ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

JANUARY • 35¢

MICROPHONES!

for CB

for Hams

for Hi-Fi

PLUS A DOZEN PROJECTS!

79¢ Soup-Up for Your Hanci-Talkie

Two-Tube Miniature Hi-Fi Amplifier

Remote Signaler for CB Calls

Semiconductor Speed Control for Your Tools

Interference Filter for FM

Acoustic Cabinet for Transistor Radios

Surge-Stopper Protects Your Electronic Gear

RF Generator

Audio Generator

CW Keying Monitor

Invisible Antennas

Scope Light Shield

Where You Train Is As Important As Your Decision To Train

Electronics is a growing and expanding industry. That's why so many ambitious men are deciding to train for careers in this exciting field. They recognize the opportunities to advance and prosper. But, *where* a man trains and *how* the school of his choice teaches Electronics . . . how it encourages him to reach his goals and realize his ambitions . . . is most important to his success.

This is a fast changing world. A school offering Electronics courses must keep pace. That's why NRI—with nearly 50 years of specialized experience—now offers *eight* choices of training within the one field of Electronics. Select the course of most interest to you and receive the kind of home-study training that prepares you for a *specialized* career. NRI's large staff of specialists is always on the job keeping course material up-to-date . . . helping you earn your way while training . . . assisting you with job placement when ready. In short, whatever branch of Electronics you select, NRI is qualified through knowledge and experience to help you grow.

SPECIAL TRAINING EQUIPMENT INCLUDED

NRI "learn by practice" method is the time-proved way to learn easier, faster, better. Most NRI courses include—*at no extra cost*—special training equipment to give shop and laboratory experience in your own home. All equipment is yours to keep.

Projects you build, experiments you perform, make NRI lessons come to life. Complex subjects become interesting, easy to grasp. Your first projects are measuring voltage and current in circuits you build yourself. You use a Vacuum Tube Voltmeter which you construct. Later on, you progress into more involved experiments. If you like working with your hands, you'll enjoy learning Electronics with NRI.

THE PROVEN WAY TO BETTER PAY

Best of all, NRI provides training right in your own home and in your spare time. No time wasted getting to school. You fit study hours to your own schedule. You go as fast or as slow as you like. Check the training of most interest to you; cut out and mail the postage-free card now. Read about Electronics opportunities, NRI courses, the NRI trial plan, convenient terms.

NRI

AMERICA'S OLDEST AND LARGEST
RADIO-TV ELECTRONICS HOME-STUDY SCHOOL

Expanding uses of Electronics in industry, business, the military, are increasing the demand for trained Electronic Technicians. Electronics needs more Technicians than engineers—from four to seven times more! Electronics is changing our world, creating interesting and important career opportunities for those who qualify. NRI training prepares you.

Communications is the key to a fast-moving world, from the mobile radio in your car to the TV set in your home and the satellite in space. Technicians are needed to help operate and service transmitting equipment used in broadcasting, aviation, marine and mobile communications. Even a service Technician needs an FCC License today to work on C-Band and other Radio equipment. NRI trains you for your choice of Communications fields.

Television and Radio are bigger than ever. Color Television, after years of experimenting, is now moving ahead fast. Hi-fi stereo, PA systems, FM all mean money-making opportunities for you as a Service Technician in your own spare-time or full-time business, or working for someone else. NRI's time-tested training not only teaches you to fix sets, but shows you how to earn spare-time money soon after enrolling. Mail postage-free card.

Pick The Career You Want In The Wonderful Field of ELECTRONICS

1. INDUSTRIAL-MILITARY ELECTRONICS

Learn Principles, Practices, Maintenance of Electronic equipment used today in business, industry, defense. Covers Electronic controls and measurement, computers, servos, telemetry, multiplexing, many other subjects.

2. RADIO AND TELEVISION SERVICING

Learn to service and maintain AM-FM Radios, TV sets, Stereo Hi-fi, PA systems, etc. A profitable, interesting field for part-time or full-time business of your own.

3. COMPLETE COMMUNICATIONS

A comprehensive training course for men seeking careers operating and maintaining transmitting equipment in Radio-TV Broadcasting or mobile, marine, aviation communications. Prepares you for FCC License.

4. FCC LICENSE

Prepares you quickly for First Class License exams. Every communications station must have one or more FCC-licensed operators. Also valuable for Service Technicians. You train at home.

5. MOBILE COMMUNICATIONS

Training in installation and maintenance of mobile equipment and associated base stations like those used by fire and police, taxi companies, etc. Prepares you for First Class FCC License exams.

6. MARINE COMMUNICATIONS

Shipboard transmitting equipment, direction finders, depth indicators, radar are all covered in this course. You prepare for your First Class Radiotelephone License with Radar Endorsement.

7. AVIATION COMMUNICATIONS

For men who want careers working with and around planes. Covers direction finders, ranges, markers, loran, shoran, radar, landing systems, transmitters. Prepares you for FCC License exams.

8. MATH FOR ELECTRONICS

From basic arithmetic review to graphs and electronic formulas in one complete "short course" package of five carefully prepared texts. Quick, complete and low in cost.

MAIL POSTAGE-FREE CARD NOW

NRI

ELECTRONICS ILLUSTRATED

January 1963 — A Fawcett Publication — Vol. 6, No. 1

General Features

Special Construction Projects

Radio: CB • Amateur • SWL

Audio & Hi-Fi

Theory & Practice

Regular Departments

•

ADDRESSES
Editorial and Advertising Offices: 67 West 44th St., New York 36, N.Y. Subscriptions: Change of address Form 3579 to Subscription Dept., Fawcett Bldg., Greenwich, Conn.

•

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

•

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

•

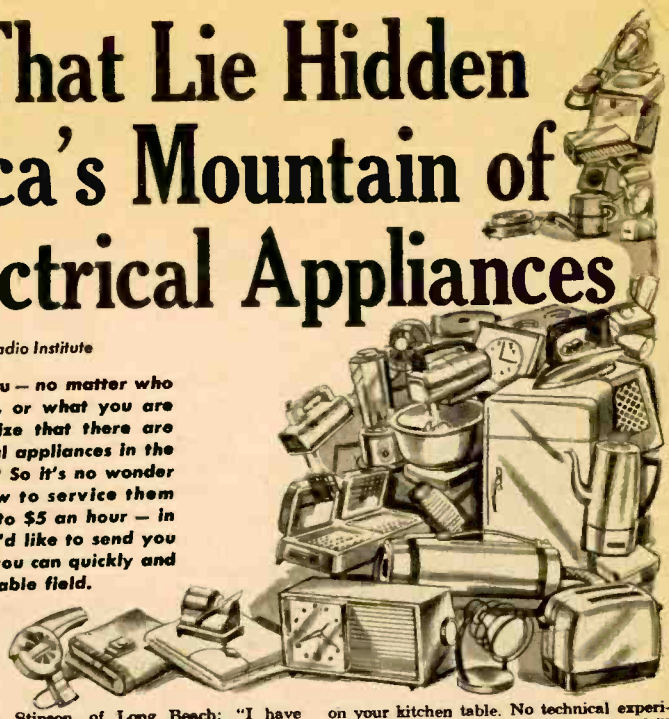
Subscription price $4 for 12 issues in U.S. and possessions and Canada. All other countries $6 for 12 issues. Foreign subscriptions and sales should be remitted by International Money Order in U.S. funds payable at Greenwich, Conn.

COVER—Photograph by Francis Duval. For microphone identification, see our article on Microphones for CB, Hams and Hi-Fi.

Profits That Lie Hidden in America's Mountain of Broken Electrical Appliances

By J. M. Smith *President, National Radio Institute*

And I mean profits for you — no matter who you are, where you live, or what you are doing now. Do you realize that there are over 400 million electrical appliances in the homes of America today? So it's no wonder that men who know how to service them properly are making $3 to $5 an hour — in spare time or full time! I'd like to send you a Free Book telling how you can quickly and easily get into this profitable field.



THE COMING OF THE AUTO created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

The appliance repair business is booming — because the *sale* of appliances is booming. One thing naturally follows the other. In addition to the 400,000,000 appliances *already* sold, this year alone will see sales of 76 million *new* appliances. For example, 4,750,000 new coffee makers, almost 2,000,000 new room air conditioners, 1,425,000 new clothes dryers. A nice steady income awaits the man who can service appliances like these. And I want to tell you why that man can be *you* — even if you don't know a volt from an ampere now.

A Few Examples of What I Mean

Now here's a report from Earl Reid, of Thompson, Ohio: "In one month I took in approximately $648 of which $510 was clear. I work only part time." And, to take a big jump out to California, here's one from J. G. Stinson, of Long Beach: "I have opened up a small repair shop. At present I am operating the shop on a spare time basis — but the way business is growing it will be a very short time before I will devote my full time to it."

Don't worry about how little you may now know about repair work. What John D. Pettis, of Bradley, Illinois wrote to me is this: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off — and have more and more repair work coming in all along. I have my shop in my basement."

We Tell You Everything You Need to Know

If you'd like to get started in this fascinating, profitable, rapidly growing field — let us give you the home training you need. Here's an excellent opportunity to build up "a business of your own" without big investment — open up an appliance repair shop, become independent. Or you may prefer to keep your present job, turn your spare time into extra money.

You can handle this work anywhere — in a corner of your basement or garage, even on your kitchen table. No technical experience, or higher education is necessary. We'll train you at home, in your spare time, using methods proven successful for over 45 years. We start from scratch — *tell* you in plain English, and *show* you in clear pictures — everything you need to know. And, you will be glad to know, your training will cost you less than 20¢ a day.

FREE BOOK *and Sample Lesson*

I think that our 24-page Free Book will open your eyes to a whole world of new opportunities and how you can "cash in" on America's "Electrical Appliance Boom."

I'll also send you a Free Sample Lesson. It shows how simple and clearly illustrated our instruction is — how it can quickly prepare you for a profitable future in this big field. Just mail coupon, letter, or postcard to me: *Mr. J. M. Smith, President, National Radio Institute, Dept. KA3, Washington 16, D.C.* (No obligation, of course — and no salesman will call on you.)

EARN WHILE YOU LEARN
with this APPLIANCE TESTER
— Yours at No Extra Charge

Your NRI Course comes *complete* with all the parts to assemble a sturdy, portable Appliance Tester that helps you earn while you learn. Easy-to-follow manual tells how to assemble and use the Tester *right away*. Locate faulty cords, short circuits, poor connections, etc. in a jiffy; find defects in house wiring, measure electricity used by appliances; many other uses.

With this Tester you save time and make money by doing jobs quicker, making sure appliances operate correctly after repairs.

MAIL THIS FOR FREE BOOK and SAMPLE LESSON

Mr. J. M. Smith, President
NATIONAL RADIO INSTITUTE
Dept. KA3, Washington 16, D.C.

Tell me how I can "cash in" on the "Electrical Appliance Boom." Send me your illustrated FREE BOOK that outlines the whole NRI Course, tells what opportunities are open to me, answers my questions, describes success of other students, and much more. Also send me the FREE SAMPLE LESSON so I can see how clear and easy your instructions are. I am particularly interested in:

☐ Spare Time Earnings ☐ Business of My Own ☐ Better Job

I understand there is no obligation on my part; and no salesman will call on me.

Name.....

Address.....

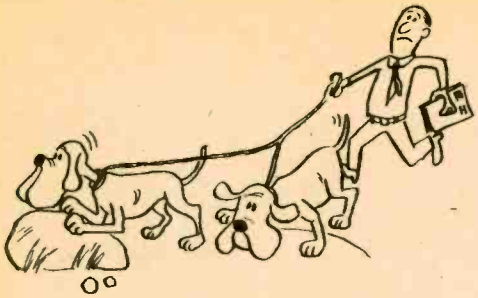
City.....Zone....State.....

Accredited Member National Home Study Council

FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York 36, N. Y.

● ***Lost Finder***



That do-it-yourself Radio Direction-Finder of yours (September '62 EI) was a pretty neat gadget, I'm sure. My neighbor built one from my copy of EI and one day he took me over to his place to show it to me. Guess what? He'd mislaid it and we couldn't find it anywhere. It's still lost. How do you find a direction-finder?

Ronald Jay
Boston, Mass.

You might try a metal-locator. If you lose that, start climbing mountains. They're hard to lose.

● ***The Sender***

In your July issue there was a piece in THE LISTENER discussing what was and wasn't a true verification from a station. I'd like to ask what constitutes a *report*. Most reports I receive are excellent, but then I get some that say: "Dear Sir: On Jan. 23 I was delighted to pick up KILT for the first time. Please verify my reception."

As you can see, there is no way of knowing for certain whether our signal was received. It is necessary for DXers to list such details as date, time, name of record, commercial, DJ commentary, etc. Then I can be sure.

Glenn M. Cook, Jr.
Chief Engineer, KILT
Houston, Tex.

● ***Handi-Talkie Talk***

I enjoyed your September issue. . . until I got to page 45, where there was a photo with a caption that talked about a Raytheon handi-talkie which operated at either 1 watt or 100 milliwatt level. The man shown in the photo is Mr. E. T. Herbig, Jr., general sales manager of E. F. Johnson Co., and the set is a Johnson Personal Messenger. Mr. Herbig was somewhat distressed, as he does not contemplate joining Raytheon.

I'm fully aware such things *do* happen and not really upset, but I would appreciate anything you can do to set the record straight.

A. E. Taylor
E. F. Johnson Co.
Waseca, Minn.

You've just set it straight, A.E., and we thank you.

● ***Yes Man***

Having built the Decision Maker in your July issue, I was disappointed to find the flash rate too slow and a partiality for the *yes* bulb. So I replaced the 100K resistors with a 250K pot, connecting the center arm to B+ and each side to the appropriate bulb. I also

[*Continued on page* 6]

men 17-55

JOB OPPORTUNITIES! EXCITEMENT! MONEY!

All this can be Yours as a trained

Electronics TECHNICIAN

OVER 6,000 FIRMS HAVE EMPLOYED DeVRY TECH GRADUATES!

Thousands of companies in the United States and Canada who have employed DeVry Tech men prove two most important facts: (1) Electronics is one of the biggest, fastest growing opportunity fields of our time; and (2) DeVry Tech graduates are "WANTED" MEN.

Whether DeVry Tech prepares you in spare time at home or in its modern Chicago or Toronto Laboratories, your training is designed to get you ready to meet the exacting standards of industry. You get practical training that not only helps to fit you for a job or a service shop of your own—but also gives you a foundation for a career that can be profitable the rest of your life.

You work over 300 learn-by-doing experiments at home, using DeVry Tech's exclusive Electro-Lab method. You build and KEEP valuable equipment. With another DeVry Tech exclusive, you have the benefit of training movies that you can show over and over until basic points are crystal clear. Special texts guide you every step of the way as well.

HOW DeVRY TECH CAN "BLUEPRINT" YOUR CAREER!

DeVry's faculty not only know how to teach Electronics, but they also understand men. They most likely know the type of problems you face. From this staff you get help, advice and understanding. It is this "human" side of DeVry's program that has caused many of our graduates to say: "DeVry Tech not only trains you for a job, they actually help you blueprint a profitable future!"

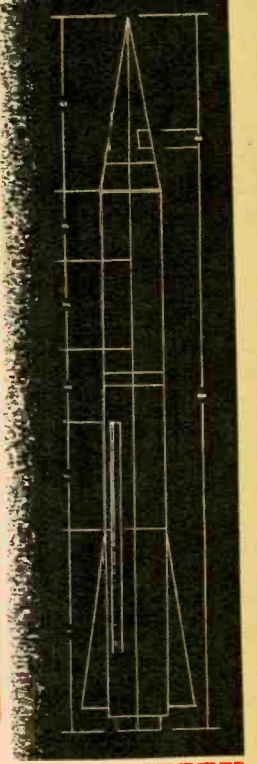
NO ADVANCED EDUCATION NEEDED!

Why don't you write for FREE FACTS today? Learn how you TOO can be a member of the great fraternity of DeVry Tech graduates across the continent . . . men who were properly trained, encouraged, appreciated and understood! SEND IN COUPON NOW!

EFFECTIVE EMPLOYMENT SERVICE

DeVry Tech's effective Employment Service is available to all graduates without additional cost.

LET DeVRY HELP YOU PREPARE AND BLUEPRINT A SOLID CAREER IN THIS FAST-GROWING FIELD!



2 FREE BOOKLETS
Send Coupon TODAY!

"One of North America's Foremost Electronics Training Centers"

Accredited Member of National Home Study Council

DeVRY TECHNICAL INSTITUTE
CHICAGO • TORONTO

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill., Dept. EI-1-T

Please give me your 2 FREE BOOKLETS, "Pocket Guide to Real Earnings" and "Electronics in Space Travel;" also include details on how to prepare for a career in one or more branches of Electronics.

Name_____ Age_____
PLEASE PRINT

Street_____ Apt._____

City_____ Zone_____ State_____

☐ Check here if you face military service.

2075 Canadian residents address: DeVry Tech of Canada, Ltd. 970 Lawrence Avenue West, Toronto, Ontario

FEEDBACK

Continued from page 4

replaced the .1-mf capacitor with an .05. Now I can adjust the pot to give an equal ratio between the *yes* and *no* bulbs.

Presley Smith, Jr.
San Angelo, Tex.

As our article said, the two neons and R3 and R4 must be matched to produce truly random choices; otherwise, the balancing pot must be used. Or maybe your Decision Maker was just trying to be nice with all those yesses.

● *Minority Report*

I read the article by Dr. Jacob Millman defining electricity (September '62 EI) and was quite amused. I think the biggest farce was your idea of even trying to define electricity. One cannot define electricity. One can only demonstrate the nature of it.

Richard B. Johnson, K1KLR
Belchertown, Mass.

One can try, can't one?

● *At The Top*

I got a laugh out of your article on MACHINES THAT READ (September '62 EI), more particularly out of the picture showing a man with one of the gadgets. The caption said he was the *ex*-president of the Farrington Co. I can imagine what happened between the time the picture was taken and when you printed it. I think they call it the fast shuffle.

Max Lane
Chicago, Ill.

BECOME A RADIO

Build 10-20 Radio and Electronic Circuits at Home

ALL GUARANTEED TO WORK!

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 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 small price you pay. 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 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 several 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, hardware, tubing, punched metal chassis, Instruction 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 servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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 Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

Choose From These Popular "Edu-Kit" Models

#10A: 10 Circuits $14.95

#15A: 15 Circuits $19.95

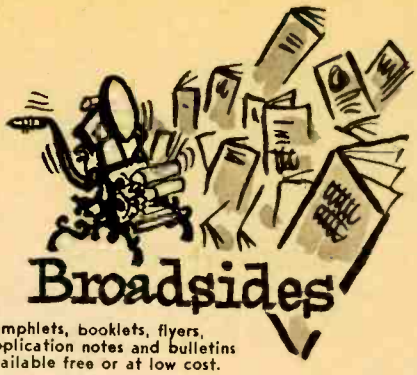
#16A: 16 Circuits (Includes Printed Circuitry) $22.95

#20A: 20 Circuits (Includes Printed Circuitry and 4 Advanced Circuits) $26.95

NOW! TRAIN AT HOME IN RADIO AND ELECTRONICS

ORDER DIRECT FROM AD . . . . USE COUPON ON NEXT PAGE

RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS



Broadsides

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

Design Considerations in Selecting Photoconductive Cells is a 28-page booklet devoted to photocell principles, design possibilities and test equipment. Fifteen sample schematics are included. It's available free from GE's Technical Information Service, Receiving Tube Dept., Owensboro, Ky.

National Transistor's engineering bulletin E-504 explains the problems of accurate and repeatable measurements of **silicon and germanium diodes.** Title: Measuring Forward Conductance and Reverse Leakage of Silicon and Germanium Diodes. Free from the company at 500 Broadway, Lawrence, Mass.

A description of how **traveling wave tubes** are made can let you in on what TWT's really are and what they can do. A brochure on the manufacture of these highly specialized devices is available free from Sylvania, 1100 Main St., Buffalo, N. Y.

Another free offering from Sylvania (see above) is a catalog of classroom and **Educational Aids,** listing inexpensive wall charts and publications that depict construction and operation of electron tubes. Tubes included are cathode ray, receiving and industrial types.

Everything from an Ohm's Law slide rule to nutrition computers shows up in Dyna Slide's free catalog of **calculating aids.** To obtain a copy write to Dyna at 600 S. Michigan Ave., Chicago 3, Ill.

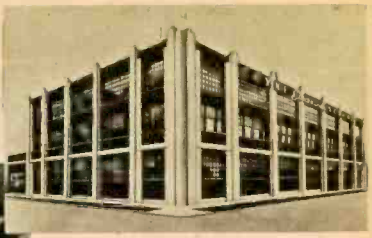
1963 catalogs are free for the asking from Allied Radio, 100 N. Western Ave., Chicago, Ill.; Heath Co., Benton Harbor, Mich.; Lafayette Radio, 111 Jericho Tpke., Syosset, N. Y. and Radio Shack, 730 Commonwealth Ave., Boston, Mass.

A wall chart of **radio transistor replacements** is available free from GE, 3800 N. Milwaukee, Chicago, Ill.

You Have Aptitude for Electronics

...Why Not Make It Your Career?

Get the Training You Need at COYNE then Step into High Salary Position in the Branch of Electronics *You Like Best!*



No matter what branch of electronics you prefer, you'll have no trouble landing just the job you want—*provided you get the right kind of training.*

Without this training you'll not get far. *With* it most of our graduates start right out with a beginner's salary of $100 a week or more. Once you've started, you can move ahead fast to more important jobs that pay as much as $14,000 a year.

AIRLINES NEED MEN

Who pays this kind of money to beginners? You'd be surprised at how many fine openings there are for Coyne trained men—in small towns and big cities everywhere all year 'round. For example, the airlines are always on the lookout for men who can fill jobs as radio mechanics, aircraft electricians and electronic systems technicians, to mention only a few. From a good starting salary, a trained man can quickly boost his income to $8,000 a year. And that is by no means the limit.

THE MISSILE INDUSTRY

Another field where employers are clamoring for trained men is the missile industry—an industry growing so fast as to be almost unbelievable. Here there is a constantly increasing need for trained men. Every day these companies are hiring electronic technicians, laboratory technicians, electronic assembly inspectors and field service engineers. A field service engineer *with minimum experience* can easily demand and get $8,000 a year—plus extra compensation in the form of living expenses and incentive pay.

COMPUTERS—Data Processing

A tremendous field. Men with basic electronic training are welcomed by manufacturers to receive further training—while on salary in—the operation and maintenance of their specialized equipment. Opportunities unlimited. No ceiling on salaries.

TV and RADIO Manufacturers

Perhaps the biggest opportunities of all are to be found with the large electronic manufacturers. With these giants, job opportunities are practically without limit.

And the same thing can be said of salaries. These radio and TV manufacturers are expanding into new fields and are growing at an unheard of rate. Any man with ability and ambition can grow with them, earn promotion after promotion. With these promotions come frequent pay raises as he continues to step from one important job to one still more important.

OR, YOUR OWN BUSINESS

Hundreds of graduates have gone to work for *former* graduates, servicing TVs and Radios, Air Conditioners, Refrigerators, other household appliances—then, after learning business methods have branched out and started their own shops. Others have started their own shops immediately upon graduating. Profits as independent business men, after taxes and other business expenses, are as high as $10,000 to $20,000 a year.

These are not dreams. They are realities. But don't try to break into Electronics "on your own." You can save years of struggle and disappointment by first getting the necessary training at the great shop-laboratories of the Coyne School in Chicago.

CHICAGO—THE NATION'S ELECTRONICS CENTER

Don't get the idea that coming to Chicago to learn with Coyne is a costly or complicated undertaking. *Nothing could be further from the truth.* With modern transportation, *Chicago is "close by" no matter where you live.* High living costs? Not at all. We find a place for you to live—a place where, in many cases, your room and board cost no more than you would pay at home. And don't forget that you have every opportunity to earn money while you learn. Our employment department helps you get a part time job if you need extra money.

And think of the training you will get! Coyne is the oldest, largest and most completely equipped Resident School of its kind. And it is right in the heart of America's electronics center! Best of all, you can start your training with only a small down payment. Then take care of the balance *after you graduate!*

FREE BOOK You've just read a bare outline of what Coyne offers to men who want to get into electronics. You'll find the complete, fascinating story in our big 48-page book "Your Opportunities in Electronics," we'll be glad to send you free. Read this Book before you make up your mind what you want to do.

We'll mail the book to you free and postage prepaid. You will not be under the slightest obligation. No salesman will call at your home. Mail the coupon now, or send your name on a postcard. When you see this wonderful book, you will be glad you sent for your free copy.

Coyne Electrical School

Chartered as an Educational Institution not for Profit

Dept. 13-A Chicago 7, Illinois

FREE!

Clip OUT AND MAIL NOW!

COYNE ELECTRICAL SCHOOL, Dept. 13-A
1501 W. Congress Parkway, Chicago 7, Ill.

Send me your big 48 page Book "Your Opportunities in Electronics" and complete information about getting training for a high paying position in electronics. You are to send everything free and postage prepaid and it is understood that no salesman will call at my home.

Name .....

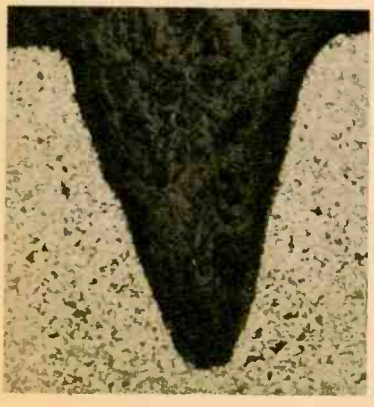
Address .....

City ..... RR No. or Zone .... State .....

...electronics in the news

Lasers, Lasers, Lasers . . . When someone gets around to writing a history of the electronic developments in this decade, the laser is certain to be one of the first devices discussed. The laser (an acronym for Light Amplification by Stimulated Emission of Radiation) up to now has been little more than a laboratory gadget, but in the near future we will begin to see practical applications. The device enables scientists to perform totally new experiments and also helps them do old tasks better. The photo at left demonstrates the fact that the laser is moving out of the lab and into the field. It shows the first visible-light unit put on the market, offered by the Perkin-Elmer Corp., Norwalk, Conn. Designated the Model 110, the laser resembles a slide projector. It employs a helium-neon gas tube, emitting a bright red beam of coherent (in phase) and visible light at a wavelength of 6,328 angstroms. P-E expects the 110 to be snapped up by firms doing work in optical communications, physiological and biological research, and ranging and tracking. The price is $7,900, which seems to put it out of the hobbyist's reach—at least for the time being.

The chap in the photo at right is holding in his right hand the newest gadget in the laser field—an optical trigger—and in his left hand a regular ruby laser. The trigger, developed by Raytheon, is a glass cube fitted with a glass disc and positioned at the output end of a laser. When the disc is against the cube the latter is not reflective, blocking escape of energy from the laser's atoms, which have been pumped to a highly excited state. Then the disc is moved enough to break the optical interface and the cube becomes reflective. The dammed-up energy crashes out in one giant pulse that lasts about one ten-millionth of a second and has a million-watt punch. Raytheon developed the trigger for use in an optical radar system, which would be several thousand times more accurate than microwave radar. Sperry Gyroscope has developed a slightly different optical radar system—a laser *doppler* radar. This apparatus would measure the motion of any target by detecting the apparent frequency shift observable when transmitter and target are in motion relative to each other. Sperry believes its unit could measure speeds all the way from five miles a second to one-thousandth of an inch per second. Spaceships on interplanetary journeys are seen as the customers.



More down-to-earth is a use for the laser thought up by Hughes Aircraft, which developed the first working laser. Hughes is experimenting in the use of the laser's high-energy beams to weld, cut and melt metals to close tolerances. At left is a photomicrograph showing a hole burned in a block of steel by a laser burst. Magnification is 100. In another experiment, RCA engineers used a ruby laser to burn a whole through a sapphire crystal.

GET YOUR First Class Commercial F.C.C. LICENSE IN 12 WEEKS!

Is the course proven?

A high percentage of our fulltime resident students get their 1st class licenses within 12 weeks from the time they start the course. Intensive FCC license training is our specialty – not just a sideline.

Is the course complete?

The Grantham course covers all 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.

Is the course "padded"?

The streamlined Grantham course is designed specifically to prepare you to pass certain FCC examinations. All of the instruction is presented with the FCC examinations in mind. If your main objective is an FCC license and a thorough understanding of basic electronics, you want a course that is right to the point – not a course which is "padded" to extend the length of time you're in school. The study of higher mathematics or receiver repair work is fine if your plans for the future include them, but they are not necessary to obtain an FCC license.

Is it a "coaching service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC type test so you can discover daily just which points you do not understand and clear them up as you go along.

Is the school accredited?

Accreditation by the National Home Study Council is your assurance of quality and high standards. Grantham is accredited.

Is it a "memory course"?

No doubt you've heard rumors about "memory courses" and "cram courses" offering "all the exact FCC questions." Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand – choose Grantham School of Electronics.

THE GRANTHAM *FCC License Course in Communications Electronics is available by CORRESPONDENCE or in RESIDENT classes.*

For further details concerning F.C.C. licenses and our training, send for our FREE booklet

Grantham Schools

Accredited by the National Home Study Council

1505 N. Western Ave. Los Angeles 27, Calif. (Phone: HO 7-7727)	408 Marion Street Seattle 4, Wash. (Phone: MA 2-7227)	3123 Gillham Road Kansas City 9, Mo. (Phone: JE 1-6320)	821-19th Street, N.W. Washington 6, D.C. (Phone: ST 3-3614)

FIRST CLASS F.C.C. LICENSE IN 12 WEEKS

Grantham resident schools are located in four major cities – classes in F.C.C. license preparation are offered at all locations. New day classes begin every three months, and new evening classes begin four times a year.

MAIL COUPON NOW – NO SALESMAN WILL CALL →

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS
NATIONAL HEADQUARTERS OFFICE
1505 N. Western Ave., Hollywood 27, 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:

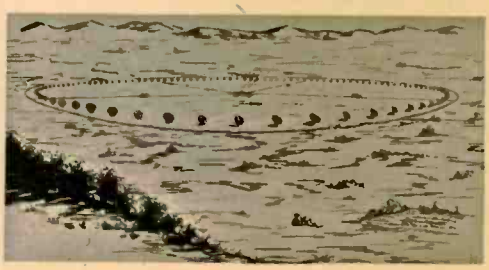
☐ Home Study, ☐ Resident Classes 38-A

. . . electronics in the news

'Tenna Trailer . . . Neatly packed together on the trailer in our photo are all the sections for a 30-foot parabolic

dish antenna which IT&T is shipping to Rio de Janeiro, Brazil. Along with it will go a van and two other trailers, representing a mobile satellite communications station. The NASA's experimental communications satellite Relay will link the station at Rio with one at Nutley, N. J., in the first North America-South America sky-high communications project. The facilities, spanning 4,820 miles, will have telephone, teleprinter and data transmission capabilities. Later modifications may make television relay possible. When hooked up with Telstar, the two systems would give the Americas and Europe a live TV link.

Sun Shots . . . Australia is building a giant radio heliograph to photograph the sun in a study of solar storms. It will



consist of 100 parabolic antennas, each 42 feet across, arranged in a circle two miles wide (see our drawing). The Ford Foundation is helping finance the project.

What Job Do You Want In Electronics?

Whatever it is, Cleveland Institute can help you get it!

Yes, whatever your goal is in Electronics, there's a Cleveland Institute program to help you reach it *quickly* and *economically*. Here's how: Each CIE program concentrates on electronics theory as applied to the solution of practical, everyday problems. Result . . . as a Cleveland Institute student you will not only learn electronics but *develop the ability to use it!* This ability makes you eligible for any of the thousands of challenging, high-paying jobs in Electronics. Before you turn this page, select a program to suit your career objective. Then, mark your selection on the coupon below and mail it to us *today*. We will send you the complete details . . . without obligation . . . if you will act NOW!

Electronics Technology

A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

First Class FCC License

If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

Industrial Electronics & Automation

This exciting program includes many important subjects as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

Electronic Communications

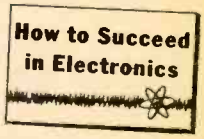
Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

Broadcast Engineering

Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.

Mail Coupon TODAY For FREE Catalog

Cleveland Institute of Electronics
1776 E. 17th St., Dept. EI-43
Cleveland 14, Ohio



Please send FREE Career Information prepared to help me get ahead in Electronics, without further obligation.

CHECK AREA OF MOST INTEREST –

- ☐ Electronics Technology
- ☐ Industrial Electronics
- ☐ Broadcast Engineering
- ☐ First-Class FCC License
- ☐ Electronic Communications
- ☐ _____ (other)

Your present occupation_____

Name_____ Age____
(please print)

Address_____

City_____ Zone____ State_____

EI-43

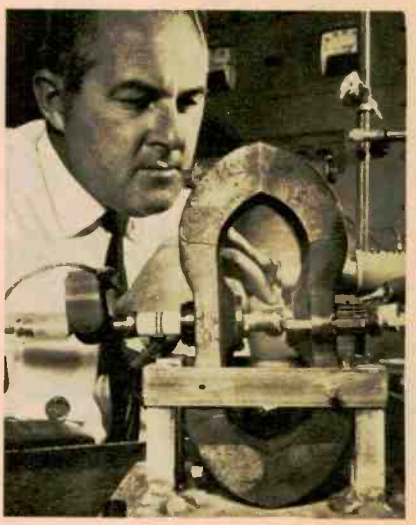
Cleveland Institute of Electronics

1776 E. 17th St., Dept. EI-43
Cleveland 14, Ohio

Accredited Member

. . . electronics in the news

Millimeter Magic . . . The Hughes Aircraft people have designed a new tube which they claim will make it possible



to cut through the ionization blackouts experienced by astronauts during reentry. The radio blackout caused more than a few problems when Astronaut Carpenter came down from orbit. The Hughes solution is a high-power traveling-wave tube (arrow points to the tube inside a large horseshoe magnet) which operates in the millimeter wavelengths. Millimeter waves, which fall between microwaves and light waves and run from about 30,000 to 300,000 mc, go right through an ion shield, such as that surrounding a returning space capsule. Radio waves, on the other hand, are stopped cold.

NOW! at a price you can afford!

MAKE MORE MONEY in ELECTRONICS

TELEVISION-RADIO

BETTER...MORE COMPLETE...LOWER COST... WITH NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING!

BETTER... Training that is proved and tested in Resident School shops and laboratories, by a School that is the OLDEST and LARGEST of its kind in the world.

MORE COMPLETE... You learn ALL PHASES of *Television-Radio-Electronics.*

LOWER COST... Other schools make several courses out of the material in our ONE MASTER COURSE . . . and you pay more for less training than you get *in our course* at ONE LOW TUITION!

Prepare for your F.C.C. LICENSE

Be prepared for secure future in
- INDUSTRIAL ELECTRONICS
- COMPUTERS
- GUIDED MISSILE SYSTEMS
- ELECTRONIC CONTROLS

or go into . . .
- COLOR TV REPAIR
- HI-FI AND SOUND SYSTEMS
- BROADCASTING STUDIOS
- INSTALLATION

TOP PAY... UNLIMITED OPPORTUNITIES LIFETIME SECURITY CAN BE YOURS!

You are needed in the Television, Radio, and Electronics industry! Trained technicians are in growing demand at excellent pay—in ALL PHASES, including Servicing, Manufacturing, Broadcasting and Communications, Automation, Radar, Government Missile Projects.

NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

YOU LEARN BY BUILDING EQUIPMENT WITH KITS AND PARTS WE SEND YOU. Your National Schools course includes thorough Practical training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step perform more than 100 experiments, and you build a complete TV set from the ground up that is yours to keep! A big, new TV picture tube is included at no extra charge.

EARN AS YOU LEARN. We'll show you how. Many students pay for their course—and more, while studying.

GET THE BENEFIT OF OUR OVER 55 YEARS EXPERIENCE

APPROVED FOR GI TRAINING

ACCREDITED MEMBER

NATIONAL TECHNICAL SCHOOLS

World-Wide Training Since 1905

Write to Dept. R4Y-122

4000 So. Figueroa Street

Los Angeles 37, California

YOU GET...

- 19 Big Kits—YOURS TO KEEP!
- Friendly, Instruction and Guidance
- Job Placement Service
- Unlimited Consultation
- Diploma—Recognized by Industry
- EVERYTHING YOU NEED FOR SUCCESS!

IMPORTANT SEE OTHER SIDE

THESE TWO FREE BOOKS TELL HOW

SEND FOR FREE FULLY-ILLUSTRATED BOOK AND ACTUAL LESSON TODAY.

Your own copy of "Your Future In Electronics-Television-Radio" will be mailed to you at once. No salesman will call; there is no obligation. Cut out card along dotted lines, fill in and mail today!

NO POSTAGE NECESSARY.

CUT OUT AND MAIL THIS CARD TODAY

Yes, I want to make more money in Electronics-TV-Radio. Send me your FREE Fully-Illustrated Opportunity Book and Actual Lesson today.

RUSH TODAY—NO POSTAGE NECESSARY

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

☐ Check here if interested only in Resident Training at Los Angeles. R4Y-122

Veterans: Give date of discharge _____

NO SALESMAN WILL CALL; NO OBLIGATION ON YOUR PART

DON'T BE HALF-TRAINED

Be a MASTER TECHNICIAN in ELECTRONICS-TV-RADIO

Only N.T.S. offers you ALL 8 PHASES in ONE MASTER COURSE

SUCCESS IS THEIRS; IT CAN BE YOURS TOO!

I cannot praise N.T.S. enough. I've just graduated and already I have started repairing radios and servicing TV's . . . At 53, I'm starting a new life and my diploma from National Technical Schools is my proudest possession.

William E. Eckenrod

As field director of Berean Mission Inc., I have complete charge of our radio work. With the expert advice and training I am receiving from you I can do my own repairs on our recorders and P.A. systems, besides keeping our radios going. My training from N.T.S. helps keep us on the air. I feel privileged to be a member of such a fine institution.

Rev. Enoch P. Sanford

Thanks to N.T.S. I have a business of my own right in my home. I have paid for all my equipment with money earned servicing TV sets. Yes, N.T.S. gave me my start in television.

Louis A. Tabat

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it has been going real good. I started part-time but I got so much work that I am doing it full-time. Thanks to National Technical Schools.

Alvin Spera

SEE OTHER SIDE

ALL 8 PHASES IN ONE MASTER COURSE

PHASE 1
TELEVISION INCLUDING COLOR TV
90% of homes have at least one set. Color TV is becoming more popular daily. TV Stations grow in number, need technicians. Maintenance and repair offer big opportunities.

PHASE 2
RADIO—AM & FM
Radios in homes, cars, schools, all need expert upkeep. Stations expand as FM becomes popular. Now transistors boom entire field.

PHASE 3
INDUSTRIAL ELECTRONICS
Computers, Data-Processing machines, Electronic Controls, Guided Missile Systems are new fields where Electronics play a vital role.

PHASE 4
SOUND SYSTEMS
New popularity of Hi-Fi-Stereo, as well as industrial sound systems and business intercoms make this a highly specialized and important field.

PHASE 5
FCC LICENSE PREPARATION
FCC License holders have a wide range of top jobs open to them. FCC License now a requirement for most Communication jobs.

PHASE 6
RADAR AND MICROWAVES
These are the communications systems of the future, already used in tracking and contacting satellites.

PHASE 7
AUTOMATION & COMPUTERS
Automation and Computer electronics are the new tools of industry and commerce. Skilled Technicians in these fields are in great demand at top pay.

PHASE 8
BROADCASTING & COMMUNICATIONS
In the entertainment industry, or in commerce, communications and broadcasting have great importance. Installation and maintenance of equipment requires trained technician know-how.

RESIDENT TRAINING AT LOS ANGELES
If you wish to take your training in our famous Resident School in Los Angeles—the oldest and largest school of its kind in the world—check special box in coupon.

Approved for GI Training

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

Address correspondence to Dept R4Y-122
4000 So. Figueroa Street
Los Angeles 37, California

National Technical Schools also offers Complete Home Study Training Programs in Auto Mechanics & Diesel, Air Conditioning, Refrigeration-Electrical Appliances, and Home Appliances Repair. For Information and FREE BOOK write the School, Dept. RDC, stating course desired.

FIRST CLASS
Permit No. 3087
Los Angeles, Calif.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

— POSTAGE WILL BE PAID BY —

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905
4000 So. Figueroa Street
Los Angeles 37, California

The Electronic Catalog of the Year
BY POPULAR DEMAND!

over 1,000,000 new friends—amateurs, pros, hi-fi devotees, hams—have already sent for it!

■

EASY TIME PAYMENT TERMS take up to 2 years to pay

284 PAGES
OVER 10,000 ITEMS

Partial list of products in our New 1963 Catalog

- Amateur Radio
- Antennas
- Batteries
- Books
- Capacitors
- Controls
- Hi Fi
- Microphones
- Needles
- Phonographs
- Public Address
- Radios
- Resistors
- Tape Recorders
- Test Equipment
- Tools
- Transformers
- Transistors
- Tubes
- Wire

YOU CAN STILL GET RADIO SHACK'S GREAT NEW 1963 Electronic CATALOG

FREE

For you and 2 Friends
MAIL CARD TODAY

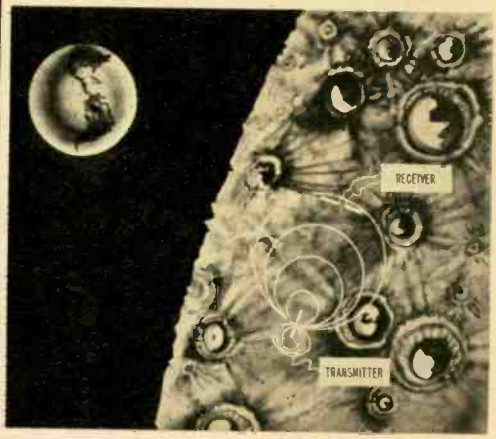
Yes, over 1,000,000 brand new friends have been added to the millions who shop regularly from Radio Shack's big catalog but we want everyone interested in electronics to have this great money saving shopping guide so we've printed 500,000 more for you and your friends. Mail the card opposite today and get your share of the newer and better things in electronics in this fine new book.

Whether you are a music devotee, a radio ham, a professional operator, or just interested in the great world of communications as a hobby, you'll be excited and delighted with the vast assortment of precision-built, high-quality, guaranteed products in Radio Shack's famous catalog. And you'll save too as you never saved before. Our easy credit terms make it convenient and simple to buy what you want when you want it and pay later. Mail the card opposite now!

RADIO SHACK CORPORATION 730 Commonwealth Ave. BOSTON 17, MASS.

. . . electronics in the news

Moon Beam . . . National Bureau of Standards scientists at the Central Radio Propagation Laboratory have



been theorizing about what kind of radio equipment man will need when he gets to the moon. Factors considered included the absence of ionized atmospheric layers and a dry, insulating surface. Their conclusion (sketched in the drawing): use an end-fed long-wire, lying right on the non-conducting surface, for transmitting and a dipole for receiving. They figure a 16-watt signal at 100 kc will reach 62 miles.

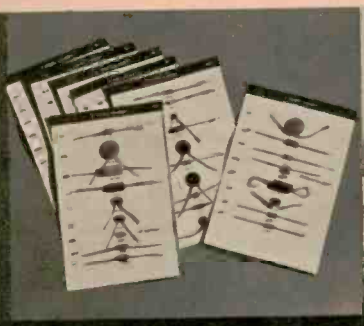
Tiny Tube . . . A Geiger counter tube so small you could lose a dozen of them in your pocket has been developed by

the EON Corp. for tumor study at Columbia-Presbyterian Medical Center. The beta-counting tube is a quarter-inch long and .04-inch in diameter. It is inserted directly into body tissues for study of radioactive isotope uptake by tumors. The tube is shown (arrow) being inserted into a hypodermic needle; lead is at left.

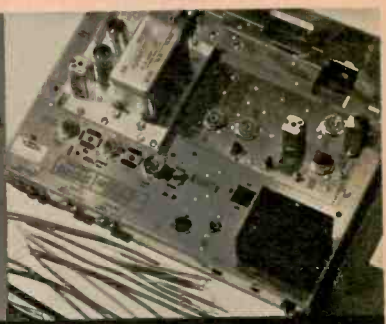
Here's why Audio Magazine says Scott® Kits are

"Simplest to build..." and have "Engineering of the highest calibre"*

The exclusive Scott full color instruction book shows every part and every wire in natural color and in proper position. To make the instruction book even clearer, each of the full color illustrations shows only a few assembly steps. There are no oversized sheets to confuse you.

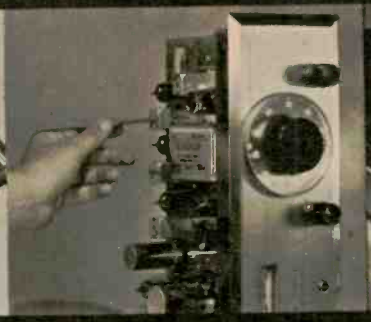


Each full color illustration is accompanied by its own Part Chart . . . another Scott exclusive. The actual parts described in the illustration are placed in the exact sequence in which they are used. You can't possibly make a mistake.



Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.

There are certain areas in every professional high fidelity component where wiring is critical and difficult. FM front ends and multiplex sections are an example. In Scott Kits these sections are wired at the factory, and thoroughly tested by Scott experts, assuring you a completed kit meeting stringent factory standards.



Tuners are aligned with the unique Scott Ez-A Line method using the meter on the tuner itself. This assures perfect alignment without expensive signal generators. Amplifier kits require no laboratory instruments for perfect balancing.

The new Scott Warrantee Performance Plan guarantees that your kit will work perfectly when completed. If you have followed all recommended procedures and your kit fails to work Scott guarantees to put your kit in working order at the factory at minimum cost.

When you finish your kit you'll be delighted by its handsome good looks. And when you turn your Scott Kit system on you'll know for yourself why the expert editors of leading high fidelity magazines like Audio say . . . "only the most sophisticated engineering thinking could design a kit as simple and foolproof as this . . ."*

*Audio — February 1951, Pages 54-56

SCOTT®

H. H. Scott, Inc., 111 Powdermill Road, Dept. 20-01, Maynard, Mass.

FREE STEREO RECORD

demonstrating new FM Multiplex Stereo and explaining all important technical specifications.

SEND ME FREE STEREO record plus 20 page 1963 "Guide to Custom Stereo" new Scott kit brochure

Name _____

Address _____

City _____ State _____

Include names and addresses of any interested friends.

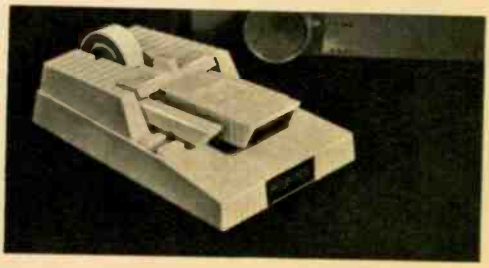
Export: Morhan Exporting Corp., 458 Broadway, N. Y. C.
Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto

Electronic Marketplace

Platter Spinner . . . AR's first product outside its famous line of speakers is a 33⅓-rpm turntable which, the maker

states, meets NAB (professional) specs. It is so stable that a hammer blow on the top plate does not make the stylus jump grooves. The platter weighs 3.3 lbs., is belt-driven by synchronous motors. Turntable comes complete with tone arm (less cartridge), base and dust cover at a price bound to cause some ripples in the audio field—$58. Acoustic Research, Inc., Cambridge 41, Mass.

Stereo Splicer . . . New Gibson Girl splicer is designed for 4-track stereo, has special blade adjustments and a



visual peep-window. $11.50; Robins Industries, Flushing 56, N. Y.

Marketplace

Suppressed $$ . . . Costing only $99.50 (less power supply), the Meteor SB-175 ham transmitter features suppressed-

carrier *double*-sideband transmission and runs 100 watts on conventional AM, 175 watts CW. Crystal control 10- through 80-meter bands, 5x8x12 inches. It can be used either fixed or mobile. World Radio Labs, Council Bluffs, Iowa.

Transistors with Muscles . . . Who said transistors are low-power devices? An all-transistor basic stereo power ampli-

fier brought out by Lafayette develops an even 100 watts (IHFM) per channel. It contains 16 power transistors (two in each output stage) plus 14 silicon diodes. The vertical ribs on the front (see cut) are heat sinks to help get rid of some of those heat watts. Model LA-280WX. $300. Lafayette Radio Electronics, Syosset, N. Y.

Many companies are fielding new all-transistor integrated amplifiers, among them Knight with a 100-watter for $189.95 and Heath with a similarly rated kit selling for $134.95.

Marketplace

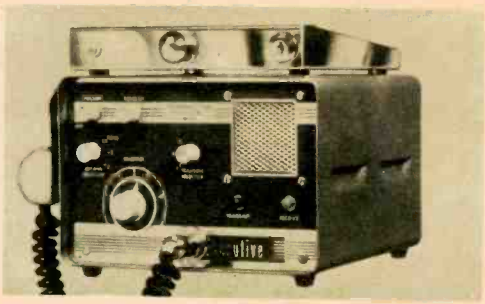
Working Polish . . . An anti-static polish for plastic surfaces, being marketed by GE, does more than clean and shine. It also neutralizes dust-attracting static charges in such things as plastic-surface TV face plates and meter faces. TV face plates often get a coating of static-attracted dust that makes viewing an eye-straining ordeal, while a charged meter case may attract the needle enough to give you an incorrect reading. The makers also claim the polish removes minor abrasions and scratches from a television picture screen or plastic cabinet. 75 cents for 8 oz. General Electric Co., Owensboro, Ky.

Party Line to Private Line . . . Ideal for the small business that has a base control station and several mobiles, the

Heathkit Tone Squelch gives silent stand-by CB operation and offers selective calling, using four audio tones to call any one of four other stations working on the same channel. A monitor-all switch position restores the rig to general communication. The Tone Squelch can be connected to most popular CB transceivers. Its operational mechanism is a resonant-reed relay. During stand-by it really *is* silent—the speaker is disconnected! AC kit GD-162A, $34; DC kit GD-162D, $38. Heath Co., Benton Harbor, Mich.

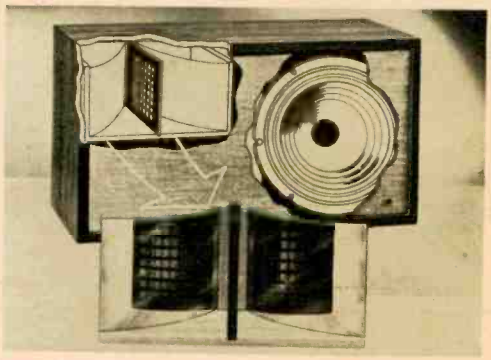
Marketplace

Mobile Mount . . . Your mobile CB or ham transceiver mounts (and locks) neatly under the dash, yet can be taken



out quickly for service or indoor use, if you happen to be using an Irvan Rig-Loc. Rig-Loc is a universal mounting frame (shown on top of an Executive CB transceiver) to which most rigs can be secured via a key and slide lock. Mounting requires four holes in transceiver's top. Irvan Ferromagnetics, Van Nuys, Calif.

Tweeter Reflections . . . An electrostatic tweeter in a new type of housing and a husky electrodynamic woofer are com-



bined in the JansZen A-500 speaker system. A range of 30 to 30,000 cps is claimed. The push-pull tweeter assembly is mounted vertically in a special reflective housing (see upper left corner of cabinet and closeup in foreground) that spreads the sound and eliminates the spotlight effect often associated with high-frequency sound radiators. $125 and up. Neshaminy Electronic Corp., Neshaminy, Pa.

Marketplace

Auto-Diode Tester . . . That's the name of a new instrument for checking the silicon diode rectifiers used with alternators in many new cars. A direct-reading meter indicates whether a suspected diode is shorted or has high leakage. $15. Leece-Neville Co., Cleveland 3, Ohio.

Music to Swim By . . . Even the unchanging piano is yielding to the pressures of the electronic age. Wurlitzer has brought out an all-transistor, battery-operated job that weighs 81 pounds. That's not exactly a light load to lug along on a picnic, but we'll have to admit it doesn't measure up to a baby grand's gross. The legs can be removed and stowed in a cover that snaps over the 64-note keyboard when in the toting mode. Package measures 39x21x8 inches, small enough to fit in most car trunks. It will cost you around $400. Wurlitzer Co., DeKalb, Ill.

BEST BUYS IN STEREO AND MONO HI-FI

Transistorized Stereo/Mono 4-Track Tape Deck RP100
Semikit (electronics in kit form) $299.95 Wired $399.95

New Stereo FM Multiplex Tuner ST97
Kit $99.95* Wired $149.95*

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

70-Watt Integrated Stereo Amplifier ST70
Kit $99.95 Wired $149.95

40-Watt Integrated Stereo Amplifier ST40
Kit $79.95 Wired $129.95

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

Stereophonic Dual Preamplifier ST84
Kit $59.95 Wired $89.95

Stereo Power Amplifiers

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

FM-Multiplex Autodaptor MX99
Kit $39.95 Wired $64.95
Cover Optional, $2.95
(Patents Pending)

Bookshelf Speaker System HFS1 Kit $39.95 Wired $47.95

BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Citizens Band Transceivers 770 Series from Kit $79.95 Wired $109.95.

U. S. Pat.

60W CW Transmitter =723
Kit $49.95 Wired $79.95

Walkie-Talkie Citizens Band Transceiver #740
Kit $54.95. Wired $79.95. Complete with rechargeable battery & charger.

BEST BUYS IN TEST EQUIPMENT

Metered Variable Auto-Transformer 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® (U.S. Pat.)
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

General Purpose 5" Scope #427
Kit $69.95 Wired $109.95

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 $16.90

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

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

AC Volt-Watt Meter #261*
Kit $49.95
Wired $79.95
*Formerly called #260

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

EICO

EXCELLENCE IN CREATIVE ELECTRONICS

Over 2 MILLION EICO instruments in use throughout the world. Compare, take them home — right "off the shelf" — from 2000 neighborhood dealers, most of whom offer budget terms.

EICO, 3300 N. Blvd., L.I.C., N.Y. EI-1
☐ Send free Catalog describing over 106 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

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M.

ELECTRONICS ILLUSTRATED
JANUARY 1963

LOOK WHAT'S HAPPENED TO RADIO!

Transistors, cars, TV, hi-fi, stereo FM . . .

all have conspired to give radio a new image.

By C. M. Stanbury II

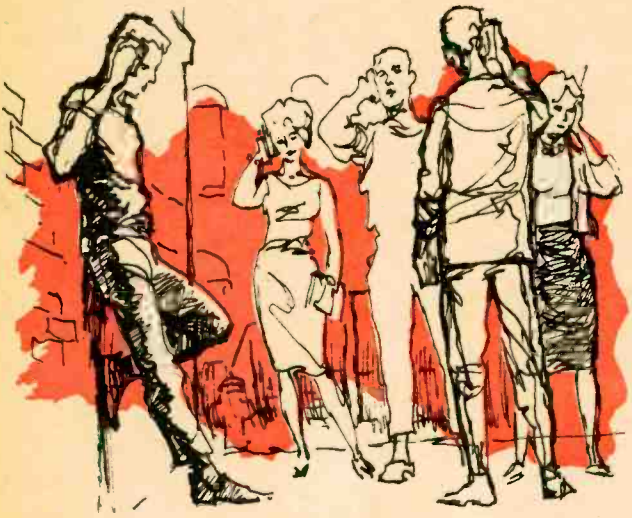
EVERYTHING is subject to change, someone observed long ago. But among our mass information and entertainment media none has changed quite as much as radio. The movies, television, national magazines—we've seen them vary style and content but the original marks of the mold that formed them still are visible. Radio, especially commercial broadcasting, has taken on a totally new image since the war. Whether it is an image that pleases the greatest number of listeners is open to discussion. But at least radio has shown itself to be adaptable; it has *tried* to please its audience. And quite an audience it is.

If you are one of the many who views radio as passe, you must admit that, to Americans, the old-fashioned must have some special charm. For in our nation there are as many radios as people—183.8 million at last count. In 96 out of every 100 homes you'll find some kind of receiving instrument.

In these post-war years of change we've seen commercial radio's secure domain invaded by a brash upstart that fought tooth-and-nail for the industry's lifeblood, the advertising dollar. Television, it appeared for a while, would doom radio to an obscure role in our lives. It was as if the horse and buggy had stayed on to do battle with the automobile. But TV, though it has become a giant, never was able to deliver a coup de grace. From its beachhead in areas where television couldn't reach, through the support of networks with interests in both combatants, and by offering features TV could not duplicate, radio made a comeback.

Today, those funny collection jars labeled *Help Stamp Out TV!* are gone from the desks of radio executives. The industry figuratively has turned its back on its adversary, throwing its energies into creating a new life for itself. A nation of radio listeners we once were, and we still are, despite the burning stare of television's astigmatic eye.

The radio we know now is nothing like what once entertained, informed and even enlightened us. The old days are far gone. Amos and Andy have given up the riotous life. Father Barbour of One Man's Family, drawing nigh 100, presumably is reading his National Geographic in some nursing home. And Helen Trent's romances, though perhaps as soul-searing as ever, are at least less public these days.



Radio soap opera is dead, as are most of the other program formats that once were familiar.

But radio, in its resurrected life, has nothing to complain about. In fact, the two organizations most concerned with its health, the National Association of Broadcasters and the Radio Advertising Bureau, find much to brag about. In the most recent year for which figures are available, the medium took in 668 million advertising dollars. That's hardly the index of a dying industry.

Another indicator of the business (and profit) potential of radio is the amazing increase in the number of new stations. Any hard-headed businessman willing to sink a fortune in building a new transmitter isn't doing it for amusement. He's certain of a profitable return. The FCC's latest tally shows 3,742 commercial AM stations on the air, of which 805 also operate an FM transmitter. Pure FM, which has experienced a decline and rebirth of its own, is represented by 386 stations.

On the program side, radio seems to be in the middle of a major change in format. The so-called good music format is increasing in popularity, though the term is being watered down before our eyes. It might be more correct to say *better* music.

Up-to-the-minute news, a radio staple from the beginning, has become so important that most stations give you at least a capsule every half-hour. NBC's News of the Day is consistently rated as the top network show in size of audience. And the West Coast has come up with the most dramatic new format of all—the continuous-news station. No music, no drama. Just news, markets and weather (plus enough religion to meet FCC requirements).

In the record-playing field, radio has taken some strange turns. Disc jockeys go back more than 30 years, to the day when Martin Bloch originated the art, but there have

been switches in approach and presentation. The standard talk-popular music format took on perceptible changes at the beginning of the last decade.

DJ's became stronger personalities and music variety gave way to specialty numbers. First came straight hillbilly tunes, followed by the bane of many sound minds —rock 'n' roll. Along with rock 'n' roll, we were introduced to the top-40 program, in which the most popular tunes of the day were played. The fact that virtually the same music blared out *every* day finally seems to have cooled the audience. As a result, the good-music format is taking over.

Disc jockeys, who once were known to give interesting facts about the music they played, or at least furnished interesting gab, seemingly are going in more and more for cute and pointless remarks. On good-music stations they appear to be losing out to straight announcers, which may be a sign of the future.

With its current fare of mostly music and news, radio is in no position to change the country's culture and mores, which it once might have been capable of doing. Weighty and powerfully influential are terms that no longer apply. Rather, the medium has become the source of background music for doing housework by, for driving through rush-hour traffic by and (unfortunately for many with sensitive ears) for dancing the Twist to.

Transistor radios, turned out by the millions (16 million in the last two years alone) in Japan and America, have made radio a personal, at-your-side companion, particularly for teen-agers. The image of a boy or girl walking down the street with a palm-size radio pressed against one ear is duplicated in every town in the country. And this image has affected radio programming. Stations are interested in playing what those teen-agers want to hear.

FM radio in particular supplies music via commercial sound systems to many stores and restaurants, of course.

Radios now are classed as the most popular of all car accessories. There are some 47 million radio-equipped cars on the road and better than three out of every four new autos come with a radio.

In all of these areas, radio found a place where television could not compete and then exploited the opportunity to the fullest. The leaders who quarterbacked radio's counterattack against TV exhibited wisdom in their moves. And, though television is dominant at night, radio still has the larger audience between 6 a.m. and 6 p.m. The

[*Continued on page* 121]

SEMI-CONDUCTOR SPEED CONTROL for your

electric drill . . . sewing machine . . . saber saw . . . portable band saw . . . food mixer . . . food blender . . . movie projector . . . sander . . . fan . . . lathe . . . etc.

By J. R. Jacques General Electric
Rectifier Components Department

SUPPOSE you want to reduce the speed of your electric drill for some heavy-duty hole-making. Or you need to slow down your saber saw to cut through some half-inch boiler plate without burning up the fine-tooth blade. Installing a variable power resistor in series with your tool isn't the answer. Sure, the drill or saw would run slower, but considerable power would be lost and it would probably stall. The torque required by a heavy-duty task just wouldn't be there.

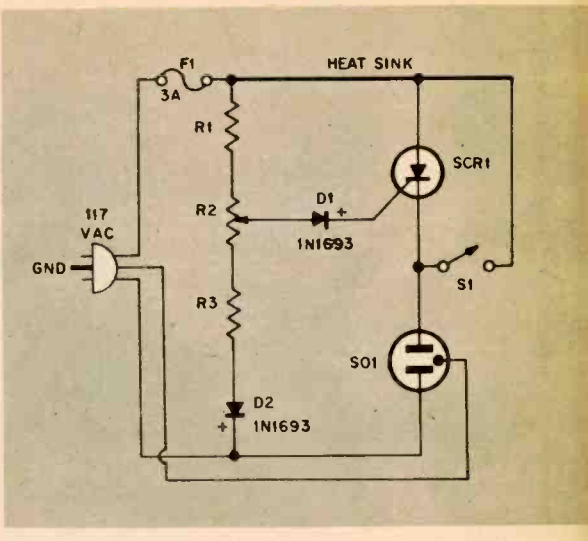
A recent brainchild of semiconductor research has provided the answer for you. The silicon controlled rectifier unit described here can be built for about $12 and provides an effective control over the speed of any *series-universal* type motor. The tool simply is plugged into the control box which, in turn, is plugged into a 117-volt outlet. Not only is the control continuously variable, but the amount of power provided by the speed-control *automatically adjusts it-*

PARTS LIST

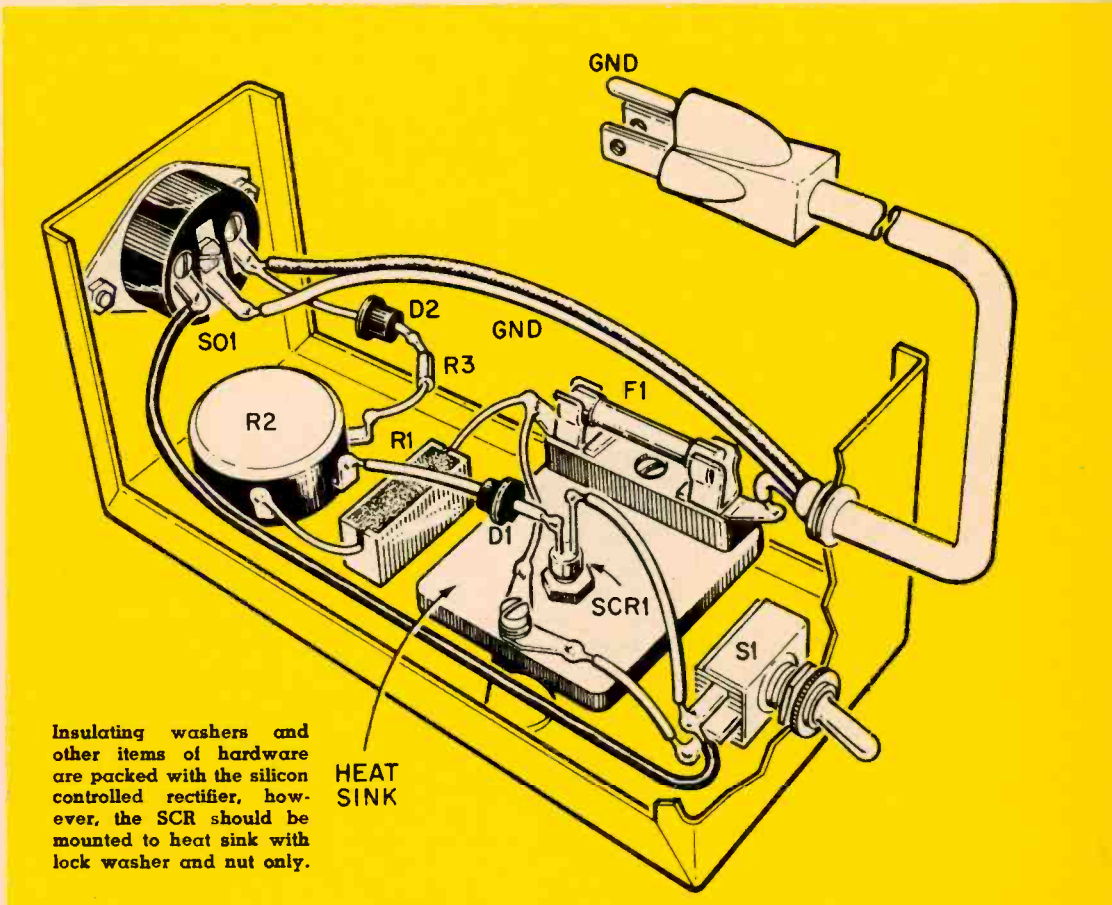
Resistors:
R1—2,500 ohms, 5 watts
R2—250-ohm, 4-watt wirewound potentiometer
R3—33 ohms, ½ watt (see text)
D1,D2—1N1693 diodes
S1—SPST toggle switch
F1—Fuse block with 3 A, 3AG slow-blow fuse
SCR1—GE C15B silicon controlled rectifier
SO1—AC receptacle (Amphenol #61F1 female with ground)
Misc.—3¼"x2⅛"x1⅝" Minibox (see text); line cord with grounding type plug; standoff insulators for heat sink; knob; etc.
The above parts (excluding the cabinet and heat sink) are available as a package from Allied Radio, 100 N. Western Ave., Chicago 80, Ill. Stock #53B511. Price: $11.

PARTS LIST
(Heavy-Duty Version)

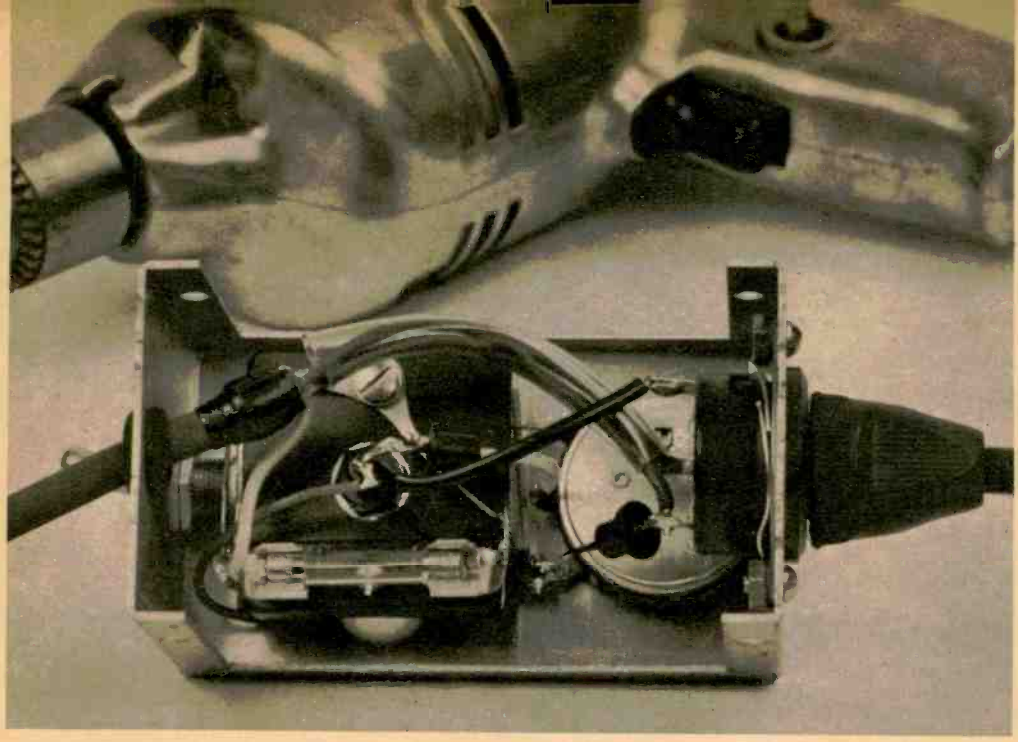
Same parts listed above except the following:
F1—Fuse block with 8 A, 3AG slow-blow fuse
SCR1—GE C-37B silicon controlled rectifier
R1—1,000-ohm, 5-watt resistor
Allied Radio stock #53B512. Price: $15.75



S1 switched to the full-speed position takes SCR1 out of the circuit but the resistors will run warm.



Insulating washers and other items of hardware are packed with the silicon controlled rectifier, however, the SCR should be mounted to heat sink with lock washer and nut only.



Compact prototype unit would benefit from larger heat sink and cabinet. Ventilation holes are required.

self to the work being done. In other words, if a drill tends to slow down because of the load, the speed control unit automatically supplies more power and thereby maintains an essentially constant speed.

Besides drills and saber saws, this speed-control works with almost any motor-operated tool or appliance with a universal motor within its 3-amp. rating —sewing machines, band saws, food mixers, blenders, movie projectors, sanders, fans, lathes, vibrators, etc. A heavy-duty version (see Parts List) with an 8-ampere rating can be constructed from the same plans.

Construction Notes. There are a few precautions to be taken in the construction of the speed-control. Layout is not critical, but care must be taken in the heat sinking of silicon control rectifier SCR1. As is shown, SCR1 is mounted on a heavy copper or aluminum disc, which in turn is electrically insulated from the box by standoffs. If you can spare the room, it would be a good idea to build the unit in a larger cabinet than is shown in order to incorporate a larger heat sink. For intermittent use, the 1½ x 1½-inch heat sink is adequate, but the larger the better.

If certain tools or appliances do not go as slow as desired in the minimum speed setting, R3 can be changed to reduce speeds even more. Your particular tool may require a 22-ohm to a 68-ohm, ½-watt resistor. Too low a resistance may lead to erratic motor operation. The heat sink for the heavy-duty model should be aluminum or (preferably) copper, about 5 x 5 inches, and at least $\frac{1}{16}$-inch thick.

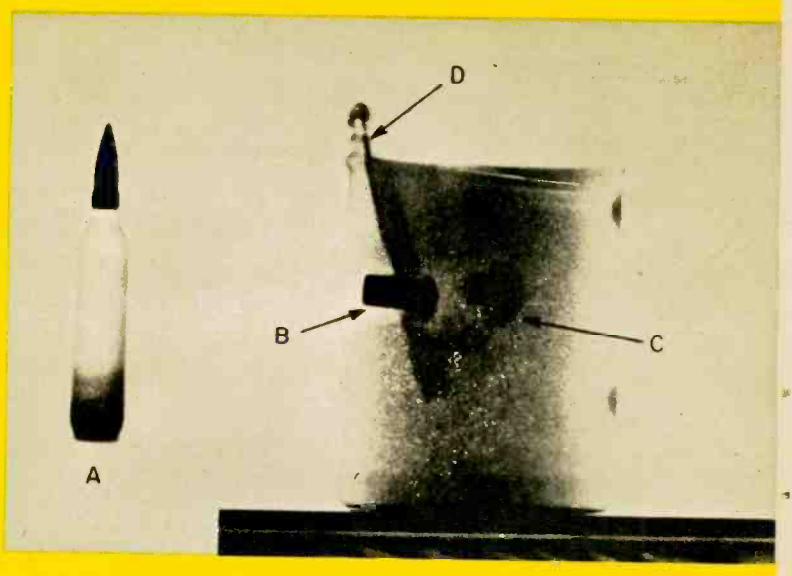
If you are not certain that your tool or appliance has a universal motor (most do) you can check by looking for the brush holders. If the motor housing label indicates that the tool can operate on AC or DC, then you can assume that it has a universal-type motor.

The theory of operation of the speed-control is quite complex, despite the simplicity of the circuit worked out at General Electric. Rather than attempt a short and possibly misleading explanation here, we refer you to GE's Silicon Controlled Rectifier Manual, which has a lengthy theoretical discussion of similar circuits on page 125. The Second Edition of the manual, available at most large jobbers or from General Electric, Rectifier Components Dept., West Genesee St., Auburn, N. Y., costs $1.50.

A HAM AT 10 FATHOMS

A NAVY Commander, J. Dan Reilly, Jr., holds the distinction of being the first ham to QSO from a submarine while submerged. Dan, W4NMK, is skipper of the USS Cutlass, a 306-foot fish. Using the craft's regular communications equipment, he works 15, 20 and 40 meters, mostly sideband. His antenna is a 12-foot base-loaded whip. When the Cutlass is submerged to communications depth the keel is about 60 feet (ten fathoms) under and the antenna is just above water. Dan was surprised to find that signal strength, particularly on 20 meters, increased by some 40 db when he submerged. The groundplane effect of the water evidently makes the difference. In one six-week cruise Dan made 625 contacts with 42 states, 28 foreign countries and Antarctica, mostly while submerged. He also arranges phone patches so his crewmen can call home. And he has a 100 per cent QSL record. The insert shows him in his shack aboard the Cutlass.—*Robert Hertzberg, W2DJJ*

A NEW LOOK IN X RAYS



Progress hits the X-ray tube, grandpa of all electronic devices.

By Nicholas Rosa, W1NOA

THE X-RAY tube—whose name, at least, is familiar to everyone—has a unique history among electronic devices. It was one of the first invented, coming before radio, but remained basically unchanged for six decades. Wilhelm Roentgen discovered X rays in 1895 but it was not until the last couple of years that progress caught up with his brainchild. X-ray tubes are now appearing in totally new forms to tackle bold new jobs.

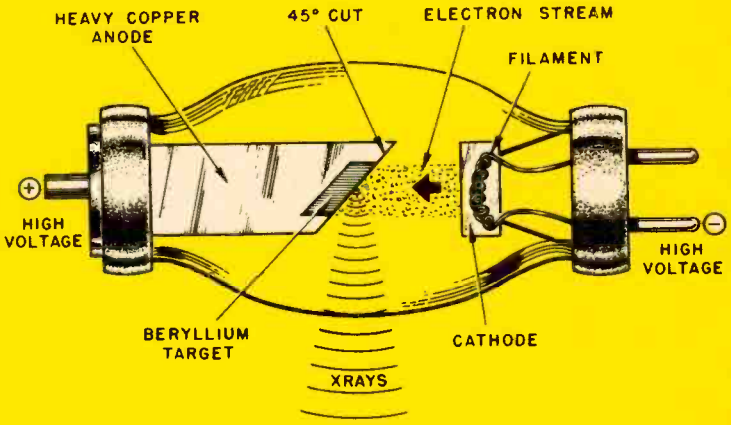
The photo at the top of this page may resemble any other bullet-in-flight shot, but there is a big difference. The bullet in positions (B) and (C) is *inside* an aluminum salt shaker filled with water. Its image was stopped in flight by X rays, which penetrated the metal of the shaker. The two exposures, each lasting 1 microsecond, were made just 25 microseconds apart.

Such stop-motion X-ray pictures (radiographs) and X-ray movies (cineradiographs) are now possible for the first time with an improved pulsed-beam system designed by Zenith. Besides sharp pulses, the equipment produces a high-intensity, highly focussed beam.

The radiographs at the bottom of the opposite page demonstrate a new X-ray image-amplifying system built by Picker. At left is a picture of an RCA Nuvistor tube illuminated by the sharp beam of Picker's rotating-anode X-ray tube. The other shot was made with a conventional X-ray beam. It is fuzzy because the beam is wide (.02 inches) and suffered from penumbra, a side beam of half-light surrounding a bright central spot. (A flashlight beam has a penumbra around a central spot.) The new Picker tube eliminates penumbra with internal focussing and reduces the beamwidth to .012 inches, producing a sharp photo.

The new X-ray systems have the usual medical uses, but they also can be used for non-destructive industrial testing, peering through metal, plastic and other materials to observe the inner workings of mechanical and electronic devices. For instance, a control circuit for a rocket can be observed when, in operating condition, it is subjected to vibration, heat, impact, etc. Via X rays, it is possible to see relays throwing, wire leads vibrating or tube filaments tearing loose. There is no need to tear the equipment apart later,

Two-exposure shot at left demonstrates the abilities of Zenith's improved pulsed X-ray system, which can take movies of high-speed phenomena. The bullet from cartridge (A) is shown as it punctures aluminum salt shaker filled with water (B); 25 microseconds later the bullet is shown as it mushrooms at (C). (D) is a trigger which initiated the series. Such high-speed X-ray photos were impossible with previous equipment. Diagram at right shows diode-type X-ray tube.



or even open the lid, to find out what happened.

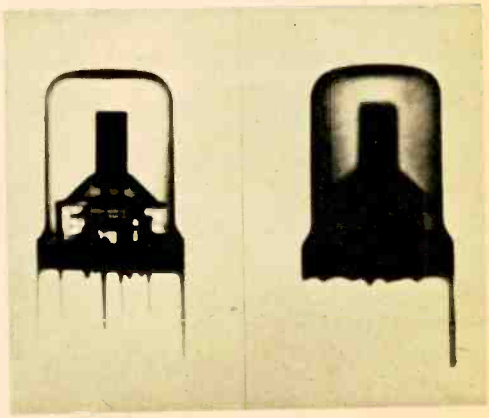
In the standard diode X-ray tube electrons from a cathode (see diagram) hit a copper anode and cause it to emit X rays, just as tin emits sound when hit by gravel. Usually a target of beryllium or tungsten, which produce more X rays than copper, is embedded in the anode.

The A. O. Smith Corp. of Milwaukee has combined an X-ray tube with that atom-smasher gadget, the linear accelerator, to produce the Big Bertha of the field. It is a tube 11 feet long and 30 inches in diameter. Electrons, pushed through the tube by radio-frequency waves, slam into the anode near the speed of light. Output of this 8-million-electron-volt tube is 6,000 roentgens per minute, where medical machines give off fractions of a roentgen per hour. The beam can penetrate and inspect a sheet of steel 16 inches thick.

Other new developments in the field include experiments with X-ray pictures in color at Argonne National Laboratory and an X-ray microscope in Britain.

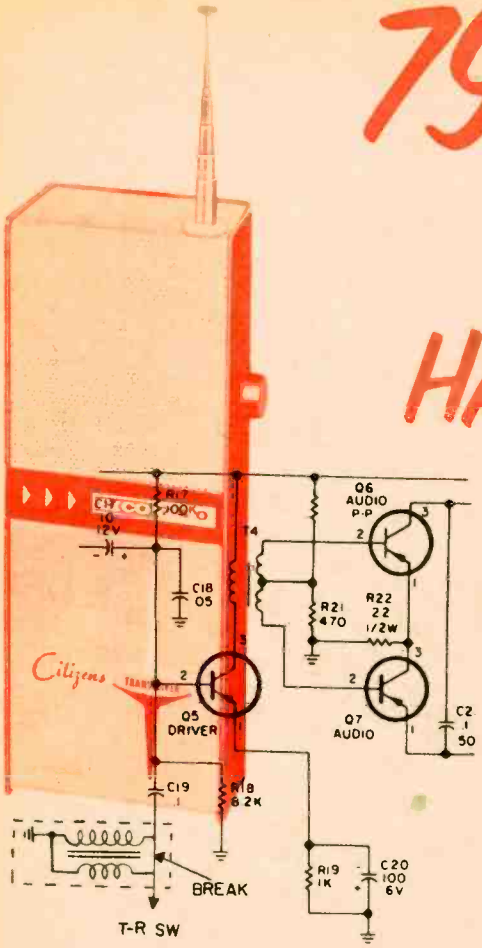
X rays fall toward the top of the electromagnetic spectrum, being shorter in wavelength than visible light or ultraviolet radiation. Wavelength runs from about .1 to 100 angstroms (there are 25.4 *billion* angstroms in an inch). As X rays get shorter, their energy increases.

Of still shorter wavelength are the gamma rays, which sit atop the spectrum and are even more powerful than X rays. There are experiments afoot to use gamma rays (and even neutron bombardment) for penetrating materials that block X rays. Thus, though X rays have just managed to catch up with modern electronic progress, they might one day be outmoded.



Picker X-ray image-amplifier gives sharp shot of tube (left) but standard photo (right) is fuzzy.

79¢ Soup-Up for your HANDI-TALKIE



EICO 740 schematic with added transformer.

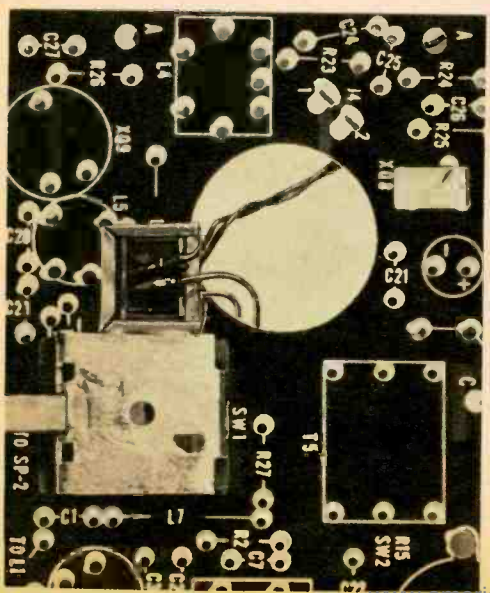
Are you a 100-milliwatt weakling? Add mighty modulation muscles with EI's six-bit soup-up.

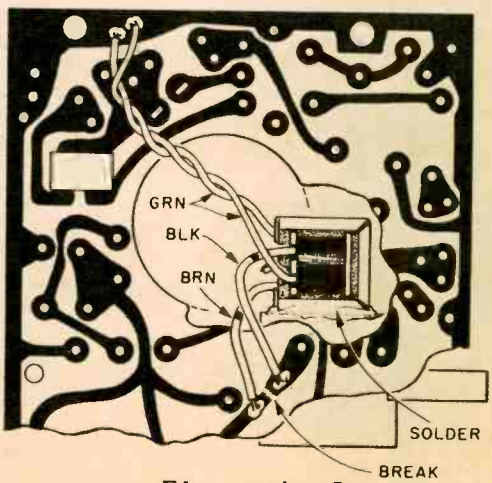
By Martin Schecter
2W2228/WA2IDY

WHEN you're using a handi-talkie on the Citizens Band or License-Free Band you don't ordinarily expect much range or quality. That 100-milliwatt signal just doesn't have the moxie.

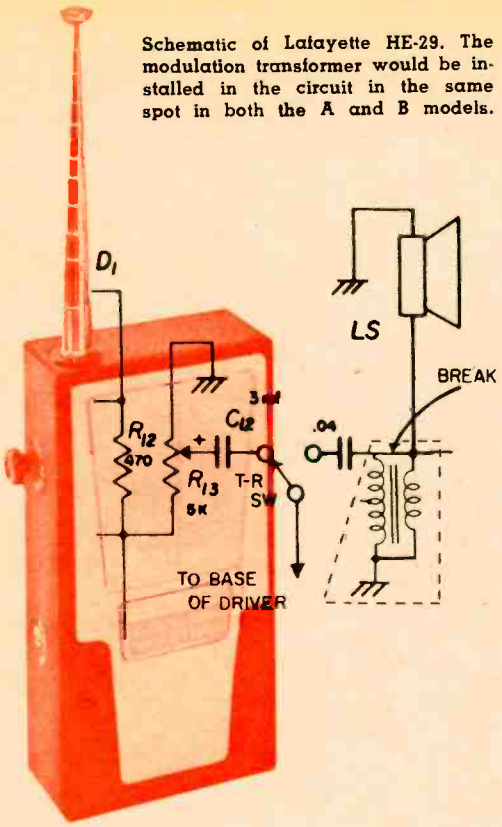
But by adding just one 79-cent transformer, you can give your little squawker modulation with muscles for a longer, cleaner reach. Your signal which may have been lost in the mud, now can cut through almost like a 5-watter. And the soup-up is legal too.

Circuit board of 740 before parts are installed showing mounting and connections of transformer. Foil side of the board at right shows the small break that must be made in the foil conductor.





Electronics Illustrated



Schematic of Lafayette HE-29. The modulation transformer would be installed in the circuit in the same spot in both the A and B models.

A big factor limiting handi-talkie performance is inadequate modulation. This, in turn, is due to the use of the speaker as a microphone for transmitting. The problem goes back to the speaker's impedance, which usually is 8 ohms or lower. This is fine when the speaker is used as a speaker because the transceiver's audio output transformer matches the output impedance of the audio transistor(s) to the speaker. The story is different, however, when the speaker becomes a mike and is switched to feed the base of the input (or driver) transistor. The transistor's input impedance runs about 2,500 ohms and an 8-to-2,500 mismatch is severe enough to cut the power delivered to the transistor by a significant amount. To obtain maximum signal transfer, a matching transformer is needed.

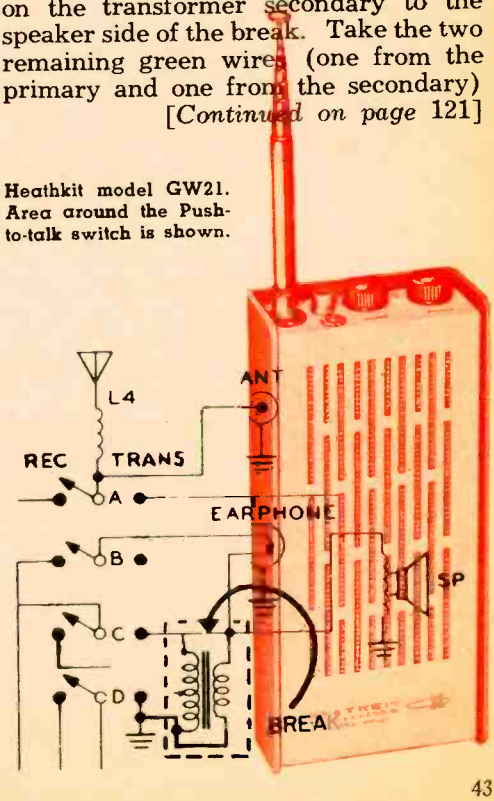
The ideal transformer would have an impedance ratio of about 300 to 1. The problem is finding a transformer of that ratio small enough to mount in an already-crowded handi-talkie cabinet. The best bet from the price, size and ratio standpoint is the Lafayette TR-99, a 79-cent subminiature transformer originally designed for output service.

In our application, its normal 500-ohm primary serves as the secondary connected to the base of the transistor. The red center-tap on the winding is cut short and ignored. The secondary of the transformer (black, green) serves as the speaker input.

Installation in most handi-talkies is quite easy. Mount the transformer as close as possible to the printed wire that leads from the speaker to the base of the driver transistor. Solder the frame of the transformer to any ground connection or to the outside of an IF can. If you can't locate a good solder point, epoxy glue can be used. The switch bracket of the model 740 EICO handi-talkie, as shown in the photo, served as a convenient mounting point.

Use a razor blade to make a small break in the circuit board wiring in the area shown in the EICO unit. Connect the black primary lead to the side of the printed wire which leads to the base of the transistor. Connect the brown lead on the transformer secondary to the speaker side of the break. Take the two remaining green wires (one from the primary and one from the secondary)

[*Continued on page* 121]



Heathkit model GW21. Area around the Push-to-talk switch is shown.

HI-FI RECORD GUIDE

by Warren DeMotte

IT WAS on October 30, 1961, that 72-year-old Artur Rubinstein played the first in a series of ten Carnegie Hall recitals, scheduled to span 40 days and 89 compositions. Foresightedly, RCA Victor was on hand with recording equipment, for the great pianist was in top form, as the first record to be released (see cut) so eloquently testifies.

The disc comprises compositions by four 20th Century composers: Debussy, Prokofiev, Szymanowski and Villa-Lobos. The playing is sensitive, spontaneous and communicative, well captured by the recording and with a minimum of audience noise and a maximum of live-performance excitement.

International co-existence received a boost when Mercury carried its mobile recording unit to Russia and taped American pianist Byron Janis and the Moscow Philharmonic under Kyril Kondrashin in Prokofiev's Third and Rachmaninoff's First Piano Concertos. Inspired by the history-making occasion, the musicians fashion a pair of slashing, virile performances. The magnificent sound justifies the transportation of top equipment thousands of miles.

A mightier concerto, Beethoven's Emperor, is committed to disc by pianist Rudolf Serkin and the New York Philharmonic under Leonard Bernstein. It is given a probing, heroic interpretation, grand in scope and vital in execution, with brilliant sound.

More Beethoven, probably his most profound composition, is performed by the Juilliard Quartet, the architectural, abstract, imaginative String Quartet in C Sharp Minor, Opus 131. The reading is fervent and understanding, the sound transparent.

Pipe organ sound of splendid clarity and vibrancy is realistically captured in Carl Weinrich's disc of Bach Organ Music. Four of the Master's towering compositions are accorded authoritative, forthright performances.

More Bach and more fine sound appear in Sylvia Marlowe's rendition of the 18th Century composer's Goldberg Variations. She plays this hour-long harpsichord masterpiece with zest, dedication and insight, and the recording is crystalline.

Even earlier times are represented in Spanish Medieval Music, sung and played by the New York Pro Musica, conducted by the enterprising Noah Greenberg. Especially fascinating are 12 Cantigas de Santa Maria, written in the 13th Century by King Alfonso the Wise, a monarch who deserved his title. Marvelously colorful music, performed and recorded with consummate skill.

Vanguard has coupled Haydn's 103rd and 104th Symphonies in one of its low-price demonstration discs. The performances are first-rate and the recording is superior, making this an enticing bargain.

Billy Vaughn has an aptitude for turning out hits and A Swingin' Safari is a good example of this talent. His arrangements are colorful, his performances lively, and he balances a dozen songs in a well-integrated program.

[*Continued on page* 118]

CW KEYING MONITOR

Without direct connection to your transmitter, this compact accessory gives you the low-down on the sound of your own CW.

By Herb Friedman, W2ZLF

WITHOUT a recorder, you could never find out how your voice really sounds to others. Just so, without a keying monitor it's impossible to know how your fist sounds to the ham you're working. The click-clickety-click of your key tells you little about the quality of your CW. A monitor which produces a tone corresponding to your signal lets you know exactly what you're putting out—and helps improve your code.

EI's keying monitor is unique in that it requires no connection to the transmitter (yes, it *is* ideal for field days!). For convenience the monitor was built as two units. The first, which we will call the *keyer*, is designed to pick up and detect the RF output of your transmitter. As the schematic shows, the keyer comprises a detector and amplifier.

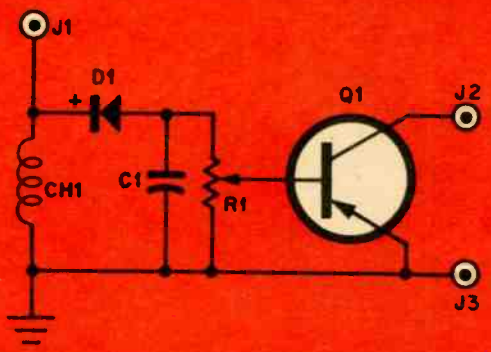
The second and more complex unit is an audio *oscillator* that can be triggered by (depending upon the setting of S1) the output of the keyer (connected to J4-J5) or by a code practice key connected to J8-J9. Selector switch S1 is set on the *key* position for code practice or to *xmit* for monitoring. In the *key* position, no battery current is drawn. Headset outputs J6 and J7 disconnect the speaker when phones are inserted. In author's unit shown, *keyer* switch position corresponds to *xmit*.

Standard components are used throughout and except for T1, none is

The keyer unit is built in a metal cabinet so be sure to insulate jacks J1 and J2. Be careful of the detector diode's polarity when installing it.

KEYER PARTS LIST

R1—500,000-ohm potentiometer
C1—.001 mf ceramic disc capacitor
Q1—2N217, 2N109 (or equiv.) D1—1N34A diode
CH1—2.5 millihenry ferrite RF choke (Miller 6302)
J1—Insulated jack J2,J3—Binding posts
Misc.—Minibox, approx. 2"x1½"x4"



Simple broadband detector circuit in keyer is designed to provide signal to trigger oscillator.

critical. If desired, greater volume can be obtained by using a 6-volt battery in place of the two series-connected cells shown.

Construction

The keyer is housed in a metal Minibox while the oscillator uses a Bakelite cabinet with the components mounted on its removable front panel. A piece of screening installed between the speaker and panel protects the speaker from damage. Since Bakelite is an insulator, the oscillator's binding posts can be mounted directly on the panel.

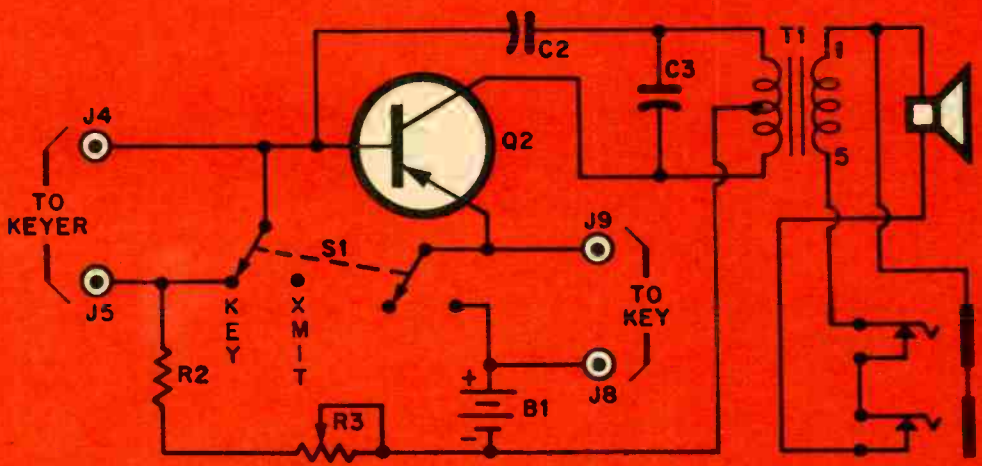
Checkout and Use

Set S1 to the *key* position. When a jumper is connected across *key* terminals J8 and J9, a tone will be heard in the speaker. The tone is adjusted by R3. Next, set S1 to the *xmit* position. A tone will be heard when a jumper is placed across keyer terminals J4 and J5. If the tone isn't heard in either test, check for wiring errors.

If the keying monitor is to be used with a low-power (under 100 watts) transmitter the keyer should be mounted on or close to the transmitter's cabinet. An inexpensive collapsible antenna or length of buss bar plugged into J1 usually will pick up sufficient signal to operate the keyer. However, if a whip antenna doesn't work, replace it with a length of wire and slip the wire's free end through a ventilation hole into the transmitter. For high-power transmitters, the keyer is placed near the transmission line and a length of wire from J1 is wrapped around the transmission line. One or two turns usually does the trick.

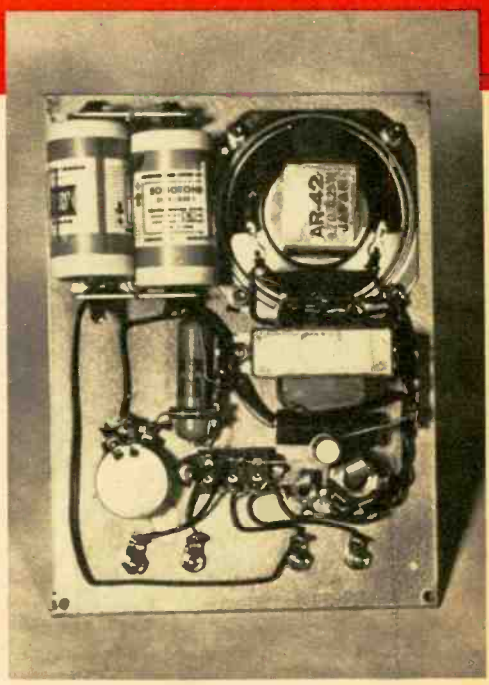
Connect keyer binding post J3 to J4 on the oscillator and keyer binding post J2 to J5. Set S1 to the *xmit* position and turn on the transmitter. Starting from full counter-clockwise position, advance R1 until a clean tone is heard. When you key the transmitter the monitor's tone should be steady. If the tone is unstable, advance R1 slowly until the tone steadies.

In practice, a well-grounded transmitter with a low SWR will not require resetting the keying monitor's antenna or R1 when the transmitter is shifted from band to band.



The red lead of T1 is connected to B1; the brown lead to C2, C3 and the blue lead to Q2-C.

Components mount on the plastic front panel of the oscillator unit. Other layouts are possible.



OSCILLATOR PARTS LIST

R2—4,700 ohms, ½ watt
R3—10,000-ohm potentiometer
C2—.05 mf tubular capacitor
C3—.02 mf tubular capacitor
Q2—2N217, 2N109 (or any PNP high-gain audio transistor)
T1—Output transformer (Lafayette TR-12)
B1—3 to 6 volt battery
J4,J5,J8,J9—5-way binding posts
J6—Standard closed-circuit phone jack (Switchcraft type 12A or equiv.)
J7—Miniature closed-circuit phone jack (Switchcraft type 42A or equiv.)
S1—DPDT slide switch
1—3.2-ohm 2½" speaker (Lafayette SK-65 or equiv.)
Misc.—Cases; terminal strips; plastic cabinet with panel, 6¾"x5¼"x2¼"

Theory

A sample of the transmitter's RF is fed to detector rectifier D1. The resultant DC is applied through R1 to Q1's base. Normally, Q1's emitter-collector impedance is high. When the DC is applied the e-c impedance falls to a low value—providing a switch action at jacks J2-J3. The circuit of the oscillator differs from the usual code practice oscillator in that it is specifically designed for monitor use. Its pitch approximates normal BFO tone and its output is designed for monitoring. It will not wake up the household when used late at night.

The headphone output (also at a comfortable level) is available at two jacks: J6, which takes a standard phone plug, and J7, a miniature jack which enables you to use a transistor radio earpiece.

MICROPHONES!

FOR CB • FOR HAMS • FOR HI-FI

By John Milder and Herb Friedman, W2ZLF/2W6045 Contributing Editors

ONE OF THE most vital accessories of tape recorders, amateur radio transmitters and Citizens Band transceivers is the microphone. What comes out in the way of sound or signal must first be funneled in through the mike.

Choosing the *right* microphone for your communications shack, recorder or PA system is more than a matter of buying the most expensive model. Mikes costing several hundred dollars are excellent for certain jobs but would prove unsuitable for a CB transceiver. On the other hand, a microphone you could pick up for less than $5 might be your best bet for a mobile ham installation.

The correct microphone depends on the equipment itself, how and where it is used and what you want out of it.

The job of any microphone is to turn sound waves into electrical energy. A flexible diaphragm inside the mike's case vibrates in accordance with variations in sound pressure that reach it. These vibrations are translated into electrical waveforms by some kind of generating or control device. There are five main types of microphones, plus a sub-type or two:

The Ford car of the field is the *carbon* microphone. You find it everywhere, the closest probably being the one in your telephone handset. You can buy one for less than a dollar. The carbon mike (Fig. 4) consists of a small button containing carbon granules. The flow of an electric current (usually supplied by an external battery) through the button is controlled by the pressure put on the granules by a vibrating diaphragm. Thus, the response of the diaphragm to sound waves is translated into a corresponding electrical signal. A sub-type is the double-button carbon mike, which has a button on either side of the diaphragm.

If you own a tape recorder, it more

Fig. 1—Pickup or sensitivity pattern of non-directional microphone.

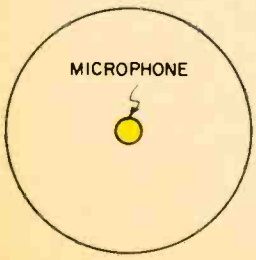
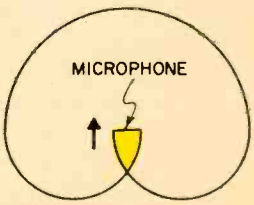


Fig. 2—Polar diagram of the bi-directional microphone's pickup.

Fig. 3—Mikes with a cardioid pattern have a frontal pickup.



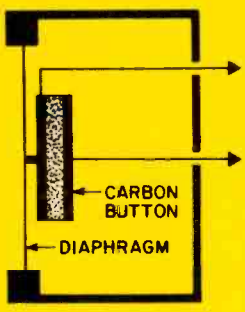


Fig. 4—Carbon mike varies current flow through button.

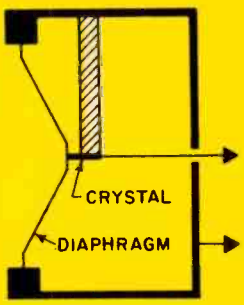


Fig. 5—Crystal mike produces signal when element is flexed.

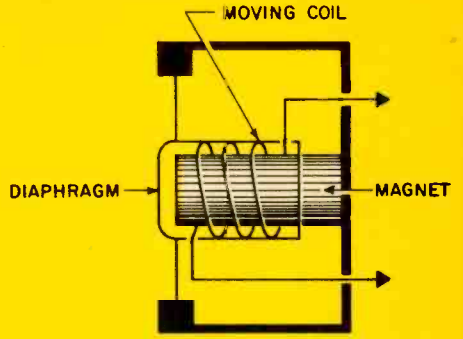


Fig. 6—Dynamic mike coil moves within permanent magnet's field.

than likely came with a *crystal* microphone (Fig. 5). In this type, the diaphragm is attached to a Rochelle salt crystal, a piezoelectric material. When bent or flexed by the diaphragm, the crystal generates an electrical signal. A sub-type is the *ceramic* microphone, in which a man-made ceramic element replaces the natural crystal.

A fair-size step beyond the carbons and crystals is the *dynamic* or moving-coil microphone. Its working principle (Fig. 6) is similar to that of the loudspeaker, but in reverse. As sound waves strike the diaphragm an attached coil of fine wire is moved within a fixed magnetic field, generating an electrical signal (remember that an electric current is induced in a conductor when it cuts magnetic lines of force).

A sub-type of the dynamic is the *controlled-reluctance* microphone, also called controlled-magnetic or armature mike, and more often than not referred to as a dynamic, although its construction is somewhat different. In this type, a diaphragm moves a metal armature inside a stationary coil mounted in a magnetic field. The armature's interfering with the magnetic field induces a current in the coil.

A cousin of the dynamic is the *ribbon* microphone (Fig. 8). An exceedingly thin metal ribbon, suspended in a magnetic field, does double duty as both diaphragm and generating element. The ribbon's movements under varying sound pressures are converted directly into a signal via the principle of cutting magnetic lines of force.

At the top of the microphone line is the *condenser* microphone which occasionally, but not often, is called the capacitor mike. In its operation (Fig. 7),

Fig. 7—Condenser mike's diaphragm serves as one plate of condenser; movements vary capacitance.

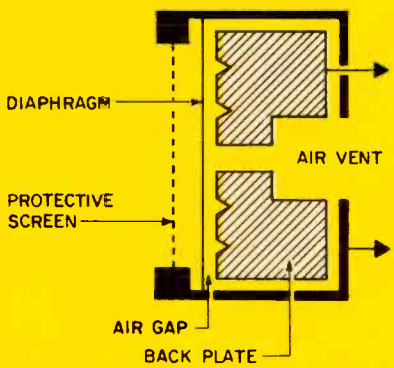
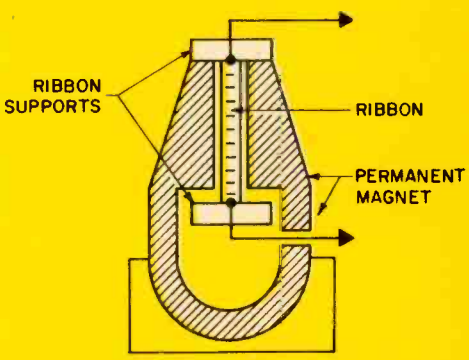


Fig. 8—In ribbon mike the ribbon itself is the generating element, moving in a magnetic field.



Dart M-100 carbon mike has an on-off switch, sells for $6.50. M-200 crystal mike costs same.

Sonotone's push-to-talk ceramic is aimed at CB. It has magnetic mount. The CM-30M costs $9.70.

Lafayette's PA-274 dynamic mike has PTT, 200-10,000 cps response and is non-directional—$9.70.

the diaphragm becomes the moving plate of a variable condenser. A small air gap away is another sheet of metal representing the fixed plate. A voltage is impressed on the two plates. Vibrations of the moving plate (diaphragm) change the capacitance of the condenser and this in turn varies the voltage to produce a signal. Condenser mikes cost up to several hundred dollars.

Microphones also are classified according to sound pickup pattern. One type is equally sensitive to sound coming from any direction and is called *non-directional* (see Fig. 1). A second type (Fig. 2) is sensitive in front and back but will not pick up sound from the sides. It is called *bi-directional*. A third type (Fig. 3) has a heart-shaped pickup pattern and is called *cardioid* (to get the connection, think of cardiac).

There are other classes and styles, too. Hand mikes, most popular for communications use, come with and without push-to-talk buttons. Models with small stands are for use on a table or desk, and some of these have a grip-to-talk feature, with a push-button or bar built into the stand. The public address hand mikes have a simple on-off switch. A third main style is the mike that mounts on a floor stand.

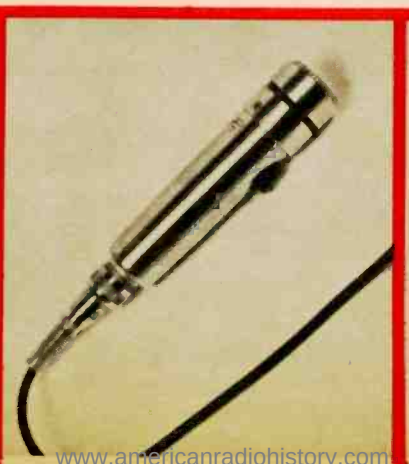
But these variations in style and the uses they imply are obvious, as are other classifying factors which will be discussed later.

CB and Amateur Microphones

Using the proper microphone in Citizens Band and amateur communications can mean the difference between a poor signal and a powerful one that cuts through QRM. Mechanical construction and switching are important because they contribute to ease of operation. But the first characteristic

New controlled-reluctance mike is a special noise-cancelling type; the Shure 488 costs about $40.

The Shure model 245S is cardioid ceramic for high-noise area use. It has an on-off switch—$21.76.



Special ceramic for CB use has non-directional pattern and PTT switch; Shure 201 costs $10.58.

Electro-Voice model 714S is a ceramic, has PTT feature and a coiled black cable. Price is $9.70.

The Shure Unidyne III is a dual impedance dynamic for hi-fi, has 50-15,000 cps response—$49.98.

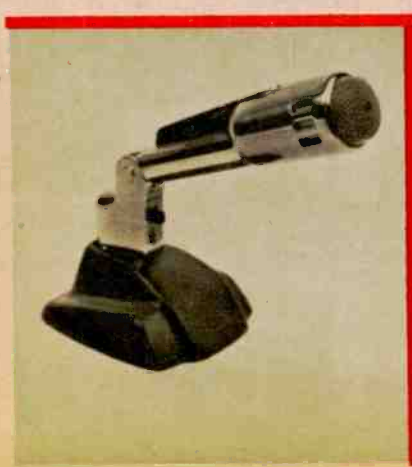
Grip-to-talk mike is designed for dispatching work; 100-9,000 cps response. Shure 520SL—$26.46.

you should consider when buying a CB or ham mike (or any other one) is frequency response. Microphones fall into two groups. One group has a flat response: within reason, a low-frequency sound equal in intensity to a high-frequency sound results in an electrical signal of equal strength. The second group usually is referred to as the communications or shaped-response microphones. The low-frequency response here is attenuated to produce a crisp quality.

The choice of response depends largely on your voice quality. Most of the voice's energy is in the low-frequency range (90-500 cps). But the midrange (500-5,000 cps), which has little energy, contains most of the intelligence. If a person with a bass-heavy voice uses a flat-response mike the transmitter will be driven to 100% modulation by the low frequencies, while the intelligence-carrying midrange remains below 50% modulation. If this person uses a communications microphone with low-frequency attenuation, his voice may not sound as natural but the midrange can be boosted to the desired 100% modulation. The effect at the receiver would be an increase of at least 6 decibels in talk power—equivalent to doubling the signal strength.

A strident voice with considerable high-frequency energy, such as a girl's voice, can be uncomfortable to listen to for any length of time. By using a flat response microphone and speaking close-in to accentuate the low frequencies, the received signal can be mellowed and readability improved. But remember that close-in miking may give you a problem known delicately as ssspitty sssibilants, which is annoying. However, sibilants can be suppressed by using a microphone which attenuates

The Electro-Voice 664 mike is for hi-fi; 40-15,000 response and controlled pickup; price is $49.98.



Sonotone CM-10A ceramic for tape recording; response is 50-11,000. Matched pairs available—$10.29.

Lafayette PA-104 is dynamic with stand. Switched dual impedance. 40 to 13,000 cps response; $9.75.

Knight 4500 dynamic is for tape recording; 60-12,000 response; non-directional type; costs $22.95.

The Electro-Voice 644 is a highly directional dynamic; 40 to 12,000 cps response; it is for hi-fi—$64.68.

Shure's 540S Sonodyne II is a general-purpose tape, PA mike; non-directional pickup—$29.37.

the frequencies above; it is 5,000 cps.

Unless you are troubled by excessive high-frequency voice energy, a microphone having low-frequency attenuation probably would be best.

Until recently, common CB and amateur microphones, because of low cost, were non-directional (see above and Figs. 1, 2 and 3). In a reverberant room such a mike picks up echoes from the walls, as well as the primary sound. The echo can be so severe as to interfere with the intelligence. Non-directionals also give trouble in mobile service, where road and engine noise kills intelligibility. One solution is to speak close-in and use low amplification. But a better one is a microphone with a cardioid field pattern (Fig. 3). With maximum sensitivity into the diaphragm and reduced sensitivity to the rear and sides, a cardioid cuts random noise pickup and provides higher intelligibility in reverberant or noisy locations.

Three types of microphone elements are used in moderately priced CB and amateur microphones: carbon, crystal (including ceramic) and dynamic.

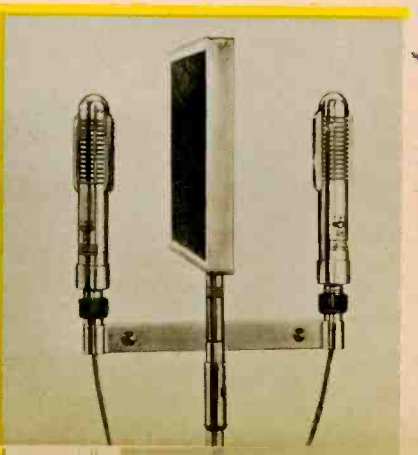
Natural crystal and ceramic microphones have similar frequency responses and output levels. Either can be obtained with flat or low-frequency-attenuation characteristics. Because of the moderate cost, most CB/amateur equipment is designed to use these microphones. While either type gives good base-station performance, the natural crystal mike is heat and humidity sensitive and is not recommended for mobile service. Since the ceramic element is not heat sensitive, it is the modern mobile CB/amateur mike.

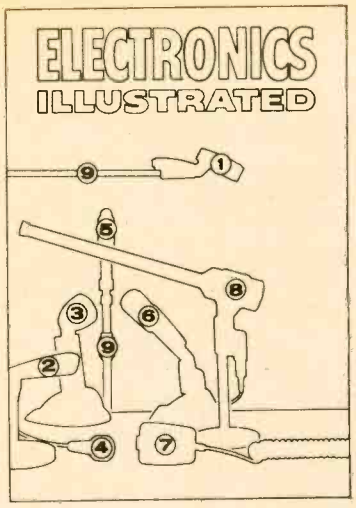
The dynamic mike, which is more expensive, offers low distortion, flat response and a rising midrange to give

Electro-Voice 652A is special, inconspicuous dynamic mike for TV and radio broadcasting use.

The Shure 300 ribbon microphone has flat frequency response from 40-15,000 cps, is bi-directional.

Two matched Dynaco B&O mikes are set up with special vane to separate sound for stereo use.





The microphones shown on our cover are: (1) Shure 540S Sonodyne II; (2) Knight KN-4500; (3) Shure 520 SL; (4) Sonotone CM-10A; (5) Dynaco B&O; (6) Electro-Voice 664; (7) Sonotone CM-30M; (8) Electro-Voice 644 and (9) the stand and the boom shown are made by Atlas Sound Co.

Home recording is increasing in popularity. Family shown here is recording musical efforts on a stereo tape machine.

definition to the voice. The output level usually is equal to or less than crystal output. It is rugged, can take abuse and often is suggested where equipment is subject to hard knocks. Otherwise, it has no advantage in CB/amateur use, unless you want to sound like a broadcast station. But several dynamic communications microphones are available at moderately high prices for applications where their special characteristics are desired.

The carbon microphone is heat and humidity resistant. It does require a power supply but this, in turn, gives it a high output, making possible the elimination of one stage of amplification in the modulator. Within limits, it also is rugged. However, its poor frequency response and high waveform distortion result in a distinctive carbon-mike quality.

Lastly, you should consider how and where your mike will be used. In mobile service your rig certainly should have the push-to-talk (PTT) feature.

Price-wise, CB and amateur mikes cover a wide range. As noted previously, a carbon model can be picked up for about a dollar. Crystals and ceramics of the type accompanying original equipment run from about $4.50 to $12; high-quality ceramics from $12 to $20. Quality crystals with cardioid pattern range all the way from $14 to $37.

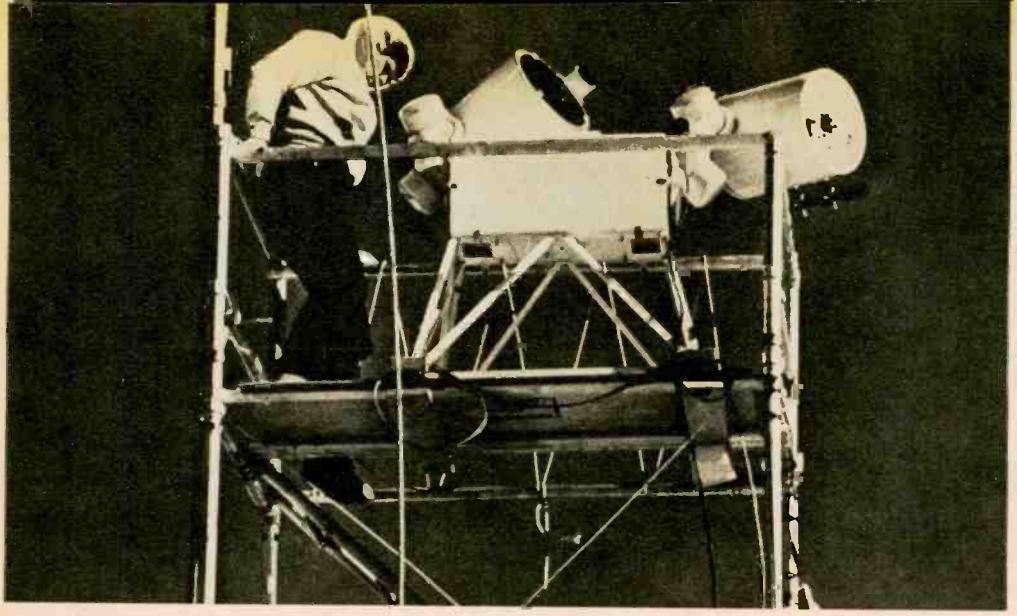
Unlike microphones in the tape-recorder field, the mikes supplied with the original equipment in CB and amateur work usually are adequate, although many operators prefer something better.

Microphones for Recorders

If you are a serious tape recorder hobbyist, you probably already know how important is the role of the microphone in making successful recordings. The more live taping you do in and out of your living room, the more this importance will be brought home. There's no way for your recorder to recover sound lost at the mike.

A mike usually comes with a recorder, except for the higher priced semi-professional rigs, and an original-equipment model has two undeniable advantages. First, it is free. Secondly, it's rugged. You can drop it, or dogs and

[*Continued on page* 114]

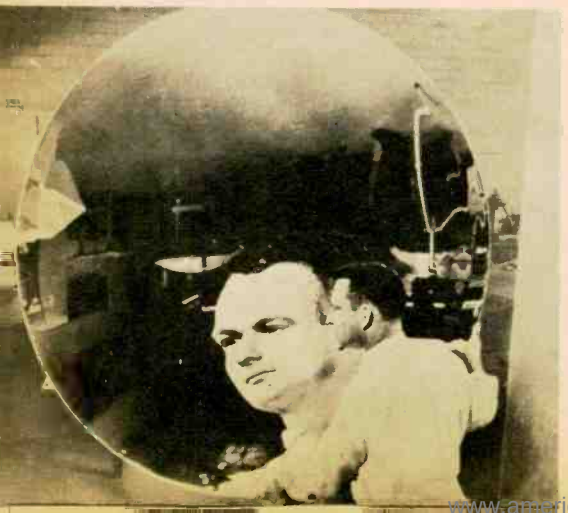


A transmitter for space, using a beam of light as carrier, is tested on a Mojave Desert tower.

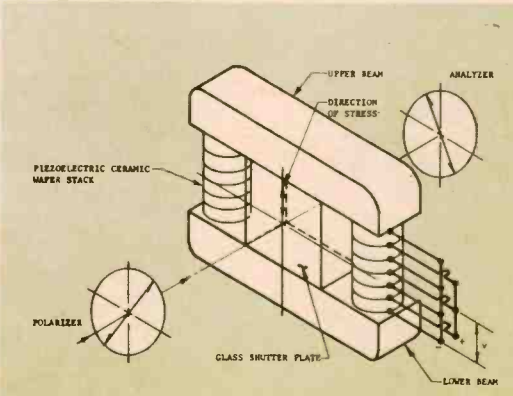
Solar Communications For Space

IN OUTER SPACE man is likely to turn to the source of power closest at hand—sunlight—for his communications and certain other needs. The Air Force and Electro-Optical Systems, Inc., have been experimenting in the Mojave Desert with a rig that would use a beam of sunlight concentrated by huge mirrors to communicate between space stations and spaceships over millions of miles. The system's beam-modulating equipment is merely a piece of glass held between two metal poles joined at the ends by piezoelectric wafers (see diagram below). When voltage is applied to the wafers they shrink or swell (depending on polarity). This stresses the glass, which in turn changes the polarization of the light passing through and, in effect, modulates it. The same process in reverse demodulates the light and recovers the message.

Mirror antenna collects sunlight and produces a narrow beam on which data can be transmitted.



Light modulator has piece of glass, metal beams and stacks of piezoelectric wafers (see text).



RCA training at home can be the smartest investment you ever made

Look what you get in the Course in Radio and Electronic Fundamentals

40 Fascinating THEORY LESSONS

Containing all the basic principles of radio and electronics in easy-to-understand form.

40 EXPERIMENT LESSONS

Each containing absorbing, practical experiments bound together in 20 books.

40 SERVICE PRACTICES

Full of practical, time saving and money-saving servicing tips, bound into 20 books.

PLUS ALL THIS AT NO EXTRA COST···

15 KITS

to build a Multimeter, AM Receiver and Signal Generator. Kits contain new parts for experiments, integrated so as to demonstrate what you learn in the lessons and to help you develop technical skills. Each kit is fun to put together!

MULTIMETER

A sensitive precision measuring instrument you *build* and *use* on the job. Big 4½" meter with 50 microamp meter movement. 20,000 ohms-per-volt sensitivity d-c, 6,667 a-c.

AM RECEIVER

Have the satisfaction of building your own radio receiver with this high-quality 6-tube superheterodyne set. Big 5" speaker, fine tone!

SIGNAL GENERATOR

A "must" for aligning and trouble-shooting receivers. Build it for your own use. 170 KC to 50 MC fundamental frequencies for all radio and TV work.

LET RCA TRAIN YOU AT HOME

RCA Institutes, one of the leading technical institutes in the United States devoted exclusively to electronics, offers you the finest training-at-home. The very name "RCA" means dependability, integrity, and scientific advance. Practical work with your very first basic lesson. You build and keep prime quality equipment. Pay as you learn. No installment payments necessary. You pay for your next study group only when you order it. And remember, in electronics the more you know the higher you go. Licensed by the University of the State of New York.

CLASSROOM TRAINING

Classroom training in New York City and Los Angeles. Day and Evening classes start four times a year. In addition, Radio Corporation of America offers a limited number of basic courses in Chicago, Philadelphia, and Cherry Hill, N. J. (near Camden). Indicate your preference on attached card.

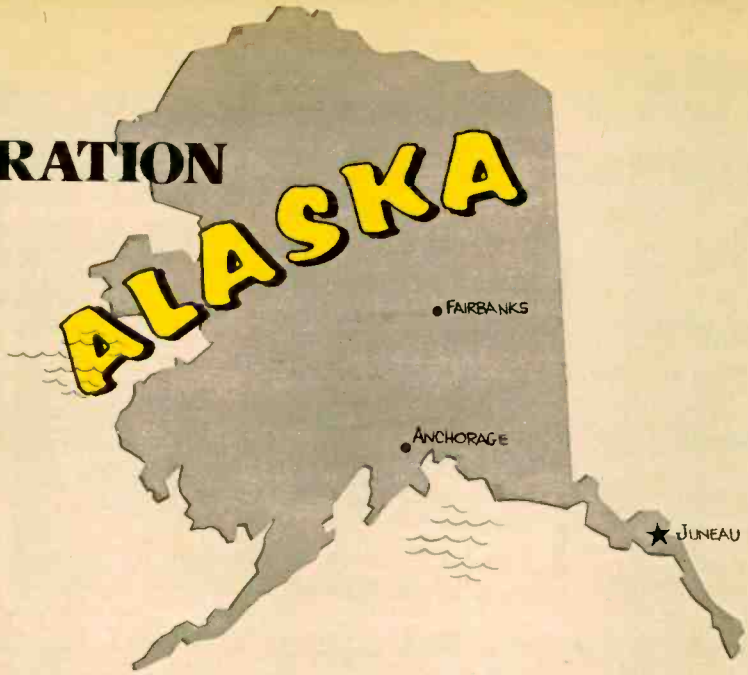
SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY!

Check Home Study or Resident School Box

RCA INSTITUTES, INC. A SERVICE OF RADIO CORPORATION OF AMERICA,
350 WEST 4TH ST., NEW YORK 14, N. Y. 610 S. MAIN ST., LOS ANGELES 14, CALIF.

The Most Trusted Name in Electronics

OPERATION ALASKA



ALTHOUGH Alaska now is our 49th state, it remains one of the most difficult parts of the world for American DXers. There are two major reasons: Alaska has no short-wave broadcast stations and the state lies entirely within the auroral zone —that region of high signal absorption and frequent magnetic storms that play hob with radio communications. But Alaska *can* be bagged on the broadcast band or via aeradios.

The Land of Northern Lights has an ample supply of BCB stations, heard best west of the Mississippi. Possibly the top prospect is clear-channel KFAR, Fairbanks, on 660 kc. The station runs 10 kilowatts. Western DXers should try for this one during fall, winter and spring between 2300 and 0300 PST. In the East, listeners must wait until Monday morning between 0100 and 0500 EST, when powerful WNBC goes off. Other BCBers heard at distant points include KINY (800 kc) and KFQD (730 kc) at Anchorage, and KICY (850 kc) at Nome, known as the Voice of the Arctic. You can forget about the other Alaskan BCBers as DX prospects.

If you live in the Northeast or find BCB DX too rough, try for the FAA aeradios at Anchorage (KIS) and Fairbanks, which operate on short-wave frequencies as high as 17 mc. During daylight KIS is on 17905.5, 13274.5, 11356.5 and 8939 kc, while Fairbanks uses 11356.5 and 8871 kc. Night KIS channels are 5521.5, 5544, 2973, 2987 and 2931. Fairbanks is on 5499, 5544, 2973 and 2931. As the list makes obvious, the stations share some channels. Reports go to either F A A office.

—*C. M. Stanbury*

Best DX prospect among Alaskan stations is KFAR, Fairbanks, whose QSL letter is shown.

THE HAM SHACK

BY ROBERT HERTZBERG W2DJJ

ROGER DODGER . . . There is a strange trend, especially among operators at military ham stations, to use the word *Roger* as the affirmative answer to a question. It's not only improper, but confusing. What's wrong with coming out with an unmistakable *yes*?

During several encounters in this corner with Roger, we've always pointed out that the word is the common phonetic for R (Romeo boosters to the contrary), and in telegraphic practice Roger is the signal of receipt or acknowledgement. It means *received*. How it has become distorted to mean *yes* is a mystery to me.

A Gallon of Juice . . . Some recent visitors to my shack accuse me of pulling a weak practical joke (another one, they say, as if I'd had a long history in the field). The point of their suspicions is a common paint can, handle and all,

that sits on top of my transmitter (see photo).

But it's no gag. That paint can is a serious and useful accessory—a 50-ohm dummy antenna capable of dissipating 1,000 watts of power, or a full gallon in ham parlance. The paint can is merely a simple and inexpensive container for the gallon of mineral oil which surrounds the actual resistive element and dissipates the heat. The trade name of this juice bucket is Cantenna. It's sold as a kit (Model HN-31) by Heath. Assembly time is likely to run all of 30 minutes.

Time . . . If you tune just above the 40-meter ham band you are likely to encounter CHU, a Canadian standards station that transmits highly accurate time signals which include AM voice reports at intervals. The specific frequency is 7335 kc. CHU often can be heard when skip conditions lower the boom on WWV signals on 5 and 10 mc.

While we're talking about the Canadian standards station it might be added that CHU also transmits on 3330 and 14670 kc. The time and station identification are given in voice during the last ten seconds of each minute. ID is Dominion Observatory, Canada.

The Voice . . . You'd think a man who makes his living as a network TV announcer does enough talking and sees enough of microphones during his working day. Not Don Cordray of Van Nuys, Calif. What do you think he does when he gets home? Right. He goes on the air with his ham station.

As WA6MSE, Don is accustomed to being asked, when he works a new one, "Say, haven't I heard your voice somewhere?" He runs high power and puts a potent signal into the East Coast.

Better word? . . . To refer to children as harmonics may be cute but it doesn't fit the facts of life, electronic or human. Figure it out. A harmonic is an integral multiple of a single fundamental frequency. A ham harmonic, it follows, would have to be the offspring of a single parent. Parthenogenesis (look it up in your dictionary) occurs in plants but not in people. A better term would be heterodyne, which is a third signal that results from the mixing of two frequencies. And if you think your kids are especially bright you can call them superheterodynes.

Do strong local stations foul up your FM reception? You can eliminate the problem with EI's low-cost

FM Interference Filter

By F. David Herman

BEFORE FM STEREO, most FM receivers got by with an indoor antenna. But now in most cases, stereo reception requires an outdoor antenna to soup up the signal delivered to the receiver input. Unfortunately, nearby FM stations can ride in on the antenna with a signal strong enough to overload the tuner's front end and cause distortion and cross-modulation. If one strong station appears at several points on the dial, cross modulation is probably your problem.

The best technique for reducing the signal of the offending station is to use a tuned filter such as the one shown. By tuning the filters to the frequency of the offending station, you can reduce the unwanted signal by up to 30 db, while the other FM signals reach the receiver with their normal strength. With S1 closed, the filter is short-circuited out of the line.

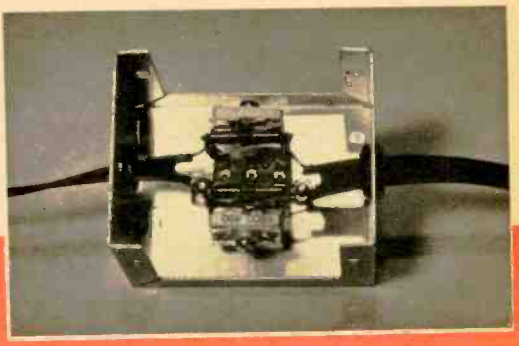
Mount S1 in the exact center of the front panel of the small cabinet used. A DPDT switch is specified because the extra terminals permit the components to be mounted directly on the switch.

To permit adjustments, drill $\frac{5}{16}$-inch holes in the box cover opposite C1 and C2.

Connect the 300-ohm twinlead as shown. If you use coaxial downlead only one-half of the filter is needed. Eliminate L2 and C2 and use a SPDT switch. Connect the downlead's center conductor to one side of the filter. Connect a short length of coax from the other end of the filter to the receiver. Solder the coax shields together inside the box.

Operation. Connect the downlead to either side of the filter and connect as short a length as possible from the other side to the FM receiver. Using an insulated alignment screwdriver (passed through the holes in the cover) close the plates (clockwise) of C1 and C2. Set S1 so the filter is in the circuit and tune in the offending station. Adjust either capacitor *slowly* for *minimum* signal, then adjust the other capacitor for minimum signal. Since there is a slight interaction repeat the procedure several times.

The filter should only be used to eliminate the problem of cross-modulation. While the filter has sufficient selectivity to permit reduction of offending signals close to the desired station, it can't cut down interference caused by adjacent channel stations. If this is attempted, both stations' signals will be reduced.

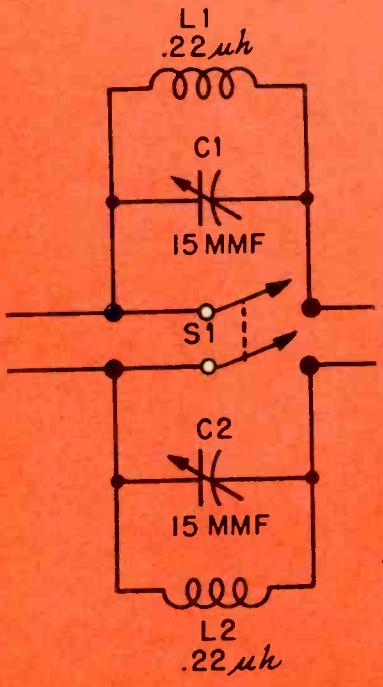


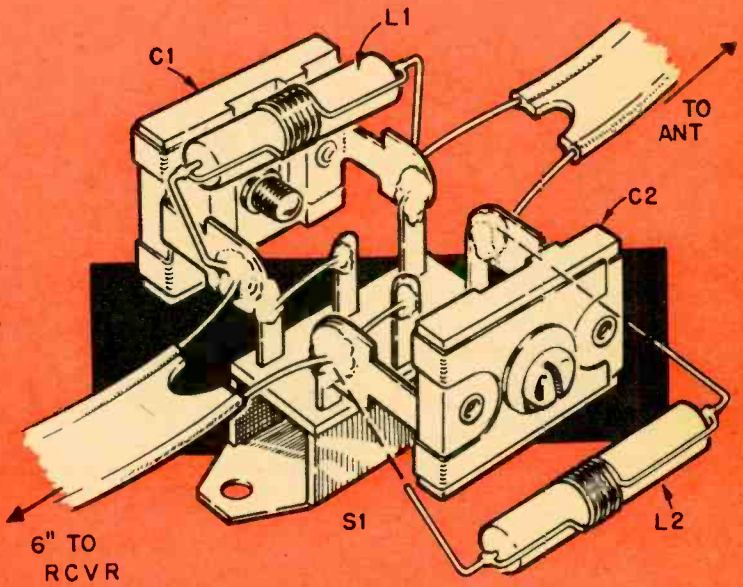
Any small box will serve to house the few components required by the FM interference filter.

When slide switch S1 is closed, filter circuit is shorted out of the 300-ohm transmission line.

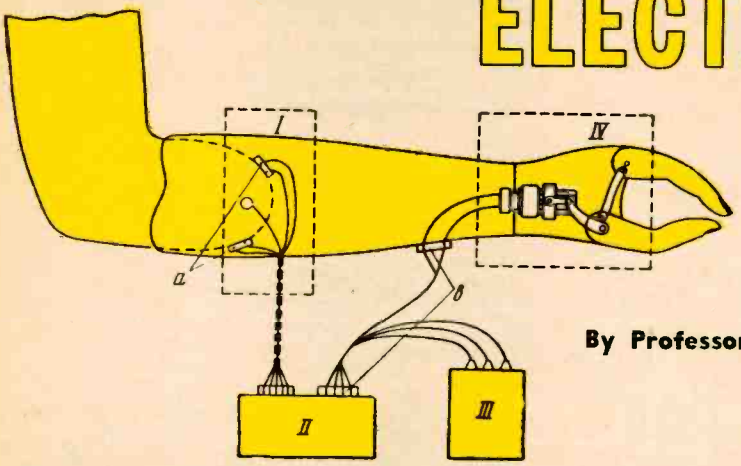
PARTS LIST

L1,L2—.22 microhenry chokes (Miller type 4584)
C1,C2—1.5 mmf-15 mmf trimmer capacitors (value not critical)
S1—DPDT slide switch
Misc.—Minibox, 3"x2"x1½"; 300-ohm twinlead; rubber grommets





RUSSIA'S AMAZING ELECTRONIC HAND



By Professor Aron E. Kobrinsky

Doctor of Engineering,

U.S.S.R. Academy of Sciences

Biocurrents of the arm are used to control prosthetic device.

OVER FIVE YEARS ago staff members at the Mechanical Engineering Institute of the U.S.S.R. Academy of Sciences and the Central Research Institute for Prosthetic Appliances put forward the idea of employing the biocurrents of a living organism for controlling technical mechanisms and appliances.

Any excitation process in a living tissue is attended by electrical potentials arising and changing in it. Nerve tissues exhibit a complex of discrete pulses, and muscles are caused to contract. These electrical oscillations are of a definite frequency. Any act of motion is reflected in the flow of electric pulses from the central nervous system to the peripheral organs.

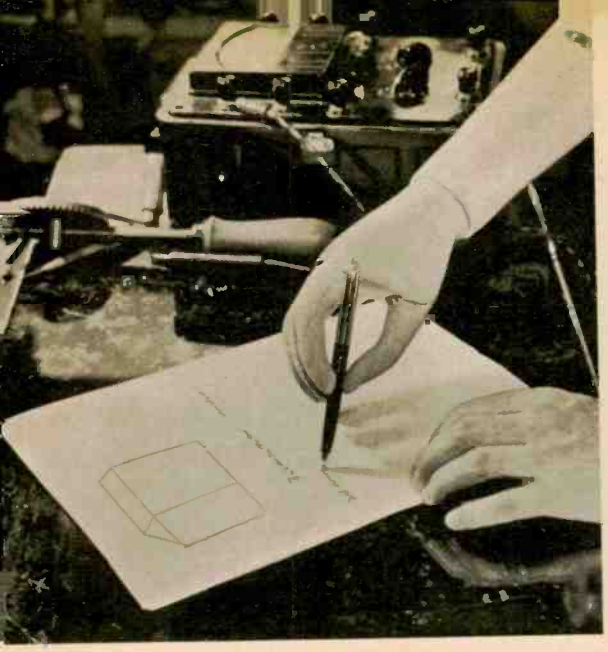
If a "program of work" [such as a hand movement] is always accompanied by the same complex of electric pulses, a device may be constructed to respond to these pulses. In other words, the device would be bioelectrically controlled. An artificial forearm is the first of these devices built. Its purpose is to restore partially the functions lost due to amputation.

The point in this case was control of the artificial hand through the use of those bioelectric signals that arise in the truncated muscles of the forearm. To control the hand, a patient would use the coordinating habits that existed prior to the amputation. A semi-design scheme is shown here [upper left].

The hand drive mechanism was designed so as to have the thumb and the block of the four fingers move simultaneously when the fingers were joined or moved apart. Control called for two bioelectric signals: one to control grip, one to control release. The groups of muscles in the stump which perform the functions of bending the hand and fingers were selected as such sources.

The lead-off of biocurrents was performed by electrodes positioned on the patient's forearm stump—one pair over the bending muscles, the other over the releasing muscles. The biocurrent led off was amplified and treated in a control unit [see Roman numeral II] to obtain useful information on the commands from the nervous system. Only one index of the bioelectric signal—its power—was used as carrier of useful information in the appliance control system.

The actual closing and opening of the hand were performed by a miniature executive drive powered by a storage battery [Roman numeral III].



Artificial forearm with hand controlled by the biocurrents in stump of patient's truncated arm is tested in writing experiment in Russian lab.

Russian scientists adjust electronic hand and arm; second model lies on table. EI presents Soviet professor's report on the unique device.

The forearm weighed 1.2 kilograms [2.6 lbs.], and the belt with amplifier and power units weighed the same.

Great attention was paid to making the artificial limb "sensitive." In the first models feedback was visual. That is, the patient watched the position of the artificial hand and, in accordance with his observations and intentions, strained one or the other set of muscles [bending or releasing].

The noise and vibrations made by the limb as it operated proved to be a source of feedback signals to the patient. He could hear the hand opening or closing and could feel the vibrations of its motions. These sensations conveyed certain information to the patient.

The bioelectric forearm in no way limits the movements of the patient's body and requires no forced motions. The work of the hand itself, being performed by electric power rather than muscle power, does not tire the patient. Present-day artificial forearms using drive rods activated by body movements do tend to tire the patient.

The first experiments have shown that the use of such bioelectric systems affords new opportunities in artificial limb making.

Editor's Note

EI's exclusive report on the Russian bioelectric forearm was prepared in the Soviet Union by Professor Kobrinsky, a specialist in electronics and cybernetics. We believe our readers will be interested in the concept and mode of operation, although the author fails to report on how well the arm and hand performed. We must assume the device still is experimental.

Dr. Richard A. Markoff, EI's Contributing Editor on Medical Electronics and a psychiatrist who has done prosthetic research, says: "I have no extensive knowledge of the Russian experiments, although the volume of their publications on prosthetics indicates an active interest in the subject. The work Dr. Kobrinsky describes may be an isolated study. We in America have done some research in this area but abandoned the concept early as insufficiently advantageous as compared to pneumomechanical methods."

KIT
EI
REPORT

Paco C-25
IN-CIRCUIT CAPACITOR CHECKER

IF YOU'VE done any troubleshooting at all, you know about capacitors and their problems. They become open, shorted or leaky. Suppose you suspect that an RF bypass capacitor shunting a tube's cathode resistor is open. You can't check it with an ohmmeter because the cathode resistor is shunting it. You'll have to clip out the suspected capacitor, test it, and perhaps if it isn't the troublemaker, solder it back in place. And then on to the next suspect.

The in-circuit capacitor checker may be the solution to your problem. It's designed to do just what its name indicates . . . check capacitors for opens or shorts without the necessity of removing them from the circuit. In most circuits there can be shunt resistances as low as 10 ohms without invalidating the test.

At $19.95 the PACO in-circuit capacitor checker kit is inexpensive enough to pay for itself quickly—in time saved on tough troubleshooting jobs.

Construction. Although the Model C-25 could be considered a piece of gear for the professional, it also is of interest to the electronics hobbyist. PACO, with this in mind, has an excellent well-illustrated instruction manual, with a section on soldering techniques, and clear step-by-step instructions. No errors or ambiguities were encountered.

All parts are first installed and wired on a sub-chassis which is later mounted to the front panel. This effectively eliminates cramped corners and tricky assemblies. Only an evening's work was required to bring the unit from box to bench.

The Circuit. Referring to the schematic, in the *short* test position with test clips connected across a shorted capacitor, the voltage at the 6C4 grid (obtained from the trans-

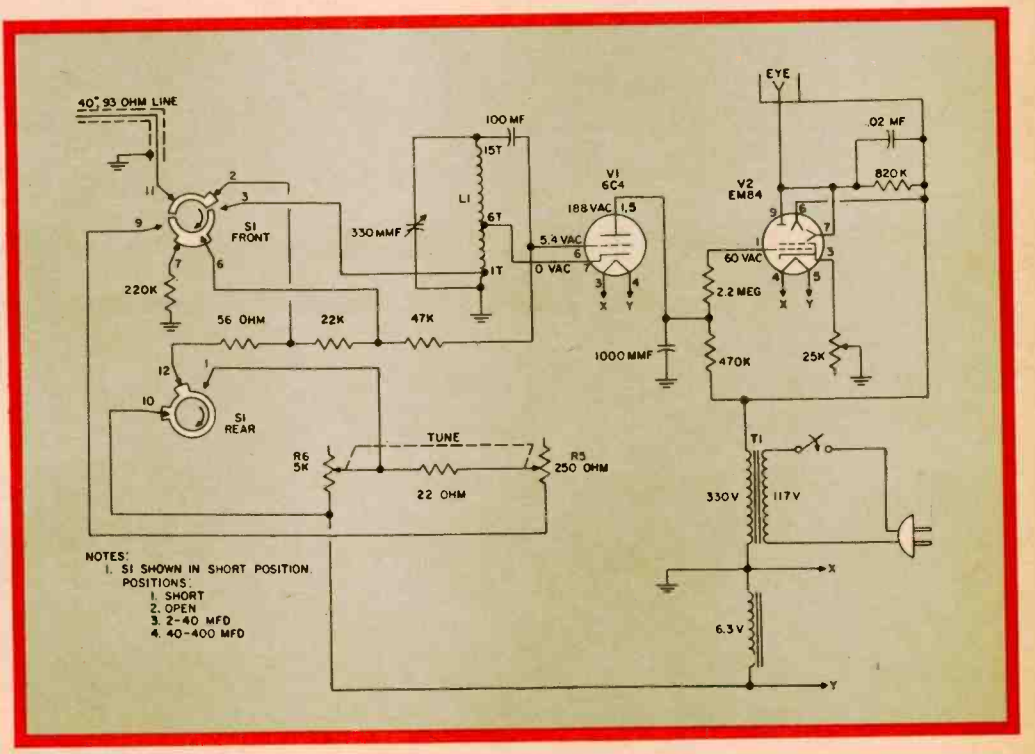
former's filament winding) drops to zero. The resulting increase in the 6C4 plate voltage, direct-coupled to the EM84 eye tube grid, produces a sharp increase in the EM84's plate current and the eye closes.

In the *open* test position, the 6C4 grid potential is provided by an oscillator operating at approximately 40 mc. At this frequency, the 40 inches of coaxial test cable represent a quarter-wavelength line. With the test clips connected across an open capacitor, the line is unloaded and appears as a short circuit at the one-turn tap on coil L1, a quarter-wavelength away. The shorted turn damps the oscillations and the tube's grid voltage drops. This in turn, closes the eye. When a good capacitor is tested and the coax line is loaded, the oscilator continues to function and the eye is biased open by the oscillator grid voltage. The virtue of this type of test is that normal circuit shunt resistances and stray capacities do not upset the results.

The electrolytic check is divided into

[*Continued on page* 114]

Completed checker before tube installation is shown above. Complete schematic below indicates simplicity of the RF oscillator circuit used.



HOW TO WIN AN EI DX AWARD

Some tips to the beginner on qualifying for an EI DX certificate.

THE SECOND Award Period announced by EI's DX Club is in full swing. Short-wave listeners and broadcast band fans, by DXing as few as ten or 15 countries, can qualify for handsome engraved certificates (see photo below) which have a special value in that they are *earned*. After getting verification of your reception (QSL card or letter), fill out the DX Log which appeared in the November '62 EI, or an equivalent homemade log, and mail it before March 1, 1963.

On the opposite page is a chart designed to help beginners win our new ten-country *Special* certificate. The 16 short-wave stations, representing 16 countries, are those most easily received in North America. The time shown is the period when the stations are strongest while broadcasting in English (subtract one hour for CST, etc.). As soon as you hear a station, log it—write down the date, time, frequency and call letters. Then add information about signal strength, interference and a description of program details. Later, send this information in a letter to the station, adding data about your receiver and antenna. At the end of your report request a QSL card or letter, and enclose an International Reply Coupon. To make sure you end up with at least ten countries verified, try for the whole 16 in our list. Any station on any frequency counts toward a *Special*, *General-50* or *General-100* (DX Century) award, of course. The basis of all awards is the number of different *countries* DXed—not number of stations.

For those working toward our new 15-country *Broadcast Band* certificate, our BCB chart offers 21 stations, representing 18 countries. Logging and reporting are the same as for short wave but reception occurs only at night; late fall and winter is the best season for BCB DX. Foreign stations can be picked up best between the FCC's every-10-kc allocations (540, 550, 560 kc, etc.). In the East, Europe and Africa come in around local sunset and midnight. On the West Coast, try for Asia and the Pacific after midnight. Local sunset is the choice time to go after the Latin American transmitters.

DX GUIDE FOR BEGINNERS

COUNTRY	STATION	KC	TIME (EST)	ADDRESS
Argentina	RAE	9690	2200, 0100	Sarmiento 151, Buenos Aires
Australia	R. Australia	11710	0714, 1014	Box 487, GPO Melbourne
Congo	R. Brazzaville	11725	2015	BP 108 Brazzaville
Costa Rica	TIFC	6037, 9645	2300-2400	Apt. 2710 San Jose
Czechoslovakia	R. Prague	7345, 9550	2000, 2300	Stalinova 12, Prague 2
Ecuador	HCJB	9745, 11915, 15115	2100-2400	Casilla 691, Quito
Haiti	4VEH	6100, 9770	2000-2300 (Sat, Mon)	Box 1 Cap Haitien
Israel	Kol Israel	9009	1615-1645	B'casting House Jerusalem
Japan	R. Japan	9505, 15135, 17705	1930-2030 2230-2330	NHK, Tokyo
Netherlands	R. Nederland	5985, 6035	1930-2030	POB 222 Hilversum
Philippines	Far East BC	11850	1000-1130	Box 2041, Manila
Portugal	V. West	6025, 6185	2100, 2245	Rua St. Marcal 1, Lisbon
Sweden	R. Sweden	9725, 11805	2045, 2215	Box 955, Stockholm 1
Switzerland	Switzerland Calling	6165, 9515, 11865	2030-2215 2315-2400	Freudenberger Platz, Berne
U.S.A.	KGEI	11955, 15240	1730	Box 887 Belmont, Calif.
U.S.S.R.	R. Moscow	7135, 9720	Evening	Moscow

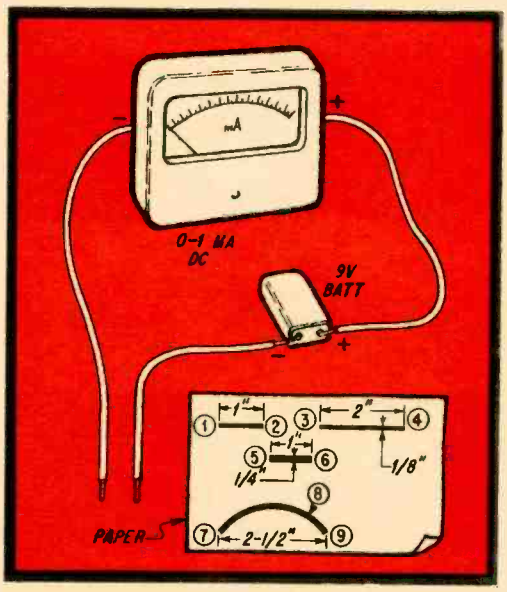
DX GUIDE TO THE BROADCAST BAND

KC	COUNTRY	STATION	CITY	LANGUAGE
640	Guatemala	R. Nacional (TGW)	Guatemala	Spanish
650	Hawaii (U.S.A.)	KORL	Honolulu	English
655	El Salvador	R. Nacional (YSS)	San Salvador	Spanish
665	Portugal	Emissora Nacional	Lisbon	Portuguese
670	Japan	NHK (JOBK)	Osaka	Japanese
730	Colombia	R. Tricolor (HJCU)	Bogota	Spanish
730	Mexico	XEX	Mexico City	Spanish
740	Canada	CBL	Toronto, Ont.	English
828	Nicaragua	Ondas del Luz (YNOL)	Managua	Sp & Eng
830	Windward Is.	R. Caribbean	Castries	Fr & Eng
830	Japan	NHK (JOBB)	Osaka	Japanese & Eng
1020	Venezuela	Cadena Rumbos (YVQB)	Caracas	Spanish
1035	Haiti	4VEH (4VE)	Cap Haitien	Fr & Eng
1075	Costa Rica	TIFC	San Jose	Sp & Eng
1110	Venezuela	Cadena Rumbos (YVNN)	Caracas	Spanish
1180	Ryukyu Is.	V. America	Okinawa	Oriental (several)
1185	Honduras	V. Centro America (HRVW)	San Pedro Sula	Spanish
1196	W. Germany	V. America	Munich	European (several)
1376	France	R. Francais	Lille	French
1466	Monaco	R. Monte Carlo (3AM2)	Monte Carlo	Fr, Eng & Ger
1570	Mexico	XERF	Ciudad Acuna	Eng & Sp

INSTANT RESISTORS

TO MAKE the world's simplest resistor just draw a line with a soft pencil on a piece of writing paper. Simple though it is, this resistor can demonstrate how a commercial resistor controls a flow of current. The parts for our resistor experiment are a 9-volt battery (transistor radio type) and a 0-1 ma DC meter (which is used throughout this beginner's series).

Use a soft pencil to draw the four shapes shown. Block in the outlines carefully, going over each several times. Shapes 1-2 and 3-4 should be ⅛-inch wide, 5-6 and 7-9 should be ¼-inch wide.



Wire up the meter and battery as shown, with the two free leads serving as probes. Do not allow them to touch each other as this can send a damaging surge of current through the meter.

Begin by pressing the probes firmly against the left and right ends of resistor shape 1-2 while watching the meter. There will be a current reading of approximately .5 ma. Remember the value.

Next, move the probes to the ends of shape 3-4. The current here should be about half the first reading.

Let's see what we've determined from these steps. First, carbon can conduct current. It is not a perfect conductor since the meter indicated little current flow. The carbon in the 1-2 shape presents an amount of resistance, or opposition, which permits perhaps .5 ma to flow. If you measured the resistance with an ohmmeter, the reading would be approximately 18,000 ohms.

Moving the probes to the second shape cuts the current in half—which reveals that the *length* of the carbon path has a significant effect on its resistance. Doubling the length of a conductor, as in this case, doubles its resistance and the battery can therefore push only half the current through it. Note that shape 3-4 may be considered as two 1-2 shapes, in series with each other. Total resistance is effectively doubled. This demonstrates series resistance.

Now measure the current through the form 5-6. The reading here is about 1 ma. You can see that 5-6 actually is the equivalent of a pair of stacked 1-2 shapes. The increase in current indicates that a lower resistance path has been created—the pathway, in effect, widens and offers less opposition. This demonstrates parallel resistance.

A variable resistor, such as a potentiometer is easily simulated with the shape between 7 and 9. Place one probe on the edge near 9, the other near 7. Now slide the probe at 7 smoothly over the carbon toward 9. As you do this, the meter reading should rise, as decreasing resistance is presented between the points. One precaution during this step: don't go past 8 or the meter is likely to become overloaded.

Next column we are going to discuss resistor voltage dividers and how they are used.—*Len Buckwalter*

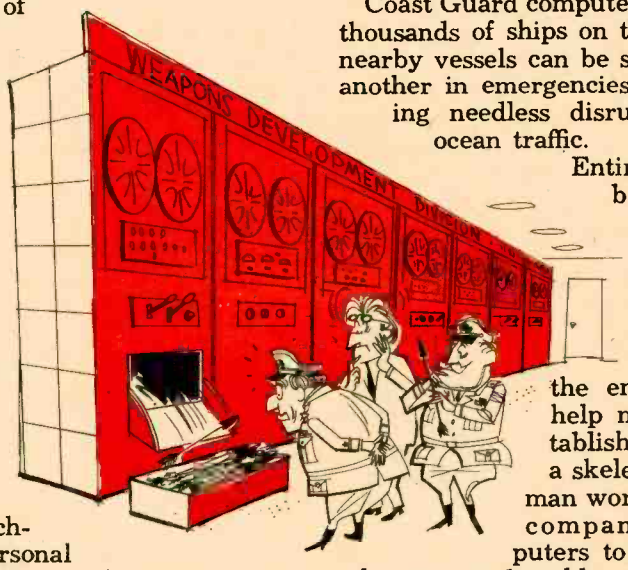
SECOND THOUGHTS ON THINKING MACHINES

Can we come to depend too much on those amazing computers?

By Sanford Maizel

DEPENDING on what paper you read, you might be led to conclude (1) computers are incredibly inept machines that commit horrendous errors, or (2) that computers are so talented they are about to take over man's thinking chores.

We're all familiar with the first type of news story—the one telling how a computer ordered and shipped a million frammises to our troops in Europe, who use only 27 of them a year. The second type—which points out how smart our thinking machines are getting—is likely to appear several times a week as new and better computers are designed.



If it were not for the fact that computers are reaching into our personal little worlds—yours and mine—we could leave the contemplation of robot brain technology to the men who design, build and use them. But the monsters are not keeping their distance. They are coming in the front door via gas and electric bills, license-renewal forms and insurance premium notices.

The question is not whether the invaders are inept or talented. We know they can be either, depending on their human builders. Rather, it concerns what thinking machines can do for us and, even more, what they can do *to* us.

Most computer stories we read show the subject in a good light, and justifiably so. In just one day a computer laid out 16,000 alternate designs for a new chemical plant, then selected the best.

Coast Guard computers keep track of thousands of ships on the high seas so nearby vessels can be sent to help one another in emergencies, without causing needless disruption of other ocean traffic.

Entire mills have been designed around mechanical brains which supervise the production of steel, inspect the end product and help maintain the establishment with only a skeleton force of human workers. Insurance companies use computers to work out complex actuarial problems in minutes, the ones that once required hundreds or thousands of old-fashioned man-hours.

Still, there is another side to the story. Not long ago a fine Mid-Western university, using electronic grading machines, was astounded to find that 560 students in a class of 800 had been dismissed from school. In its highly auto-

"What do you mean my job's been abolished? I own this company!"

mated setup, information from computers flowed directly to electric typewriters, which spun out dismissal notices that were mailed without human assistance, or human checking.

Then there was the big firm that installed automatic check-writers that promptly managed to send two dividend checks to every shareholder. Trouble was, they were supposed to get only one each.

One hardly could be surprised that stories about computers are printed and told in profusion. Thinking machines are big news today.

Computer people could tell you about dozens of remarkable abilities possessed by their brainchildren. How fast they are, how reliable, how tireless, etc. But the thinking machine's most important quality probably lies in the *amount* of work it can perform in a given time. You could refer to this as the device's speed in solving a problem. But something more is involved. Mathematical geniuses can solve problems at high speed, too. Their weakness is their inability to maintain that speed.

Take the problems surrounding space flight—the computing of orbits, reentry time, probable landing spot and all the rest. The sheer *amount* of work involved, bracketed by the limits of time, lies beyond human capacity. By the time the problems were worked out on paper the solutions would be of no use.

In a related vein, projecting the course of an enemy missile in flight is impossible by normal methods. By the time our most brilliant scientists came up with the answer, the missile would have landed and the dust settled. There wouldn't be anyone around to check the figures. Computers *must* be used.

Though you might call a big computer an electronic genius, you'd have to be referring to the amount of work it could perform, not to its own makeup. For computers are basically simple devices with a memory system for storing information and a retrieval system for getting back the part of it you need. The stored data itself can cause the machine to do only two things: react or not react. Complexity comes to computers only because of the size of their memories and the equipment for storing and retrieving information.

To argue that computers are good for us or bad for us—or good or bad in themselves—would be sheer nonsense. Computers are tools which can be of immense help to us, just as the typewriter, the lawn mower and the vacuum cleaner are. Such a statement has a double edge: it says computers can help, but it also says there is some part of *us* in the picture. And it is this point—how much of a given project is performed by a mechanical brain and how much by a human one—that is open to discussion.

Super-speed is of no help if the

"It says we ought to spend it on sodas."

"All right, Robbie. They said you could do it. Now let's just see you try."

answer you get is wrong. If a human-type dean had been watching at some point in that electronic grader's chain of operations, the dismissal notices never would have gone out.

The thinking machine is no better than the men who program and use it, and anyone who believes a computer will solve his dividend-paying or class-grading problems is misleading himself. *He* must first solve any problems he has, then tell the machine how to keep repeating the solution. And pity the poor guy who makes a mistake in his instructions!

Columnist Richard Starnes once gave a wry twist to that point when he wrote, "What will finally destroy the black art of cybernetics is the fact that these electronic prodigies never forget anything—they faithfully remember the mistakes that are fed into them as well as store away all the correct rubbish they are given."

The term *cybernetics* refers to the comparative study of, or relationship between, a man's brain-nerve system and the electro-mechanical processes of computers. Dr. Norbert Wiener, father of cybernetics, has said, "Machines can and do transcend the limitations of their designers, and in so doing they may be both effective and dangerous."

Computers have no trouble surpassing the men who build them in speed and staying-power but to depend on them for a grain of original thinking is disastrous.

"The computer is a complex, expensive tool, and one that must be used with skill and discretion," says Dr. Denis Sinclair Phillips, Director of New York University's Management Institute. "It's no more sensible to expect a moron to make good use of a computer than he would of a slide rule."

Even when properly employed, the thinking machine carries its own built-in dangers. Those who use it can come to depend on their mechanical marvel to their own detriment. They may ask it to solve the simplest of problems, in effect frittering away the investment in a million-dollar machine by having it do ten-cent work. But more than wasting invested money, the computer captive, by expecting the machine to do his own mental work, allows his mind to grow dull. His ability in creative, original thinking vanishes.

Computers *are* getting faster and more versatile, but no more intelligence can be taken out of them than is put in. The computer *had* to be invented; if it weren't needed it wouldn't exist. But man must keep reminding himself *not* to take the term *thinking machine* literally. *He* is the earth's only thinking machine.

"No danger—it'll land a thousand miles away. Want to check my figures?"

GOOD READING

By John Milder

THE ENCYCLOPEDIA OF ELECTRONICS. Edited by Charles Susskind. Reinhold Publishing Co., New York. 974 pages. $22.50

Normally, a book such as this would not fall in the province of this department, devoted as it is to talking about volumes for the hobbyist's bookshelf. Susskind's tome is a massive reference for those who work, or intend to, in electronics, rather than for the layman or hobbyist. But there are reasons why those whose profession does not require this book should consider buying it—the hefty price notwithstanding. As an opening reason for all this, you'll find a majority of entries are by acknowledged experts in the fields covered, in many cases by the men who originated the new concepts and devices described. For another, there is abundant material here for anyone who has a lively mind and curiosity about the progress of electronics.

The editor obviously has tried to keep descriptions of complicated matters free from impenetrable jargon, although many entries still are tough going for the non-technical reader. Since the book is aimed at professionals, many topics of interest to the hobbyist are omitted or mentioned but briefly. Even with these qualifications, however, this is a uniquely valuable book. In many respects it is, as the title indicates, *the* encyclopedia of electronics.

HOW TO MAKE MORE MONEY IN YOUR TV SERVICING BUSINESS. By John Markus. McGraw-Hill, New York. 346 pages. $7.95

Despite a crass title that almost made me pass it by, this is a valuable and long-overdue book. It is meant for anyone who wants to run a good, *honest* TV repair shop—precisely the man whose good nature often puts him out of business before customers can find him. How to Make Money will not help the sharpie with new hints on how to cut corners or bamboozle customers but it should aid men of good will. Its emphasis is on the day-to-day details of running a repair business (there is nothing on TV circuits or theory).

In refreshingly straightforward language, Mr. Markus describes how to set up a repair business, how to run it efficiently and, above all, how to attract and keep customers who will value what you have to offer. And, despite the experiences you and I may have had, there still are a few people who want to run their businesses like that.

ELECTRONICS FOR EVERYONE. Second Revised Edition. By Monroe Upton. Signet Books, New York. 352 pages. 75 cents

This paperback, in its first edition, already has introduced thousands of laymen to the mysteries of electronics. It provides what many other basic books promise but fail to deliver: an easygoing, understandable exploration of electronics. Our illustration, from the book, pictures Abbe Nollet's famous experiment in which a Leyden jar was discharged through a mile-around circle of monks. Upton's style is breezy but informative, and his introductory chapters on the atom and electron are particularly well-gauged to hold the interest of the newcomer. There is an occasional example of oversimplification that borders on the misleading, and the book's revision has not brought it completely up to date on matters such as semiconductors, but the little volume remains excellent for beginners.

FREE FOR '63

1963 CATALOG NO. 630

LAFAYETTE RADIO ELECTRONICS

388 GIANT-SIZED Pages
The Largest Catalog in Our 42-Year History

It's New — It's Big — It's Better Than Ever
It's From the "World's Hi-Fi & Electronics Shopping Center"

The exciting, all-new 1963 Lafayette Catalog features thousands of items for the audiophile, experimenter, technician, hobbyist, serviceman . . . Citizens Band, Tape Recorders, Stereo Hi-Fi, Ham and Amateur Equipment, and much more.

No Money Down on Lafayette's Budget Plan

ONLY LAFAYETTE OFFERS THESE OUTSTANDING EXTRAS:
√SATISFACTION GUARANTEED OR MONEY REFUNDED √LOWEST PRICES √EXCLUSIVE LAFAYETTE KITS √LARGEST STOCK SELECTION √BUY THE EASY-WAY WITH EASY-PAY . . .

LAFAYETTE FM/AM STEREO MPX TUNER

LT-78

89.50

- Tuned RF Stage; Duplex 3 Gang Tuning Condenser
- Automatic Frequency Control and Noise Filter

LAFAYETTE HE-20C C.B. TRANSCEIVER

HE-20C

109.50

- Officially Approved For Use in Canada
- 8 Crystal Controlled Receive and Transmit Positions

LAFAYETTE 10-TRANSISTOR C.B. "WALKIE-TALKIE"

33.95 each, 2-for-62.90

HE-29B

- 50% More Powerful—Extra RF Stage
- Receives and Transmits up to 2 Miles

LAFAYETTE "SQUELCHER"

HE-55 **10.95**

- Noise Eliminator and Squelcher
- Improves Reception in Most C.B. Transceivers

LAFAYETTE 4-TRACK STEREO TAPE DECK

RK-140 **99.50** less case

- Built-in Transistorized Stereo Record/Play Preamps
- Records Sound-on-Sound

MAIL ORDER AND SALES CENTER
111 Jericho Turnpike, Syosset, L. I., N. Y.

OTHER LOCATIONS

Jamaica, N. Y.
New York, N. Y.
Bronx, N. Y.
Scarsdale, N. Y.
Newark, N. J.
Plainfield, N. J.
Paramus, N. J.
Boston, Mass.

OPENING FALL 1962 — NATICK, MASS.

LAFAYETTE RADIO ELECTRONICS, Dept. EIA 3-2
P.O. Box 10, Syosset, L. I., N. Y.

☐ $_____ enclosed for Stock No. _____, shipping charges collect.

☐ Send me the Free 1963 388-Page Lafayette Catalog

Name_____

Address_____

City_____ Zone_____ State_____

a no-cost

ACOUSTIC CABINET for TRANSISTOR PORTABLES

By Sal Stella

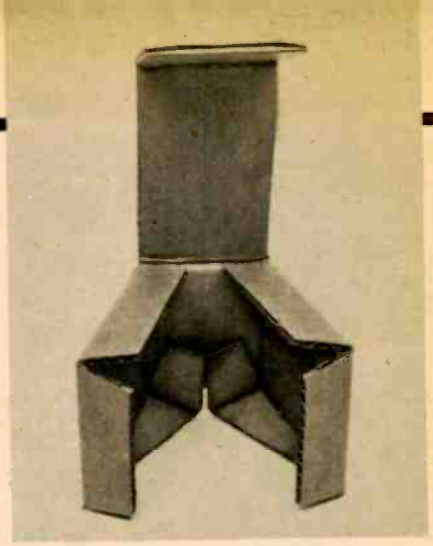
MOST transistor radios have a somewhat tinny sound because of their small loudspeakers and lack of baffle.

You can remedy the situation for your own small pocket portable by building a cost-free cabinet that substantially improves both the tone quality and the sound projecting ability of your little radio. No modifications are required on the radio. It is simply slid into the cabinet so that the speaker area is centered in the box. As can be seen from the photos the tuning and volume controls are not blocked.

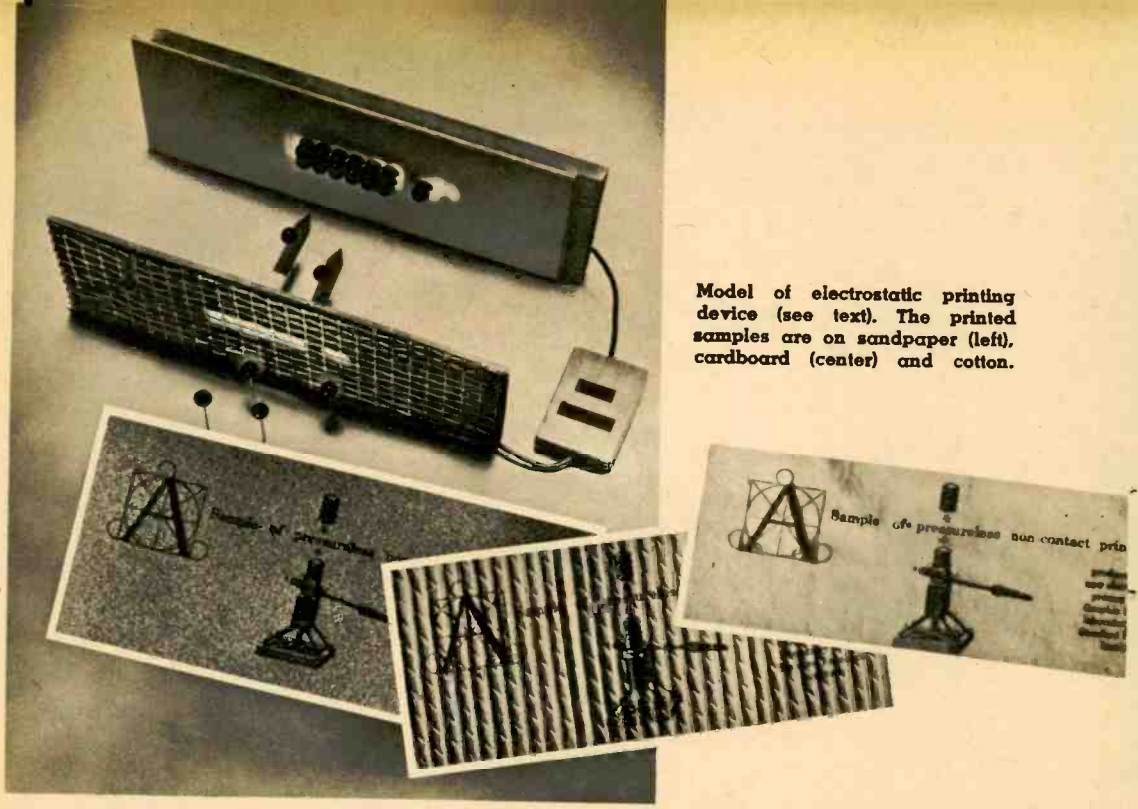
The model shown is made out of corrugated cardboard. Cut out the pattern and make the fold lines as shown. Pre-bend the corrugated cardboard along the fold lines for easier handling. Then glue the tabs to the tab anchor areas, squaring up the box as you do so. Follow the sequence of numbers. First secure tab #1 to tab anchor #1, tab #2 to tab anchor #2, etc. Cut out the openings to fit your own radio at the suggested angle, making sure the bottom of the radio rests on the floor of the cabinet.

In the photo at right, the cabinet is actually being held upside down. For tabletop use it's best to set up the cabinet so that the radio speaker faces slightly upward.

The cabinet may be made of ¼" plywood using the same dimensions.



Each tab should be glued or stapled to its corresponding grey anchor area. The cut-out for the radio is made after cabinet is assembled. Rear edge of radio should touch the back and top of the cabinet. Tab and the anchors #3 and #4 are omitted.



Model of electrostatic printing device (see text). The printed samples are on sandpaper (left), cardboard (center) and cotton.

TRUE ELECTRONIC PRINTING

AN ELECTROSTATIC printing process devised at the Stanford Research Institute represents the first basic change in printing techniques in decades. It promises simpler printing equipment and may render better picture reproduction with a 200-line-per-inch screen, compared to 150 lines used in such magazines as EI. The process is truly electronic. A model of the SRI device is shown above. The fine-mesh screen (see model) is charged to 1,500 volts. A stencil, in which the area to be printed is transparent and the rest opaque, is applied to the screen. The paper (top of photo) is placed near the screen, backed by a metal plate of opposite polarity from that of the screen. A mixture of dry-ink pigment and resin is brushed into the screen. These particles (black balls in photo) acquire a charge from the screen and are attracted to the plate. Only those in transparent areas of the stencil can get through, coming to rest on the paper in the pattern of the stencil. Heat fixes them in place. The material being printed doesn't have to be paper. The ink sticks to any surface.

Prototype of the electronic printing machine. Note the DC power supplies in rear of picture.

PRIZE SHACKS

WIN $20! In each issue EI publishes photographs of three Prize Shacks—Citizens Band, short-wave listening and amateur radio rooms or corners that have an attractive and efficient-looking layout. To the owner of each Prize Shack we pay $20. We invite you to send us a picture of your CB, SWL or ham shack, along with a list of your equipment. We prefer 8x10-inch glossy prints. Pack your picture well to prevent damage in the mail. Unused photos are returned. The address: EI Prize Shacks, 67 W. 44th St., New York 36, N. Y.

CB

Seth B. Paull operates 1W1717 from this CB shack in Bristol, R. I. He uses the station in his radio and TV business and also in emergency work with Bristol County CB Club. Gear includes a USL TR800 5-watter, Lafayette HE-29 handi-talkie, bank of 22 crystals and a Mark 1 beacon.

SWL

Prize SWL shack owner is L. R. Ferguson, Dallas, Tex. He has no less than four Hallicrafters and Hammarlund receivers. And outside are five antennas that include a 90-ft. long-wire and a 60-ft. inverted V. He has DXed 100 countries, all states.

HAM

Our attractive ham shack is run by Fred J. Harris, Jr., K9YSC, Bellwood, Ill. He's an ex-Novice with Technician ticket, is now working on a General. In shack are a Hallicrafters receiver and Knight T-50 CW transmitter.

some FCC thoughts

FCC's Ivan Loucks (left), chief of CB operations, during chat with EI's CB Editor, Len Buckwalter.

Loucks answers the most-asked questions on Citizens Band Radio.

By Len Buckwalter, 1W5733

MANY'S THE TIME most of us have looked through the Citizens Band rules and wondered what some of that legal stuff really means in everyday operations. Take *frequency-determining elements*, for instance. We've been mulling that one over for three or four years.

Not long ago we got some of the elusive answers we've been looking for when we had a long talk with the FCC's Ivan H. Loucks, who is top man on CB as chief of the Land Transportation Division.

Since the rules state that a CB operator cannot tamper with *any* frequency-determining element in the transmitter, we opened with wondering aloud whether this would not include crystals.

Mr. Loucks's answer, it turns out, won't affect the huge amount of crystal trafficking now going on. It is perfectly all right for anyone to install new crystals, said Chief Loucks, *if* the manufacturer certifies the required .005% tolerance for your transceiver. But he did caution against the practice of crystal-swapping between units. This might lead to off-frequency operation, a too-common cause of illegal performance.

This led to another interesting interpretation of Part 19. Let's say that a dealer sells you a crystal that misses the .005% spec. You install it and operate, none the wiser, until the FCC pegs you with an off-frequency notice. Who is responsible? It's *you*, the CBer, not the manufacturer. The FCC has no jurisdiction over equipment makers and is interested only in who *commits* the offense (a good reason for sticking with reputable CB manufacturers).

Another hazy area came into focus when we asked about the numerous signaling systems that have appeared. Mr. Loucks's answer roasted the turkey calls and Q-birds. You *can* use tones to attract attention, but it's not that simple. Any non-voice signals must be used to operate some device which performs the attention-attracting chore. For instance, a tone can work a relay that rings a bell, lights a lamp, etc. The evil with tone alone is that it can be used to transmit intelligence, like one beep for yes, two for no, and a tone, though it gets through where a voice will not, can cause interference.

How about scramblers, those attachments that make the voice sound like it went through an electronic mixer? They're permissible. Scrambling, according to Mr. Loucks, is just another means to insure privacy of communications. The principle fits in with the intent of the Communications Act—specifically Section 605, which contains the secrecy provision.

The Chief then shed some more light on 605. According to the law, QSL cards

on CB

mailed by many CBers are illegal, said he. QSLing a station you hear, but don't work, makes you a third party. To divulge what you hear is against the law. In effect, the QSL card does it. The situation is further aggravated by the fact that other persons (such as mailmen) can read a post-card type QSL. Mr. Loucks added the suggestion that the whole process of CB QSL's reflects an undesirable hobby-type operation. Why confirm a short-range contact?

How about a power increase beyond five watts? The answer was simple. It would defeat a major reason for bringing the band into existence. More power is virtually synonymous with stricter regulation, and the cost of equipment would rise sharply (it would have to, since the technical specs would tighten). And you could look forward to stricter operating rules to cope with interference that inevitably results from higher power.

What about raising the 20-foot limit on antenna height? Mr. Loucks sketched in the little-known basis for the rule. It seems that the Federal Aviation Agency controls all air space and considers 20 feet over man-made or natural formations the top figure for many areas. The FCC chose it for all CB antennas because, admittedly, any other approach produces a staggering amount of paper work. If handled on an individual basis, as in other radio services, each CBer would have to pinpoint his latitude and longitude. Then the FCC would have to check each one for aeronautical hazards. The blanket 20-foot decision simply makes life easier for the heavily burdened FCC operatives.

Mr. Loucks's hints for the future: watch for a rewrite of Part 19 to clarify some of the legal language. And hold on to your pocketbook—the Commission has toyed with the idea of fines (not to exceed $25) to bring errant CBers into line.

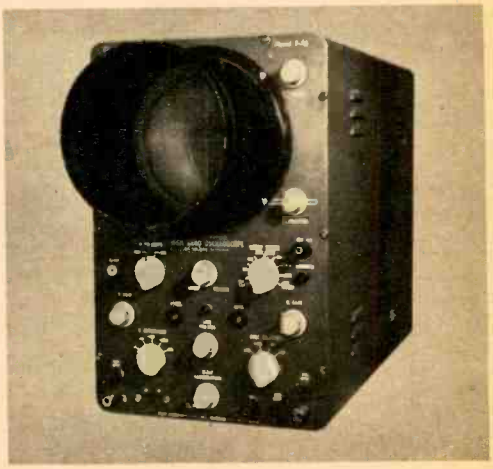
Fines for breaking the rules: it sets one to thinking. Which, no doubt, was the FCC's intention.

CRT SHIELD *for your* SCOPE

IF YOU are troubled by reflections on the screen of your oscilloscope when trying to view a critical trace, you can make an excellent CRT shade from a cigar tin. The Dutch Masters brand is packed in a can whose outside diameter makes a perfect friction fit inside the bezel of a number of current scopes.

A before and after view of the cigar container.

To adapt the can, simply run its bottom through a standard can opener. This will provide a hollow cylinder which should be sprayed flat black inside to kill reflections. When mounting the shade, squeeze its sides slightly and press-fit it into place.—*Dave Gordon*



The shield in place on a Paco model S-55 scope.

THE MINI-FI

A mono amplifier for $10 . . . stereo for $15! Two tubes, 20 db of feedback, direct coupling and Ultra-Linear output produce the cleanest two watts you've ever heard!

By Dave Gordon

AUDIOPHILES usually prefer 15 watts or more per channel for living room hi-fi, but there are times when an amplifier that puts out a clean couple of watts will do a specific job more efficiently. For instance, a small, high-quality amplifier is well suited for use with a tape deck, or it can feed the center-channel speaker in a stereo setup.

The EI Mini-Fi is just such an amplifier. Simple and easily built, it delivers an exceptionally clean 2 watts and fills the bill where power requirements are low but fidelity requirements are high. And it can be constructed in either of two versions—mono or stereo. Building cost runs about $10 for the mono model, about $15 for stereo.

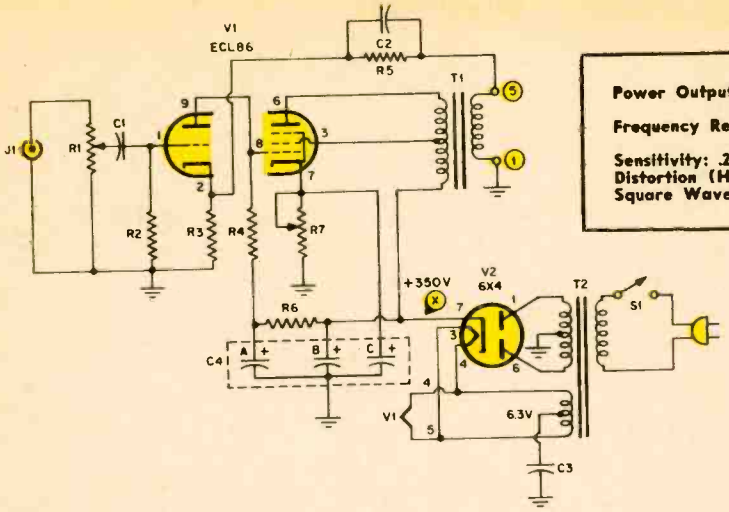
With the Mini-Fi, an inexpensive FM tuner and EI's Duoflex speaker (July '62 issue) or similar system, you can have a top-quality FM radio at a fraction of the cost of commercial equivalents. Or if you want an outstanding phonograph at minimum cost, you can feed the output of a high-quality ceramic cartridge directly into the Mini-Fi's input jack.

Two keys to the Mini-Fi's quality are a carefully selected output transformer and a new tube, the ECL86, which combines a high-gain triode with a sensitive output pentode.

The Mini-Fi's circuit has several offbeat aspects (see schematic). Starting at input jack J1, control R1 establishes the level of input signal. If the associated equipment has a built-in volume control, R1 may be omitted. Capacitor C1 is necessary to prevent the grid bias achieved by the 10-megohm grid resistor (R2) from being shorted out by the input load. The 68-ohm cathode resistor (R3) does not function as a bias resistor but simply lifts the cathode off ground

PARTS LIST

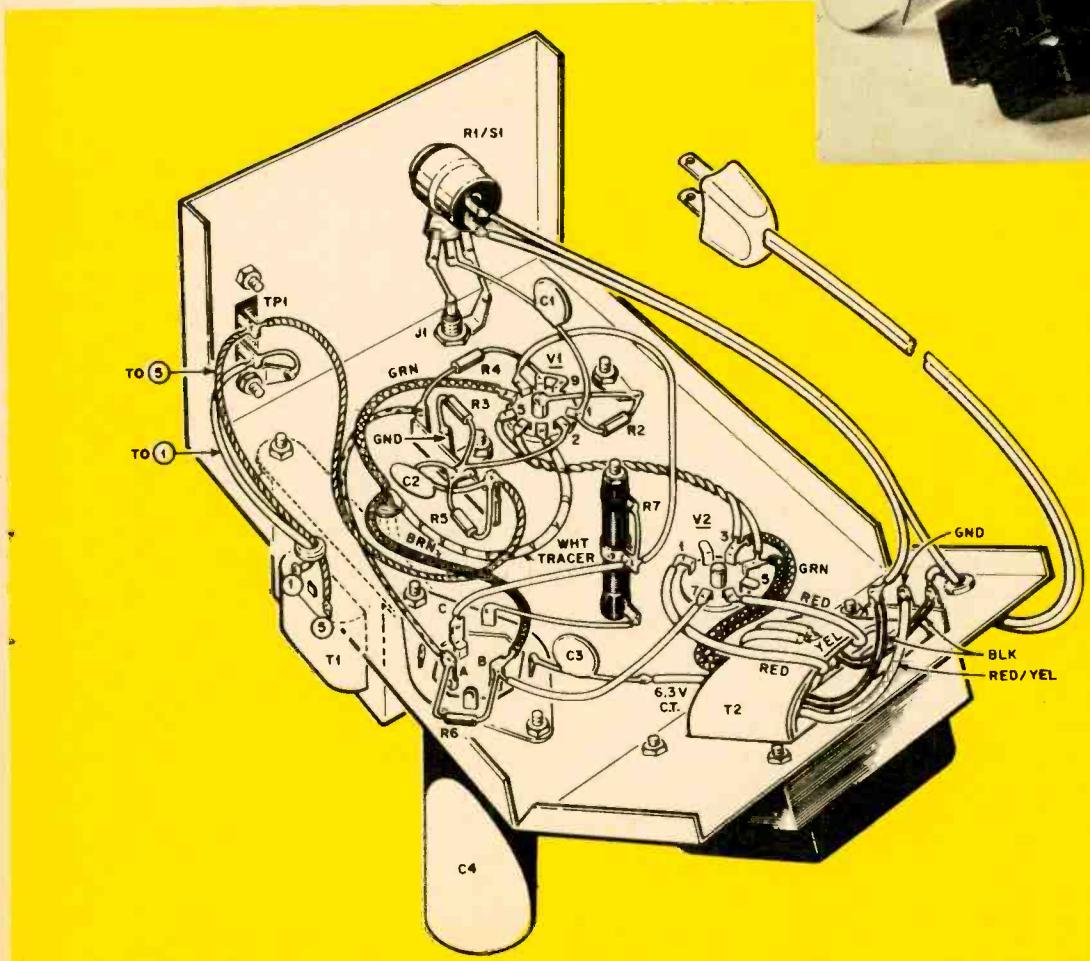
Resistors: ½ watt, 10% unless otherwise indicated
R1—500,000 ohm or 1 megohm pot. w/switch S1
R2—10 megohm
R3—68 ohms
R4—470,000 ohms
R5—1,200 ohms
R6—680,000 ohms
R7—Any value 7,500 to 10,000 ohms, 10 watt adjustable
Capacitors:
C1—.01 mf ceramic disc
C2,C3—.02 mf ceramic disc
C4—40 mf @ 450 V; 10 mf @ 450 V; 80 mf @ 200 V triple-section can-type electrolytic (see text)
T1—Universal output transformer (Lafayette TR13) see text
T2—Power transformer. Secondaries: 6.3 V @ 1.5 a, 750 V @ 40 ma, centertapped (see text)
TP1—2-screw terminal strip
J1—Phono jack
Misc.—7-pin tube socket, 9-pin socket, 4-lug terminal strip, wire, etc.



TECH SPECS

Power Output: 2.25 watts (rms) before clipping (@ 1 kc)
Frequency Response: +0db, —3db; 25 cps—40 kc (@ .75 watts)
Sensitivity: .275 volts (rms) for fu l output
Distortion (HD): 1% @ 1 watt, 2.5% @ 2.25 watts
Square Wave Response: No ringing at any frequency

Output transformer T1 is wired in an Ultra-Linear or split-load configuration. A slight advantage is realized by this hookup in the below-100 cycles performance of the Mini-Fi amplifier.



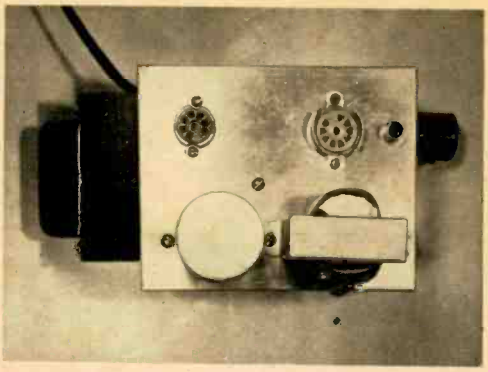
sufficiently to allow feedback to be applied to the cathode. Resistor R4 serves as both the plate load resistor of the triode and the grid return of the pentode. This means that the pentode grid is operating with a voltage on it *equal* to the plate voltage of the triode. Since the ECL86 pentode requires about 8.75 volts bias on the grid, an over-large cathode resistor (R7) provides a voltage drop equal to 8.75 volts *plus* the triode's plate voltage.

For optimum results, the bias on the output tube must be adjusted critically with R7. It's not possible to specify an exact resistance for R7 because with a direct-coupled circuit, in which one tube's plate voltage is another tube's grid voltage, the normal voltage variations tend to add up. As measured with respect to the cathode (in other words, with the positive lead of your meter on pin 7 and the negative on pin 8), R7 should be adjusted for 8 volts. With respect to ground, both pins 7 and 8 will show anywhere from 100 to 150 volts positive, but pin 7 will be 8 volts more positive than pin 8. The grid voltage on the output tube should be measured with a VTVM (preferably) or a 20,000 ohms/volt VOM.

If the equipment is available, a better way to determine the correct bias on the pentode is to use an audio generator and oscilloscope. Connect an 8-ohm load resistor to the output terminals of the amplifier, feed a 1-kc signal into J1 and, with R1 on full, adjust R7 for maximum undistorted output as viewed on the scope. The level of the 1-kc signal fed into J1 and R7 should be adjusted with respect to each other, so maximum signal output with minimum clipping is obtained.

Since the cathode of V1's pentode section is operating with over 100 volts on it (to compensate for the high grid voltage), the plate and screen grid must be raised above their normal 250 volts by an additional 100 volts to insure proper current flow. This accounts for the high plate and screen voltages on the ECL86.

Parts Substitutions. Certain parts changes are permissible. Wired as shown, the Mini-Fi has an input sensitivity of .25 volts. In other words, .25 volts applied to J1 (with R1 wide open)

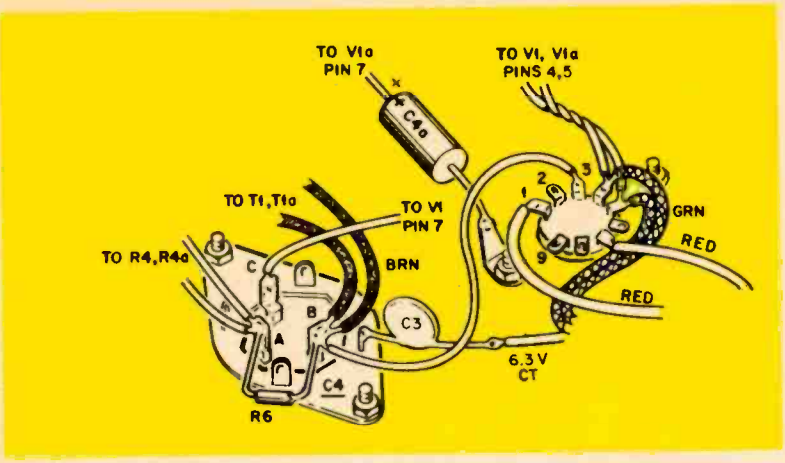


Top chassis view of Mini-Fi shows socket and component placement. Keep V2 away from filter C4.

will drive the Mini-Fi to full output. However, if more gain is desired, feedback resistor R5 can be *increased* in value. Capacitor C2 should be decreased in the same ratio. Input control R1 may be 500,000 ohms to 2 megohms.

Output transformer T1 was selected on a price vs. quality basis. There's no point in substituting another transformer unless it's in the $6-or-over-range. If a better quality transformer is used, feedback components R5 and C2 will have to be readjusted. Select R5 so that approximately .25 volts input drives the amplifier to full output. The value of C2 will have to be established experimentally as follows. Set R1 half open and use the smallest value of C2 that eliminates the resulting supersonic oscillation as viewed on a scope. As an alternative, feed in a 10-kc square wave and adjust C2 for the flattest tops.

Power transformer T2 may be a surplus or junkbox component. Its high-voltage secondary can range from 600 volts center-tapped to 750 volts center-tapped (300-0-300 to 375-0-375) with at least a 40 ma rating. If the high-voltage secondary is in the 600-650 volts center-tapped range, no additional parts are required. However, if the DC voltage at the 6X4 cathode (pin 7) exceeds 380 volts, install a resistor between pin 7 of V2 and C4B. This point is marked X on the schematic. The value of the resistor is determined experimentally, but should be a 4-watt job at 500 ohms or higher. In any case, select the resistor to provide about 350-375 volts at C4B.



Pictorial of the power supply for the stereo version shows the revised power supply wiring. All other components are doubled for stereo. Note that a metal mounting plate is used for the filter capacitor in both mono and stereo versions.

If the filament winding of transformer T2 has a center-tap as shown, do *not* connect it to ground because the high cathode voltage on the pentode section may arc over to the filament. Connect capacitor C3 to the center-tap as shown. If the filament winding has no center-tap, connect C3 to pin 4 of V1. C3 is not critical and values from .002 mf to .05 mf will serve.

Filter capacitor section C4A may be anywhere from 10-50 mf at 450 volts, C4B should be 40 mf or higher at 450 volts and C4C can be 20-80 mf at 150 volts rating. If a resistor is installed at X, an additional 8-20 mf capacitor at 450 volts may be installed from pin 7 of V2 to ground. If desired, separate capacitors instead of the multiple-section can type shown may be used.

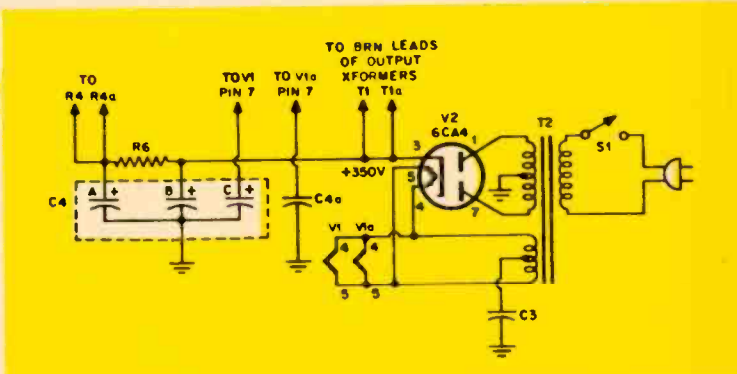
The stereo version of the Mini-Fi requires little redesign. All components are duplicated except those in the power supply. A power transformer capable of suplying at least 80 ma is required and a heavy-duty rectifier tube, the 6CA4 is substituted for the 6X4. The 6CA4 requires a 9-pin socket instead of the 7-pin type used by the 6X4. All other components not shown in the partial schematic and pictorial of the stereo model are duplicated. The new or additional power supply components are indicated by the letter a in the diagrams. Capacitor C4Ca is a tubular electrolytic with the same specifications as C4C.

A larger chassis will have to be used. No size is specified here, because the physical size of the larger power transformer will determine the overall chassis dimensions.

The Mini-Fi is designed for an 8-ohm speaker load. With either a 16- or 4-ohm load there will be a slight loss of power, but the high level of feedback will keep distortion low.

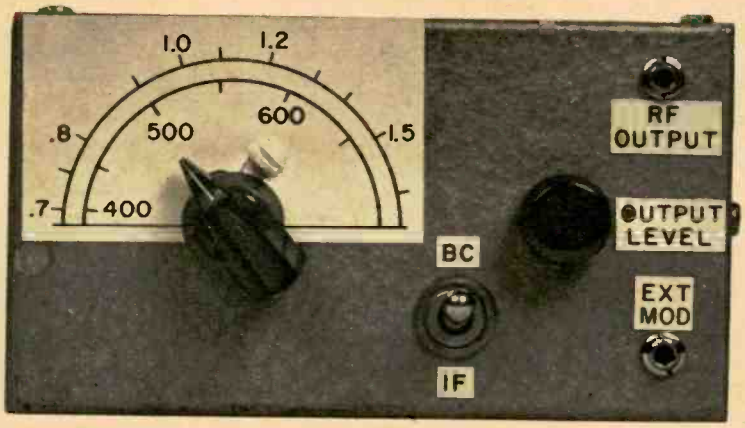
If desired, the stereo version may be operated monophonically by feeding the same signal into both input jacks and paralleling the outputs for a 4-ohm output impedance.

In listening tests, the Mini-Fi is impressive. It appears to be able to drive any speaker system except suspension types.



For the stereo version of the Mini-Fi, the power supply is redesigned. A new rectifier tube, a 9-pin socket, a heavier-duty transformer, and an additional filter are required.

Build These Pocket-Size



RF SIGNAL GENERATOR

Easy-to-build one-transistor unit covers the basic alignment frequencies for radio testing and servicing.

THIS little RF generator will handle about 95% of the service jobs requiring an RF test or alignment signal. Up to .25 volts of unmodulated RF is available in the range of 400 kc to 1600 kc divided in two bands. These frequencies cover all the common BC radio IF and RF frequencies.

The shielding case and isolation from the AC line due to battery operation minimizes RF leakage. An input jack for external modulation (J2) allows the Audio signal generator or other external audio source to be used.

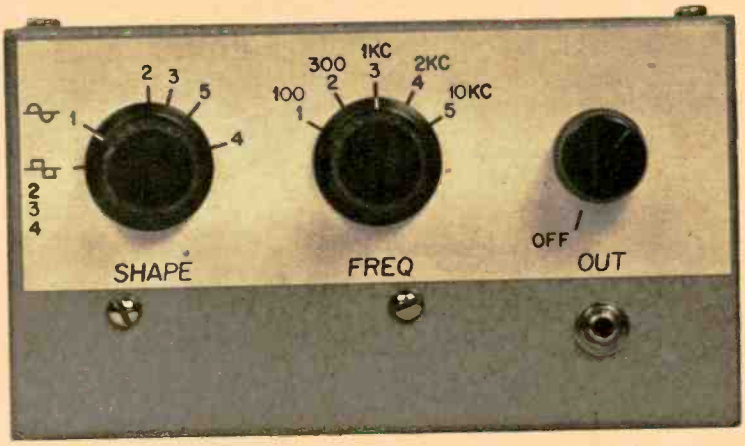
Construction. Cut the tuning capacitor (C1) shaft to a length of ⅝ inch and the output control (R4-S2) shaft to $\frac{5}{16}$ inch. C1 is mounted to the front panel with 6-32, ¼-inch machine screws into the tapped holes on the capacitor. The other front panel components mount in a normal manner. Clip short the terminal lugs of L1 and discard the short pickup lead. The normally grounded terminal of L1 is soldered to the separator on C1 as shown in the pictorial. A holding clamp for battery B1 is constructed as in the audio generator. Since tuning capacitor C1 is slightly too deep to permit the back of the case to be fastened using the existing screw holes, drill a new set of pilot holes for self-tapping screws. There will be a ⅛-inch gap at each end of the case, but this is not critical with respect to signal leakage or use.

Calibration. The RF generator can be calibrated easily with an accurately aligned broadcast receiver. The BC band of the generator is calibrated first. Set S1 to its open position. Connect the generator leads to the receiver's antenna and ground terminals or across the loop antenna terminals with a small capacitor (about .0001 mf) between the "hot" lead of the generator and the antenna. Turn on the receiver and genera-

[*Continued on page* 88]

Test Instruments

By
Forrest H. Frantz, Sr.



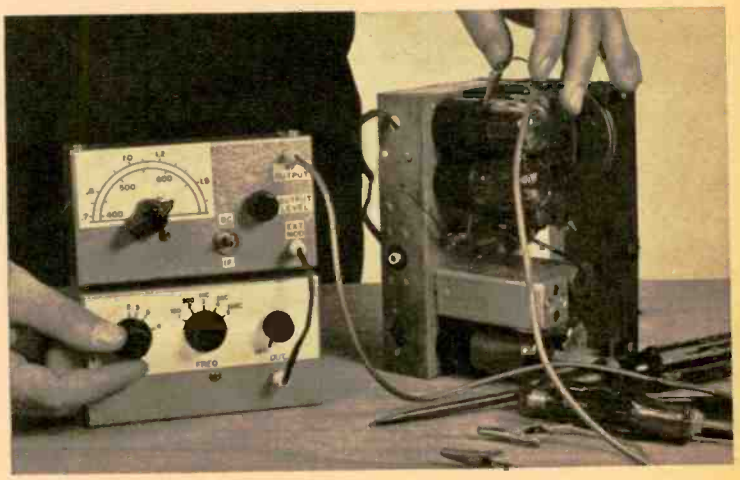
AUDIO SIGNAL GENERATOR

Companion audio instrument produces both sine and square waves for hi-fi and public address amplifier testing.

DESIGNED around a single transistor, this compact generator can be used for audio testing or to modulate an RF signal generator. It provides five different sine-wave frequencies with low distortion. Square waves of poorer quality are also available.

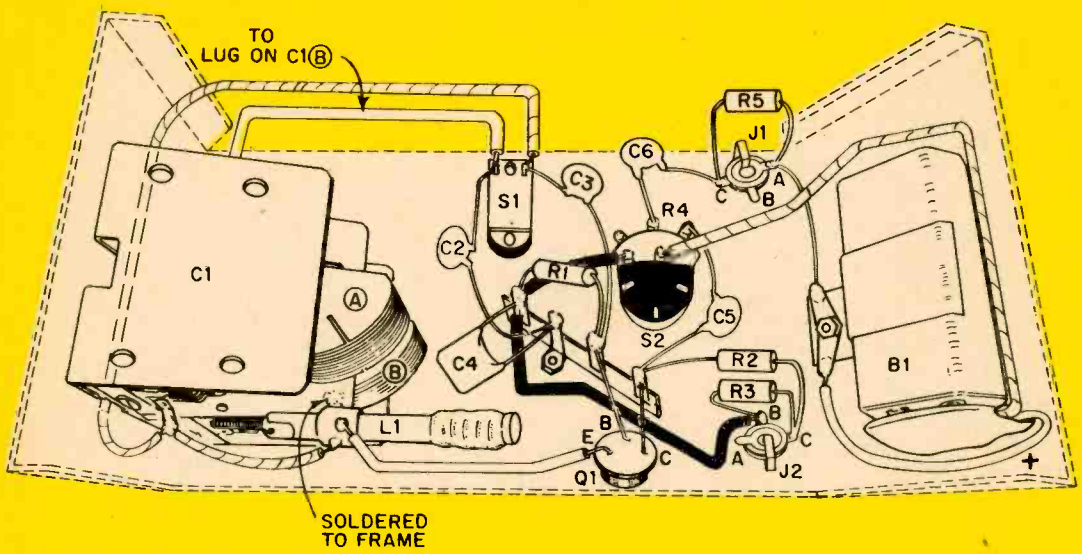
Construction. No special problems should be encountered in the construc-

[*Continued on page* 90]



Functioning as a team, the two instruments make radio receiver alignment a snap. Each generator may also be used independently when situation demands.

RF SIGNAL GENERATOR



tor. Modulation is not required. Tune in a station at the low end of the broadcast band between 600 kc and 700 kc. With output control R4 set to a high level, tune C1 to zero beat with the station. At the frequency of each broadcast station you should hear a heterodyne whistle, which should lower in frequency, disappear, then rise in frequency. Adjust the ferrite core of L1 if necessary to place 700 kc at the bottom left side of the dial. Mark the frequency of the broadcast station on the generator scale at the point where the heterodyne whistle becomes a growl and disappears (zero beat). Continue this process throughout the dial using known frequency broadcast stations as your standard. Don't trust the dial calibration of your radio more than you have to.

Now set S1 to the IF position and connect a jumper lead from the oscillator section (smallest gang) of the radio to chassis ground. Tune the RF generator for a loud signal in the receiver. Assuming the radio has a 455 kc IF, mark this frequency on the generator dial. Now remove the jumper wire and you can calibrate the rest of the scale against the low end of the broadcast band using the same technique as that given above.

Using the Generator. The application of the RF signal generator is conventional in that a .01 capacitor should be used in series with the output lead for IF alignment, and a 100 mmf for broadcast RF alignment. The output lead is a single conductor shielded cable with a miniature plug for matching J1 on one end and Minigator clips for connecting to the receiver on the other.

For alignment without using a modulated signal, monitor the receiver's AVC voltage with a VTVM.

To align a receiver without a VTVM, AF modulation must be provided. The audio signal generator is a natural companion to the RF generator. Simply connect the audio generator output directly into the RF generator external modulation jack J2. A VOM set for its lowest AC range is clipped across the speaker's voice coil leads to monitor the output tone.

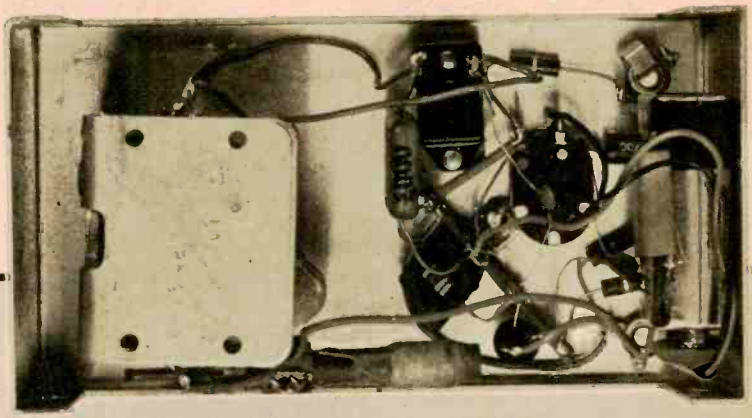
Possible Troubles. The RF Generator was tested for a variety of components and was not critical. However, if trouble is experienced first recheck the circuit for correct wiring, shorts, shorted capacitor plates, poor connections, reversed polarities, etc. If every-

thing seems to be in order, try:

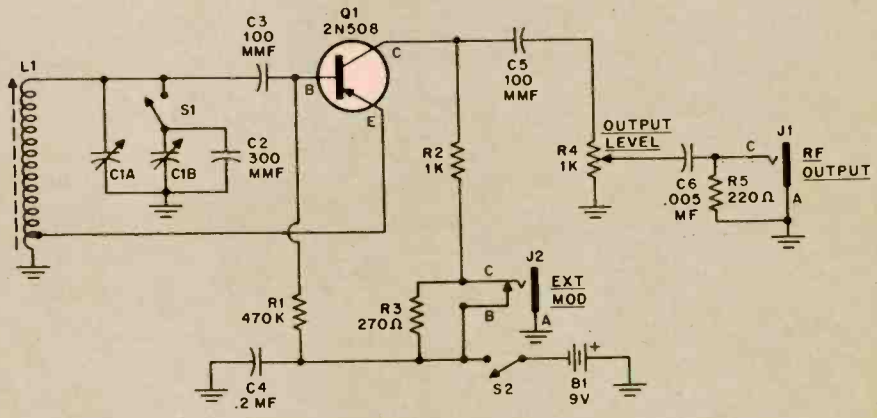
- Changing R1 to a value anywhere from 330,000 ohms to 560,000 ohms.
- Changing R2 to a value between 820 and 2,200 ohms.
- If a substitution has been made for L1, the leads to ground and tap on the lower portion of the coil may have to be reversed.

Circuit Description. The RF signal generator utilizes a Hartley oscillator circuit. C1A tunes the BC band. IF band operation is obtained by paralleling C1A with C1B and C2. Signal pick-off at the collector of Q1 through a 100 mmf capacitor (C5) to the 1,000 ohm output control (R4) minimizes external circuit loading effects on the generator. External modulation (when used) is applied to the collector circuit.

One of the RF generator's most attractive qualities is its size. It literally fits into a pocket or, if you are a radio serviceman, into the corner of your service case. The audio generator matches it in size.



Internal view of the RF generator. Parts layout is not critical. Terminal keying of jacks J1 and J2 is seen on next page.

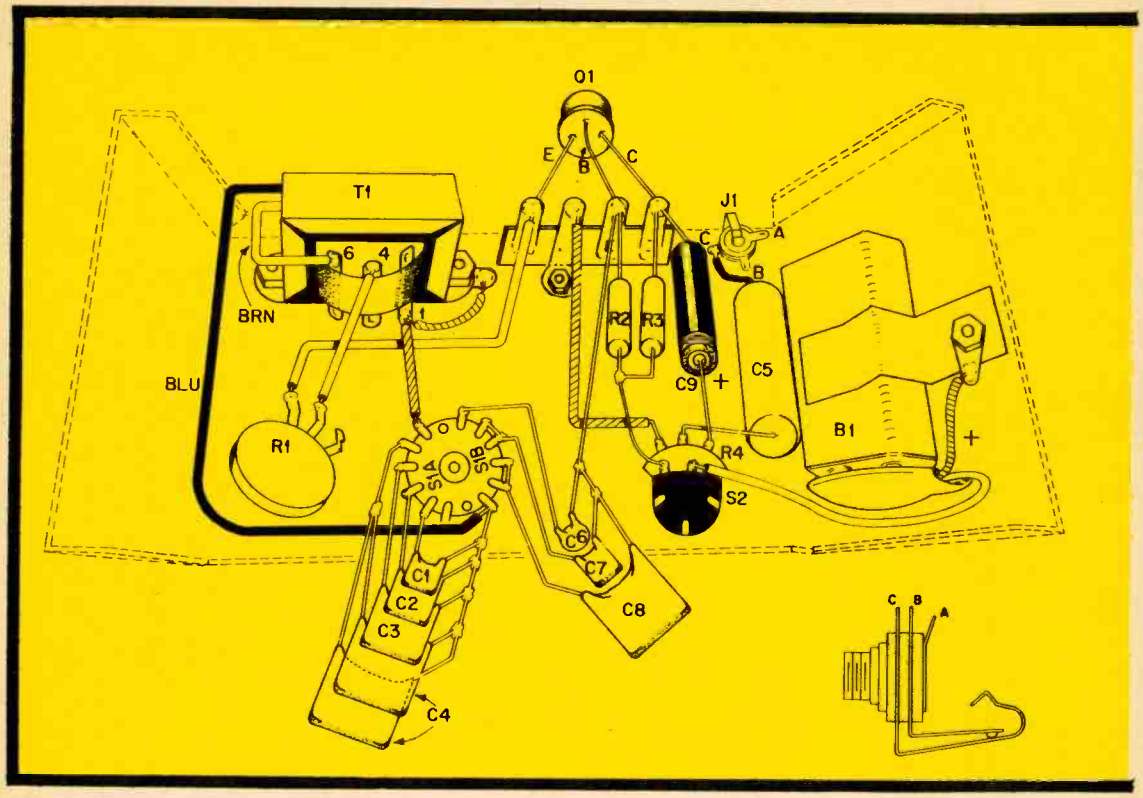


RF GENERATOR PARTS LIST

Resistors: 10%, ½-watt
R1—470,000 ohms
R2—1,000 ohms
R3—270 ohms
R4/S2—1,000-ohm miniature volume control w/ switch
R5—220 ohms
Capacitors:
C1A,B—Two-gang, 365 mmf each gang, variable
C2—300 mmf (mica)
C3,C5—100 mmf ceramic disc
C4—.2 mfd, low voltage miniature ceramic
C6—.005 mf, 600-V or higher, ceramic disc
Q1—2N508 transistor
L1—Tapped transistor antenna loopstick (Lafayette MS-299 or equiv.)
S1—SPST toggle or slide switch
B1—9 V battery and connector
J1,J2—Miniature jacks plus mating plugs
Misc.—Aluminum cabinet, 5¼"x3"x2⅛"; four-lug soldering strip; knobs, etc.

A kit of parts is available from Lafayette Radio, 111 Jericho Tpke, Syosset, N. Y. Stock #SP-286: Price $6.55.

AUDIO SIGNAL GENERATOR



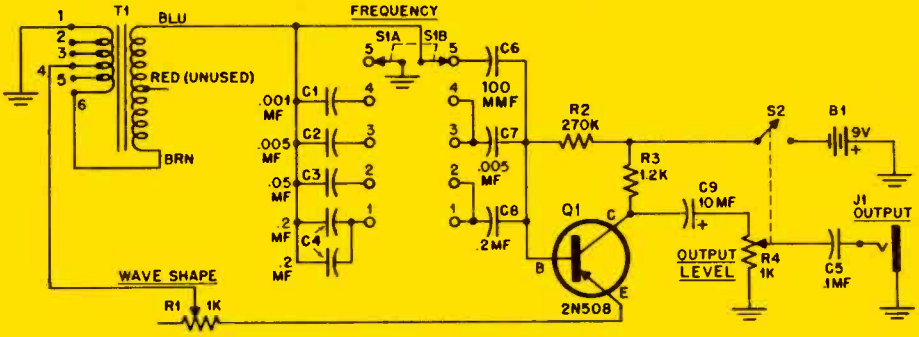
tion of the unit. Use the standard precautions when soldering the transistor to the terminal strip to avoid heat damage. Some wires in the pictorial (particularly in the area of S1) are shown longer than necessary for the sake of clarity. In practice, keep the leads as short as possible and use spaghetti or plastic tape to insulate any components or leads that may short out. Jack J1 is mounted directly on the metal cabinet which grounds its terminal A.

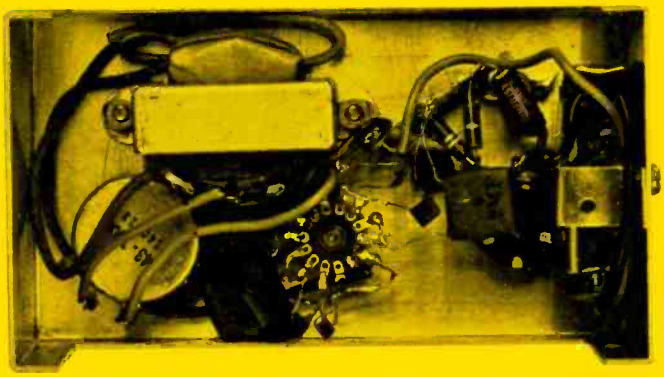
The battery clamp is formed from a strip of aluminum about ¾ x 2 inches. Drill and bend as required to hold the battery in place.

Cement a piece of high quality paper to the front panel with rubber cement. All of the markings *except* the index marks on the shape control may be placed on the paper before you fasten it to the panel.

Calibration. Connect the output of the audio generator to an oscilloscope or a VTVM. Set the output control for maximum. Set the frequency control to 5 (10 kc) and adjust the shape control for a clean sine wave (as seen on the scope) or for a 1 volt output on a VTVM. Mark the shape setting 5. For each position of the *frequency* switch find and mark a *shape* setting. On the 1 (100 cps) and 2 (300 cps) positions, there may be a low-frequency variation of output when you adjust for best sine wave or 1 volt output. If this occurs, simply adjust the *shape* control for increased output till the output steadies.

Using the Generator. The Audio Signal Generator may be used for signal tracing in public-address amplifiers, hi-fi amplifiers, tape recorders, audio sections of radios and TVs. Simply inject the generator's signal to the input of the amplifier under test and measure AC voltage at the input and output of succeeding stages with a VTVM, audio VTVM or an oscilloscope. Loss of signal or extremely low gain indicates the trouble area.





Universal output transformer serves as inductive element in generator's one-transistor circuit. Wave shape and frequency are determined by setting shape control pot R1 in conjunction with switch S1.

Distortion problems can be localized by the same technique except that a scope is used as an indicator. In all cases, reduce the signal generator output sufficiently to prevent overloading.

The maximum output power of audio amplifiers can be determined. Connect the signal generator output to the amplifier input. Connect a scope across the load resistor (high wattage 4, 8 or 16 ohms) and appropriate speaker terminals. Increase the signal generator output till the wave form on the scope shows clipping. Measure the AC voltage across the load resistor.

Other applications for the Audio Frequency Signal are as a modulator for the RF signal generator, frequency response testing, etc.

Square waves can be obtained on the 300 cps, 1 kc and 2 kc frequency ranges by setting the shape control to zero. The square waves are symmetrical and might be more properly called rectangular waves. This type of output was not a design objective and is simply a plus.

Circuit Description. The basis of the circuit is the Hartley oscillator with capacitors C1 through C4 in combination with T1 forming the tuned circuit. The amount of feedback is controlled by C6 through C8 and shape control R1.

AUDIO SIGNAL GENERATOR PARTS LIST

Resistors: ½-watt, 10% unless otherwise indicated
R1—1,000-ohm potentiometer
R2—270,000-ohm R3—1,200-ohm
R4/S2—1,000-ohm miniature potentiometer with switch
Capacitors: Low voltage ceramic types (except C5)
C1—.001 mf C4—.4 mf (two .2 mf in parallel)
C2,C7—.005 mf C5—.1 mf paper, 600 volts
C3—.05 mf C6—100 mmf
C8—.2 mf
C9—10 mf, 15 V miniature electrolytic
T1—Universal output transformer (Lafayette TR-12, no substitute)
Q1—2N508 transistor
J1—Miniature phone jack
S1—2-pole, 5-position miniature non-shorting rotary switch (Lafayette SW-78 or equiv.)
B1—9-V battery
Misc.—1 5¼"x3"x2⅛" Minibox; 4-lug soldering strip; knobs, etc.

A kit of parts is available from Lafayette Radio, Stock #SP-287: Price $8.90.

KIT
EI
REPORT

Fisher KX-200

STEREO MASTER CONTROL AMPLIFIER

THE MOST recent of the major hi-fi manufacturers to enter the kit field, Fisher Radio offers as its first release a stereo master-control amplifier. Rated at 35 watts (40 watts IHFM) per channel, the model KX-200 has all the features one would expect in a late-model integrated stereo amplifier, plus several novel design ideas.

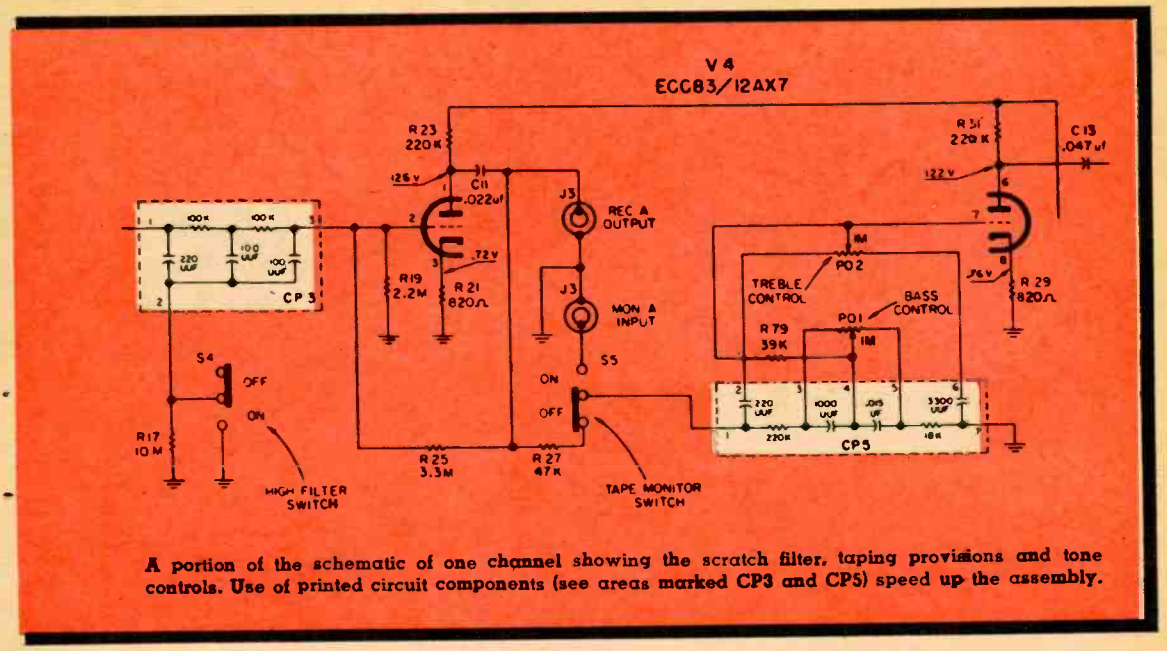
Fisher's approach to the instruction manual and kit construction procedure ranks among the best we've checked. The instructions are exceptionally well done and are written with a light touch calculated to hold the interest of the kit builder. Scattered throughout the manual are phrases such as ". . . if you have any parts left over you goofed! Go back and check . . ."

The Construction process is broken down into 20 stages, each stage occupying one side of a page with the pictorial on the facing page. With few exceptions, the components required for each stage are packaged as a group in a plastic bag, each with its own parts list.

When you unpack the kit you'll notice that almost all controls, terminal strips and tube sockets are premounted. Furthermore, all leads are precut and stripped to the exact length required. But even with so much of the work done for you remember that this kit is almost the equivalent of two mono preamp-amplifiers. You still can figure on a week of evenings to complete the kit.

The Fisher circuit is quite straightforward. Looking at one channel, you'll find a dual-triode preamp stage with feedback equalization for tape and phono. This is followed by a triode with a feedback switching arrangement which permits it to serve simultaneously as a tape output and monitor head input for use with tape recorders (see schematic).

The tone controls are of the "losser" type and are quite effective. The driver



A portion of the schematic of one channel showing the scratch filter, taping provisions and tone controls. Use of printed circuit components (see areas marked CP3 and CP5) speed up the assembly.

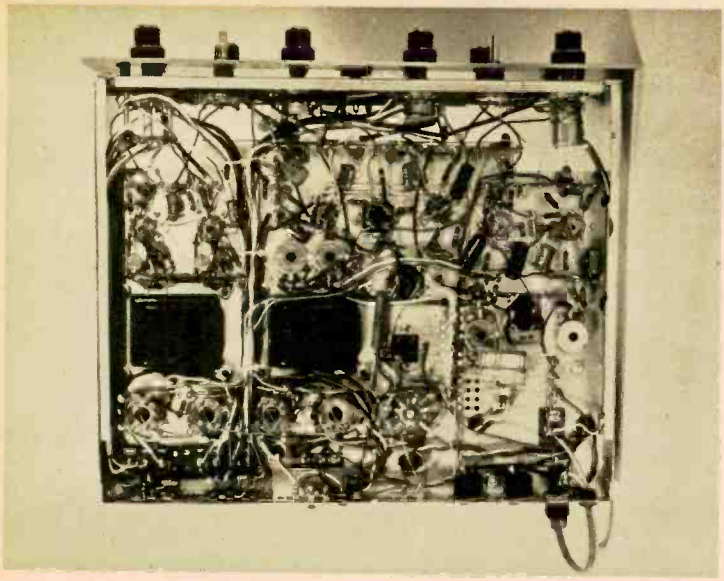
stage uses a pair of direct-coupled triodes in a split-load phase inverter to feed a pair of 7591 output tubes.

As can be seen in the photos, the output transformers are massive and contribute much to the unit's excellent power response. A silicon diode power supply serves the high voltage requirements of the amplifier. In the interest of low noise, all filaments in the amplifier, with the exception of the output tubes, are operated on DC.

Some special features of the Fisher are worth mentioning. A built-in meter serves for output tube balancing and bias adjustments. Far from a gimmick, the meter is a worthwhile feature which lets you keep tabs on the proper operation of the output tubes. The meter enables you to adjust the circuit for optimum performance and even indicates when the tubes may need replacement. (It can be seen on the rear panel in our photo.)

The arrangement for a center-channel speaker is novel. The secondaries of the output transformers in the Fisher have their 4-ohm taps grounded and their commons used for the feedback take-off point. A center-channel output terminal is connected between the common of

Close-up of chassis rear shows metering provisions and center channel speaker output. Five-position switch immediately above meter selects its function—(either bias or balance) for each channel.

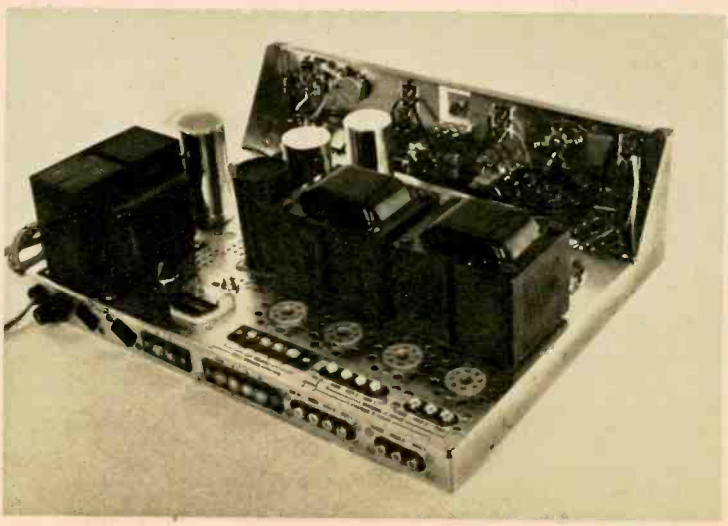


The under-chassis view of completed amplifier. Aside from the modules, the entire amplifier is handwired. An open, well spaced layout simplifies construction and even an absolute beginner should have no difficulty in successfully completing Model KX-200.

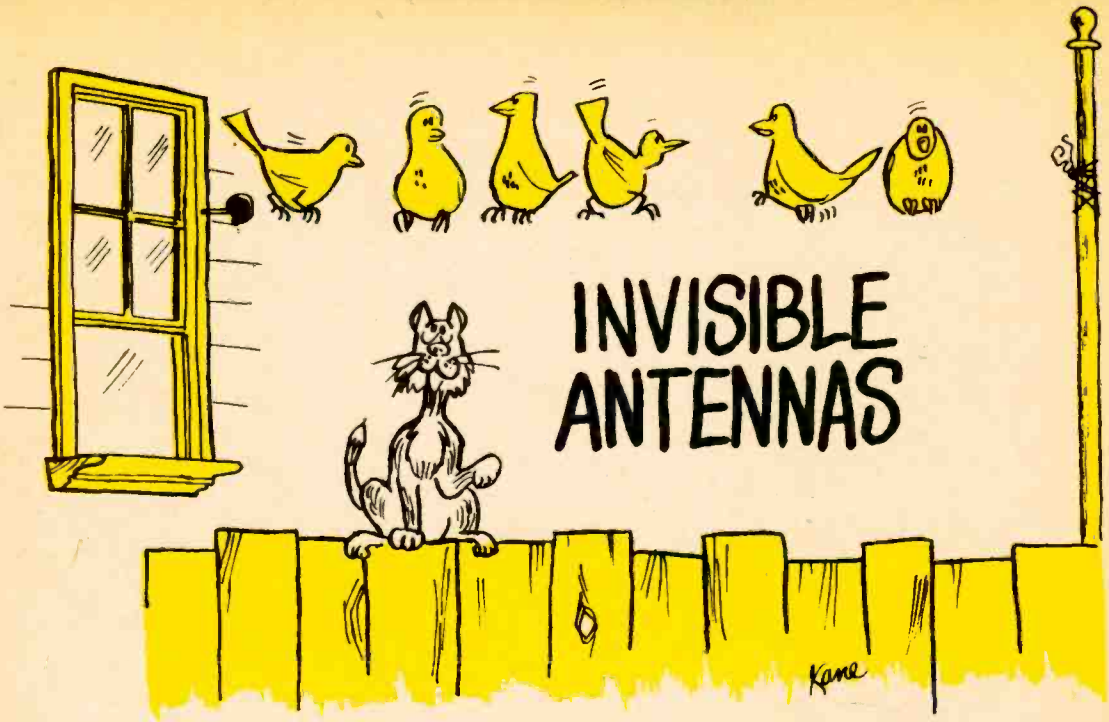
one transformer and the 16-ohm tap of another. This provides an A+B center-channel feed which not only can be used for stereo fill (without the need of a separate center-channel amplifier), but will drive an extension speaker in your bedroom with a mono version of the program playing in your living room.

Tech Specs. It's always gratifying to check out an amplifier and find that the manufacturer has hewn to the straight and narrow path in his specifications. Our tests confirmed every printed specification on the KX-200—and they are quite good. For example, Fisher specifies an output power (one channel) of 35 watts (rms) at an intermodulation distortion of only .8%. We obtained .76%. Fisher claims a frequency response *at 35 watts* of 20 cps to 20 kc, ±1db. We obtained the same response, but ±.5db.

As a final comment, the Fisher KX-200 not only measures up extremely well, but sounds as good as the best we've heard in its power range. —



Rear chassis view of completed unit before installation of tubes. Note the two massive output transformers which contribute to the Fisher's excellent power response. The four sockets for the output tubes (with ventilating holes spaced around them) are seen between the rear apron and output transformers. The voltage amplifier tube sockets are hidden from view but logically placed close to front panel.



Your neighbors will never know if they can't see your skyhook!

By Steve Bacon, W2CJR

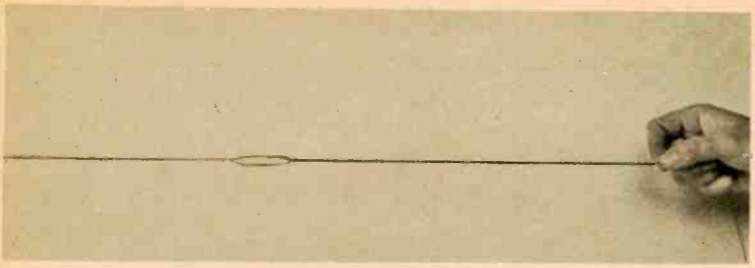
SUPPOSE you are the world's most enthusiastic ham or short-wave listener. You can hardly wait to try out that new rig—except for one thing: an antenna. Those fortunate enough to live in more rural areas can simply string a wire betwixt house and barn. But the inmates of those concrete-and-steel apartment jungles have a more serious problem.

One frustrated ham we know solved it by loading up the steel beams of the elevator shaft. Sitting over his rig in the wee hours, he found his vertical antenna worked well enough for local contacts. Unfortunately, the janitor got suspicious when his fingers started drawing arcs from the control panel of the elevator. Our friend, now at a new QTH, at last report was experimenting with the fire escape.

Fine-wire antennas are a more orthodox solution. Using any magnet wire from No. 18 on down, you can construct an antenna that is virtually invisible. The main consideration is how fine a wire you can use and still expect the antenna to support its own weight.

One chap, a ham, used a strand of No. 24 to erect a half-wave antenna for 40 meters (about 65½ feet from the formula) and found that enameled wire blended perfectly with surrounding brick buildings. Minor complications aside (he put the thing up on Halloween and was mistaken for a prankster), the antenna works well and the secret is safe—unless the landlord gets fantastically sharp-eyed or lucky.

It's senseless to put up a fine-wire antenna and then load it down in both weight and visibility with large glass or ceramic insulators. Quarter-inch styrene tubing, available at your local radio supply emporium, is the answer. For end insulators, saw off pieces about 2½ inches long. Drill a $\frac{1}{16}$-inch hole in each end for the wire and you have a miniature, almost transparent, insulator (see photos). To fasten the ends of the antenna, use ordinary TV lead-in insulators of the screw or masonry nail type. Besides holding well, these make the whole assembly look less suspicious because you see such stand-offs everywhere.



VIEW FROM 5 FEET—Just how hard-to-see a fine-wire antenna can be is demonstrated by this photograph. Directly to the left of the thumb is an antenna of No. 32 wire with a plastic-tube insulator in center. Can you see it?

If your primary interest is in short-wave listening you can merely drop the end of the antenna wire down from the near insulator and attach it to the antenna post of your receiver. The styrene tubing makes an excellent feed-through insulator. Drill a small hole through the window sill or other convenient spot and line it with tubing before threading through the wire.

If you intend to use the antenna for transmitting, a few more problems are involved. Pi-network coupling is a boon in matching fine-wire antennas properly, and the size of wire you select will depend on how much power you intend to run. As a rule of thumb, *any* size wire capable of supporting itself will take up to about 30 watts. After that, it's a matter of experimentation involving actual output of your transmitter and how well your antenna is loading.

A Brooklyn ham hooked his 90-watt CW rig to an antenna made of No. 24 wire. His first couple of test dits left a plume of smoke in the air and his wire in two pieces on the ground. Obviously, he needed heavier wire. And just as obvious is the fact that fine-wire antennas are for low-power operation only.

Reactance rises sharply as wire gauge goes up (and the wire itself becomes smaller). The smaller the wire, the more problems you'll have in trying to make an impedance match. Tuned small-wire antennas are likely to be sharp at one frequency but way off at others. Single-band operation probably is best and presents fewer troubles.

There are other counterspy-type antenna gimmicks, of course. If you live on a fairly high floor you can dangle a wire out the window in the evening and then reel it in before dawn and the probing eyes of the TVI-nervous nellies start darting around in their morning search of the premises.

We know of several hams who have taken a sudden patriotic turn—buying a flagpole and mounting it in a bracket centered on the window sill. How were the neighbors to know that the pole also served as an antenna radiating element? Another way of doing it is to stretch a wire "brace" from the end of the pole to a screw eye in the top of the window frame. The wire then becomes the radiator. Various types of window-sill antennas are easy to devise for the higher frequencies—10, 6 and 2 meters, the Citizens Band, etc.—because of the small size.

If your friendly landlord permits the mounting of TV antennas on the roof, so much the better. Put up a beam and tell him that it's a new kind of TV antenna.

A word of caution: don't try to feed RF from your transmitter into a master TV antenna—that is, unless you happen to be in the TV repair business or want to hear your neighbors talking about the night lightning struck.

A HANDFUL—A complete 50-foot antenna with one insulator; the antenna runs directly to the rig.

THE LISTENER

SWL-DX NOTES

BY C. M. STANBURY II

PERUVIAN PRIZE . . . One of the better DX trophies in Latin America right now is a QSL card from OAX8K, Radio Atlantida, at Iquitos, a town that may be in Peru, or maybe Ecuador. And that's why this little kilowatter attracts the DX hunter—both countries claim Iquitos. Peru seems to have a pretty firm grip at present. OAX8K often can be heard in North America on 9625 kc.

Peru as a whole should give us some hot listening in the next year or so, regardless of who is in power. A sample came last July, when SWL's could hear the leaders of a military junta, which had just seized power, shouting about liberty and making promises for 1963, all on Radio Nacional del Peru. At the same time, the private commercial broadcasters were doing business in the usual, quiet way, with Latin music, commercials and Billy Graham. Obviously, the way to keep out of politics—and keep your license—in Peru is to ignore the rattling guns and exploding bombs.

R. Nacional is best picked up here on 9562 kc, which is OAX4R, a 40-KW transmitter in Lima, although it also appears sometimes at 854 kc on the broadcast band as OAX4A with 20 KW. All broadcasts are in Spanish but when you hear short announcements delivered in an excited tone, interspersed with martial music, you know something is up.

Most widely received commercial Peruvian station is OAX4W, Lima. Its ID is R. America; frequency is 9450 kc.

Program Note . . . WRUL is carrying a program for DXers produced by James J. Howard, executive editor of the American SWL Club. It is heard at 1300 EST on Saturdays (15440, 15380 kc) and repeated at 1730 EST on Mondays (15440, 15385 kc).

The Word . . . Two letters we've received from NASA officials (in answer to queries) explain why the radio frequencies used by our astronauts are not made public.

Says Lt. Col. John A. Powers, the Public Affairs Officer: "Although this type of information . . . is not classified, it is not the policy of NASA to release these particular facts."

Adds Ben Gillespie, Chief of Industrial Communications: "Should voice transmissions by the astronaut be monitored by short-wave listeners . . . not familiar with the mission, flight plan, etc., many erroneous conclusions might be drawn. Such a possibility could conceivably influence the astronaut's reporting of his reactions and observations."

The point is well made. Imagine the reaction if half the world heard and attempted to analyze this actual report from an astronaut: "This is Friendship VII. I'm very warm. I'm not, I'm just remaining, remaining motionless here, trying to keep as cool as possible."

However, many facts about Mercury communications have been announced or pieced together by DXers. Below are the identifiers used by stations in the Mercury communications network. In previous issues we've listed the most-used short-wave frequencies (compiled from non-governmental sources).

Happy listening!

MERCURY STATION IDENTIFIERS

ID	Location	ID	Location
ATS	Atlantic Tracking Ship	GYM	Guaymas, Mexico
BDA	Bermuda	HAW	Hickam AFB, Hawaii
CAL	Point Arguello, Calif.	IOS	Indian Ocean Tracking Ship
CNV	Cape Canaveral, Fla.	KNO	Kano, Nigeria
CTN	Canton Island	MUC	Muchea, Australia
CYI	Canary Islands	TEX	Corpus Christi, Tex.
EGL	Eglin AFB, Fla.	WHS	White Sands, N. M.
GBI	Great Bahama Island, Bahamas	WOM	Woomera, Australia
GTI	Grand Turk Island, Bahamas	ZZB	Zanzibar

make it an
OLD-FASHIONED CHRISTMAS!

The Christmas Tree by Winslow Homer, a wood engraving, Metropolitan Museum of Art.

give your buddies a present they'll ENJOY!

It's not exactly a new idea . . . just a little obscured by bourbon-flavored toothpaste and mink-lined shaving mugs. But the presents most appreciated are those enjoyed beyond the moment of receiving. This Christmas, give your friends a present they'll *really* enjoy . . . a subscription to ELECTRONICS ILLUSTRATED. They'll thank you all year because the gift *lasts* all year. Whether your chums are hams, CBers, short-wave listeners, hi-fi fans, experimenters, general electronic hobbyists—beginners or experts—they will enjoy ELECTRONICS ILLUSTRATED, the *best* magazine for hobby electronics. And so will you . . . so give yourself a subscription, too! Just write the names of your friends on the handy card and drop it in the mail. We'll bill you later. Each person on your list will receive a handsome gift announcement in your name just before Christmas.

Special Christmas Gift Rates

First 1-year gift	$2.00
Each add'l 1-year gift	$1.50
Special 2-year gift	$3.00

In U. S., possessions & Canada

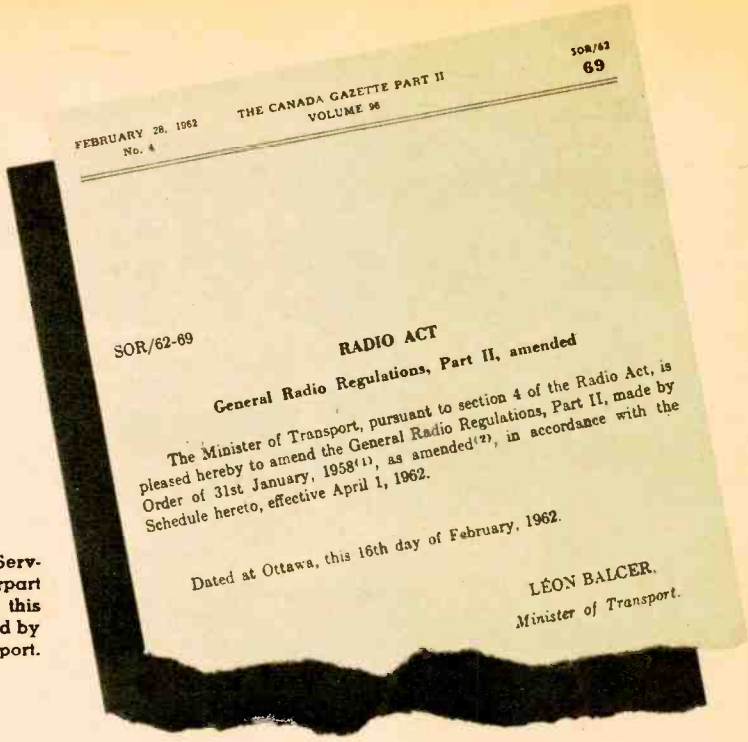
MERRY CHRISTMAS!

ELECTRONICS ILLUSTRATED

Fawcett Building, Greenwich, Conn.

CB CORNER

BY LEN BUCKWALTER
1W6733



FEBRUARY 28, 1962 THE CANADA GAZETTE PART II SOR/62
No. 4 VOLUME 96 69

SOR/62-69

RADIO ACT

General Radio Regulations, Part II, amended

The Minister of Transport, pursuant to section 4 of the Radio Act, is pleased hereby to amend the General Radio Regulations, Part II, made by Order of 31st January, 1958(1), as amended(2), in accordance with the Schedule hereto, effective April 1, 1962.

Dated at Ottawa, this 16th day of February, 1962.

LÉON BALCER,
Minister of Transport.

Rules for General Radio Service, the Canadian counterpart of CB, are contained in this small bulletin; it was issued by the Department of Transport.

CANADIAN CB

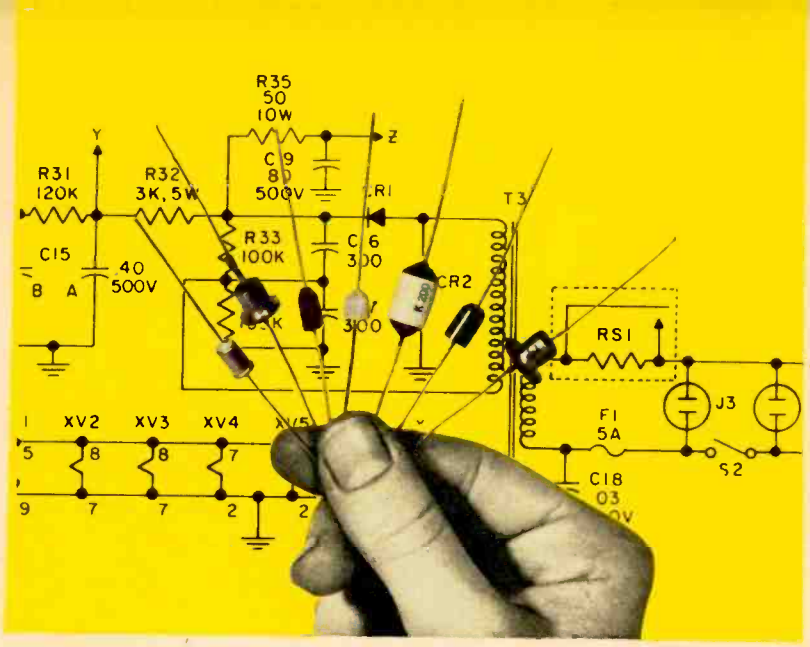
CANADA's new General Radio Service, it develops, gives our neighbors to the north about the same operating privileges accorded stateside CBers. Through the offices of the Department of Transport (equivalent to our FCC), we've come into possession of a set of GRS rules.

The GRS sets up a 19-channel band of frequencies which correspond to our channels 4 through 22. The service is intended for short-range, no-skip communication for business or personal use. But a close comparison of U. S. and Canadian rules shows some differences.

A slightly startling difference is that Canadian equipment must be type-approved by the government, a requirement noted especially by U. S. manufacturers intent on shipping CB rigs over the border. Some of their advertising already carries the line, *Now approved for use in Canada.* FCC type-approval is voluntary and few makers have stepped forth for the shiver-and-shake workout. But the GRS policy may have an upgrading effect on equipment destined for both markets.

Our Part 19 says nothing about receivers but GRS rules outlaw the superregenerative circuit (which can radiate interference). And not only does the Department of Transport state that output power must be limited to 3 watts *output* (or 5 watts input), there's a limit to power developed across *receiver* antenna terminals—20,000 picowatts (micromicrowatts).

[*Continued on page* 121]



HOW TO USE SILICON RECTIFIERS

Some dos and don'ts on handling the common SR.

By Bert Mann

EVER SINCE it appeared a half-dozen years ago, the silicon rectifier has excited the interest of the electronic hobbyist. And little wonder, for the SR can handle relatively high current, has extreme efficiency, produces virtually no heat and occupies a fraction of the space required by a tube.

Let's compare the SR to an equivalent tube rectifier. The tube may require up to 15 watts to light its filament; the SR has no filament. The tube may have an internal voltage drop as high as 50 volts; the SR's drop is nominally 1.2 volts. The tube is large; the SR is the size of a pencil eraser.

But if silicon rectifiers are so good, why not use them to replace all rectifier tubes in hi-fi rigs, transmitters, test instruments, etc.? When available ratings and cost permit, SR's *are* being used in new equipment. However, when you try to use them to soup up older equipment, you run into snags.

For us, the important SR characteristics are its PIV (peak inverse voltage) also called the PRV (peak reverse voltage) and the maximum surge current rating. PIV is the total voltage applied to a rectifier in a non-conducting direction. For a tube, a PIV of 1,500 volts is not uncommon. However, the PIV ratings of low-cost SR's usually are no higher than 750 volts. This is the SR's first problem.

This PIV rating sounds more complicated than it actually is. A half-wave rectifier circuit allows one-half the 60-cps AC alternation to pass through and blocks the other half. A perfect rectifier would be a dead short for current flowing in one direction (the forward direction) and an open circuit for current flowing in the opposite direction (reverse). The PIV rating is concerned with the peak voltage across a rectifier in the non-conducting direction.

Note that the term *peak* is used. When we speak of the AC line as 117 volts, we actually are referring to the *effective* voltage, or rms. Figure 1 shows the relationship among the rms, peak and peak-to-peak voltages of the sine-wave AC line.

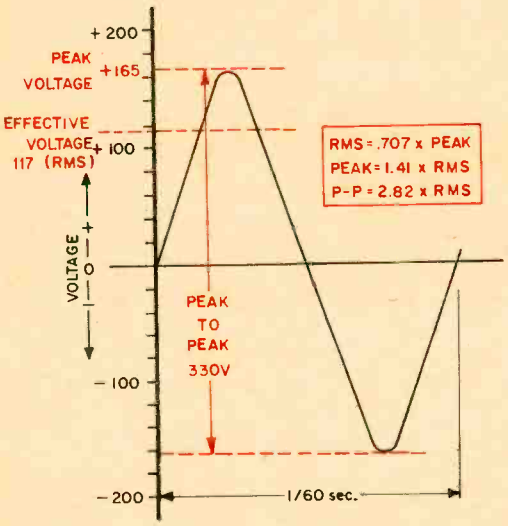


Fig. 1. A 60-cps sine wave from AC line can be analyzed into RMS, peak, and P-to-P voltages.

Practical PIV

Let's take a look at the PIV problems encountered when building new equipment. Figure 2 shows a common half-wave power supply (ignore Rs for the present). For half-wave and full-wave circuits, the PIV across the diode(s) is equal to 2.8 × the applied AC voltage (rms). We get the 2.8 factor as follows. When SR1 conducts on alternate half cycles, filter capacitor C1 charges essentially to the *full peak*. If T1 has a 125-volt secondary, C1 will charge to 175 volts DC. In the part of the AC cycle when SR1 is not conducting, C1's charge of 175 is a positive reverse voltage on the cathode of SR1, at the same time, the negative part of the AC cycle is a negative reverse voltage at the SR's anode. Actually there are two separate voltages "pressing" in opposite directions across the SR. As far as the SR is concerned, the total PIV across it is 2.8 × 125 or 350 V. Even though you are working with only 125 volts AC, you can see how the SR has to withstand 350 volts. Actually you should allow for manufacturing and power line variations by increasing the required PIV rating by another 10%. Therefore, the PIV factor actually is 3.1. With a 125-volt secondary voltage, we would use an SR

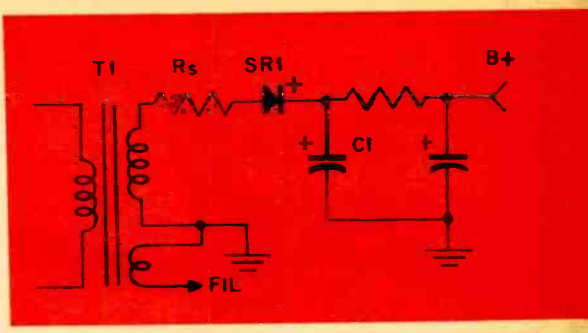
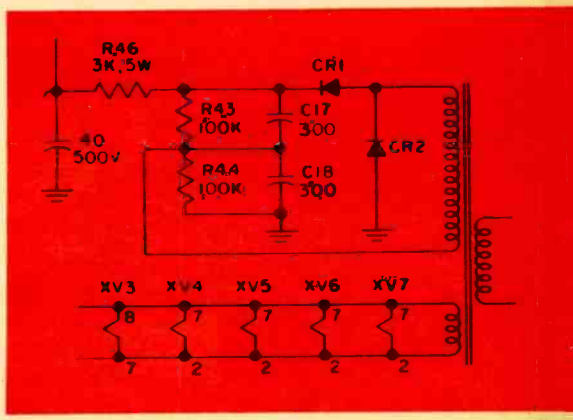
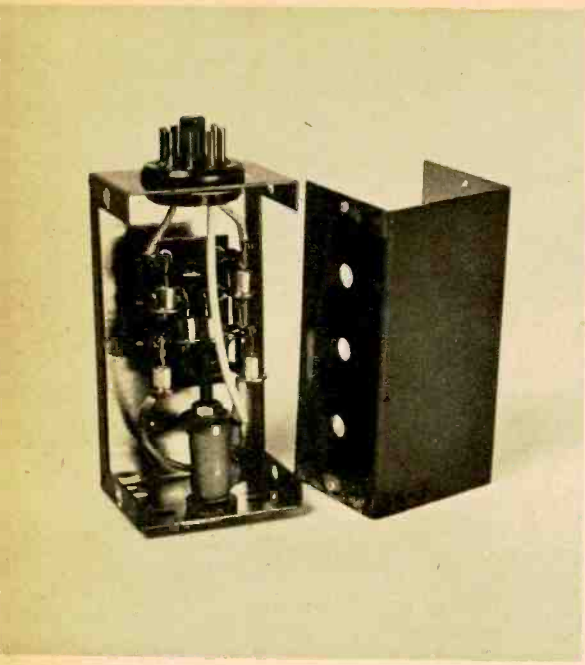


Fig. 2. A common half-wave rectifier circuit.

Fig. 3. Voltage doubler circuit used in hi-fi power amplifiers has excellent voltage regulation.





Rectifier tube replacement sold by TAB includes equalizing resistors and series surge protector.

with a rating of *at least* 390 PIV. You'll find that a PIV rating of 400 is standard value for operation at or around line voltages.

Doubler at Work

Another common SR circuit is the full-wave voltage doubler. Using a doubler straight off the AC line or through a 125-volt secondary power transformer will provide (under a moderate load current) slightly over 260 volts DC. Some TV and hi-fi power supplies use transformer secondaries as high as 180 volts in this type of circuit. The schematic in Fig. 3 is from the EICO HF89 100-watt stereo amplifier power supply which develops a B+ of 500 volts.

Assuming CR1 conducts first (on the first half-cycle) the charging current flow is from the top end of the secondary through CR1, C17 and back to the bottom of the secondary winding. On the second half-cycle, CR2 conducts. Now the charging current flows from the bottom end of the secondary through C18

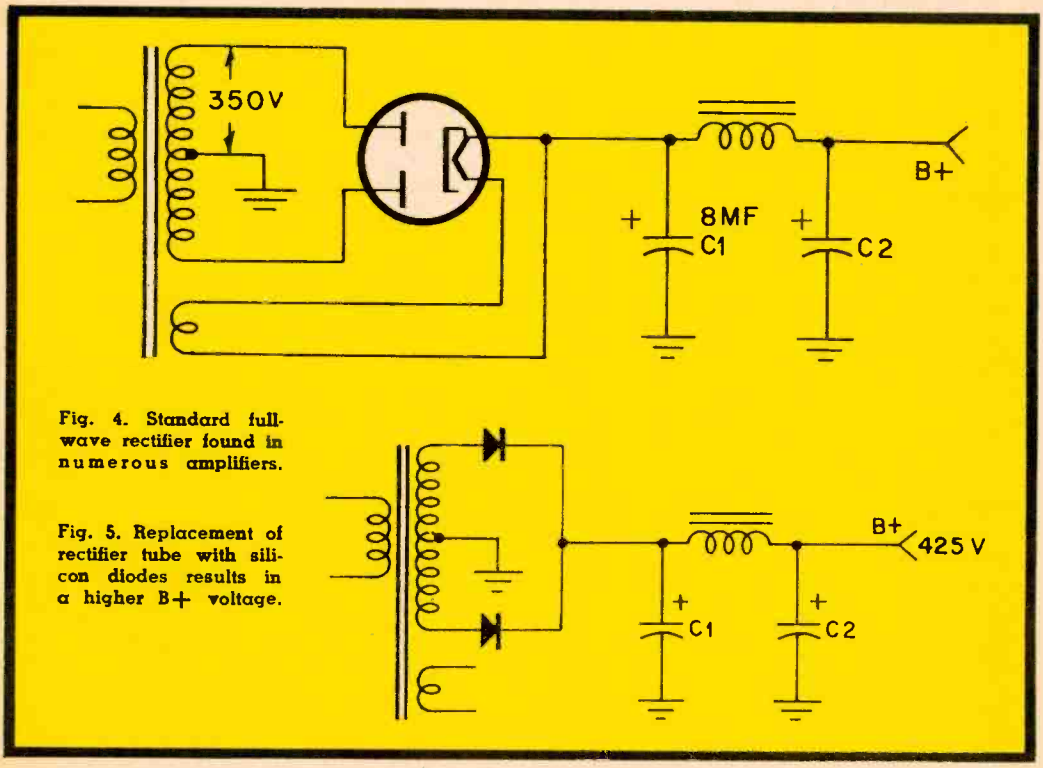
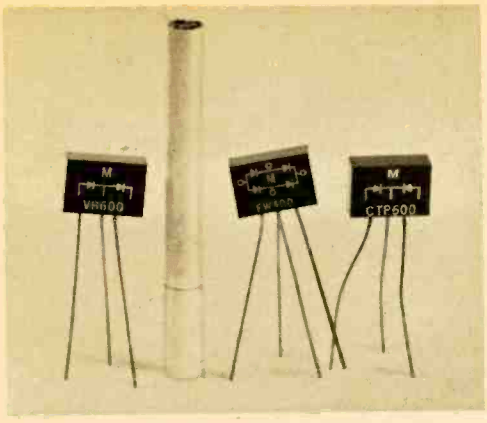


Fig. 4. Standard full-wave rectifier found in numerous amplifiers.

Fig. 5. Replacement of rectifier tube with silicon diodes results in a higher B+ voltage.



The new Mallory prepackage silicon rectifier circuits include several configurations. The four-lead unit (center) incorporates a full-wave bridge.

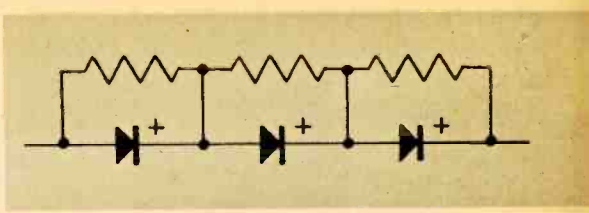


Fig. 6. Circuit above is used when diodes are series-connected for operation at high voltage.

to ground and then from ground up through CR2 to the top end of the secondary. Both C17 and C18 get charged close to the peak voltage of the secondary. Since C17 and C18 are connected in series under no-load conditions the *total* voltage across them (as read from the positive end of C17 to ground) is *double* the peak AC voltage applied. However, as current drain increases, the voltage output of a doubler tends to fall. Since the doubler is actually two half-wave circuits in series, the minimum PIV rating of each diode still must be 3.1 times the applied voltage.

The Surge Story

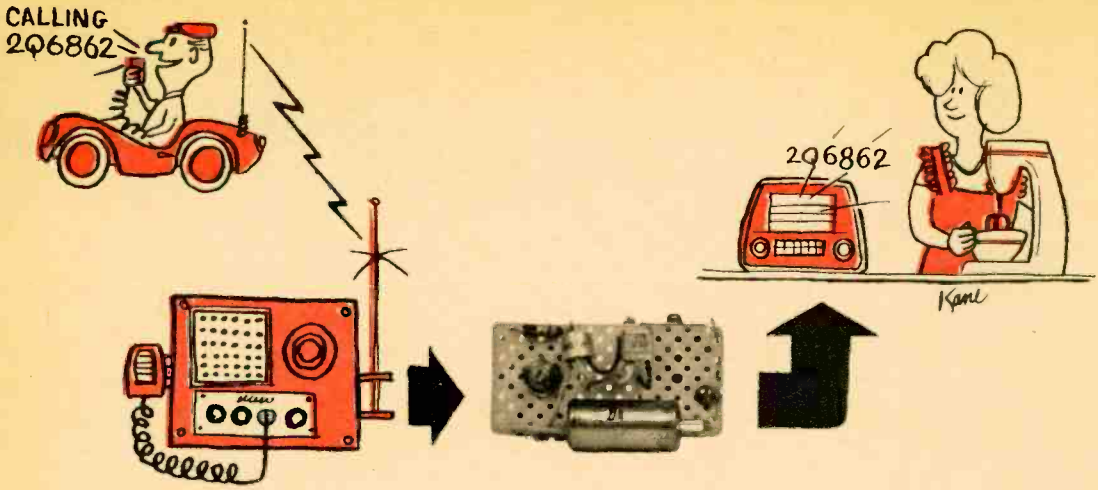
Now let's get back to Rs in Fig. 2. Usually not used in rectifier tube circuits, Rs is a protective device which limits the surge current through the diode. At the instant SR1 first conducts, uncharged C1 is practically a short circuit. This causes a high current through SR1, limited only by the resistance of the transformer secondary and the negligible resistance of the diode. Note that when working directly from the AC line there is nothing to limit the current through SR1 except its internal resistance. Even though the current surge lasts only a fraction of a second (until C1 charges) it may destroy the semiconductor.

Low-cost SR's have a safe surge current rating of only 15 to 30 amperes. Since the rating seldom is given, assume a rating of 15 a. Rs, which in this case represents a fixed resistor *plus* the DC resistance of the secondary, is calculated to limit the surge current to 15 a. (When working from the AC line, Rs represents *only* a fixed resistor.) The value of Rs is determined from Ohm's Law: R=E/I. I equals the maximum surge current of 15 amperes and E equals the *peak* applied voltage, which is 1.4 × 125 or 175 V. Therefore in Fig. 2, Rs = 175/15 = 11.7 ohms. If the transformer secondary's DC resistance is more than 11.7 ohms, no additional resistor is needed. Low-current 125-volt power transformers usually measure more than 25 ohms and semiconductor safety is assured. However, with high-current, high-voltage transformers the secondary resistance may not be sufficient for surge protection and an additional fixed resistor will have to be used. In our illustration, the AC source is the line. The 11.7-ohm resistor (rounded off to 12 ohms), therefore, must be used since the line has no internal resistance.

The *fixed* Rs must have the proper wattage rating, which is twice the dissipated power. The dissipated power is equal to the continuous current multiplied by the fixed Rs ($W = I^2Rs$).

Knowing how PIV and surge current ratings are used, we can progress to the replacement of rectifier tubes with semiconductors. Figure 4 is the reference, a power supply used in an audio amplifier. Each rectifier plate has 350 volts AC applied. As shown, the supply delivers 385 volts at 90 ma current. When the tube is replaced with silicon diodes, the B+

[*Continued on page* 118]



remote controlled

BREAK-IN/SIGNALER

for CB

Multi-purpose accessory for your CB receiver can be hooked up to do a number of signaling and switching jobs.

By Tom Jaski, 12W1688

NOW you can listen to your car radio and still be sure your CB rig will respond to any calls coming in on your channel. Or you can be certain the lady of the house does not miss your call home on 27 mc, even if the kitchen radio is cranked up to where she can hear it in the basement. The secret lies in a little palm-size break-in/signal device.

The gadget can be hooked in a variety of ways. It can:

- Switch the CB call into any AM radio speaker (cutting out the radio's own signal).
- Serve as a high-quality squelch circuit (many built-in squelches don't really quiet a receiver) by switching on your transceiver's audio *only* when a call comes in.
- Light a "call lamp."
- Turn off a transmitter.

Our remote control unit provides a basic switch action via a relay and can be used to turn on or off virtually *anything*. The gadget "listens" for a call on the channel monitored by your CB receiver and closes its relay when it detects one.

The 6-12 volts required by the circuit may be supplied by a car battery, an external filament transformer or by the transformer in your CB transceiver. The controlling signal is the AVC voltage of the CB receiver. When a carrier comes in, the AVC voltage rises. This voltage is amplified by transistors Q1 and Q2 which energizes relay RL1. Control R1 regulates the voltage difference needed to close RL1.

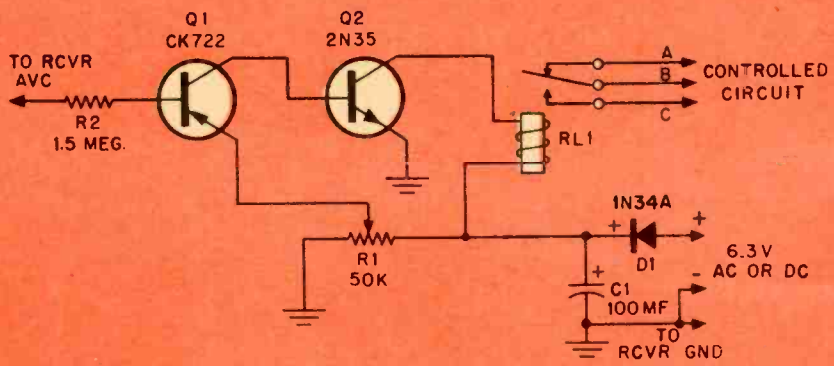
Construction is not critical and the unit can be built on a piece of perforated board. Keep AC carrying leads away from the transistors. Only a single ground connection should be made to the board to avoid ground loops. The circuit board is small enough to be installed in the CB receiver.

Connections to the unit depend on

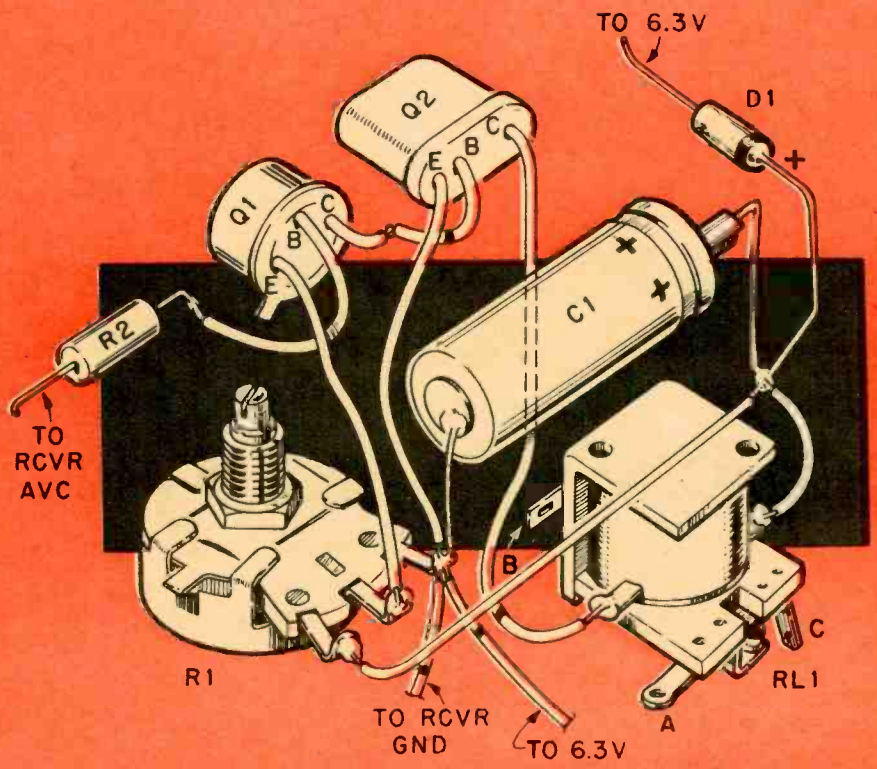
PARTS LIST

R1—50,000-ohm miniature potentiometer
R2—1.5 megohm resistor
C1—100 mf, 15 V miniature electrolytic capacitor
Q1—2N1265, CK722, 2N107 or equiv. transistor
Q2—2N233, 2N35 or equiv. transistor
D1—Diode, 1N34A or equiv.
RL1—Sensitive relay, Sigma 11F-6000 or 9000 or equiv. (relay is not critical)

Unit may be powered by almost any voltage source. For DC operation diode D1 may be omitted. Although marked for 6.3-volt operation 12 volts AC or DC may be used.



Simple circuit has two transistors direct-coupled as a DC amplifier driving a relay. Resistor R2 isolates Q1's low input impedance from AVC.



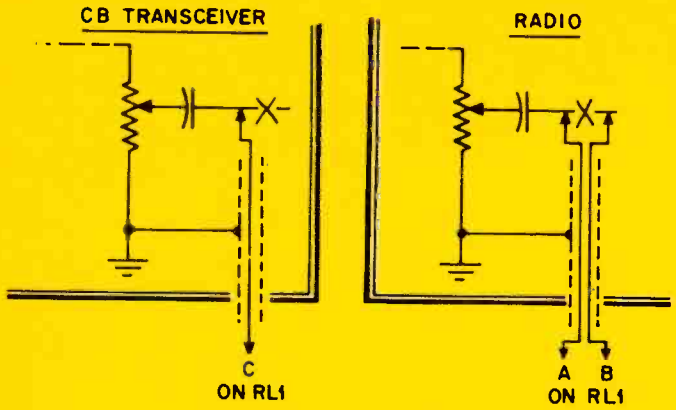


Fig. 1
Connections for switching the CB signal to a home or car radio.

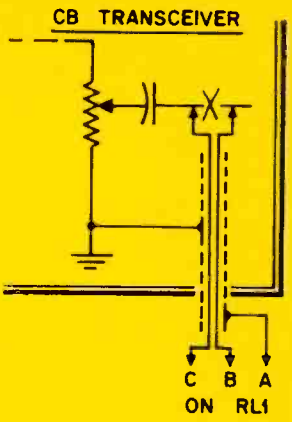


Fig. 2
Hookup for use as a squelch.

the service it is to perform. For switching CB audio to your car radio, follow Fig. 1. Note that the volume control circuits of both the CB transceiver and auto receiver must be interrupted and brought out. Figure 2 shows how to connect the unit for squelch service, using RL1 to turn the audio on and off. In every case the CB AVC must be fed into the unit. See Fig. 3 for details.

Adjustment is simple. After connecting the AVC and power take offs, tune the receiver to a blank spot and make certain relay RL1 is *not* energized. If it is, reduce the voltage on Q1's emitter with R1. Then tune to a station with a reasonably strong signal, and adjust R1 until RL1 just pulls in. With proper adjustment, a very small change in AVC voltage will close RL1.

Several different relays have been tested in this circuit, and all could be adjusted to respond to an AVC change. Both Q1 and Q2 must have low leakage current or RL1 might energize without a carrier. Maximum allowable relay current is about 40 ma, but the more sensitive the relay, the weaker the carrier change needed to energize it. With Citizens Band equipment the most sensitive relay available should be used because of the low transmitter power. To disable the break-in unit for continuous conversation, connect a SPST switch across relay contacts B-C. Although the unit will not discriminate among calls from different transmitters on the same channel, it does allow you to enjoy the music on the car or home radio until some signal comes in.

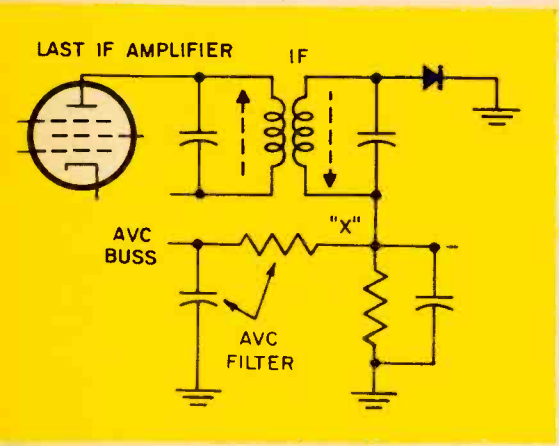
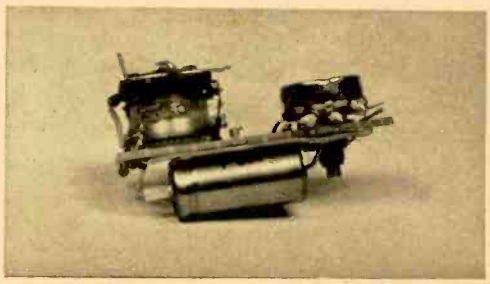


Fig. 3. Tap-off point for obtaining the AVC voltage is point "X" at the bottom end of the secondary of the last IF transformer in your CB rig.

A profile view of the Break-in/Signaler device.



how will your success in electronics compare with this man's?

Will you have a rewarding career, like Robert N. Welch? Or will you never get beyond a routine job?

It's up to you.

SUPERVISING A FREQUENCY MEASUREMENT *in the Precision Measurement Equipment Laboratory at Vandenburg Air Force Base is CREI grad Robert N. Welch. He is a Philco Tech Rep Engineer and a Section Leader in the Lab.*

LET'S LOOK AT THE FACTS. Men with ordinary qualifications may always be accepted for routine, low-paying jobs. But for critical technical assignments in well-paying career positions with engineering status—where electronics is applied to the frontiers of the missile and space programs—only men with advanced technical knowledge will do.

MEN LIKE ROBERT N. WELCH enjoy interesting and rewarding careers because they have equipped themselves with the practical and up-to-date knowledge of advanced electronic engineering technology which industry demands. Mr. Welch was a technician when he enrolled in a CREI Home Study Program. Today he is a Philco Corp. engineer with a responsible assignment at Vandenburg Air Force Base, launching site for intercontinental ballistic missiles.

YOU HAVE THE SAME OPPORTUNITY. CREI offers you, for study at home, a complete program in electronic engineering technology designed to equip you with the practical knowledge of electronic developments required for well-paying positions and put you on the level of specialization where men are most in demand and progress most rapid.

FOLLOW THE FOOTSTEPS of thousands of CREI men who hold positions as associate engineers, engineering aides, field engineers, project engineers and technical representatives.

YOU ARE GUIDED and assisted with personal attention from CREI's staff of experienced instructors. You study courses to which a number of leading engineers and scientists have made substantial contributions.

CHOOSE FROM PROGRAMS covering every important field of electronics:

Servomechanisms • Radar • Instrumentation • Computers • Aeronautical and Navigational • Communications • Aero-Space • Television • Automation and Industrial Engineering Technology • Nuclear Engineering Technology

CREI EDUCATION IS RECOGNIZED by such large corporations as Pan American Airways, Federal Electric Corp., The Martin Co., Canadian Broadcasting Co. and Mackay Radio. They pay all or part of CREI tuition for their employees.

CREI HAS 35 YEARS OF EXPERIENCE in advanced technical education through home study. CREI has developed electronics courses for the Army Signal Corps, special radio technician courses for the Navy and group training programs for leading aviation and electronics companies. CREI also maintains a Residence School in Washington, D. C. and invites inquiries from high school graduates.

YOU CAN QUALIFY for a CREI Correspondence Program, if you have basic knowledge of radio or electronics and are a high school graduate or the equivalent. If you meet these qualifications, send for the FREE 1963 edition of our 58-page book describing CREI Programs and career opportunities in electronics. Use coupon below, or write to: The Capitol Radio Engineering Institute, Dept. 1701-A, 3224 Sixteenth St., N. W., Washington 10, D. C.

Mail coupon today for FREE 58-page book —1963 Edition Now Available

CREI

THE CAPITOL RADIO ENGINEERING INSTITUTE *Founded 1927*
Dept. 1701-A, 3224 Sixteenth St., N.W., Washington 10, D. C.

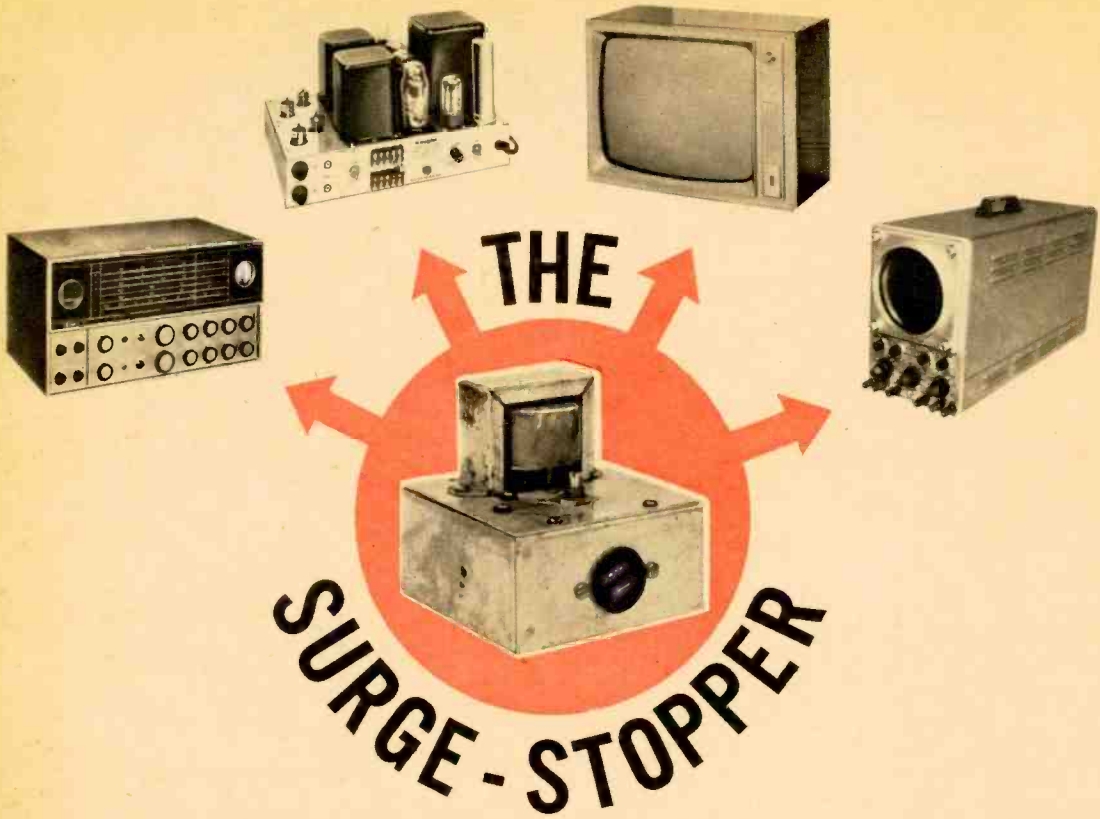
Please send me details of CREI Home Study Programs and Free Book, "Your Future in Electronics and Nuclear Engineering Technology." My qualifications are noted to obtain immediate service.

CHECK FIELD OF GREATEST INTEREST:

- ☐ Electronic Engineering Technology
- ☐ Servo and Computer Engineering Technology
- ☐ Aero and Navigational Engineering Technology
- ☐ Nuclear Engineering Technology
- ☐ Automation and Industrial Electronic Engineering Technology
- ☐ Communications

Name ..... Age .....
Address .....
City ..... Zone ..... State .....
Employed by .....
Type of present work .....
Education: Years High School ..... Other .....
Electronics Experience .....
Check: ☐ Home Study ☐ Residence School ☐ G.I. Bill

34



Inexpensive device can prevent costly burnout damage. Limits line voltage to preset maximums.

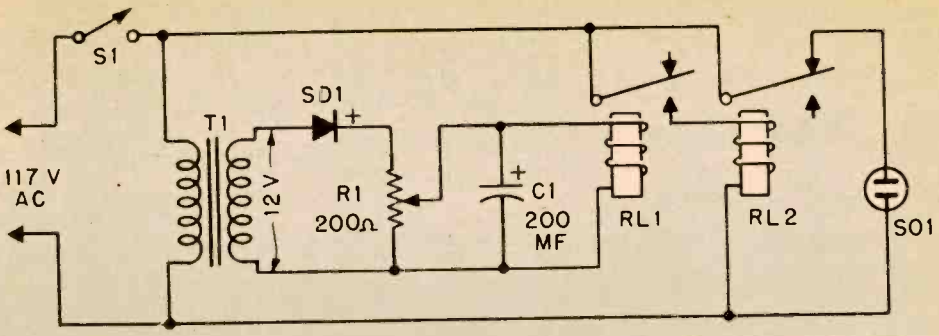
By Bob Gaulin

A FRIEND of mine recently had two pieces of test equipment burn out their power transformers. Puzzled why both should go at once, he discovered that the line voltage in his shop sometimes rises as high as 140 volts—which easily accounted for the two cooked transformers.

The Surge Stopper is designed to prevent such accidents. It monitors the AC line and turns off anything plugged into the receptacle on its side when the line voltage exceeds a preset value. It will keep the devices turned off until the "on-off-reset" switch is flipped. The Surge Stopper can be adjusted to operate over a wide range of AC line voltages. It functions by sampling the line voltage. The DC developed across R1 is tripped to close RL1 at voltage hikes.

Wiring should be done with #18 wire or lengths of zip cord. Make *sure* that relay RL1 is mounted on fiber washers and insulated from the metal chassis. Check with an ohmmeter between RL1's metal frame and the metal cabinet or chassis.

The best way to calibrate the Surge Stopper is using a variable AC supply and monitoring the output by plugging an AC meter into SO1. Simply set the AC supply to the desired cut-off voltage, and adjust R1 until RL1 pulls in and the meter falls to zero. If a variable AC source is not available, simply plug the Surge Stopper into the AC line and adjust control R1 so that with normal line voltage conditions (as read on a meter plugged into SO1) RL1 is set just before pull in.



Surge Stopper's components are non-critical and junk box parts will not impair its accuracy.

PARTS LIST

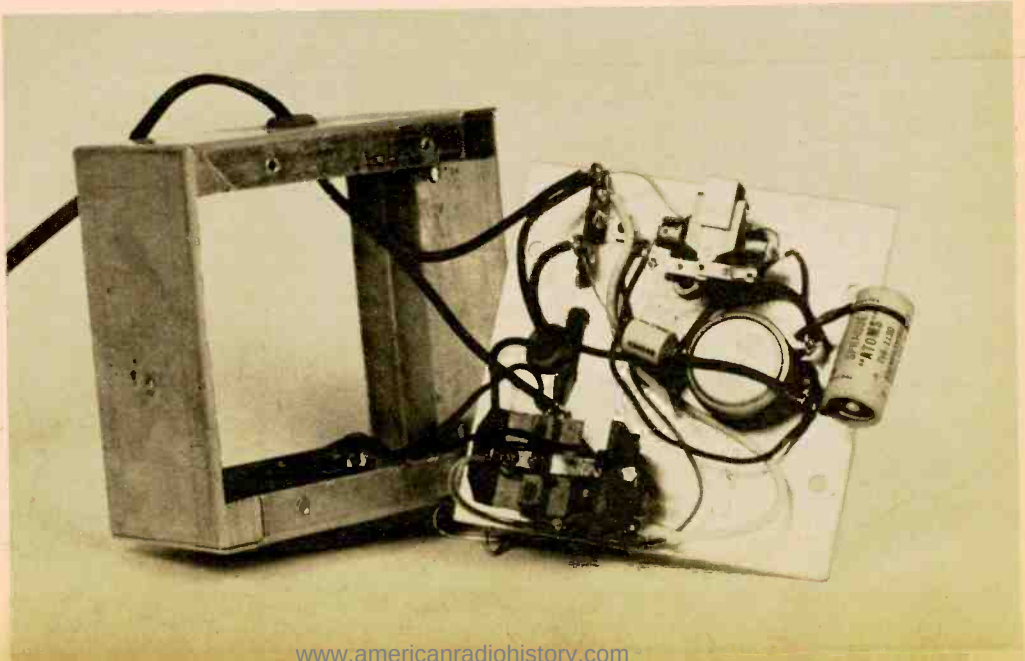
R1—200 ohm, 2 or 4 watt potentiometer
C1—100-200 mf, 12 VDC electrolytic capacitor
SD1—Silicon diode, 100 ma, 35 V RMS or higher
RL1—SPDT relay, 1,000 ohm, 7 ma DC (Sigma 11F-1000 or equiv.)
RL2—SPDT relay, 115 V AC, 5 A contacts (Potter & Brumfield KA5AY or equiv.)
T1—Filament transformer, 12.6 V secondary, .5 A or higher
S1—SPST toggle switch
SO1—AC socket
Misc.—Chassis, insulating washers, wire, etc.

The Surge Stopper is now calibrated and will turn off any equipment plugged into it. Of course, you may plug an extension into the Stopper, and use it to supply a number of devices. However, you must not exceed RL2's contact rating of 500 watts.

When you find that the Surge Stopper has turned off equipment, first check to see that the line voltage is back to normal, and then flick reset switch S1. This switch may also be used as an on-off switch for anything which is connected to the Surge Stopper.

The Surge Stopper is simple to construct, accurate and stable. It costs but a fraction of what it will save by preventing costly burn-outs. It is a useful addition in any shop and can be used to protect TV sets, hi-fi rigs, and equipment used in the field in unfamiliar areas.

Although author's model is shown built on the top panel of a chassis box, any desired layout may be employed for the unit. Relay RL1 has its wiper grounded to its frame and therefore it must be insulated.



El's 1962 Index

El's 1962 Index

C—Construction Project
Dr.—Hi-Fi Doctor
F—Feature Article
TP—Theory & Practice

Name following title is author.
Page number follows the date.

AMATEUR RADIO

AUDIO & HI-FI

CITIZENS BAND

KIT REPORTS

MEDICAL ELECTRONICS (F)

ROCKETRY AND SPACE

El's 1962 Index

El's 1962 Index

SHORT-WAVE LISTENING

TEST EQUIPMENT

THEORY AND PRACTICE

FEATURE ARTICLES

MISC. CONSTRUCTION PROJECTS

"Yep, it is a little heavier than some factory-built amplifiers. But how many of them give you a full six pounds of solder?"

HOW TO MAKE $135

70 Watts, Heath Rating; 100 Watts IHFM Music Power

"Startling Realism . . . Superb Dynamic Range . . . Smooth, full power delivery . . . Fast, effortless transient response . . . Professional . . . Convenient . . . Takes full advantage of the state of transistor art . . . Simple assembly" . . . these are but a few of the enthusiastic comments of those who have heard and seen the new Heathkit AA-21 Transistor Stereo Amplifier.

Rated at 35 watts per channel by Heath standards or 50 watts per channel by IHFM music power standards, this Heathkit combination stereo preamplifier, power amplifier delivers full power over a range of 13 cycles to 25,000 cycles, ±1 db! No compromise in dynamic range, no faltering power at the important high and low extremes of response . . . just the most satisfying solid sound you have ever heard. Its other specifications are equally impressive . . . completely factual and guaranteed!

Featuring 28 transistors and 10 diodes, the latest, most advanced in RCA semi-conductor technology, the Heathkit AA-21 not only offers record-setting performance, but also provides operational characteristics unique with transistors . . . cool operation with low power line requirements . . . steady performance under wide, external temperature variations . . . complete freedom from annoying microphonics . . . instant operation.

More than two years in development, this pace-setting unit features transformerless output circuitry plus multiple feed-back loops for flat response and finest fidelity. All controls are front-panel mounted for operating convenience, with a 5-position, dual concentric input selector which permits "mixing" inputs for tape recording purposes, etc., a 5-position "mode" selector, plus dual concentric volume, bass and treble controls. A hinged lower front panel covers all input level controls, the tape-monitor input switch, a speaker phase reversal switch, and a loudness switch which converts the volume control to a loudness control for compensated low-volume levels. The right-hand section of the lower front panel is a unique On-Off switch . . . touch to turn on, touch to turn off. All input and output connections are conveniently located on the rear chassis panel. Circuit safety is assured through the use of 5 new, fast-acting, bi-metal circuit breakers . . . no more annoying fuse-fussing.

Kit assembly is fast and simple through the use of 5 circuit boards which eliminate most of the conventional, time-consuming point-to-point wiring. The preamplifier circuits are "capsulized" to reduce wiring . . . 6 epoxy-covered modules contain 70 resistors and capacitors, all factory wired and sealed, ready for easy mounting on the preamplifier circuit boards.

Styling is in the Heathkit deluxe motif of luggage-tan vinyl-clad steel with polished, anodized aluminum trim, plastic upper front panel, extruded aluminum lower panel with matching vinyl inset, and soft, refracted panel-lighting.

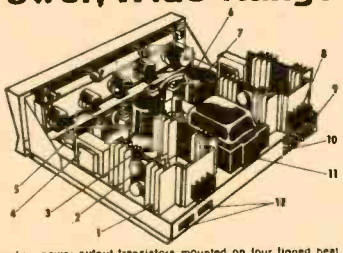
Designed to set a new standard of value, this finest of all stereo amplifiers carries a surprisingly low price tag . . . order yours now for early enjoyment.

Kit AA-21, 28 lbs., no money down, $13 mo. **$134.95**
Assembled AAW-21, no money down, $21 mo. **$219.95**

SOUND LIKE A MILLION!

Build This New Heathkit Transistor Stereo Amplifier

Full Power, Wide-Range Sound As You Have Never Heard It



1. Eight germanium power output transistors mounted on four finned heat sinks. 2. Output circuit breakers. 3. Two power amplifier circuit boards containing four transistors and six diodes. 4. Two driver transformers. 5. Two preamplifier circuit boards containing six epoxy-sealed component modules and ten transistors. 6. Two germanium driver transistors plus four electronic filter transistors. 7. Two 3,000 mfd filter condensers and four power supply diodes. 8. Two output terminal boards. 9. Stereo input jacks. 10. Tape recorder output jacks. 11. Power transformer. 12. AC power outlets. All primary and secondary controls accessible at front panel area!

SPECIFICATIONS—Power output per channel: (Heath rating), 35 watts/8 ohm load—26 watts/16 ohm load—18 watts/4 ohm load; (IHFM music power output): 50 watts/8 ohm load—34 watts/16 ohm load—25 watts/4 ohm load @ 0.7% THD, 1 KC). **Power response:** ±1 db from 13 cps to 25 kc @ rated output; ±3 db from 8 cps to 40 kc @ rated output. **Harmonic distortion (at rated output):** Less than 1% @ 20 cps, 0.5% @ 1 kc, 2.0% @ 20 kc. **Intermodulation distortion (at rated output):** Less than 1%, 60 & 6,000 cps signal mixed 4:1. **Hum and noise:** Tapehead, 40 db below rated output; Mag phono, 45 db below rated output; Aux. inputs, 60 db below rated output; Tape monitor, 70 db below rated output. **Channel separation:** 40 db min. @ 20 kc, 55 db min. @ 1 kc, 50 db min. @ 20 cps. **Input sensitivity:** (For 35 watts output per channel, 8-ohm load) Tapehead, 2 mv; Mag. phono, 3 mv; Tuner, .25 v; FM Stereo, .25 v; Aux., .25 v; Tape Monitor, .90v. **Input impedance:** Tapehead, 50 K ohm; Mag. phono, 30 K ohm; Tuner, 100 K ohm; FM Stereo; 100 K ohm; Aux., 100 K ohm; Tape Monitor, 47 K ohm. **Outputs:** 4, 8, & 16 ohm and low impedance tape recorder outputs. **Controls:** 5-pos. Selector (dual-concentric), 5 pos. Mode switch, dual-concentric Volume, Bass & Treble controls, Tape monitor sw., Loudness sw., Phase sw., Input level controls (all inputs except Tape Head & Tape Monitor inputs), Push-Push on/off switch. **Semiconductor complement:** 28 Transistors, 10 diodes. **Power requirements:** 105-125 volts, 50-60 cycles AC, 35 watts idling, no signal; 200 watts, full power out. @ 120 volts with no load on AC receptacles. **Power outlets:** 2 AC receptacles, 1 switched, 1 unswitched. **Dimensions:** 15¾" W x 5" H x 14" D.

FREE 1963 HEATHKIT CATALOG

If you are not already on our mailing list, fill in and mail the coupon below right away to receive this new Fall & Winter edition of the world's biggest electronic kit catalog. More than 100 new electronic luxuries have been added since the last issue . . . more than 250 in all, completely described and illustrated. Send for your free copy today!

HEATHKIT by Daystrom

HEATH COMPANY
Benton Harbor 39, Michigan

Please send my FREE 1963 Heathkit Catalog

Name_____

Street_____

City_____ Zone_____ State_____

In-Circuit Capacitor Checker

Continued from page 65

two ranges: 2-40 mf and 40-400 mf. In the 2-40 mf position, the filament voltage is applied across dual pot R5/R6 and the impedance of the capacitor under test, to ground. The voltage developed across the capacitor alone is applied to the grid of the 6C4. Since the voltage drop increases as the capacitance decreases, the resistance of the pot in series with the capacitor must be increased to maintain the grid voltage at a fixed level. The pot setting is calibrated on the front panel in microfarads and roughly indicates the capacitance of the electrolytic under test. The panel indication should approximate its marked value by not less than −50%.

For the higher value electrolytics (the 40-400 mf position), the R6 section of the dual control is shorted out to compensate for their lower impedance.

Microphones

Continued from page 53

babies can chew on it, and it still works. But those are its only consistent advantages. Performance is another matter. Some original-equipment microphones have surprisingly good fidelity; others are barely mediocre. Only *you* can judge whether such a mike is adequate for your purposes.

Tailored Mikes

Let's assume the mike that came with your recorder doesn't fill the bill, particularly as you branch out in your recording activities, and that you are after recordings good enough to play through a hi-fi rig without apologies. So your objective at this point should be to acquire not only a good mike, but one suited to your particular needs. More than any other type of audio gear, microphones are tailored for specific uses.

As we've said previously, most original-equipment recorder mikes are crystal or ceramic. Either type is fairly simple, effective and rugged but the man-made ceramic is favored over the natural crystal because its characteristics can be controlled in manufacture for uniform performance. The golden-eared hobbyist, however, sees a problem in its crudity. The fact that the diaphragm must twist the generating element to produce electricity means it is not likely to follow with accuracy the more subtle differences in sound pressure. The inertia of the piezoelectric material often prevents the diaphragm from following the dictates of sound waves as they crowd in on the mike. The result is what engineers term poor transient response: sound that lacks the crispness and definition of the real thing.

The dynamic microphone (Fig. 6) has an advantage in that its inertia is inherently less than the ceramic mike's. The moving mass of diaphragm, coil and mechanical linkage can be made smaller. In addition, coloration from the resonances of the materials used is much lower and frequency response can be tailored more exactly. The dynamic category unquestionably is the one of widest choice for today's amateur recordist. You can pick up a dynamic for $5 to $10—or you can spend hundreds.

Since the generating element in the ribbon microphone has nothing connected to it (its only linkage being simply the mounts that hold it in place), it obviously can be extremely sensitive. But that sensitivity also is its one big drawback. Put a ribbon mike outdoors in a stiff breeze, blow into it or get it too near an enthusiastic tuba player and you rupture the delicate ribbon. This big disability aside, the ribbon mike is a fine and versatile performer. Its starting price ($40-$50) is somewhat more than the dynamic's; its upper price range about the same.

Condenser Mike

In the simple diaphragm-fixed plate arrangement of the condenser microphone the inertia is vanishingly low. All the diaphragm has to do is follow the dictates of sound waves. (The inertia of a ribbon is almost as low but it still must move enough in its magnetic field to create a significant voltage.) But the construction of a condenser mike is intricate, which means expensive. And the

The easiest FM Multiplex tuner kit to build...

is the one you would choose for performance alone!

The Fisher KM-60 StrataKit is the inevitable choice of the kit builder who has considered the pros and cons of every FM Stereo Multiplex tuner available in kit form today. The KM-60 is by far the easiest to build—because it is a StrataKit. It is by far the finest performer – because it is a Fisher.

The StrataKit method of kit construction is a unique Fisher development. Assembly takes place by simple, error-proof stages (Strata). Each stage corresponds to a separate fold-out page in the instruction manual. Each stage is built from a **separate** transparent packet of parts (StrataPack). Major components come already mounted on the extra-heavy-gauge steel chassis. Wires are **pre-cut** for every stage – which means every page. All work can be checked stage-by-stage and page-by-page, before proceeding to the next stage.

The front-end and Multiplex stages are assembled and pre-aligned. The other stages are already aligned and require a simple 'touch-up' adjustment by means of the tuner's laboratory-type d'Arsonval signal-strength meter.

The ultra-sophisticated wide-band Fisher circuitry of the KM-60 puts it in a class by itself. Its IHFM Standard sensitivity of 1.8 microvolts makes it the world's most sensitive FM tuner kit. Capture ratio is 2.5 db, signal-to-noise ratio 70 db. Enough said.

Another outstanding feature of the Multiplex section is the exclusive STEREO BEAM, the Fisher invention that shows instantly whether or not an FM station is broadcasting in stereo. It is in operation at all times and is completely independent of the tuning meter.

The Fisher KM-60 StrataKit is very close to the finest FM Stereo Multiplex tuner that money can buy and by far the finest that you can build. Price, **$169.50***.

FREE! $1.00 VALUE! Write for The Kit Builder's Manual, a new, illustrated guide to high fidelity kit construction.

FISHER RADIO CORPORATION
21-55 44th Drive
Long Island City 1, N. Y.

The Kit Builder's Manual

Please send me without charge The Kit Builder's Manual, complete with detailed specifications on all Fisher StrataKits.

Name_____

Address_____

City_____ Zone____ State_____

210113

THE FISHER

*FACTORY-WIRED (KM-61), $219.50. WALNUT OR MAHOGANY CABINET, $24.95. METAL CABINET, $15.95.
PRICES SLIGHTLY HIGHER IN THE FAR WEST. EXPORT: FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY 1, N. Y. CANADA: TRI-TEL ASSOCIATES, LTD., WILLOWDALE, ONT.

separate power supply it requires adds to its price. At its cheapest, the condenser mike costs about $100; at its most expensive, nearly $1,000.

The most important difference between microphones of equal quality is the directional pattern of sound pickup. As we've noted, some pick up sound from only one direction, others are sensitive in a figure-eight pattern (front and back) and still others are omni-directional. These differences are partly inherent in the design of a mike's generating assembly and its outside casing but often are due equally to the mike's purpose.

The uni-directional or cardioid mike (Fig. 3) has an advantage if you want to spotlight a soloist, making him stand out against a full orchestra (other mikes with different directional patterns can pick up the rest of the orchestra). In addition, if you're recording in a noisy location, the cardioid helps zero in on what you want to record and avoids noises from an audience. When recording a lecturer whose voice is being carried by a PA system in an auditorium, the cardioid avoids feedback from loudspeakers. In other words, when your problem is avoiding unwanted sound, the cardioid pays the biggest dividend.

In The Concert Hall

But suppose you're recording a concert in a good hall. First, you probably want to pick up the reverberations that make the music sound so rich in the original. Secondly, you don't have several microphones to spot around the hall in strategic locations or, more likely, aren't permitted to do so. The situation here calls for a bi-directional (figure eight) mike. One bi-directional will pick up the orchestra from a good distance in front and also the reverberations of the hall from the back. And the fact that the mike is virtually dead to sounds coming from the sides means you won't be overwhelmed with audience coughs and creaking chairs.

The omni-directional mike might seem to be the easiest to work with: just set it up and it will pick up everything going on in a room. You might think it would hear things in the same relationship as your ears: if music is the most noticeable sound, it should turn out that way on your tapes. Unfortunately, this just isn't so. Under normal circumstances, the mike produces nothing more than a jumble of noise. Omni-directionality is desirable if you're working in a quiet hall or recording studio where you can control a situation. Under such conditions, you simply start with the mike close to the performers and back off until you feel you have the right mixture of direct sound and reverberation. But unless you're a professional recording engineer it's doubtful you work under such conditions. Under any others, omni-directionality can be a headache.

For most of us, the only situation in which omni-directionality is an advantage is for recording random conversations in a living room or for business conferences and such, where the mike can be placed in the center of the table to pick up everyone's voice. For other situations, it usually is best to use an omni-directional only in conjunction with other types.

For the serious recordist, the best choice lies in the dynamic and ribbon mikes. The cost of the condenser mike rules it out for most of us. As for the ceramic or crystal mike, it *is* possible to get surprisingly good sound at low cost with some, but if you plan to take your recorder out of the living room you run into a little matter called impedance.

Impedance

All ceramics and crystals are high-impedance mikes (impedance is the resistance any device offers to the flow of alternating current). High impedance means you can't run lines more than 5 or 6 feet between mike and recorder without losing highs. This is no problem at home, but on location it is. For one thing, you and your mike can't sit in the middle of the performers at a recital. For another, keeping the mike and the recorder close together often means your recorder's mechanical noise gets on the tape. For various reasons, then, you usually are dealing with lines from 15 to 50 feet long and a low-impedance mike is a must. You may need a transformer to convert the input of your tape machine to low impedance, since most

home machines are designed for high-impedance mikes. If your recorder's mike preamp section has adequate gain, a transformer isn't necessary. Another possibility is a mike with dual impedance. For long cable runs, use the low impedance setting; for short runs, use the higher-output high impedance setting.

Both dynamic and ribbon mikes are low-impedance devices. This fact, in combination with good performance, makes them sensible choices for the amateur recording fan. A ribbon, bi-directional by nature, often is the best initial choice when your budget limits you to one mike. Many ribbons can be had for $40 to $75 which, though not pin money, represents an investment in good recording. Thanks to the ribbon's figure-eight pattern, you almost always can come up with an efficient single-mike arrangement.

As you get more ambitious, you should consider adding a dynamic mike and a mixer to blend the sound from multiple sources. There are good values to be found in many inexpensive moving-coil mikes. Your best initial addition would be a cardioid-pattern dynamic, to allow you to spotlight and play up certain aspects of any recording situation. And finally you could add an omni-directional dynamic.

A real money-saving short cut is a pair of cheap dynamics (one omni-directional, the other cardioid) and a low-priced mixer. You save up to $20 of the price of a ribbon mike by this maneuver but you have to make careful use of the dynamics to equal the results of a single good ribbon.

Stereo

For recording in stereo, the same general rules apply but with a few twists. First, the omni-directional mike is even more of a problem since it makes the necessary separation of the two channels a tough proposition. The use of two cardioids may yield too much separation, leaving a hole in the middle. Here again, the ribbon has advantages. Its drop in sensitivity toward the sides provides separation without a hole and you can work at a reasonable distance from

performers in an auditorium. Worth investigating is a pair of mounted ribbon mikes made especially for stereo (see photo). They are set three feet apart on a single stand with an acoustic vane between them to maintain separation. Another special stereo mike houses two cardioid dynamic elements in the same case.

A few years ago it would have been futile for anyone with a home recorder to consider a better mike. But now it is likely that your tape machine, with its improved heads and recording preamplifiers, is capable of better performance than its original-equipment mike permits it to demonstrate. Even if you don't intend to take your recorder out of your living room, it probably will pay you to invest in an inexpensive dynamic mike. And if you do plan to go afield you definitely will want the boost in performance provided by the better microphones now on the market.

Hi-Fi Record Guide

Continued from page 44

Dizzy Gillespie always generates electricity, and in Carnegie Hall Concert, the microphones catch him at his most electric. Recorded live, his program is a persuasive showcase of modern big-band jazz, acidulous and powerful.

Records discussed in this column, with monaural discs listed first and stereo versions just below:

Rubinstein at Carnegie Hall *Artur Rubinstein*	RCA Victor	LM-2605	$4.98
		LSC-2605	5.98
Prokofiev: Concerto No. 3 *Janis, Kondrashin*	Mercury	MG-50300	4.98
		SR-90300	5.98
Beethoven: Emperor Concerto *Serkin, Bernstein*	Columbia	ML-5766	4.98
		MS-6366	5.98
Beethoven: Quartet, Opus 131 *Juilliard Quartet*	RCA Victor	LM-2626	4.98
		LSC-2626	5.98
Bach: Organ Music *Carl Weinrich*	RCA Victor	LM-2557	4.98
		LSC-2557	5.98
Bach: Goldberg Variations *Sylvia Marlowe*	Decca	DL-10056	4.98
		DL-710056	5.98
Spanish Medieval Music *New York Pro Musica*	Decca	DL-9416	4.98
		DL-79416	5.98
Haydn: Symphonies 103, 104 *Woldike, Vienna State Opera Orch.*	Vanguard	SRV-126	1.98
		SRV-126SD	2.98
A Swingin' Safari *Billy Vaughn Orch.*	Dot	DLP-3458	3.98
		DLP-25458	4.98
Carnegie Hall Concert *Dizzy Gillespie*	Verve	8423	4.98
		68423	5.98

Silicon Rectifiers

Continued from page 103

rises to 425. This extra 40 volts (usually lost in the rectifier tube) is responsible for most problems arising in modernizing older equipment. While C1 in Fig. 4 is rated for 450-volts DC, it normally operates with about 400 volts on it. The new higher B+ reduces C1's safety margin drastically. If the manufacturer's safety margin hadn't been as good as it was, the increased voltage might have exceeded the normal capacitor voltage ratings—and pow!

Safety in Series

Now to the second problem. The 350-volt AC secondary of the transformer in Fig. 4 means the SR must withstand 1,100 PIV (3.1 × 350). SR's with 1,100 PIV ratings are quite expensive, but by wiring two or more diodes in series as shown in Fig. 6, you can inexpensively obtain the required rating. Three 500 PIV SR's in series result in a total rating of 1,500 PIV—a more-than-adequate safety margin.

Whenever SR's are to be wired in series, use individual ratings which approach the required PIV. This way you can be sure the total PIV rating is more than adequate. Do not series-connect two diodes whose total PIV rating just equals the required value. Should the reverse resistance of one diode vary, or not be up to spec, the diodes will blow and probably take several components with them. Even if you're not using close-rated diodes it's a good idea to wire equalizing resistors across each diode as shown in Fig. 6. The equalizing resistors (500,000 ohms or 1 megohm) have no adverse effect and compensate for variation in the reverse resistance of the diodes.

You may come across circuits which have a capacitor or capacitors connected across the silicon rectifiers instead of resistors. The capacitor also serves as a protection device by taking up the shock of spikey transients generated either in the power transformer or line.

Let's take a look at the occasions when it is advantageous to convert from

a tube to silicon rectifiers. Such would be the case when equipment, because of inadequate ventilation, runs hot. Substantial heat reduction can be accomplished if silicon diodes are used to replace the rectifier tube. However, as we've discussed, silicons have practically no internal voltage drop and precautions must be taken to insure that the B+ voltage doesn't go sky high. A resistor in series with the B+ *would* drop the voltage back to the original value, but the resistor itself probably would generate almost as much heat as the rectifier tube. A better voltage-dropping technique would be to shift the location of the input filter capacitor. In Fig. 5 this would mean moving C1 over to parallel C2, thus changing the filter from capacitor-input to choke-input type. If you're lucky, the reduction in B+ will be about equal to the increase caused by the use of SR's. However, if you end up with a voltage drop greater than required retain the capacitor input filter but lower the value of C1. If C1 is 8 mf, try a 4, 2 or 1 mf electrolytic, paper or oil capacitor. The peak voltage charge across C1 under load will decrease as the capacitance is reduced and, therefore, the output voltage will drop.

Another instance when it probably would be beneficial to replace a tube rectifier with SR's is in the case of 30-W (or higher) hi-fi or PA amplifiers. The superior voltage regulation of diodes (due to low internal resistance) usually can coax from 5 to 10 watts more out of an amplifier and improve its bass power rating. In fact, silicon diodes will raise the rms (sine wave) power rating close to the same level as the "music power" rating.

In this article we've concentrated on the practical approach to silicon diodes. For a discussion of the theory of power supplies and semiconductors we refer you to SEMICONDUCTOR RECTIFIERS in the January 1961 EI.

Don't Miss the March EI!
A Special Issue on CB Radio

ELECTRONICS ILLUSTRATED Classified Ads

Your advertisement can reach this mail-buying audience for only 50¢ per word . . . payable in advance (Check or M.O. please) . . . minimum 10 words. Closing dates are the 20th of 4th preceding month i.e. copy for the May issue must be in our office by January 20th. Mail to ELECTRONICS ILLUSTRATED, 67 West 44th St., New York 36, N. Y. Word count: Zone number free. Figure one word: Name of state (New Jersey), name of city (New York); sets of characters as in key (14-D); also abbreviations as 35MM, 8x10, D.C., A.C.

SAVE MONEY • ORDER BY MAIL

• • • FOR SALE

EXCELLENT BUYS on Tubes and equipment all listed in the "Green Sheet." Send .25¢ for your copy today. Cash paid for unused tubes. Write. Barry Electronics Corp., 512 Broadway, Dept. El, NYC 12, NY.

SUPERSENSITIVE DIRECTIONAL microphone picks up faint sounds at 300 feet. Detects sound through ordinary walls. Easily built for $7.00. No electronic experience necessary. Plans $2.00. Dee Company, Box 7263-C, Houston 8, Texas.

"LISTEN-IN-COIL" PICKS up any telephone conversation in vicinity. No connection to telephone necessary. Easily concealed. $2.98 complete. Acoustical Research, 512M East 80, N. Y. 21, N. Y.

THEFT WARNING Decals! Prevent Theft, Tampering, etc. Big 2½"x3". White on Red Package (4) $2.00. KEJ-0990, P. O. Box 383, Arcadia, Calif.

TRANSISTORS, DIODES, Rectifiers, S.C.R. etc. Name Brands, Top Quality. We overstocked for our own mfg. All specs guaranteed. Write for our free price list. Autocrat, Inc., P. O. Box 536, Dept. A, Dayton 6, Ohio.

INVESTIGATORS, WRITE for free brochure on latest subminiature electronic listening devices. Dept.-5-X Ace Electronics, 11500 NW 7th Ave., Miami 50, Florida.

GOVERNMENT SURPLUS. How and Where to Buy in Your Area. Send $1.00. E.I. Surplus Information, Headquarters Bldg., Washington 6, D. C.

CONVERT ANY television to sensitive, big-screen oscilloscope. No electronic experience necessary. Only minor changes required. Illustrated plans, $2.00. Rellco, Box 10563, Houston 18, Texas.

CB-QSL-SWL CARDS. Samples 10¢. Include your personal picture on cards. No extra Cost. Signal, Adams County, Manchester, Ohio.

100 NEW INSULATED Carbon Resistors 99¢ Postpaid. Bigelow Electronics, Bluffton, Ohio.

• • • BUILD-IT-YOURSELF

PROFESSIONAL ELECTRONIC Projects—Organs, Timers, Computers, etc.—$1 each. List free. Parks, Box 1665, Lake City, Seattle 55, Wash.

• • • BUSINESS OPPORTUNITIES

MAKE $25-$50 WEEK clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81 Knickerbocker Station, New York City.

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

$100 WEEKLY POSSIBLE. Compile mailing lists and address envelopes for advertisers. Home — spare time. Particulars free. National Service, 81 Knickerbocker Station, New York City.

SECOND INCOME From Oil Can End Your Toil! Free Book And Oilfield Maps! National Petroleum, PanAmerican Building-El, Miami 32, Florida.

• • • EMPLOYMENT OPPORTUNITIES

TECHNICIANS, MECHANICS, Engineers. Live, work, and play in Sunny Southern California. America's fastest growing Missile and Space industrial center. Thousands of classifieds from local papers. $2.00. Lincoln Enterprises, Dept. E, Box 1066, Hollywood 28, California.

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

ELECTRONICS OPPORTUNITIES. 100 Addresses of Companies Hiring. U. S., Overseas. $2.00—Box 206i, Springfield, Va.

• • • TAPE RECORDERS

LEARN WHILE Asleep with your recorder, phonograph or amazing new "Electronic Educator" endless tape recorder. Details free. Sleep-Learning Research Association, Box 24-El, Olympia, Washington.

NEW CONCEPT of self-hypnosis teaches you quickly, easily. New tape! New record! Free literature. McKinley-Smith Co., Dept. T-3, Box 3038, San Bernardino, Calif.

RENT STEREO Tapes—over 2500 different —all major labels — free catalog. Stereo-Parti, 811-AY Centinela Ave., Inglewood 3, California.

TAPE RECORDERS Hi-Fi Components. Sleep Learning Equipment, tapes. Unusual values. Free Catalog. Dressner, 1523 Jericho Tpke., New Hyde Park-4, N. Y.

SALE ITEMS—Tapes—Recorders—Component Quotations. Bayla, Box 131E, Wantagh, N. Y.

• • • RADIO & TV

BEFORE YOU Buy Receiving Tubes, Test Equipment, Hi-fi Components, Kits, Parts, etc. . . . send for your Giant Free Zalytron Current Catalog, featuring Standard Brand Tubes: RCA, GE, etc.—all Brand New Premium Quality Individually Boxed, One Year Guarantee—all at Biggest Discounts in America! We serve professional servicemen, hobbyists, experimenters, engineers, technicians. Why Pay More? Zalytron Tube Corp., 220 West 42nd St., New York City.

15 DISTANCE ONE-TUBE Plans—25¢; One-tube Handbook—50¢, including Transistor experiments, catalog. Laboratories, 1131-K Valota, Redwood City, California.

FREE CATALOG—name brand tubes 65% discount, phono needles 80% or more discount, phono cartridges, picture tubes 75¢ inch, parts, parts kits, silicon and selenium rectifiers, transmitting tubes, 7" T.V. test tube $6.99, imported batteries, tube testers, etc. Want to swap or sell tube inventory? Send us your offering. Arcturus Electronics Corp., Dept. El, 502—22nd St., Union City, N. J.

DIAGRAMS FOR Repairing Radios $1.00, Television $2.00. Give make, model. Diagram Service, Box 672El, Hartford 1, Conn.

CONVERT ANY car radio to home use. Instructions $1.00. Custom Design, P. O. Box 63, Roslyn, Pa.

• • • DETECTIVES

DETECTIVE PROFESSION. Easy home study plan. Lapel pin, certificate, future. Free information. Professional Investigators, Box 41197-CC, Los Angeles 41, Calif.

DETECTIVES—EXPERIENCE unnecessary. Detective Opportunities. Write, Wagner, B-125 West 86th, New York 24.

• • • MUSIC

PIANO TECHNIC made easy, $1.25. Walter Kazaks, 234 East 58th Street, New York 22.

• • • PERSONAL

INDEPENDENT THINKERS — investigate Humanism, the scientific personal philosophy! Free literature. American Humanist Association, Dept. El-2, Yellow Springs, Ohio.

• • • MISCELLANEOUS

NEW HYPNOTISM Discoveries! Hypnotize first day! Quickly . . . Powerfully . . . "Un-noticed?" Extra: Self-hypnotic techniques. Complete Course $1 (guaranteed!). Crystal's M71-P951, Hoboken, New Jersey.

"HOMEBREW GUIDE" Complete Illustrated Instruction Manual, $1.00. Supply Catalog Included. CalBrew Supplies, Box 1005-C5, Seaside, California.

STUDENTS, TECHNICIANS — Learn and never forget Resistor Color Code. New method. $1.00. Kelley, Hasbrouck Laboratory, UMASS., Amherst, Mass.

ROCKETS: IDEAL for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 13, Colorado.

"HOMEBREWING! . . . Beers . . . Wines." Instruction Manual $1 (guaranteed!). Crystal's, 28-BE16, Millburn, New Jersey.

HYPNOTIZE UNNOTICED, quickly effortlessly or refund! Thousands satisfied! $2.00. Getro, Box 244, Cedarburg, Wisc.

PLATINUM ELECTRONIC scrap bought. Noble Metals Co., Box 90543, Los Angeles 9, Calif.

Handi-Talkie

Continued from page 43

and solder them to the nearest circuit board ground point. Ignore the red center-tap lead.

In units other than the EICO shown, you'll have to track down the exact location for installation. In every case, there's a capacitor between the lead from the speaker and the transistor base. It's important to wire in the transformer on the *opposite* side of the capacitor from the transistor base. Otherwise the transformer will short out the transistor's bias.

When soldering to the printed circuit board avoid excessive heat which may lift the foil off the board and use solder sparingly to avoid shorts.

What's Happened To Radio!

Continued from page 33

Radio Ad Bureau understandably is fond of talking about how much people listen. The figures look like this: housewives—almost 17 hours a week; teenagers—16 hours a week; auto radio listeners—56 minutes a day.

Radio's most important ace in the immediate future will be FM and stereo (two-channel) FM. Somewhere between 30 and 40 per cent of all metropolitan families have FM receivers (15 million sets are in use) and the number is increasing rapidly. The construction of new stations and stereo broadcasts have given new impetus to FM, which has just one basic attraction—fidelity. Good music simply cannot become good sound at home without the magic of FM's noise-free and wide-band signals. The hi-fi and stereo record craze did most of the work of creating a good-music market, but FM is cashing in.

The concept of giving the news at frequent intervals, which we discussed earlier, is only part of the picture. The medium always has been undisputed champion in the matter of split-second worldwide coverage. With more powerful and versatile equipment, there is no spot on earth that cannot be the scene of a remote pickup—a live description of the news while it is happening, whether it's a battle in the Congo or a riot in Hong Kong.

In local news, TV sometimes gets in the race but more often is too busy with bigger things. Radio has time to tinker with traffic bulletins and speed-trap advisories. Many stations keep mobile units on the streets and rent helicopters in their bid for split-second reporting. But dramas, comedies and quiz shows have gone to TV (only CBS produces radio plays today).

Commercial radio is only part of the story. Internationally, the medium has become a tool of both propaganda and enlightenment. There are some 3,500 short-wave broadcast stations on the air, representing every major country. The result is a wide range of discussion programs, music, cultural presentations, news and comment from every area on earth—all available to anyone with a short-wave receiver. Short-wave listening has become a major hobby.

Much SW material is for foreign consumption, though in many countries short-wave is a major means of communication and the people are more faithful radio listeners than in the United States. There are now 450 million home radio receivers in the world.

As a hobby, radio has never enjoyed greater popularity. A quarter-million Americans are now licensed amateurs, and there are more than 300,000 Citizens Band licensees, although CB is intended as a means of communication rather than a hobby.

C B Corner

Continued from page 99

The GRS allows both AM and FM modulation. When a station is more than six miles from an airfield the antenna may sit on its own tower 75 feet above ground. One hitch is that the top of the antenna may not rise more than 30 feet over any formation within a radius of 1,000 feet. No doubt these restrictions are designed to keep signals from straying too far, but they do give freer rein than the flat 20′ U. S. rule.

RAD-TEL

You Get MORE For Your Money!

RAD-TEL'S QUALITY

BRAND NEW TUBES

FOR TV, RADIO AND HI-FI

1-YEAR GUARANTEE

UP TO **75% OFF**

1-DAY SERVICE · Over 500 Types in Stock

SERVICEMEN:
RAD-TEL HAS THE LATEST TUBE TYPES.

THE SIGN OF RAD-TEL'S RELIABILITY FOR OVER 15 YEARS

*Manufacturers Suggested List Price

EACH TUBE ATTRACTIVELY BOXED & BRANDED RAD-TEL

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	0Z4	.79		6AU8	.87		6K6	.63		12CU5	.58
	1AX2	.62		6AV6	.41		6S4	.52		12CU6	1.06
	1B3	.79		6AW8	.90		6SA7GT	.99		12CX6	.54
	1DN5	.55		6AX4	.66		6SH7	1.02		12D4	.69
	1G3	.79		6AX5	.74		6SJ7	.88		12DE8	.83
	1J3	.79		6BA6	.50		6SK7GT	.95		12DL8	.88
	1K3	.79		6BC5	.61		6SL7GT	.84		12DQ6	1.04
	1R5	.77		6BC8	1.04		6SN7	.65		12DS7	.84
	1S5	.75		6BE6	.55		6SQ7GT	.94		12DT5	.76
	1T4	.72		6BF5	.90		6T4	.99		12DT7	.79
	1U5	.65		6BF6	.44		6T8	.85		12DT8	.78
	1X2B	.82		6BG6	1.70		6U8	.83		12DW8	.89
	2AF4	.96		6BH8	.98		6V6GT	.54		12DZ6	.62
	3AL5	.46		6BJ6	.65		6W4	.61		12ED5	.62
	3AU6	.54		6BJ7	.79		6W6	.71		12EG6	.62
	3AV6	.42		6BK7	.85		6X4	.41		12EK6	.62
	3BC5	.63		6BL7	1.09		6X8	.80		12EL6	.50
	3BN6	.75		6BN6	.74		7A8	.68		12EZ6	.57
	3BU8	.78		6BQ6	1.12		7AU7	.65		12F8	.66
	3BY6	.58		6BQ7	1.00		7EY6	.75		12FA6	.79
	3BZ6	.56		6BU8	.70		7Y4	.69		12FM6	.50
	3CB6	.56		6BX7	1.11		8AU8	.90		12FR8	.97
	3CS6	.58		6BZ6	.55		8AW8	.93		12FX8	.90
	3DG4	.85		6BZ7	1.03		8BQ5	.60		12GC6	1.06
	3DK6	.60		6C4	.45		8CG7	.63		12J8	.84
	3DT6	.54		6CB6	.55		8CM7	.70		12K5	.75
	3GK5	.99		6CD6	1.51		8CN7	.97		12L6	.73
	3Q4	.63		6CG7	.61		8CS7	.74		12SF7	.69
	3S4	.75		6CG8	.80		8EB8	.94		12SK7GT	.95
	3V4	.63		6CL8	.79		8FQ7	.56		12SL7	.80
	4BQ7	1.01		6CM7	.69		9CL8	.79		12SN7	.67
	4CS6	.61		6CN7	.70		11CY7	.75		12SQ7GT	.91
	4DT6	.55		6CQ8	.92		12A4	.60		12U7	.62
	4GM6	.60		6CR6	.60		12AB5	.60		12V6	.63
	5AM8	.79		6CS6	.57		12AC6	.55		12W6	.71
	5AN8	.90		6CS7	.69		12AD6	.57		12X4	.47

RAD-TEL TUBE CO. NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

	5AQ5	.54		6CU5	.58		12AE6	.50		17AX4	.67
	5AT8	.83		6CU6	1.08		12AE7	.94		17DQ6	1.06
	5BK7	.86		6CY5	.70		12AF3	.73		18FW6	.49
	5BQ7	1.01		6CY7	.71		12AF6	.67		18FX6	.53
	5BR8	.83		6DA4	.68		12AJ6	.62		18FY6	.50
	5CG8	.81		6DE6	.61		12AL5	.47		19AU4	.87
	5CL8	.76		6DG6	.62		12AL8	.95		19BG6	1.39
	5CQ8	.84		6DJ8	1.21		12AQ5	.60		19EA8	.79
	5EA8	.80		6DK6	.59		12AT6	.50		19T8	.85
	5EU8	.80		6DN6	1.55		12AT7	.76		21EX6	1.49
	5J6	.72		6DQ6	1.10		12AU6	.51		25AX4	.70
	5T8	.86		6DT5	.81		12AU7	.61		25C5	.53
	5U4	.60		6DT6	.53		12AV6	.41		25CA5	.59
	5U8	.84		6DT8	.94		12AV7	.82		25CD6	1.52
	5V6	.56		6EA8	.79		12AX4	.67		25CU6	1.11
	5X8	.82		6EB5	.73		12AX7	.63		25DN6	1.42
	5Y3	.46		6EB8	.84		12AY7	1.44		25EH5	.55
	6AB4	.46		6EM5	.77		12AZ7	.86		25L6	.57
	6AC7	.96		6EM7	.82		12B4	.68		25W4	.68
	6AF4	1.01		6EU8	.79		12BD6	.50		32ET5	.55
	6AG5	.70		6EV5	.75		12BE6	.53		35C5	.51
	6AH4	.81		6EW6	.57		12BF6	.60		35L6	.60
	6AH6	1.10		6EY6	.75		12BH7	.77		35W4	.42
	6AK5	.95		6FG7	.69		12BK5	1.00		35Z5	.60
	6AL5	.47		6FV8	.79		12BL6	.56		36AM3	.36
	6AM8	.78		6GH8	.80		12BQ6	1.16		50B5	.69
	6AQ5	.53		6GK5	.61		12BR7	.74		50C5	.53
	6AS5	.60		6GK6	.79		12BV7	.76		50EH5	.55
	6AT6	.49		6GN8	.94		12BY7	.77		50L6	.61
	6AT8	.86		6H6	.58		12BZ7	.86		70L7	.97
	6AU4	.85		6J5GT	.51		12CN5	.56		117Z3	.85
	6AU6	.52		6J6	.71		12CR6	.67		807	.75

FREE! Send For New Tube & Parts Catalog
Send For Trouble Shooting Guide

Be your own TELEVISION REPAIRMAN

The Original NOW YOU CAN
FIX YOUR OWN TV SET BOOK

You can fix your own TV if you have TV Fixit Book . . . because 80% of troubles are caused by tubes. This book explains, illustrates trouble and what tubes cause this trouble. Pinpoints in over 3000 layouts by model number, position and type tube causing trouble.

No. 170..... **$1.00**

CHEATER CORD Easy to work on set while panel is off.
6 ft., No. 154..... **29¢ ea.** Lots of 3—25¢ ea.

RAD-TEL TUBE CO. TV, RADIO AND HI-FI

DEPT. EI-1 55 CHAMBERS STREET, NEWARK 5, NEW JERSEY

TERMS: 25% deposit must accompany all orders, balance C.O.D. Orders under $5: add $1 handling charge plus postage. Orders over $5: plus postage. Approx. 8 tubes per 1 lb. Subject to prior sale. No C.O.D.'s outside continental U.S.A.

ORDER FORM ● MAIL TODAY

RAD-TEL Tube Co.
Dept. EI-1
55 Chambers Street
Newark 5, New Jersey

Total Tubes $_____
Total Part(s) $_____
Postage $_____
Grand Total $_____

ENCLOSED IS $_____ Please rush order.

SEND: _____Book(s) Be Your Own TV Repairman @ $1.00 ea. #170
_____Cheater Cord 29c ea. Lots of 3 - 25c ea. #154
Orders under $5.00 - Add $1.00 handling charge - plus postage.

FREE! ☐ Send FREE Tube and Parts Catalog
☐ Send FREE Trouble Shooting Guide

NAME .....

ADDRESS .....

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

NEW LOOK FROM PACO

IN LOUDSPEAKERS:

REVOLUTIONARY NEW PACO SPEAKER SYSTEM DARES TO USE 6" CONES!

PACO is proud to present the Model L4 System, a revolutionary new development in loudspeaker design that offers a degree of brilliance, clarity and quality unequaled by speakers selling for as much as $300. Yet this remarkable speaker system costs only $99.95 net.

Here's the secret. Developed by a brilliant and famous audio designer, the new system consists of three 6-inch woofer mid-range speakers in close configuration and a tweeter. Normally, 6-inch speakers have very high cone resonance, no bass response and low power capacity. In this system, however, a special ball diffuser, bonded to the voice coil form, disperses sound in the middle frequency and widens the normally narrow axis beam of the speaker. The result is an extremely smooth response in the middle range.

Each speaker cone also has three struts bonded to it, and to each diffuser. This produces a rigid diaphragm which eliminates edge distortion and provides the much-desired "piston effect" up to 7,000-8,000 cycles. The arrangement also produces a cone resonance in the mid-range woofers of approximately 40 cycles—comparable to the most expensive woofer.

Model L4 by PACO: $99.95 net.

Because of their close proximity, the three speakers act as a single mass in moving air, but without the sluggishness often associated with large speakers. And, each individual speaker remains light enough to produce an accurate mid-range. This elimination of the cross-over between bass and mid-range affords an even greater degree of clarity and fidelity. With a response of 45-18,000 cycles, the system is capable of reproducing every nuance of even the most intricate musical passage. Designed to operate with all amplifiers, its impedance is 8 ohms. See and hear it at your dealer or write today to PACO Electronics Co., Inc., Glendale 27, New York.

IN HIGH-FIDELITY KITS:

The ST-55MX FM Stereo Multiplex Tuner Kit and the SA-50 Stereo Preamp-Amplifier Kit (50 watts: 25 per channel) are two completely new, decorator-designed units that enhance the decor of any home. Handsome new styling and color scheme make this combination look as distinctive as it sounds. And, like other famous PACO kits, the ST-55MX and SA-50 assemble ⅓ faster and easier than similar kits sold by other kit makers.

ST-55MX FM Stereo Multiplex Tuner Kit (Prealigned; less enclosure): $99.95 net. Factory wired (includes enclosure): $159.95 net. Enclosure: $7.95 net.

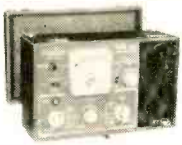
SA-50 Stereo Preamp-Amplifier Kit (less enclosure): $79.95 net. Factory wired (includes enclosure): $149.95 net. Enclosure: $7.95 net.

ST-25MX FM Stereo Multiplex Tuner Kit (Pre-aligned, less enclosure): $69.95 net. Factory wired: $99.95 net. Enclosure: $14.95 net. (walnut); $4.95 net. (metal).

IN TEST-EQUIPMENT:

A complete line of PACO test equipment is now available in kit form for the audiophile, ham operator and electronic technician who wants maximum quality at lowest possible cost.

New Model T-62 Grid Circuit Analyzer Tube Tester and Megohmmeter. Tests Novars, Compactrons and Nuvistors. Kit: $49.95 net. Factory wired: $67.95 net.



New Model T-63 CRT Tester and Rejuvenator. Utilizes a true beam current test circuit. Kit: $44.95 net. Factory wired: $59.95 net.

New Model G-32 Sweep Generator and Marker-Adder. Simplifies sweep alignment procedures. Kit: $85.95 net. Factory wired: $129.95 net.

New Model G-34 Sine and Square Wave Generator. Versatile coverage of 7 cps to 750 kc sine and square wave in 6 bands. Kit: $64.95 net. F'cty wired: $99.95 net.

New Model G-36 Color Bar and White Dot Generator. Features ease of operation and utmost stability. Kit: $119.95 net. Factory wired: $179.95 net.

Model C-25 In-Circuit Capacitor Tester. Tests for faulty capacitors without removing them from circuit. Kit: $19.95 net. Factory wired: $29.95 net.

Model V-70 Vacuum Tube Voltmeter. Versatile, AC operated, peak to peak. Kit: $31.95 net. F'cty wired: $49.95 net.

Model S-55 Wide-Band Oscilloscope. Covers range between DC and 5 mc. Kit: $95.95 net. Factory wired: $155.95 net.

Model G-30 RF Sig. Generator. Fine and coarse attenuators handle any signal level. Kit: $32.95 net. Wired: $44.95 net.

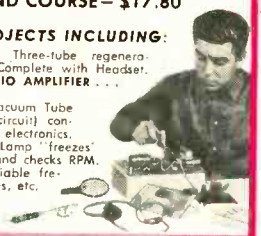
PACO ELECTRONICS COMPANY, INCORPORATED, 70-31 84th STREET, GLENDALE 27, NEW YORK
Division of Precision Apparatus Co., Inc. Export: Morhan Exporting Corp., 458 Broadway, N. Y. 13, N. Y.

Space Age Science — An Exciting Hobby for All!

The AMERICAN BASIC SCIENCE CLUB announces a new expanded line of EDUCATIONAL SCIENCE UNITS.

Every one a unique and unequalled value! Choose from the exciting selection below — or get them ALL in one great MASTER LAB!

UNIT 1 ELECTRONICS LAB AND COURSE — $17.80



ALL THE EQUIPMENT FOR 65 PROJECTS INCLUDING:

RADIO — SHORTWAVE AND BROADCAST. Three-tube regenerative circuit. Uses 115V AC house current. Complete with Headset.
CARBON MICROPHONE and two-stage **AUDIO AMPLIFIER** . . .
RADIO TRANSMITTER for code or voice.
DC POWER SUPPLY (Power Transformer, Vacuum Tube Rectifier and 20-20 mfd. capacitor filter circuit) converts home AC to the DC required for electronics.
STROBE LIGHT — oscillator controlled Neon Lamp "freezes" the motion of vibrating or rotating objects and checks RPM.
RIPPLE TANK WAVE GENERATOR with variable frequency. Produces standing waves, nodal lines, etc. Invaluable in understanding wave theory.
CODE PRACTICE OSCILLATOR with manual, "Steps to A Ham License." All you need to pass the FCC Ham License Exam.
SIGNAL TRACER and **CONTINUITY TESTER.** Valuable trouble-shooting tools. Use explained in accompanying manual, "Simplified Radio-TV Servicing."

A valuable electronics Lab with parts by RCA, Mallory, Pyramid, GE, Centralab, Stackpole, Trim and other reliable mfgs. Retail value of parts alone over $25.00.

plus . **WHEATSTONE BRIDGE** (Measures Resistance) . . **SOLENOID COIN TOSSER** . . **MAGNETIZER AND DEMAGNETIZER** . . **ELECTROMAGNETIC RELAY** . . **BURGLAR ALARM** . . **PROXIMITY DETECTOR** . . **EXTINCTION VOLTMETER** . . **GALVANOMETER** . . **THERMOCOUPLE** , . **"MYSTERY" SHOCK BOX** . . and many more!

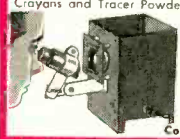
Graphic demonstrations with **VACUUM TUBES, TRANSFORMER, POTENTIOMETER, CAPACITORS,** and other electronic components make it indelibly clear what they do and how they do it. Vivid experiments illustrate the **ELECTRON THEORY, DC** and **AC CHARACTERISTICS, INDUCTANCE, REACTANCE, CAPACITANCE, RECTIFICATION, AMPLIFICATION** and other electronic principles.

The easiest, most exciting way to a solid background in electronics. Basic enough for beginners — rewarding enough for the "Pros."

All the equipment for all the above with full instructions (4 manuals, 2 auxiliary textbooks) plus bonus ELECTRIC SOLDERING IRON for only $17.80 Postpaid.

UNIT 2 OPTICS AND PHOTO LAB — $11.95

35MM PROJECTOR. Sturdy black steel lamp housing with inner chimney and baffle for cool operation; 140W Projection Lamp; Large Twin Condensing Lenses for extra brightness; Rotary Switch; 6 Foot Cord. Included is an extra projection assembly that makes it a Micro-Projector as illustrated.
PHOTO-DARKROOM LAB. Enlarger — Contact Printer, Safe Light, 3 Plastic Developing Trays, 2 Clips, 2 Thermometers, Developing Chemicals, Printing and Enlarging Paper, Darkroom Handbook. All you need to develop negatives, make prints and enlargements.
MICROSCOPE. 50X, 150X, 200X. Precision ground and polished Lenses. Ramsden Eyepiece, Sub-stage Lighting, Polarizer. Produces photomicrographs in connection with Photo Lab. Microscopy manual included.
ULTRAVIOLET LAMP. Produces dazzling color effects with invisible, black light. Used for crime detection, mineralogy and science. Fluorescent Ink, Crayons and Tracer Powder are included with instructions on UV Applications.



SPECTROSCOPE (at left). Analyze the spectra of glowing gases. See and identify the Fraunhofer Lines. Measure the wave length of light rays. A quality instrument featuring an easy-to-read built-in scale and a powerful condensing system for a bright spectrum. Equipment includes an Alcohol Burner and a 2 Watt Neon Spectral Lamp. Full instructions cover theory and use.

Complete Photo and Optics Lab only $11.95 Postpaid.

UNIT 3 ANALOG COMPUTER — $3.95

ELECTRONIC COMPUTER. Electronically multiplies, divides, calculates powers, roots, logarithms. The problem is set up on the scales of two linear potentiometers and the answer is found by listening for the null point on the third potentiometer. Powered by two flashlight batteries (not included). Assembles in minutes — no soldering. **Comes with Headphone, three sets of scales and complete instructions. Only $3.95 Postpaid.**

UNIT 4 PHOTOELECTRONIC RELAY — $7.95

COMPLETE PHOTO-RELAY UNIT. Supersensitive Crystal Photocell; rugged Electronic Amplifier; Double Throw Relay; large 1⅞" diameter Condensing Lens; Mounting Board; Cabinet; Hardware; Hook-up Wire; Solder and complete instructions for easy assembly (soldering required). Features automatic "on and off" or holding circuit operation; Sensitivity Control; Plug-in Outlet for controlled circuit. Use it for door announcers, counters, alarms, day-night light switches, etc. Operates on 115V AC. **Complete Photo-Relay set-up. Only $7.95 Postpaid.**

UNIT 5 TELESCOPE AND TRANSIT — $5.95

TELESCOPE with combination **ALT-AZIMUTH** and **EQUATORIAL MOUNT** 44X erect image, 22X astronomical telescope, 28" long. Four ground and polished Lenses. Ramsden Eyepiece gives large field.
SURVEYOR'S TRANSIT LEVEL adapts from alt-azimuth mount. Has vertical and azimuth scales, Spirit Level and Leveling Platform. A practical instrument for laying out foundations, ditches, fences, etc. Also used as a range finder.
Telescope, Mount, and Transit (everything except the wooden legs of tripod) **complete with full instructions . . . only $5.95 Postpaid.**

UNIT 6 ATOMIC ENERGY LAB — $5.95

ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. See the vapor trails of speeding alpha and beta particles, and of cosmic rays from outer space.
SPINTHARISCOPE gives a dramatic magnified ringside view of exploding atoms.
ELECTROSCOPE — metal housed with Scale and Magnifying Viewer. Measures background radiation and tests sample sources.
SAFE RADIOACTIVE MATERIALS. Alpha Source in handy container and Uranium Ore (Ox U_3O_8 0.229%). **Full instructions and explanations open up the fascinating field of nuclear physics. $5.95 Postpaid.**

UNIT 7 WEATHER STATION — $6.95

CUP ANEMOMETER and **WINDVANE** give remote readings of wind speed and direction on indoor Mounting Board (lead-in wire not furnished).
BAROMETER, SLING PSYCHROMETER (measures relative humidity), **RAIN GAUGE, CLOUD CHART, WEATHER MAP. Complete set-up for the amateur meteorologist, including Forecasting Manual. Only $6.95 Postpaid.**

UNIT 100 *ALL* THE PROJECTS OF *ALL* THE UNITS (1, 2, 3, 4, 5, 6 and 7) IN ONE BIG "MASTER LAB" ONLY $33.60 Postpaid

MANY EXTRA PROJECTS WITH THE MASTER LAB are made possible by combinations of the various units. For example the electronic equipment of Unit 1 supplies an **ELECTRONIC TIMER** for the Photography Lab of Unit 2. Another Master Lab plus is the **LIGHT BEAM TRANSMITTER - RECEIVER** shown below. The Light Beam Receiver combines the photocell of Unit 4 with the audio amplifier of Unit 1. The "Transmitter" uses the projection equipment of Unit 2.

Talking on a Light Beam

NOTE: MASTER LAB ALSO AVAILABLE IN A SERIES OF 8 MONTHLY KITS

SEND ONLY $2.00 WITH COUPON — PAY ONLY $3.95 Plus COD Postage on arrival of each kit. (Complete Master Lab in 8 monthly shipments.)

The Master Lab is much more than a group of fascinating projects. It is a true "Learn-By-Doing" science course with 8 instruction books and 6 auxiliary manuals — jam-packed with science information. *EASY—FUN—EDUCATIONAL!*

ACTUAL USE IS THE ONLY WAY TO APPRECIATE THIS MASTER LAB. ORDER YOURS TODAY — ON 10 DAY APPROVAL — MONEY BACK GUARANTEE. SEE FOR YOURSELF . . . YOU WILL BE AMAZED AND DELIGHTED!

PRAISED BY EDUCATORS

"You offer a range of experiments usually performed only in the better high school and college laboratories. The number of concepts presented, and the clarity and concreteness of their development is amazing."

R. M. HELM, Prof. of Physics, East Carolina College, Greenville, N. C.

AMERICAN BASIC SCIENCE CLUB, INC., 501 E. CROCKETT, SAN ANTONIO, TEXAS

CHECK HERE ☐ FOR PAID IN FULL ORDERS
Send me POSTPAID the unit(s) checked. I enclose $.

Unit 1 $17.80	Unit 2 $11.95	Unit 3 $3.95	Unit 4 $7.95	Unit 5 $5.95
Unit 6 $5.95	Unit 7 $6.95	UNIT 100 "MASTER LAB" $33.60		

CHECK HERE ☐ FOR MASTER LAB ON MONTHLY PLAN
Start sending me AMERICAN BASIC SCIENCE CLUB'S UNIT 100 "MASTER LAB" in a series of 8 monthly kits. I enclose $2.00 and will pay $3.95 plus COD postage on arrival of each kit. I may cancel unshipped kits any time.

NAME ..... STREET .....

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

ALL SHIPMENTS ON 10-DAY APPROVAL — WITH FULL REFUND GUARANTEED