lead-in. Special lightning arresters are also designed to protect power and telephone lead-in lines.

Actually, the term "arrester" is a misnomer, since the real function of this device is to shunt lightning, or lightning-induced current, to ground. It makes physical contact with the wires in your lead-in cable and is in turn connected directly to a ground rod. An arrester can be attached to an antenna mast proper, but for real protection one should be installed at the point where the lead-in begins. It should be at least as close to ground as is the equipment connected to the lead-in wire.

If your lead-in wire is a shielded cable, merely grounding the shield will serve the same purpose as a lightning arrester. In fact, some authorities recommend running shielded lead-in cable right into the ground before running it into the house.

Just what kind of protection system will best suit your needs is ultimately your decision to make. But of this much you can be certain. With a system that is properly installed and carefully engineered, the charge you get out of the next thunderstorm will go safely to ground. And ground is precisely where it wanted to go in the first place. —30—

Thinking Man's Radio

(*Continued from page* 70)

alignment tool, adjust the i.f. transformers (starting with the first one and working "forwards") for maximum output from the speaker. Always keep the generator's output as low as possible. Repeat the i.f. adjustments two or three times to compensate for interaction.

Next, set the generator to about 1620 kc. and open the set's tuning capacitor fully. Adjust the trimmer marked *"Osc."* (on the back of the tuning capacitor) for maximum output. Then move the generator's output to 530 kc., close the tuning capacitor, and adjust the slug on the oscillator coil for, as before, maximum speaker output.

Shift the signal to 1400 kc. and tune the receiver until you pick it up. Adjust the antenna trimmer (also on the back of the tuning capacitor case) for maximum sound. Finally, set the generator to 1000 kc., tune the set to pick up the signal, and adjust the antenna coil slug.

Final Assembly. There will be a few small pieces of scrap plastic left over after you assemble the skull. Use these pieces to build a brace to support the speaker. Cement the brace into place only after you are sure that the speaker and chassis will fit in the skull when the top is on.

Before the speaker is put in place, two studs must be mounted on it to support the chassis. After this is done, the speaker is mounted in the skull and the chassis attached to the studs. Short metal or fiber spacers should be used to prevent the rear of the speaker from shorting against the chassis.

Place the battery wherever it seems convenient or, better yet, mount a battery holder somewhere in the skull.

Small knobs must be used on the controls if the top of the skull is to fit in place. It may be necessary to shorten the shafts somewhat. A battery binding post will serve as the volume control's knob.

In addition to its more prosaic uses, the "Thinking Man's" radio can be adapted for "Carl and Jerry" type stunts. For example, try using the radio as a spooky centerpiece at a party. It will answer questions put to it by your guests—if you station an accomplice in the next room with a wireless broadcaster. —30—

Sweet Sixteen

(*Continued from page* 58)

such a manner that each can be easily cut to length after assembly. Tack each rail in place with small nails before drilling holes for the assembly screws. Place screws at 6″ intervals down the side, turning them in tightly, and proceed around the square in this manner until all four rails are attached firmly to the front panel.

Cut the extending ends of the side rails off flush. Be sure that the cut edge is even so that the external finish railing (*D*) will fit properly as shown in the illustrations. Save the pieces of 2″ x 6″ you cut off for use in the next step.

Internal bracing is provided by the short pieces of 2″ x 6″ (*E*). Attach them as shown in the photo, at the center and two other spots on the inside of the front panel, using at least two screws in each bracing block.

Now paint the entire front panel black with screen enamel so that the speakers won't show through the grille cloth in the completed unit. Let the paint dry—it shouldn't take more than 30 minutes—before proceeding.

In the meantime, you can attach the acoustic padding to the inside surface of the back panel (*B*), being sure to leave a 2″ clearance at each side for the side rails. Use carpet tacks or a stapler to attach the padding.

After the paint dries, it's time to apply acoustic padding to the inside surface and attach the speakers. Center each speaker over its hole and secure it with No. 6 sheet-metal screws through the mounting holes in the speaker frame. Tighten the screws lightly, and be careful not to damage the cones.

Wiring the Speakers. With all speakers attached, you're ready to wire them up. If phasing must be checked because of mixed models, connect a 1.5-volt flashlight cell to the terminals of each speaker in turn and note whether the cone moves in or out. If necessary, reverse the connections to make the cone move out. Then mark the speaker lug which is connected to the positive terminal of the cell, using a crayon or china marking pencil.

If all your speakers are identical, phasing is not necessary. Simply mark one terminal of each speaker, marking the corresponding terminals on all speakers. Consider the marked speaker terminals to have positive polarity, and wire the speakers together as shown in the diagram. Standard No. 18 hookup wire is satisfactory for connecting the speakers, but it's best to use a generous length of lamp cord for the wire (see diagram) which runs from the system to the amplifier.

At this point, only one step remains to complete the system so far as sound is concerned—attaching the back panel (*B*). Drill a small hole near one corner of the panel and thread the wire from the amplifier through the hole. Then position the back panel on the speaker box and tack it in place temporarily with small nails. Use wood screws at 6″ intervals for permanent attachment.

Dressing Up the System. All subsequent construction steps deal with the decorative finish of the system. First, the grille cloth must be attached. It's best to lay it in place, tack the center of one side, stretch the opposite side and secure it, then work from the center to each corner. When two sides are secure, repeat the process on the other two sides. A stapler works well for tacking the cloth in place, and if all tacks or staples are driven into the sides rather than into the front panel, they will be hidden when the external finish railing is attached.

The 1″ x 8″ external finish rails (*D*) should be attached in the same "ring" fashion as the side rails—secured by sixpenny finishing nails hammered flush, then cut to final length after assembly. Note that they mount flush with the rear of the box, leaving an overhanging lip around the grille cloth. Fill any cracks or knotholes with "Plastic Wood," let it dry, and sand smooth with a fine grade of sandpaper.

Now you're ready to apply the furniture finish, which consists of a square yard of "Contact" table-top material available from larger department stores (usually in the "notions" department). This material, a photographic replica of hand-rubbed wood grain in a number of patterns, is self-adhesive. Simply cut it to size, smooth it down carefully on the finish railing, and your "Sweet Sixteen" speaker system is ready to go! Want to try another for stereo? —30—

Short-Wave Report

(*Continued from page 71*)

week are devoted to nothing but letter writing.

Several readers have asked if we DX at all. The truth is that very little time is spent in actual DX'ing though we do attempt to verify as many reports as possible by actual listening. Like most DX'ers, we have a few favorite programs we listen to while answering the mail.

When you send in reports or write for leaflets or information, please bear in mind that we will reply at the earliest possible moment. And remember that while we may not acknowledge your reports immediately, they are very much appreciated, and further reports will always be welcomed.

DX Unlimited. A fairly new club, DX Unlimited, puts out a bulletin containing short-wave and amateur news, some advertising, a "for-sale" column, and, at times, construction projects. Future plans call for inclusion of a broadcast-band column and articles on hi-fi and CB activities. The club's yearly dues are $1.20, plus a 20-cent registration fee. For further information, write directly to DX Unlimited, 6216 20th St., N.W., Seattle 7, Wash. If applying for membership, list your name, address, make and model of your receiver and/or transmitter, antenna, call letters (amateur or short-wave) and any organizations to which you belong.

Current Station Reports

The following is a resume of current reports. All times are Eastern Standard and the 24-hour system is used. At time of compilation all listings are as accurate as possible. Stations often change frequency and/or schedule with little or no advance notice. Please mail your reports to: Hank Bennett, P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month.

Albania—ZAA has moved to 5955 kc., and is readable at 1735 with Eng. news but is badly QRM'ed. *(WPE3NF)*

Andorra—*R. Andorra,* 5991 kc., is heard well on certain days around 1715 with a variety of music and frequent ID's. *(WPE3NF)*

Australia—Melbourne has moved from 11,760 kc. to 11,710 kc. for the N.A. daily xmsn at 0714-0815. Another new channel is 7190 kc. where VLG7 operates at 0243-0330 in Eng. to the mid-Pacific areas. *(WPE6AIU, WPE6BOA, WPE8BAG, WPE9ADP, WPEØAE, WS)*

Austria—The Austrian Radio Shortwave

Service, Vienna, is scheduled on 9770 kc. at 0600-0800; on 7245 kc. at 2300-0000 and 0800-1400; on 7200 kc. at 0400-0600; and on 6155 kc. at 0000-0400 and 1400-1600. Reports are welcomed and should be sent to *R. Austria*, P. O. Box 700, Vienna, Austria. *(WPE1AAC, WPE1BBB, WPE1BY, WPE3BQX, WPE9KM, MT)*

Colombia—*R. Sutatenza* has opened a new xmtr on 6075 kc. and is noted in closing at 2200 with full ID. It is dual to 5075 kc. *(WPE4BC, WPE9KM)*

A previously unidentified station is *R. Vision*, Medellin, 6105 kc., noted with news at 1845-1900. *(WPE2AXS)*

Cook Islands—ZK1ZA, Rarotonga, has moved from 4965 kc. to 5050 kc. with s/on at 2330; s/off may be at 0100 although fading usually blots the signal out by 0030. This xmsn is mostly English with Island music. *(WPE6EZ)*

England—The BBC Services timetable to Africa and the Colonies has been altered and now reads (for the time period 0445-0600 only): to Rhodesia and Nyasaland at 0445-0500 (Thursday); to East and Central Africa at 0445-0500 (Friday and Saturday); to the same areas at 0530-0545 (daily); to S. Africa at 0545-0600 (Sunday and Thursday); to Mauritius at 0545-0600 (second Tuesday of the month) and to East and Central Africa at 0545-0600 on Monday, Wednesday, Friday, and Saturday. These xmsns are all Eng. and are on 25,720 and 21,640 kc. Other schedule changes list the Pacific Service at 0300-0345 on 15,375 and 11,750 kc., and the Arabic Service on 18,080 kc. at 1100-1200, 1330-1345, and 1445-1500. A new program, "Shortwave Listener's Corner," is aired on Wednesdays at 0715 on 25,720, 21,470, 21,710, 17,870. 15,070, and 15,110 kc., and on Thursdays at 2015 on 6110, 9510, 9825, 11,820, 11,860, and 12,040 kc.; also on Thursdays at 1230 over 17,870, 15,070, 15,110, and 15,140 kc. *(WPE9DN, G2PE3Y)*

Ethiopia—Addis Ababa has a test xmsn to W. Africa on 15,345 kc. and to W. Europe on 11,875 kc. from 1525 to 1535 s/off. Reports go to *Radio Addis Ababa*, Director of Admissions, P. O. Box 1364, Addis Ababa. *(WPE1TH)*

Falkland Islands—Port Stanley is heard on 3958 kc. from 1922 with pop tunes. They now run to 2015 s/off, all English. *(GP)*

Finland—Helsinki, 15,190 and 17,800 kc., carries Eng. at 0630-0700 Saturdays with a DX program on the first and third Saturday of the month and "Musical Mailbag" on the second and fourth Saturday. "Finlandia Mixture" in Eng. is given on Tuesdays at 0830-0900. *(WPE5AG)*

France—Paris is operating on a new frequency of 11,885 kc. with a native language xmsn closing at 2000. *(WPE9KM)*

Another outlet heard well is on 7240 kc. at 0125-0145 to the S. Central Pacific in French. This is a move from 7280 kc. *(WPEØAE)*

Gabon Republic—*R. Gabon*, Libreville, operates on 4775 kc. at 1230-1700 daily. You might well log this one towards the end of the period. Reports are verified by letter. The address: *Radiodiffusion du Gabon*, B.P. 150, Libreville, Gabon. *(WPEØTA)*

Germany—*Deutsche Welle*, Cologne, is now

using 5980 kc., dual to 9605 kc. at 1900-2030 to Central America in Eng. and Spanish. *(WPE2BRH, WPE9KM, WPEØEW)*

At time of compilation, German lessons for Eng. listeners were being given at 2100-2120 Sundays and Wednesdays. *(WPE1BDB, WPE2BYW, WPE6UD)*

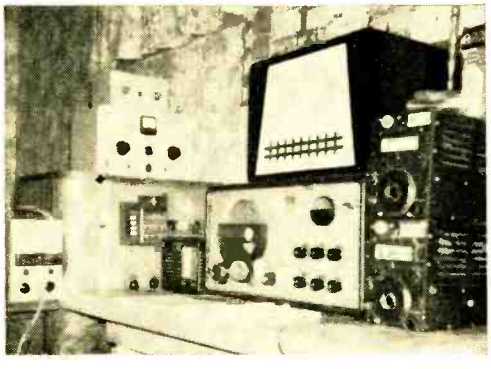
R. Liberty, Munich, operates on 3990 kc. at 2200-1500; on 6055 kc. at 2000-2200; on 7130 kc. at 1900-2100 and 1600-1800; on 7245 kc. at 1700-2300; on 9730 kc. at 1200-0300; on 15,340 kc. at 1700-0000; on 17,730 kc. at 0000-1600; on 17,850 kc. at 0000-0300 and 1200-1700; on 17,865 kc. at 2300-1900. The outlets on 9660, 11,935, 11,965, 15,395. and 15,410 kc. operate 24 hours daily. Reports go to Damenstiftstrasse 5, Munich-2. *(WPE1BM)*

Haiti—4VEH, Cap Haitien, is now on 6120 kc. and is heard from 2200 to 2330s/off; also at 0530 with answers to letters. *(WPE1AAC, WPE1BM, WPE4BC, WPE4HJ, WPE6BOV, WPE6EZ)*

Iceland—TFJ, Reykjavik, was noted on 11,785 kc. with opening at 1456, eight gongs at 1500, and a talk in Icelandic. It is believed that TFJ may now be on 11,780 kc. though this channel is effectively blocked by the BBC. *(WPE1BM)*

Indonesia—Eng. xmsns from *The Voice of Indonesia* are given at 0600-0700 on 11,785 and 9585 kc. to Australia, New Zealand, and Pacific areas; at 0930-1030 on 9585 and 11,795 kc. to S.E. Asia, India, Pakistan, Japan, and Western N.A.; and at 1400-1500 on 11,785 and 9865 kc. to Europe and New Zealand. *(WPE5RB)*

Japan—*R. Japan*'s complete new schedule reads: to N.A. at 1930-2030 on 15,135, 17,725, and 21,520 kc.; to N.A. and Hawaii at 0000-0200 on 9525, 11,800, 15,235, and 17,825 kc.; to Europe (I) at 0230-0330 on 15,135, 17,725 and 21,610 kc.; to Europe (II) at 1400-1600 and to the Mid East at 1145-1345 on 9525, 11,800, and 15,135 kc.; to Australia and New Zealand at 0430-0530 on 11,855, 15,235 kc.; to the Philippines and Indonesia at 0630-0700 on 11,855, 15,135, and 17,725 kc. The General Service is broadcast at 1900-1930, 2100-2130, and 2300-2330 on 15,115, 17,785, and 21,610 kc.; at 0100-0200, 0300-0330, 0400-0430, and 0500-0530 on 11,815, 15,105, and 17,785 kc.; at 0600-0630 on



Listening post of Kjell Skollingsberg, WPE7TM, Salt Lake City, Utah, features a Hallicrafters SX-42, Heath Q-Multiplier, and standby RCA receiver. He has 43 countries logged, 37 verified.

11,815, 15,105 and 15,235 kc.; and at 0700-0730 and 0800-0900 on 11,780, 11,815, and 15,235 kc. *(WPE1BD, WPE2AVZ, WPE2BRH, WPE5AG, WPEØADY, WPEØAE)*

Jordan—A verification from Amman lists the schedule as 2230-0305 on 9530 kc. (100 kw.) and 11,810 kc. (7.5 kw.). *(WPE5AG)*

Malaya—Here is the complete schedule of the BBC Far Eastern Station, Singapore. The asterisked xmsns are relays of the Asian Service of the BBC; the other xmsns are relays of the General Overseas Service of the BBC. Those xmsns followed by (a) close at 1205 Saturdays. To N. & E. China, Hong Kong, Korea and Japan: 0410-0630 on 17,755 kc.; 0415-0430 on 15,435 kc.; 0415-0600 on 11,955 kc.; 0600-0630* on 11,955 kc.; 0630-0845 on 15,435 kc.; and 0700-0745* on 9690, 11,955, and 15,310 kc. To S. China, Vietnam, Laos, and Cambodia: 0410-0630(a) on 9690 and 17,755 kc.; 0415-0430 and 0630-0845 on 15,435 kc.; 0415-0600 on 11,955 kc.; 0630-0700* on 7120 kc.; 0630-0745* on 9690 and 11,955 kc.; 0700-0745* on 15,310 kc., 0800-1150(a) on 9690 kc.; 0800-0815(a) on 9725 and 11,955 kc.; 0845-0915(a) on 9725 kc.; and 0845-1150(a) on 11,955 kc. To Indonesia: 0410-0530 (to 0515 on Sunday, Tuesday and Saturday) on 7120 and 11,820 kc.; 0445-0530 (to 0515 on Sunday, Tuesday and Saturday) on 9725 kc.; 0530-0600* (from 0515 Sunday, Tuesday and Saturday) on 7120, 9725, and 11,820 kc.; 0600-0615 on 7120 and 9725 kc.; and 0600-0630 on 11,820 kc. To Burma and Thailand: 0815-0845 on 9725 and 11,955 kc. To India, Ceylon, and Pakistan: 0800-0845, 1100-1150(a), and 0845-1100* on 11,820 kc.; and 0900-1150(a) on 9690 kc. To Australia: 0800-0815 on 9690 kc. *(WPE5AFU, GP)*

Martinique—Fort-de-France on 2420 kc. is noted with a strong signal airing a Hindi music program around 2040. *(WPE3NF)*

Mexico—A station on 2315 kc., possibly bearing the call XEFSM, has been tuned from before 0000 to 0200 with Mexican music and Spanish anmts. It may be an experimental station for it is not heard daily. *(WPE6EZ, WPEØAE)*

Morocco—The Moroccan Broadcasting System is scheduled as follows. To Southern Morocco (10 kw., Sebaa-Aioun): in Arabic at 0130-0500, 0700-1000 and 1300-1600 on 7115 kc.; in French at 0145-0330, 0730-0900, and 1330-1800, in Spanish at 2030-0400, 0900-1000, and 1800-1900, and in Eng. at 0700-0730 and 1300-1330, all on 7225 kc. To Africa (50 kw., Sebaa-Aioun, except 11,735 kc. which is 50 kw., Tangier): in Arabic at 0130-0500 on 6190 kc., at 0700-1000 on 15,345 and 11,735 kc., and at 1300-1900 on 9505 kc.; in Eng. at 1300-1330, in French at 1330-1530, and in Arabic at 1530-1830, all on 11,735 kc. To the Middle East (100 kw., Tangier): in Arabic (a special program) at 1300-1600 on 9700 kc. Both 9505 & 9700 kc. vary down a few kc. *(WPE1BM)*

Netherlands—The latest schedule from Hilversum reads: Weekdays at 0500-0550 to New Zealand, Australia on 21,480 and 17,775 kc., 0900-0950 to Africa and India on 25,610 and 15,425 kc., 1615-1705 to N.A. and Europe on 6020, 11,730, and 15,220 kc., and 2030-2120 to N.A. on 9590 and 6025 kc.; Sundays at 2100-2230 with "Happy Station Program" on 9590 and 6025 kc. All of these xmsns are in English. *(WPE2BRH, WPE6UD, WPE9AGB, WPE9DN)*

Paraguay—ZPA16, *R. Cultura,* 6210 kc., is a new outlet noted daily around 1900 with music and commercials, all Spanish. Location is Colonelo Viejo. *(GP)*

Peru—OAX7Z, *R. Turiota,* Turiota, 5790 kc., is another new channel heard irregularly at 1500-2100, all Spanish. They claim to be on 6050 kc. with 1 kw. *(GP)*

Portugal—The latest schedule from *Emissora Nacional,* Lisbon, reads: to Eastern N.A. on 11,875 kc. at 1900-2300 (also from 1945 on 9750 kc.); to Western N.A. on 9740 kc. at 2100-2300; to Timor on 21,495 kc at 0500-0800 (also to Macao to 0815); to India, Pakistan, and Persian Gulf areas on 21,495 kc. at 0815-0930 (also from 0845 on 17.880 kc.); to Goa at 0930-1215 on 21,495 kc. (also to 1200 on 17,880 kc.); to British S. & E. Africa at 1215-1300 on 17,895 kc.; to Sao Tome, Angola, and Mozambique at 0500-0815 and 1215-1600 on 21,700 kc., and 1300-1600 on 17,895 kc., and at 1430-1630 on 15,125 kc.; to Portuguese Guinea and Cape Verde Islands at 0500-0800 on 21,700 kc., at 1430-1900

SHORT-WAVE CONTRIBUTORS

Stanley Schwartz *(WPE1AAC)*, Bridgeport, Conn.
Richard T. White *(WPE1BBB)*, Pawtucket, R. I.
Anson Boice *(WPE1BD)*, New Britain, Conn.
Robert Anderson *(WPE1BDB)*, New Britain, Conn.
Jerry Berg *(WPE1BM)*, W. Hartford, Conn.
Alan Roth *(WPE1BV)*, Bridgeport, Conn.
William Hill *(WPE1TH)*, Hartford, Conn.
John Schmelzer *(WPE2AVZ)*, Buffalo, N. Y.
Robert Newhart *(WPE2AXS)*, Merchantville, N. J.
Albert Mencher *(WPE2BRH)*, Bayside, N. Y.
Mike Bercutt *(WPE2BVW)*, Binghamton, N. Y.
Henry Mendenhall *(WPE3BQX)*, Glenolden, Pa.
George Cox *(WPE3NF)*, New Castle, Del.
Grady Fertuson *(WPE4BC)*, Charlotte, N. C.
Alan Knapp *(WPE4HJ)*, Roanoke, Va.
Johnnie Adams *(WPE5AFU)*, El Dorado, Ark.
William Bing *(WPE5AG)*, New Orleans, La.
Barry Keil *(WPE5MW)*, New Orleans, La.
S/Sgt. Pedro Vasquez *(WPE5RB)*, Irumagawa, Japan
Don Schwab *(WPE6AIU)*, Long Beach, Calif.
Bob Caldwell *(WPE6BQA)*, La Canada, Calif.
Robert Pietsch *(WPE6BOV)*, San Francisco, Calif.
J. Art Russell *(WPE6EZ)*, San Diego, Calif.
James Saindon *(WPE6UD)*, Coronado, Calif.
Ken Shaffer *(WPE8BAG)*, Dayton, Ohio
Jim Erdelyi, Jr. *(WPE8CCQ)*, Parma, Ohio
Bill Waltz *(WPE8UM)*, Pittsburgh, Pa.
Lee Lannoye *(WPE9ADP)*, Green Bay, Wis.
Earl Kinmonth *(WPE9AGB)*, Joliet, Ill.
J. P. Arendt *(WPE9DN)*, Aurora, Ill.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
Richard Olson *(WPEØADY)*, Rochester, Minn.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
James Howard *(WPEØEW)*, Kansas City, Mo.
Gerhardt Martens *(WPEØTA)*, Frazee, Minn.
Shaler Hanisch *(SH)*, Pasadena, Calif.
Giacomo Perolo *(GP)*, Bauru, Brazil
William Smith *(WS)*, New York, N. Y.
Matti Takala *(MT)*, Helsinki, Finland
George Henley *(G2PE3Y)*, Watford, England

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corp.
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
N.A.—North America
QRM—Station interference
R.—Radio
S/off—Sign-off
S/on—Sign-on
xmsn—Transmission
xmtr—Transmitter

RAD-TEL

RAD-TEL'S FIRST QUALITY

WHY PAY MORE? - BUY DIRECT FROM RAD-TEL FOR SAVINGS AND PERFORMANCE IN RADIO AND TV TUBES

Up to 75% OFF on BRAND NEW TUBES

GUARANTEED ONE FULL YEAR!

You Can Rely On Rad-Tel's Speedy One Day Service!

NOT USED—NOT PULLED OUT OF OLD SETS • EACH TUBE INDIVIDUALLY AND ATTRACTIVELY BOXED!

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Q.y.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
___	024M	.79	___	4BQ7	.96	___	6AR5	.55	___	6CG7	.60	___	6SA7GT	.76	___	6EB8	.94	___	12B4	.63	___	12EL6	.50	___	19BG6	1.39
___	1AX2	.62	___	4BS8	.98	___	6AS5	.60	___	6CG8	.77	___	6SK7	.74	___	10DA7	.71	___	12BA6	.50	___	12EG6	.54	___	19T8	.80
___	1B3GT	.79	___	4BU8	.71	___	6AT6	.43	___	6CM7	.66	___	6SL7	.80	___	11CY7	.75	___	12BD6	.50	___	12EZ6	.53	___	21EX6	1.49
___	1DN5	.55	___	4BZ6	.58	___	6AT8	.79	___	6CN7	.65	___	6SN7	.65	___	12A4	.60	___	12BE6	.53	___	12F5	.66	___	25BQ6	1.11
___	1G3	.73	___	4BZ7	.96	___	6AU4	.82	___	6CR6	.51	___	6SQ7	.73	___	12AB5	.55	___	12BF6	.44	___	12F8	.66	___	25C5	.53
___	1J3	.73	___	4CS6	.61	___	6AU6	.50	___	6CS6	.57	___	6T4	.99	___	12AC6	.49	___	12BH7	.73	___	12FM6	.45	___	25CA5	.59
___	1K3	.73	___	4DE6	.62	___	6AU7	.61	___	6CU5	.58	___	6U8	.78	___	12AD6	.57	___	12BL6	.56	___	12K5	.65	___	25CD6	1.44
___	1L6	1.05	___	4DK6	.60	___	6AU8	.87	___	6CU6	1.08	___	6V6GT	.54	___	12AE6	.43	___	12BQ6	1.06	___	12SA7M	.86	___	25CU6	1.11
___	1LN5	.59	___	4DT6	.55	___	6AV6	.40	___	6CY5	.70	___	6W4	.75	___	12AF3	.73	___	12BY7	.74	___	12SK7GT	.74	___	25DN6	1.42
___	1R5	.62	___	5AM8	.79	___	6AW8	.89	___	6CY7	.71	___	6W6	.69	___	12AF6	.49	___	12BZ7	.75	___	12SN7	.67	___	25EH5	.55
___	1S5	.51	___	5AN8	.86	___	6AX4	.65	___	60A4	.68	___	6X4	.39	___	12AJ6	.46	___	12C5	.56	___	12SQ7M	.73	___	25L6	.57
___	1T4	.58	___	5AQ5	.52	___	6AX7	.64	___	60B5	.69	___	6X5GT	.53	___	12AL5	.45	___	12CA5	.59	___	12U7	.62	___	25W4	.68
___	1U4	.57	___	5AT8	.80	___	6BA6	.49	___	60E6	.58	___	6X8	.77	___	12AL8	.95	___	12CN5	.56	___	12V6GT	.53	___	25Z6	.66
___	1U5	.50	___	5BK7A	.82	___	6BC5	.54	___	6DG6	.59	___	7AU7	.61	___	12AQ5	.52	___	12CR6	.54	___	12W6	.69	___	35C5	.51
___	1X2B	.82	___	5BQ7	.97	___	6BC7	.94	___	6DQ6	1.10	___	7A8	.68	___	12AT6	.43	___	12CU5	.58	___	12X4	.38	___	35L6	.57
___	2AF4	.96	___	5BR8	.79	___	6BC8	.97	___	6DT5	.76	___	7B6	.69	___	12AT7	.76	___	12CU6	1.06	___	17AX4	.67	___	35W4	.52
___	3AL5	.42	___	5CG8	.76	___	6BD6	.51	___	6DT6	.53	___	7Y4	.69	___	12AU6	.50	___	12CX6	.54	___	17BQ6	1.09	___	3525GT	.60
___	3AU6	.51	___	5CL8	.76	___	6BE6	.55	___	6EU8	.79	___	8AU8	.83	___	12AU7	.60	___	12DB5	.69	___	17C5	.58	___	50B5	.60
___	3AV6	.41	___	5EA8	.80	___	6BF6	.44	___	6EA8	.79	___	8AW8	.93	___	12AV5	.97	___	12DE8	.75	___	17CA5	.62	___	50C5	.53
___	3BA6	.51	___	5EU8	.80	___	6BG6	1.66	___	6HGGT	.58	___	8BQ5	.60	___	12AV6	.41	___	12DL8	.85	___	17D4	.69	___	50DC4	.37
___	3BC5	.54	___	5J6	.68	___	6BH6	.65	___	6I5GT	.51	___	8CG7	.62	___	12AV7	.75	___	12DM7	.67	___	17D0G	1.06	___	50EH5	.55
___	3BE6	.52	___	5U4	.60	___	6BH8	.87	___	6J6	.67	___	8CM7	.68	___	12AX4	.67	___	12DQ6	1.04	___	17L6	.58	___	50L6	.61
___	3BN6	.76	___	5U8	.81	___	6BI6	.62	___	6K6	.79	___	8CN7	.97	___	12AX7	.63	___	12DS7	.79	___	17W6	.70	___	117Z3	.61
___	3BU8	.78	___	5V6	.56	___	6BK7	.85	___	6S4	.48	___	8CX8	.93	___	12AZ7	.86	___	12DZ6	.56	___	19AU4	.83			
___	3BY6	.55	___	5X8	.78	___	6BL7	1.00																		
___	3BZ6	.55	___	5Y3	.46	___	6BN6	.74																		
___	3CB6	.54	___	6AB4	.46	___	6BQ5	.65																		
___	3CF6	.60	___	6AC7	.96	___	6BQ6GT	1.05																		
___	3CS6	.52	___	6AF3	.73	___	6BQ7	.95																		
___	3CY5	.71	___	6AF4	.97	___	6BR8	.78																		
___	3DK6	.60	___	6AG5	.65	___	6BU8	.70																		
___	3QT6	.50	___	6AH6	.99	___	6BY6	.54																		
___	3Q5	.80	___	6AK5	.95	___	6BZ6	.54																		
___	3S4	.61	___	6AL5	.47	___	6BZ7	.97																		
___	3V4	.58	___	6AM8	.78	___	6C4	.43																		
___	4BC5	.56	___	6AN4	.95	___	6CB6	.54																		
___	4BC8	.96	___	6AN8	.85	___	6CD6	1.42																		
___	4BN6	.75	___	6AQ5	.50	___	6CF6	.64																		

SEND FOR FREE TROUBLE SHOOTER GUIDE AND NEW TUBE & PARTS CATALOG.

TRANSISTORS — AT FABULOUS DISCOUNTS

	PRICE	TYPE	RATING	ELECTRICAL CHARACTERISTICS		hfe
				1CBO max.	1EBO max.	
☐	RF 49¢	GE PNP ALLOY JUNCTION GENERAL PURPOSE RF/AF	200 MW	20 μa VCB = -3V	20 μa VEB = -3V	VCE = -1.5 Ib = 5 ma 20 min
☐	AF 39¢					
☐	80¢ ea.	Power AF Med. Freq. To-3	Min. Power Output 2.25 w	20 ma VCB = -16V	20 ma VEB = -16V	VCE = -1.5 Ib = 1 ma 40 min
☐	1.40 ea.	Hi Power 15 AMP To 36		40 ma VCB = -100	40 ma VEB = -100	VCE = -1.5 Ib = 1 ma 30 min
				Series 830 OHMS		

NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

RAD-TEL TUBE CO.

55 Chambers Street — Newark 5, N. J.

TERMS: 25% deposit must accompany all orders—balance C.O.D. $1 HANDLING CHARGE FOR ORDERS UNDER $5. Subject to prior sale. Please add postage. No C.O.D.'s outside continental U.S.A. Dept. PE-161

POPULAR ELECTRONICS
Advertisers' Index
January 1961

on 17,895 kc., and at 1645-1900 on 15,125 kc.; to the Portuguese Fishing Fleet at 1630-1930 on 11,840 kc.; to Brazil at 0930-1215 on 21,700 kc., at 1630-2045 on 17,895 kc., and at 1645-2100 on 15,125 kc. *(WPE1BM)*

Portuguese India—*Emissora de Goa,* Goa, 17,835 kc., has been heard from 1330 to 1430 in Eng., with news at 1400. This station may only have been testing for it is not heard regularly. *(WPE1AAC, WPE1BM, WPE6EZ)*

South Africa—Paradys has moved from 7295 kc. to 1785 kc., with the former channel now being used for the Afrikaans Service. A new outlet, on 21,525 kc., was noted at 0945-1000; this channel is used from 0930 when 25,800 kc. is closed. The 9560-kc. outlet opens at 0055 with BBC material to 0100, then a formal s/on in English. *(WPE8NF, WPE6EZ)*

Sweden—Stockholm has moved to 11,805 kc., and has news, weather, and a Mailbag program in English to N.A. at 2045-2115. *(WPE1BM, WPE1BY, WPE2BRH)*

Turkey—Ankara on 9515 kc. can usually be heard well at 1815-1900 in Eng. to N.A.; a pop music program is featured on Saturdays. *(WPE5MW, WPE8CCQ)*

Uruguay—CXA60, *R. Sarandi,* Montevideo, 15,385 kc., carries Spanish news at 2000 followed by South American dance music. *(WPE8UM)*

Vatican City—*Vatican Radio* has been noted from 1930 to S. America on 11,740 kc.; this may be a permanent move from 11,685 kc. *(WPE9KM)*

Yugoslavia—*R. Belgrade* has moved an outlet into the 25-meter band where it is noted from 2000 s/on in Spanish on 11,885 kc. S/off at 2030. *(WPE9KM)*

Unidentified—A station, believed to be Cuban, has been noted on 15,176 kc. (Sunday only) with pro-Castro speeches and ID of *Radio Emisoras Independientes y Libres* and, at times, *Universidad Popular.* They s/off promptly at 1440. *(SH)* —30—

▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲

Voices from Europe

(*Continued from page* 46)

Most short-wave broadcasting stations use a number of transmitters on different frequencies at the same time. Generally, these are in different bands and provide the listener with an option so that he can capture the clearest signal. During the evenings, European stations are heard with strong signals in the 9- and 11-megacycle bands (31 and 25 meters). When receiving conditions are disturbed, look for stations in the 6- and 7-mc. bands (49 and 41 meters). In the early morning hours you can generally hear strong signals around 21 and 25 mc. (15 and 13 meters). The 15- and 17-mc. bands (19 and 16 meters) are used mostly in the late afternoons and early evenings. —30—

ELECTRONICS MARKET PLACE

RATE: 50¢ per word. Minimum 10 words prepaid. March issue closes January 5th. Send order and remittance to Martin Lincoln, POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

FOR SALE

15 DISTANCE One-tube plans—25¢; One-tube Handbook—50¢, including Transistor experiments, catalog. Laboratories, 1131-L Valota, Redwood City, California.

NEW, unusual. Electrical Devices for home and shop. Literature 10¢. WELLSCO, Box 3055, North Hollywood, California.

AUTO Radio Distributor, Selling, Servicing, Becker Blaupunkt, FM-AM, other European, American Sets. Save 30%+! Square Electronics, 150-60 Northern Blvd., Flushing, N. Y.

SOMETHING for sale? Place a classified ad in this section. Low-cost, fast results. It's easy.

CITIZENS' BAND! Add a Hushpuppy noise suppressor to your Heathkit, Lafayette, Globe, etc. transceiver. Squelch Action! Completely Wired. Guaranteed. $4.98. Western Mass. Electronics, Great Barrington 1, Mass.

WHY take a chance with fire. Get low cost protection with famous CO2 fire extinguisher. Only $3.98 postpaid. Damar Electric Co., 115 W. 17th Ave., Hazelton, Penna.

20 Watt 80-40 CW transmitters $19.95 postpaid. Jackson Electronics, 1605 South Raleigh, Denver 19, Colorado.

TUBES—TV and Radio tubes. Guaranteed—Save up to 80%—Write: Emkay Electronics, P.O. Box 142, Blythebourne Station, Brooklyn 19, N. Y.

WPE-SWL-CB-QSL Cards — Samples 10¢ — "Brownie" W3CJ1, 3110A Lehigh, Allentown, Penna.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

INCREASE Clarity, Presence, Depth with the New Duo-Phonic Inductor on Stereo or Mono. Send for Free Facts or order now. $29.90. Money Back Guarantee. The Audionics Co., 8 West Walnut St., Metuchen, N. J.

BALANCE Your Stereo from Across the Room—How it sounds where you sit—that's what counts! Remote volume and balance control works with any system using separate preamplifier and power amplifier or any tape deck with cathode follower outputs. Small control (5 x 3 x 2 inches) can be placed as far as 30 feet away. $26.95 in walnut or mahogany housing, $19.95 in metal. Sun Radio Service, 320 Chestnut Street, Kearny, New Jersey. WY 1-0564.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.

PARTY Records—Sampler, catalog $1.00. 3 different $3.00 postpaid. DRC-11024 Magnolia, No. Hollywood, Calif.

CADMIUM Sulphide Photo Electric Control. $9.80 Complete with relay, Photo cell etc. 115V A.C. operation. Gamma Industries, Box 407, Holmdel, N. J.

SPECIAL! QSL cards, 3 colors. $2.50 per 100. Send name, address, A.R.R.L.? call letters. Garth, Jutland, New Jersey.

SURPLUS capacitors, relays, switches, etc. Write for free brochure. Central Electronics, P.O. Box 6646, Dallas 19, Texas.

TELEPHONE Extension In Your Car. Answer your home telephone by radio from your car. Complete diagrams and instructions $2.00. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

EAVESDROP with a pack of cigarettes. Miniature transistorized FM Radio Transmitter. Complete diagrams and instructions $2.00. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

POLICE Radar Detector. Stop before those radar speed traps. Fool proof, legal system. Complete diagrams and instructions $2.75. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

BE A Spy. Correspondence course on wire tapping, bugging, telescopic sound pickup, recording techniques, microphotography, and invisible photography. Lessons in surveillance, tailing, and use of equipment. Complete course $22.50. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

TV Tape Recorder. Build your own Video Recorder. Complete correspondence course and construction details. $22.50. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

COLOR TV. Convert your black and white TV to color. Completely Electronic. No mechanical gadgets. Costs about $35. Complete construction details $4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

JUNK Your Distributor and Voltage Regulator. Improve automobile mileage and performance. Construction details for transistorized distributor and voltage regulator. $4.75. No moving parts. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

ELECTRONICS By Sleep Teaching. The thorough way to train. Catalog 25¢. Electro-Sleep, 8959 Wonderland Ave., Hollywood 46, Calif.

CORRESPONDENCE courses in Photography, Printing, Weather Analysis, Electronics, TV Tape Recording, Nuclear Engineering, from $11.25 Complete. Catalog 25¢. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

VOICE Typewriter. Dictate directly to typewritten page. Describes buffer, voice encoder, typewriter translator. Complete $4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

TV Camera. Build for less than $50. Construction Details $4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

TELEPHONE Voice Switch (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. $23.75. Post Paid US. WJS Electronics, 1130 N. Highland Ave., Los Angeles 38, Calif.

ELECTRONIC Burglar Alarm Systems. Install your own security device. Write for literature and price. WJS Electronics, 1130 N. Highland Ave., Hollywood 38, Calif.

CITIZENS Do it Yourself Antennas Mobil, Groundplane, Beam. Standard Parts, Plans $1.00. Downen Engineering, 8266 Phlox Street, Downey, California.

DIAGRAMS for repairing Radios, Television $2.00. Give make, model. Diagram Service, Box 672 E., Hartford 1, Conn.

ELECTRONIC Technicians Course Bargain! A Complete Electronic Course has been selected and outlined by leading Electronic Engineers from Bargain Libraries of Government Agencies. Send $2.00 for complete Course Outline, textbook sequence plus list other Electronic literature and where available. Educational Outlines, Box 22133, Denver, Colorado.

HI-FI Tubler Speaker for Portable transistor radios. Plugs into earphone jack $7.50. 006P 9V batteries 3 for $1.79. Glasscock Co., 2835 Searcy Dr., Dallas 11, Texas.

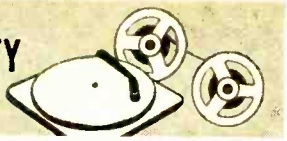
ELECTRONIC Surprise Package! 5 pounds assorted parts. $25.00 value. Only $2.98. KPJ Sales, Box 1252-B, Studio City, California.

WANTED

BUY, Sell or trade. Short-wave ham & citizens receivers, transmitters. Trigger-W9IVJ, 7361½ W. North Ave., River Forest, Ill. Chicago # TUxedo 9-6429, Mon-Fri., 12N-9PM; Sat., 9AM-5PM.

WANT to buy good equipment and accessories? Place a low-cost classified ad in this space. For information, write: Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, N. Y.

HIGH-FIDELITY



DON'T Buy Hi-Fi Components. Kits, Tape, Tape Recorders until you get our low, low return mail quotes: "We Guarantee Not To Be Undersold." Wholesale Catalog Fee. Hi-Fidelity Center, 1797PC First Avenue, New York 28, N. Y.

PRICES? The Best! Factory-Sealed Hi-Fi Components? Yes! Send for free catalog. Audion, 25P Oxford Road, Massapequa, N. Y.

DISGUSTED with "Hi" Hi-Fi Prices? Unusual discounts on your High Fidelity Requirements. Write Key Electronics, 120 Liberty St., New York 6, N. Y. Cloverdale 8-4288.

RECORDERS, components. Free wholesale catalogue. Carston, 125-P East 88, N. Y. C. 28.

HI-FI From Japan. Finest imported tuners, amplifiers, recorders, etc. Free catalog. KPJ Sales. Box 1252-B, Studio City, California.

ARE prices on Hi-Fi components too high? Write Dixie Hi-Fi, 12402 Connecticut Avenue, Silver Spring, Maryland.

TAPE & RECORDERS

RECORDING TAPE—1200' $1.35. Check our prices on Scotch, Irish and others. Pacific Magnetic Tape Supply, 3715 Monroe Street, Riverside, California.

NEW Self-Hypnosis Tape! Free literature. McKinley Co., Box 3038, San Bernardino, Calif.

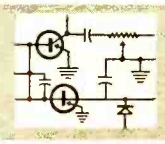
AMPEX, Concertone, Magnecord, Presto, Bogen, Tandberg, Pentron, Sherwood. Rek-O-Kut, Scott, Shure, Dynakit, others. Trades. Boynton Studio, Dept. PE, 10 Pennsylvania Ave., Tuckahoe, N. Y.

TAPE Recorders, Hi-Fi, components, Sleep Learning Equipment, tapes. Unusual Values. Free Catalog. Dressner, 69-02F, 174 St., Flushing 65, N. Y.

LOW Quotes on everything HiFi & Stereo Tapes. Bargain List: HiFi, Dept. H3, Roslyn, Pa.

RENT Stereo Tapes—over 1500 different—all major labels—free catalog. Stereo—Parti, 811-G Centinela Ave., Inglewood 3, California.

INSTRUCTION



BOOKS—All 10¢, 2000 titles, all subjects, catalog free. Cosma, Clayton, Ga.

DETECTIVE Profession. Home Study. Badge, Certificate, Future. Box 41197-AG, Los Angeles 41, California.

WRITE Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, N. Y. for information on how to place a classified ad in this section.

ENGINEERING Education for the space Age. Northrop Institute of Technology is a privately endowed, nonprofit college of engineering offering Two-Year accredited technical institute curricula and complete Bachelor of Science degree programs. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics and space technology. Write today for catalog—no obligation. Northrop Institute of Technology, 1179 West Arbor Vitae Street, Inglewood 1, California.

MYSTIC Antenna reveals secrets of nature's electronics! Locate hidden springs, water, gas, sewer lines, buried treasure! Works indoors; outdoors. Saves work, money! Easy to use. Fun for experiments! Details free. Stillwater, Box 317-T, Morris Plains, New Jersey.

SNOOPER receiver: police, fire department, ambulance, aircraft and government stations. FM-AM. Home-auto. Illustrated plans and instructions: $1.75. Technical Service Institute, 5652 Fourth Avenue North, St. Petersburg 10, Florida.

BE A Real Estate Broker. Insure security for yourself and your family. Study at home. Prepare for state examination. GI approved. Write for free book today. Weaver School of Real Estate. 2024 J. Grand, Kansas City, Missouri.

BE a Jet Engine Specialist! Earn high wages. New course on Ramjets, Pulsejets, Turbojets, Rockets, Compressors, Turbines, Afterburners, Ignition, etc. Fully illustrated. Complete, only $14.95. Afraid of Girls? Stop! Improve yourself. Know "What" to do. Develop "Winning Ways." Now confidential kit, only $9.95. Be a Detective! Know secrets of Criminology, Fingerprinting, Tracing, Tailing, etc. Develop your "Deductive Skills." Complete course, only $5.95. Special! All three, $25.00. Satisfaction guaranteed. Wilford's, 7400 Benjamin Franklin Station, Washington 4, D. C.

FREE L.P. Record and book gives instructive facts about Sleep-Education and the Audio Educator—the short cut method to learning and self-development—no obligation —SDRF—Dept. L 1, 104 East 40th Street, New York 16, N. Y.

BUSINESS OPPORTUNITIES

$12,500 Yearly Income! Sell your own Tape Recordings as Freelance International Recording representatives. Present equipment sufficient. Only $1.00 brings copyrighted comprehensive plan. International Recording, Box 202 P., Irvington, New Jersey.

JAPAN Directory. 145 Japanese manufacturing exporters, Japan and Hong Kong trade journal information. Asia opportunities. $1.00 today. Nippon Annai, Box 1150 T, Spokane 10, Washington.

INVENTIONS WANTED

INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 2420-P 77th, Oakland 5, Calif.

MISCELLANEOUS

BUY War Surplus Direct from the Government—Jeeps; Trucks; Tractors; Boats; Airplanes; Helicopters; Walkie-Talkies; Radar; Electronics; Misc.—Send for Brody's "U. S. Depot Directory & Procedures" $1.00. Box 425-(PE). Nanuet, New York.

INTERCEPT conversations 100 yards away, completely assembled Parabolic Microphone, $15.95 postpaid. Also, information sent free on other interesting devices. D'Imperio, P.O. Box 4281, Philadelphia 44, Pennsylvania.

SHOPPING GUIDE *Classified*

A HANDY REFERENCE TO PRODUCTS AND SERVICES NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST

STAMPS & COINS

FREE! $1.00 worth, your choice, from first stamp selection. No strings! Adults only. Rush request now. Philatelics, Dept. EMG-F, New Paltz, N. Y.

50 WORLD Wide Stamps, many exciting commemoratives, at only 10¢ and stamped self-addressed envelope. No approvals will be sent. Popular Electronics, Box 105, 1 Park Avenue, New York 16, New York.

GIGANTIC Collection Free! Includes triangles, early United States, animals, commemoratives, British Colonies, high value pictorials, etc. Complete collection plus big illustrated magazine all free. Send 5¢ for postage. Gray Stamp Company, Dept. Z2, Toronto, Canada.

BACK-UP coin file, nothing like it—ten year visible storage unit $1.95. Holdit Plastics. 8160 Orion Avenue, Van Nuys. Calif.

OVER 400,000 buyers and sellers will read your ad when placed in this space. It costs only 50¢ per word; minimum of 10 words including your name and address.

PHOTOGRAPHY—FILM EQUIPMENT, SERVICES

OPTICAL-Science-Math Bargains—Request Free Giant catalog "CJ"—128 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts, Amazing war surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

FREE! New 1960 catalog of all photographic books available. For your copy, send postcard with name and address to Catalog Popular Photography Book Service, One Park Ave., New York 16, N. Y.

PLASTICS

NEW Liquid Casting Plastic, clear, colors. Embed real flowers, butterflies, photos, coins. Send 25¢ for two handbooks "How to Cast Liquid Plastics" and "How to Make Extra Money at Home." Castolite, Dept. A-108, Woodstock, Illinois.

LEATHERCRAFT

FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-H39, Fort Worth, Texas.

BUSINESS OPPORTUNITIES

GROW Mushrooms. Cellar, shed and outdoors. Spare, full time, year round. We pay $4.50 lb. dried. We have 29,000 customers. Free Book. Mushrooms, Dept. 334, 2954 Admiral Way, Seattle, Wash.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station. New York.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

RADIO Parts Stores & Hi-Fi Salons! Someone "borrowing" your personal copy of Popular Electronics each month? You ought to be taking advantage of Popular Electronics' convenient resale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Popular Electronics, One Park Avenue, New York 16, New York.

BUY Direct from factories. Appliances, cameras, watches! Free details! Cam Co., 6810PE 20th Ave., Brooklyn 4, N. Y.

FREE Book "990 Successful, Little-Known Businesses." Work home. Plymouth-454M, Brooklyn 4, New York.

BIG Money—Operate own fix-it shop. Service household appliances, motors, mowers, saws, skates, etc. Free book. Christy Trades School, A-114, 3214 W. Lawrence, Chicago 25.

EMPLOYMENT INFORMATION

PLENTY Jobs. Nationwide-Worldwide. Hel. Elsinger. Box 12, Detroit 13, Mich.

HIGH Paying Jobs in Foreign Lands! Send $2.00 for complete scoop! Foreign Opportunities, Box 172, Columbus 16, Ohio.

EARN Extra money selling advertising book matches. Free samples furnished. Matchcorp, Dept. MD 11, Chicago 32, Illinois.

MISCELLANEOUS

FUN gifts and jokes galore. Catalog 10¢. Greenland Studios, Miami 47, Florida.

WHATEVER your needs, Popular Electronics classified can solve them. Simply place an ad in these columns and watch your results pour in.

ELECTRO-Scribe! Engraves all Metals, $2.00. Beyer Mfg., 10511-ZD, Springfield, Chicago 43.

WIN contest money. Our Contest Bulletin gives hundreds of tips. Lists current contests, rules. Sample, 25¢. General Contests, 1609-F, East Fifth St., Duluth, Minn.

"HOMEBREW." Make it yourself. Complete instructions $1.75. Homecrafts, Box 587-A, Bellevue, Nebraska.

BUY Wholesale, send for free shop at home catalog today Dixon Co., Box 836, Hawthorne, Calif.

AUTHORS! Learn how to have your book published, promoted, distributed. Free booklet "ZD" Vantage, 120 West 31 St., New York 1.

"WINEMAKING, Beer, Ale." Highest powered methods. Illustrated. $2.20. Eaton Bookstore, Box 1242-C, Santa Rosa, California.

WRITE Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, N. Y. for information on how to place a classified ad in this section.

SEND me your name and I'll tell you about a method that lets you take giant bass out of waters that other folks say are "fished out." Facts free. Write Eric R. Fare, Highland Park 22, Illinois.

FREE! New 1960 catalog of all photographic books available. For your copy, send postcard with name and address to Catalog, Popular Photography Book Service, One Park Ave., New York 16, N. Y.

FLYING Saucer Model $2. Walkie Talkie $59.95 Tape Recorder $39.95. Checkwriter $29.95. Tweco, 155, Indio, Calif.

HOMEBREW Guide, Illustrated. $2.00. Gauges available. CalBrew Supplies, 1225-A Luzern, Seaside, California.

20 Retractable ball pens $1.00. Ass't colors. Lebas, Box 331, Alden Manor, Elmont, N. Y.

COIN operated bowling machines, putt type, original cost up to $900.00 in good working order. Can easily be converted for use without coins for home playroom, or can be operated on locations as profitable money maker. $165.00 F.O.B. Sorry, No C.O.D. at this low price. Mahonik Amusement, Dept. 4, 280 West Eighth Street, Oswego, N. Y.

NEVER FAIL— **ZONE** YOUR MAIL

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include **your** zone number in **your** return address—after the city, before the state.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

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.***

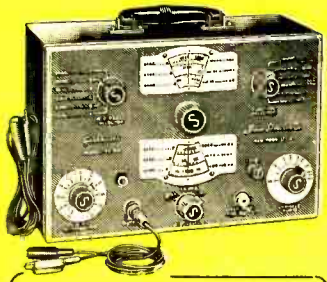
Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique. • 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 TV-50A GENOMETER

7 Signal Generators in One!



Model TV-50A GENOMETER. . .
Total Price. $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

√ 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*

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.

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).

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.

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.

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.

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only **$47.50**

USE APPROVAL FORM ON NEXT PAGE ▶

We invite you to try before you buy any of the models described on this and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

MOSS ELECTRONIC, INC. Dept. D-833, 3849 Tenth Avenue, New York 34, N. Y.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Model 77—VACUUM TUBE VOLTMETER. . .Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

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!

• Extra large meter scale enables us to print all calibrations in large easy-to-read type. • Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

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.

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.

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 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER

A Combination **VOLT-OHM MILLIAMMETER**
Plus **CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS**
Also Tests **SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES**

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

• **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500. • **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 • **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • **RESISTANCE:** 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. • **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. • **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. • **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries. • **DECIBELS:** —6 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. **All Electrolytic Condensers** from 1 MFD to 1000 MFD. **All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.**

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only $38.50

MOSS ELECTRONIC, INC.
Dept. D-833 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.

☐ **Model 70...Total Price $15.85**
$3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ **Model TV-50A ..Total Price $47.50**
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

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

☐ **Model 79 Total Price $38.50**
$8.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ **Model 85 .....Total Price $52.50**
$12.50 within 10 days. Balance $8.00 monthly for 5 months.

☐ **Model 83 Total Price $38.50**
$8.50 within 10 days. Balance $6.00 monthly for 5 months.

Name .....

Address .....

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

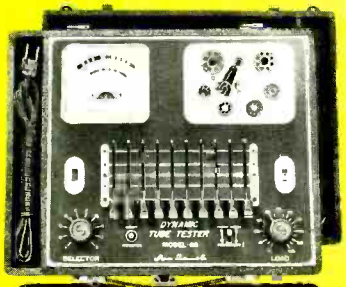
All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Superior's New Model 85—*a DYNAMIC type* **TRANS-CONDUCTANCE**

TUBE TESTER



Model 85—Trans-Conductance Tube Tester. Total Price—$52.50.
Terms: $12.50 after 10 day trial, then $8.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

● Employs latest improved TRANS-CONDUCTANCE circuit. Tests tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

● **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, +, ●, ▲, ■) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

● **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

● **NEW IMPROVED TYPE METER** with *sealed air-damping chamber* provides accurate, *vibrationless* readings.

● **FREE FIVE (5) YEAR CHART DATA SERVICE.** The chart provided with Model 85 includes easy-to-read listings for *over 1,000 modern tube types.* Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

● **SPRING RETURN SAFETY SWITCH** guards Model 85 against burn-out if tube under test is "shorted."

● **7 AND 9 PIN TUBE STRAIGHTENERS** have been included on the front panel to eliminate possibility of damaging tubes with bent or out-of-line pins.

● **AN ULTRA-SENSITIVE CIRCUIT** is used to test for shorts and leakages up to 5 megohms between *all* tube elements.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Only..... **$52.50**

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

Tests and Rejuvenates ALL PICTURE TUBES

Model 83—C.R.T. Tube Tester
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types —from 8", to 30" types.

● Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes. ● Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types. ● Model 83 employs a 4" air-damped meter with quality and calibrated scales. ● Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode. ● Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition. ● Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton—in the set!

Housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only **$38.50**

TRY FOR 10 DAYS

BEFORE you buy! ***THEN*** if satisfactory

pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

FIRST CLASS
Permit No. 61430
New York, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the U. S.

POSTAGE WILL BE PAID BY —

MOSS ELECTRONIC, INC.
3849 TENTH AVENUE
NEW YORK 34, N. Y.