MARCH • 35¢

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

BUILD AN AUTOMATIC CODE SENDER
with this diode matrix

Electronic Marvels at the World's Fair

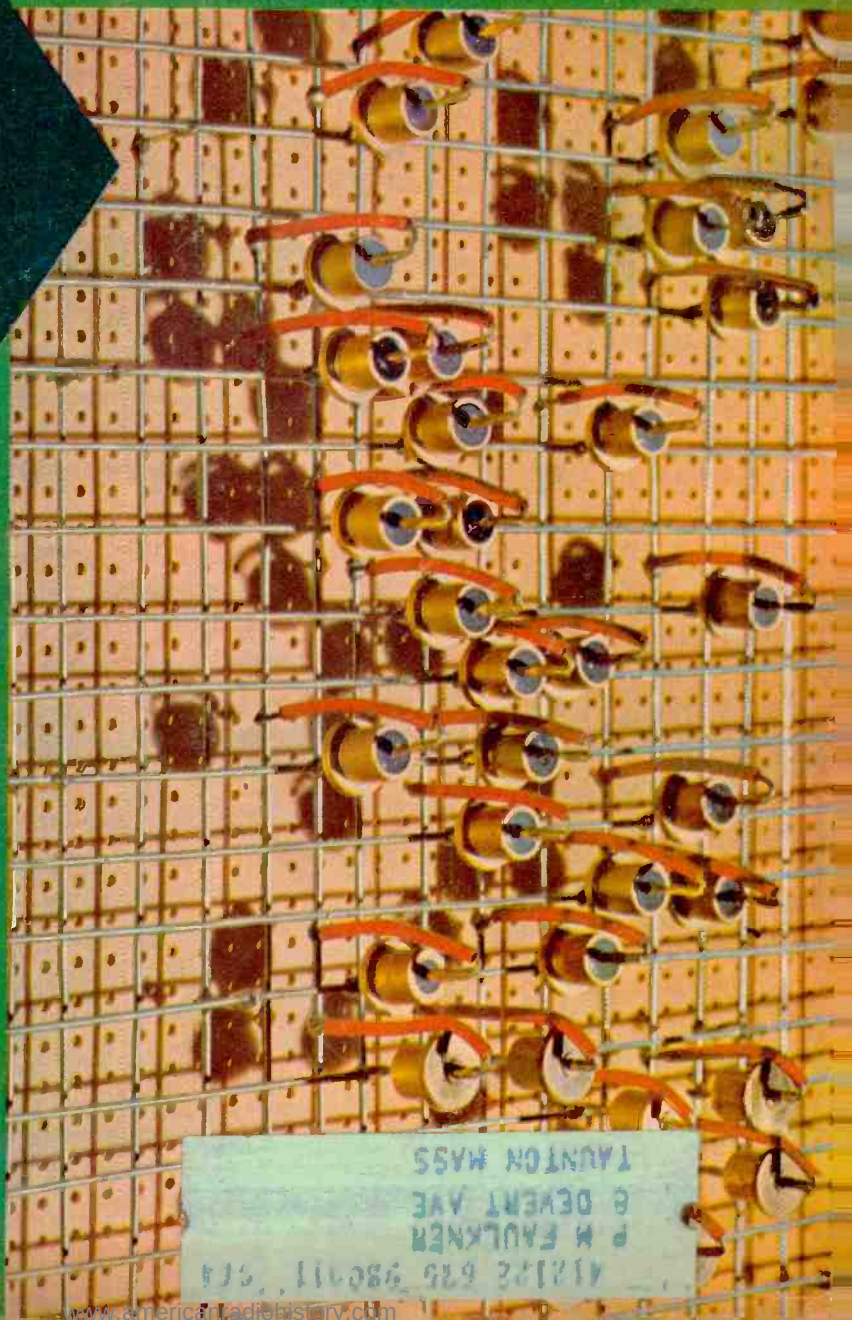
Going Stereo The Easy Way

✶

BUILD:
$10 Phone Patch
Mini Decade Box

✶

Special Section:
CB RADIO
What's Ahead for the Citizens Band?
CB PROJECTS:
Q-Multiplier
Crystal Checker
Pocket Receiver
6-in-1 Service Set



RI has been the ome for Radio-TV

Fast growing need for Skilled Technicians

NOW is the time. Now you can move forward in this dynamic growing Age of Electronics. Half a million more skilled Technicians will be needed by 1970 to install, operate, service and supervise Electronic equipment in business, industry, the military. More Technicians are needed right now than engineers—from 4 to 7 times more! That's why NRI has continued to expand its home-study training, offering ambitious men a choice of instruction plans for a choice of career fields in Electronics. Now is the ideal time to find out about training at home with NRI, the oldest, largest school of its kind. Mail card today for our two new books. National Radio Institute, Washington, D.C.

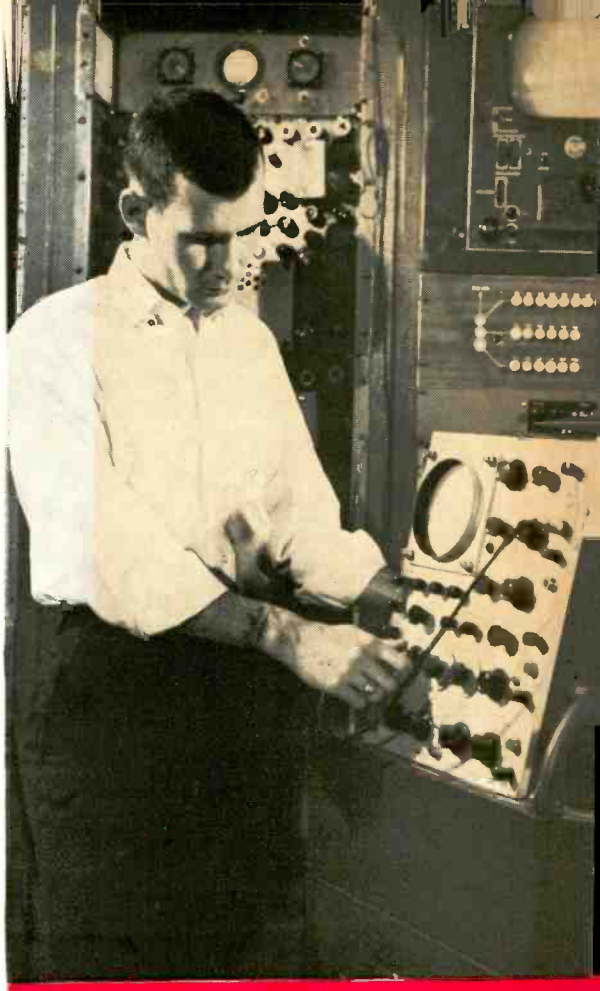
These Men Trained for Success With NRI—YOU Can, too

"I want to thank NRI for making it all possible," says Robert L. L'Heureux of Needham, Mass., who sought our job consultant's advice in making job applications and is now an Assistant Field Engineer in the DATAmatic Div. of Minneapolis-Honeywell, working on data processing systems.

His own full-time Radio-TV Servicing Shop has brought steadily rising income to Harlin C. Robertson of Oroville, Calif. In addition to employing a full-time technician, two NRI men work for him part-time. He remarks about NRI training, "I think it's tops."

"I can recommend the NRI course to anyone who has a desire to get ahead," says Gerald L. Roberts, of Champaign, Ill., whose Communications training helped him become an Electronic Technician at the Coordinated Science Laboratory, U. of Illinois, working on Naval research projects.

Even before finishing his NRI training, Thomas F. Favaloro, Sherburne, N.Y., obtained a position with Technical Appliance Corp. Now he is foreman in charge of government and communications divisions. He writes, "As far as I am concerned, NRI training is responsible for my whole future."



Save time and money Choose from

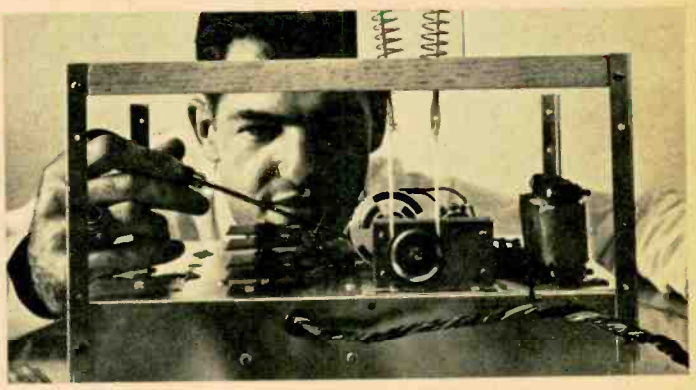
TEN SPECIALIZED INSTRUCTION PLANS

offered by NRI— oldest and largest school of its kind

NRI Equipment makes training faster, easier, more interesting

Thanks to NRI's pioneering home-study techniques, even men who didn't complete high school may successfully launch new careers. Of major importance are the creative Electronic Training Kits NRI furnishes *at no extra cost.* Use equipment you build to work exciting revealing experiments as you learn-by-doing. NRI equipment is designed to bring to life the things you read about in illustrated, easy-to-read texts. And all equipment is yours to keep and use.

MAIL POST CARD AT LEFT NOW



NATIONAL RADIO INSTITUTE
Oldest and Largest Radio-TV Electronics Home Study School
WASHINGTON, D.C.

Pick Your Career in the Wonderful Field of Electronics

1. TELEVISION-RADIO SERVICING
Learn to service AM-FM Radios, black and white and color TV sets, Stereo Hi-Fi, PA systems, etc. A profitable, interesting field for part-time or full-time business of your own.

2. 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.

3. COMPLETE COMMUNICATIONS
A comprehensive training program for men seeking careers operating and maintaining transmitting equipment in Radio-TV Broadcasting or mobile, marine, aviation communications. Prepares you for your First Class 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.

5. MATH FOR ELECTRONICS
A short course package of carefully prepared texts that take you from basic arithmetic review through graphs and electronic formulas. Quick, complete and low in cost.

6. BASIC ELECTRONICS
An abbreviated, 26-lesson course covering Automation-Electronics, Radio-Television language, components and principles. Ideal for salesmen, hobbyists and others who find it valuable to be familiar with the fundamentals of this fast-growing industry.

7. ELECTRONICS FOR AUTOMATION
For the man with a knowledge of basic electronics who wants to prepare for a career in process control, ultrasonics, telemetering and remote control, electro-mechanical measurement, others.

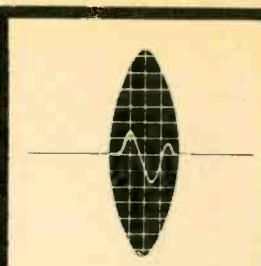
8. AVIATION COMMUNICATIONS
For men who want careers working with and around planes. Covers direction finders, ranges, markers, loran, shoran, radar, landing systems, transmitters. Prepares you for FCC License.

9. 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.

10. 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.

ELECTRONICS ILLUSTRATED

MARCH 1964 A Fawcett Publication Vol. 7, No. 2



Special CB Features

Special CB Projects

General Features

Radio: Amateur • SWL

Audio & Hi-Fi

Theory & Practice

Regular Departments

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Magazine Publishers Association, Inc.

COVER — Ektachrome by Grayson Tewksbury, EI Studios.

Has shop in basement—gets "more and more work all along"

"I HAD PRACTICALLY no knowledge of any kind of repair work. One day I saw the ad of NRI in a magazine and thought it would be a good way to make money in my spare time. 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 the basement of my home."

—JOHN D. PETTIS,
172 N. Fulton, Bradley, Illinois

IF YOU'VE BEEN WANTING TO START "A LITTLE BUSINESS OF YOUR OWN" IN YOUR BASEMENT OR GARAGE

CHECK the advantages of NRI training in Servicing Electrical Appliances

- ☐ **STEADY DEMAND** for your services. Over 400 million appliances in U.S. – 6 million sold last year alone – mean shortage of trained appliance service men.
- ☐ **NO ELABORATE EQUIPMENT NEEDED** — just simple hand tools, and Appliance Tester which we provide at no extra charge.
- ☐ **START SMALL – GROW BIG.** You can start out in your own basement or garage, in spare time. Gradually expand until you open your own shop.
- ☐ **NO NEED TO RISK YOUR SAVINGS.** Many businesses require a sizable investment. But here you can build up a following of customers *first*, then open a full-time shop if you wish to.
- ☐ **EARN $3 TO $5 PER HOUR.** Fixing appliances is a high-paying skill because the demand for trained men is so great.
- ☐ **ENJOY SEMI-RETIREMENT ON A GOOD INCOME.** When you're ready to retire, you can devote a few hours a day to this work. Live and work anywhere you please.
- ☐ **NO PREVIOUS EXPERIENCE OR TRAINING NEEDED.** We tell you and show you everything you need to know, in plain English and clear pictures.

IF YOU'RE like so many men today, you've been "hankering" to start "a little home business of your own." In spare time at first, then maybe full-time later on. Something you'd enjoy – and that pays well. Something that fills an existing need in your neighborhood or town – that "sells itself," without any high pressure arguments – that doesn't take a big investment or elaborate equipment.

This is it—Servicing Electrical Appliances! Now is the perfect time to get into it. Sales of electrical appliances have skyrocketed. Look how YEARLY SALES have risen since 1950: Coffee Makers – from 900,000 to 4,750,000. Room Air Conditioners—from 200,000 to 1,800,000. Clothes Dryers—from 318,000 to 1,425,000. Floor Polishers – from 240,000 to 1,090,000. No wonder that men who know how to service appliances properly are making $3 to $5 an hour—in spare time or full time!

Your Skill Always in Demand —"Set Up Shop" Anywhere

People need their appliances fixed in good times or bad. Once word gets around that you are trained to service them, you'll have plenty of work.

Your training costs less than 30¢ a day. And you need only the few basic tools you may already have – and an Appliance Tester which we provide at no extra charge. You can work anywhere—in a corner of your basement or garage, even on the kitchen table. If you like, you can open up your own shop, have others work for you. And you can save money by fixing your own appliances.

FREE BOOK
and Sample Lesson

Our 24-page Free Book tells how you can "cash in" on America's "Electrical Appliance Boom"—the money our students are making, what they say about us.

Free Sample Lesson shows how simple and clearly illustrated our instruction is—how it can quickly prepare you for a profitable future in this big field. Mail coupon, letter, or postcard to: *National Radio Institute, Dept. KC4, Washington 16, D.C.* (No obligation – 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.

NATIONAL RADIO INSTITUTE
Dept. KC4. Washington 16, D.C.

Please send me Free Book about your Electrical Appliance Repair Course and a free Sample Lesson. 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.

Name.....

Address.....

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

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ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

editor **ROBERT G. BEASON**
feature editor **Richard A. Flanagan**
technical editor **Robert D. Freed**
art editor **Lou Rubsamen**
editorial associate **Kevin Murphy**
production editor **Rosanne Walsh**
advertising mgr. **John F. Webster**

CONTRIBUTING EDITORS

amateur radio **Robert Hertzberg, W2DJJ**
citizens band **Len Buckwalter, KBA4480**
swl-dx **C. M. Stanbury II**
special projects **Herb Friedman, W2ZLF/2W6045**
medical electronics **R. A. Markoff, M.D.**
audio **Harry Kolbe**
audio **John Milder**
audio **David Muirhead**

EXECUTIVE STAFF

editorial director **Ralph Daigh**
advertising director **James B. Boynton**
art director **Al Allard**
associate art director **Ralph Mattison**
production director **George H. Carl**

ADDRESSES

Editorial and Advertising Offices: 67 West 44th St., New York, N.Y. 10036. Subscriptions: Change of address Form 3579 to Subscription Dept., Fawcett Bldg., Greenwich, Conn. 06830.

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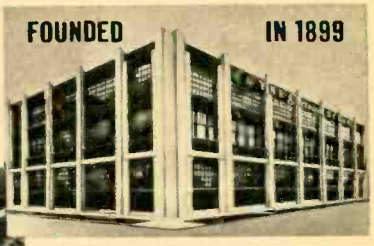
You Have Aptitude for Electronics

...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!*

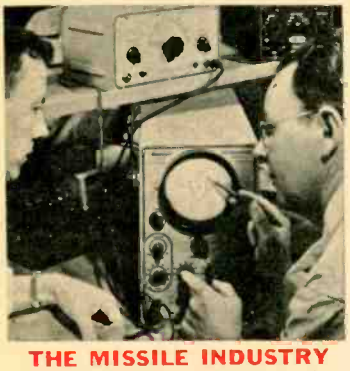


No matter what branch of electronics you prefer, you'll have no trouble landing just the job you want—*provided you get the right kind of training.*

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 CATALOG

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 which will be mailed free of charge when you return the coupon below or send your name in on a postcard today.

SPECIALTY ORIENTED STUDENT RESEARCH PROGRAM — PARTICIPATING RESEARCH SCHOOL — STATE UNIVERSITY OF IOWA

Coyne Electrical School

Chartered as an Educational Institution not for Profit

Dept. 34-A Chicago 7, Illinois

FREE!

Clip OUT AND MAIL NOW!

COYNE ELECTRICAL SCHOOL, Dept. 34-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.

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

Address ..... Phone .....

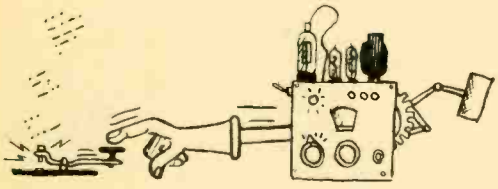
RR No. or

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

FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th Street, New York N. Y. 10036

● INSTANT CODE



Your Automatic CQ Sender (Jan. EI) is a terrific piece of equipment for every ham who pounds a key. Any chance for an automatic code sender along these same lines?

M. Kevinsley
Chicago, Ill.

It's all yours, M. Just keep going in this issue.

● COME AGAIN?

Please advise as to periodicals in recent issues of ELECTRONICS ILLUSTRATED on making small tape recorders in related areas. Your help is greatly appreciated.

E. A. Abercrombie
Statesboro, Ga.

Huh?

● NEVER SAY DIE

I would like to take issue with a statement in your review of the Japanese sheet recorder (Jan. EI). You claim that the recorder's 35db signal-to-noise ratio is similar to that of the 78-rpm record. This simply is not so. The 78 had, and always will have, superior frequency response, better signal-to-noise ratio, lower distortion and less tracking deformation. With the present state of the art, it is doubtful whether anyone would be satisfied with LP's if 78's were still available.

Lars Svensen
Brooklyn, N. Y.

We'd bet your Victrola has a morning glory horn.

● DEAR ABBIE

I am planning to be a DXer. How do I start and what do I do?

Myles H. Marks
Pittsburgh, Pa.

Listen.

● HINDSIGHT

Could you send me a set of plans so I could light a neon bulb from a 1½-volt battery? A friend of mine said it couldn't be done and I said it could.

David Gerdemann
Warrenton, Mo.

What'll it prove?

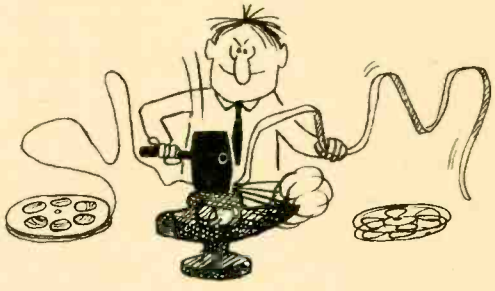
● PONY TAPES

I would like to know where I can get tapes of famous sporting events, such as the 1956 Kentucky Derby.

John Mankel
Thiensville, Wis.

Don't know, John. Maybe our pony-playing readers can help.

● THE BLACKSMITH



I have a radio/wire-recorder combination. Can the wire recorder be converted to a tape recorder? What changes are necessary?

Roland Powell
Escondido, Calif.

If you want to be brutal about it, try an anvil. Otherwise, go shopping.

[Continued on page 8]

BUILD 20 RADIO CIRCUITS AT HOME

with the New

PROGRESSIVE RADIO "EDU-KIT" ®

Reg. U.S. Pat. Off.

only $26.95

Training Electronics Technicians Since 1946

A Practical Home Radio Course

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

YOU DON'T HAVE TO SPEND
HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

FREE EXTRAS

- **SET OF TOOLS**
- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

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."

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

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

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 552 AE, Hewlett, N. Y.

FEEDBACK

continued from page 6

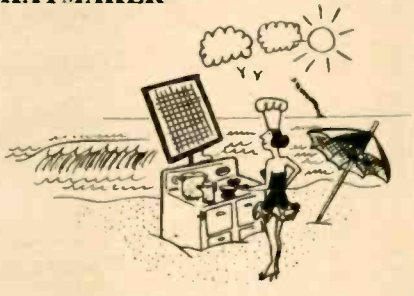
● POLICE BATS

I recently witnessed a strange incident which I would like to tell you about. I was in the radio/TV section of a large department store where I was watching a customer tune an AM/FM portable across the FM band. At first there was nothing unusual to hear—just a few local FM stations being tuned in and out. But at 96 mc police broadcasts came in loud and clear. Since the other FM sets would not pick up these signals, I concluded there was a bat in the belfry somewhere along the line. Can you clue me in on what happened?

Frank Smith
Toronto, Ont.

Hard to tell what was what without more particulars, Frank, but our guess would be a radiating oscillator plus heterodyne. A friend of ours who owns a recording studio once taped a perfect police call during a recording session with a pianist, if that's any consolation. He chalked it up to audio rectification when he discovered a police radio car only a few doors down the block. Another chap we know picks up the sound from a TV station on his FM set, though this is nothing to get excited about. The station is on Channel 6, down at the bottom of the FM band.

● HAYMAKER



My brother and I read your peice on solar cells (Jan. EI) so we are making a stove out of them. It will use sunlight.

Nancy Taylor
New York, N. Y.

Should be just grate for the beach, Nan.

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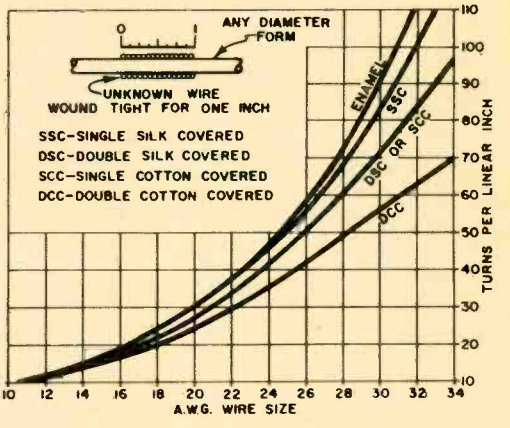
2086

Wire Gauging Made Easy

QUITE often the parts lists of a project will call for a coil of so many turns of a certain size and type wire. Many electronic experimenters have a large collection of discarded audio, IF and power transformers or other sources of usable wire of unknown gauge. The problem is always the same—what size wire is available and can it be used in the equipment being built?

After many trips to the handbooks and much measuring, it was decided to construct the graph shown below. All that is needed to use the graph is the

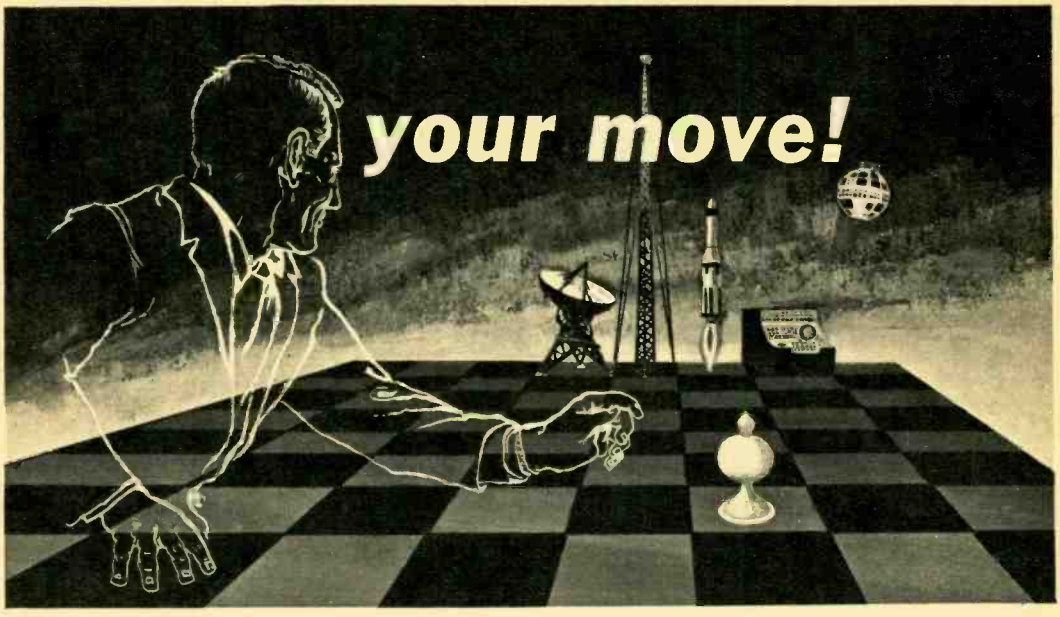


piece of the unknown wire, a coil form of any diameter (even a pencil will do) and a ruler.

Make two marks exactly one inch apart on the coil form being used. Tightly wind the wire between the one inch marks counting the number of turns made.

On the right side of the graph, locate the number of turns wound. Follow across the graph until you intersect the desired curve for a particular type of insulation. From this point go down to the bottom of the graph to find the size of the wire. As the insulation thickness may vary between manufacturers, the graph is not 100% accurate, but is close enough for all practical purposes.

—*B. Solomon*



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Grantham School of Electronics offers training *in the classroom, in the laboratory,* and *by correspondence,* as explained below.

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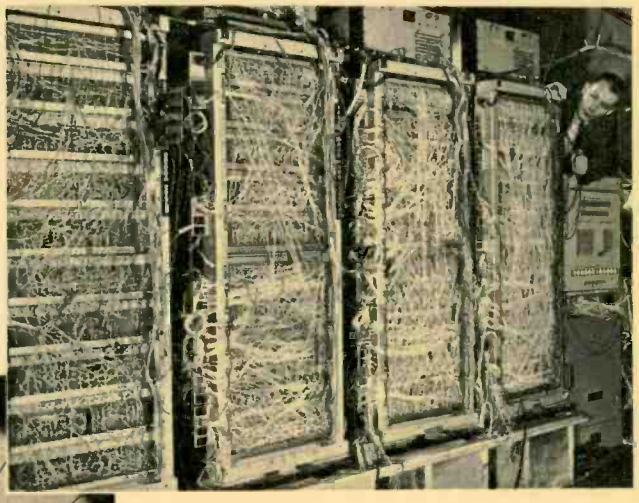
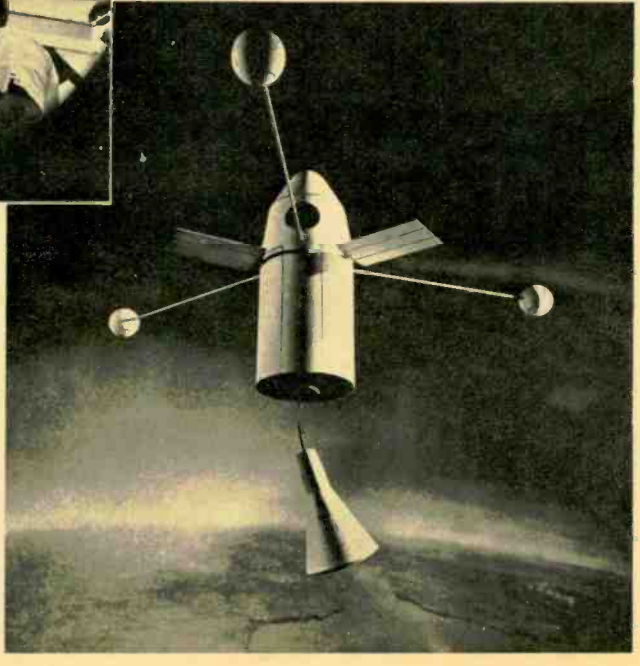
I am interested in: ☐ Home Study ☐ Classroom Training 48-C

..electronics in the news

WIRES, MAN, WIRES... This may look more like the proverbial rat's nest than an aircraft trainer, but the manufacturer will be quick to remind you that computers like this take myriads of wires—and then some. Goodyear Aerospace made two of these complex mazestrosities to simulate flying the Navy's A-6A and E-2A planes.



Come In, Kearsage . . . A new helical antenna with its own wire-fan ground plane will make communications with distant missile-tracking ships easy as talking over a shipboard intercom. Built by ITT Federal Laboratories, the antenna can handle peak envelope power of over 10 kw.



Weightless . . . 1966 may see this four-man space lab popped into orbit by powerful Saturn I or IB rockets. Designed by Republic Aviation, the space station will check on man's abilities to survive in a weightless environment. Incidentally, the ship is bigger than it looks: the main section houses the control system, while living and sleeping quarters are in the three modules out there at the ends of the spokes.

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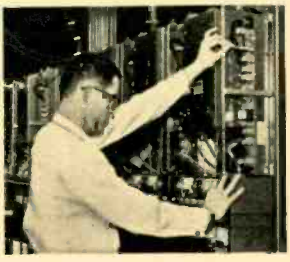

Mobile Radio, Microwave and 2nd Class FCC Preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

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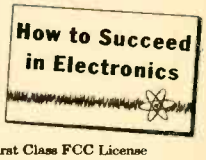

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...electronics in the news

Sol Seeker . . . There's nothing that annoys sun-worshippers like guessing where the sun is on a cloudy day. Bulova's sun-position indicator isn't going to help them much, but it will

provide attitude control for heads-up satellites by telling them which direction the sun is. Our photo shows a model of the guidance instrument.

Greatest Imposter . . . A solar simulator in hair-dryer's garb relies on an elliptical reflector (as well as something called a focal point) to capture more than 85 per cent of the radiation from a 2.5-KW

mercury-xenon lamp. Developed at Honeywell's California Ordnance Center, the device has such a highly polished reflector that dust probably would cause sunspots.

Heathkit's great base station deserves

an equally fine working partner!

In a two-way radio communications system, overall performance is only as good as it's weakest link. The deluxe Heathkit GW-42 "Master Station" CB Transceiver teamed up with the powerful GW-52 1-watt "Walkie-Talkie" brings you Citizen's Band radio facilities of outstanding capability with complete freedom and mobility of operations. Check and compare the many features offered in Heathkit equipment with any other...see why Heathkit is your best buy in CB!

"Master Station" CB Transceiver

• 5 Crystal-controlled transmit & receive channels • Built-in 3-way power supply • Built-in 4-tone selective call circuitry • All-channel receiver tuning • Built-in tuning meter • Adjustable squelch control • Switchable automatic noise limiter • Push-to-talk microphone • Beautifully styled • Easy-to-build.

Kit GW-42....23 lbs.....$119.95
Assembled GWW-42....22 lbs.....$189.95

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• Rugged 10-transistor, 2-diode circuit • Long-range transmitter—1-watt input • Sensitive superheterodyne receiver with RF stage • Adjustable squelch control • Automatic noise limiter • Crystal-controlled transmit & receive channels • $20 rechargeable battery included • Built-in 117 v. AC battery charger • Built-in battery condition meter • Easy circuit board assembly.

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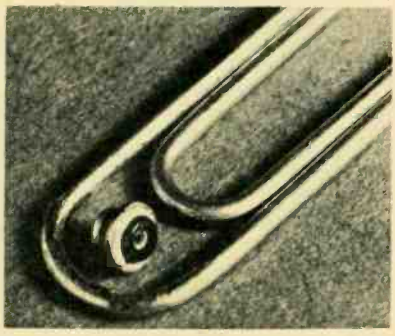
GX-124R

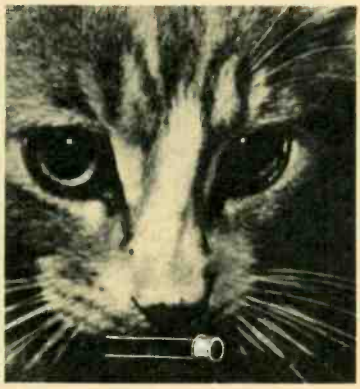
...electronics in the news

Sensitive Seer . . . Sperry Rand's new photoparametric diode is dwarfed by even a common paper clip. Yet it can detect and amplify as little as one-billionth of a watt of light modulated at



any frequency from DC to 2 gigacycles. Sperry expects to use the device to boost receiver sensitivity in laser communications and radar systems.

Meow-Wow! . . . This pea-size light detector sports a reaction time some 400 times faster than a cat's eye. Sensitive to infrared as well as visible light, the cadmium selenide unit is useful in light detection systems, automated machinery and such industrial controls as counters and limit switches. Raytheon already is producing the opto-electronic device, which can change its resistance over a range of more than 1 megohm in only five ten-thousandths of a second.



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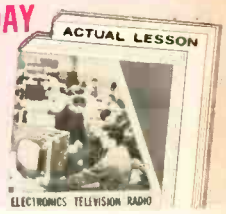

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William E. Eckenrod

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

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PHASE 3 INDUSTRIAL ELECTRONICS
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PHASE 5 FCC LICENSE PREPARATION
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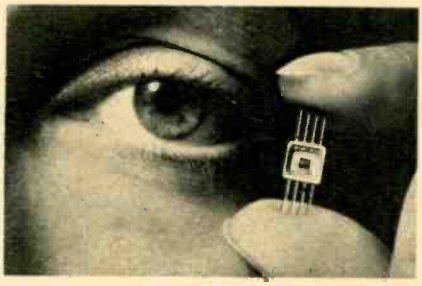
...electronics in the news

Proof Positive . . . Dick Tracy's wristwatch radio was a little ahead of its time, but pepper-speck circuits like the one in the photo prove that Mr. T. wasn't far out of line. Produced by



Westinghouse for use in military and space projects, the little squares replace as many as 50 separate transistors, diodes, resistors and capacitors. The tiny blocks are about the size of a wooden matchhead.

Rainbow Rich . . . Though it forgets all about yellow in its computations, a new color computer by Tokyo Shibaura Electric can distinguish between 100,000,000 different colors in two seconds flat. Red, blue and green are the pri-

mary colors to the computer's way of thinking, and it does its sorting by a combination of spectrophotometry and electronic computation. New hues for fabrics may come from the computer, while hospitals may use it for rapid diagnosis of incipient disease through skin color analysis.

This is the beginning of the Fisher KX-200 StrataKit.

This is the end. The absolute end in stereo control-amplifiers.

You begin the Fisher KX-200 StrataKit with the most logically organized kit package and the clearest, most detailed assembly manual in the entire field of high fidelity kits.

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 manual. Each stage is built from a *separate* packet of parts (StrataPack). Major components come *already mounted on the chassis*. Wires are *precut* 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.

As a result, you end up with an 80-watt stereo control-amplifier that is completely indistinguishable from a factory-built Fisher unit.

The KX-200 has enough power to assure peak performance with the most inefficient speakers and incorporates exclusive features like a laboratory-type d'Arsonval bias/balance meter and a third-speaker output with separate volume control. Price, $169.50.* The Fisher KX-100, a 50-watt stereo control-amplifier kit of advanced design, costs only $129.50.*

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The Kit Builder's Manual

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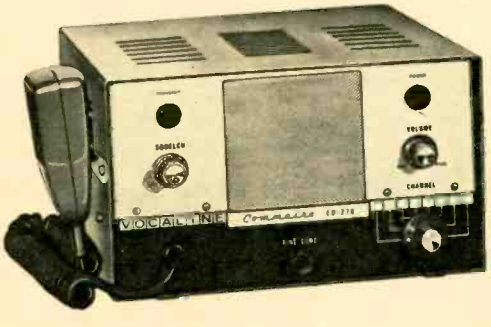
TV Quadruplets? . . . Then let the TA-66 Indoor Super-Powermate give you a hand at feeding time. The TA-66 allows you to connect up to four TV sets to a

single antenna. And, if your TV screen looks like it's mixed up with a tweed suit, the TA-66 may help eliminate the herringbone weave. $34.95. Jerrold Electronics Corp., 15th & Lehigh Ave., Philadelphia, Pa. 19132.

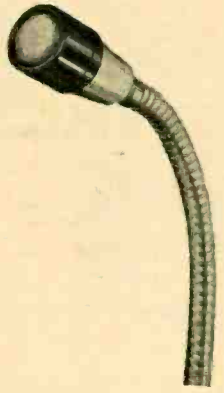
Well Squelched. . . The Commaire ED-278 Citizens Band transceiver, featuring patented squelch circuitry, transmits and receives on eight channels. Its transmitter modulates 100% under all conditions, the maker claims, and the unit has a built-in lamp on its front



panel to tell you when the transmitter is on the air. The ED-278 is housed in a two-tone, all-metal cabinet and operates from 117 VAC or 12 VDC. A special microphone helps eliminate background noise. $189.50. Vocaline Co. of America, Old Saybrook, Conn. 06475.

Marketplace

Dynamic Sound . . . The vibrant voice response, rugged styling and compact construction of the 561 dynamic microphone make it a natural for streamlining language labs or even base stations. Intended primarily for use in permanent installations, the tamper-proof mike features the Shure Duracoustic diaphragm and a —56db output level. Its low impedance—50 to 250 ohms—permits use of unusually long cables without adverse affect on the unit's 40- to 10,000-cps frequency response. $32.50. Shure Bros., 222 Hartrey Ave., Evanston, Ill. 60201.



Phones In Vogue . . . Hair do's remain untouched when you (or perhaps your secretary) wear the SEP-100 chin-fit stereophones. Fitting snugly under the chin, or atop the mop if preferred, they

offer separately tunable earphones for those of us with unbalanced ears. The plug on the SEP-100 fits either stereo or monaural output jacks, and a stereo/mono switch on the control box provides for even greater flexibility. Frequency response is exceptional, too—25 to 18,000 cps. $24.95. Freeman Electronics Corp., 729 N. Highland Ave., Los Angeles, Calif. 90038.

Marketplace

Armchair Admiral . . . If you want to be in complete control of your stereo setup while relaxing in a comfortable chair, the SC-2 stereo control box is for you. The only other necessary link in the chain of command is a pair of head-

phones terminating in a single stereo plug. You can switch from speakers to phones at will, and headphone volume and balance controls are at your fingertips. $6.95. Superex Electronics Corp., 4 Radford Pl., Yonkers, N.Y. 10700.

Do Not Disturb . . . For privacy on your CB rig, an ingenious selective caller minimizes your chances of hearing unwanted signals. When you and your call station are on a fixed frequency, you needn't stay up all night monitoring

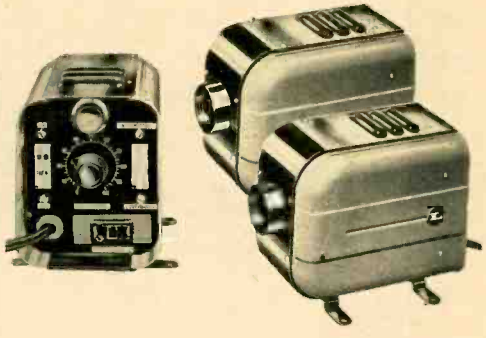
your set. The HA-100 Priva-Com indicates an incoming call with a tone and a signal light and closes a relay to activate your receiver. $32.50 each. Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791.

Marketplace

High Fashion . . . The de luxe styling, control flexibility and quality circuitry of the SA-40K stereo amplifier/preamplifier help make the unit an attractive addition to any hi-fi installation. Williamson-type circuitry and a 20-watt-

per-channel output provide top performance, and you can use this versatile amplifier for all stereo and monaural tapes, records and tuners. SA-40K kit, $49.95; SA-40C cover, $8.95; SA-40W factory-wired, $99.95. Merrell Electronics, 519 Hendrix St., Brooklyn, N.Y. 11207.

Stop, Thief! . . . The PC-45 photo-electronic relay system will signal the arrival of any unauthorized intruder. The system, also capable of counting people or merchandise, consists of a light receiver and a relay unit. A removable



infrared filter is supplied for use in security applications. Optional buzzers, electric bells and counters are available for a small additional cost. $18.95 per two-unit set. Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791.

Marketplace

SSB Ham-Bander . . . The SB-300 SSB receiver offers complete coverage of the 80- to 10-meter ham bands, linear tuning with 1-kc dial calibrations, a 2.1-kc crystal lattice filter and other premium

features. Styled in green and grey with dark green, sure-grip knobs, the SB-300 is truly a professional-looking rig. And it's compact and light enough for desk-top installation. Kit, $264.95. Heath Co., Benton Harbor, Mich. 49022.

Hot Rod . . . A pistol-shaped soldering gun aims a hot tip at your most intricate soldering jobs. Weighing only 1 lb. and housed in shock-resistant molded red plastic, the Wen 75 carries its own

built-in spotlight to illuminate the work area. Even the itchiest trigger finger will appreciate its steady grip, perfect balance and 6-ft.-long reach. $4.95. Wen Products, 5810 Northwest Hwy., Chicago, Ill. 60631.

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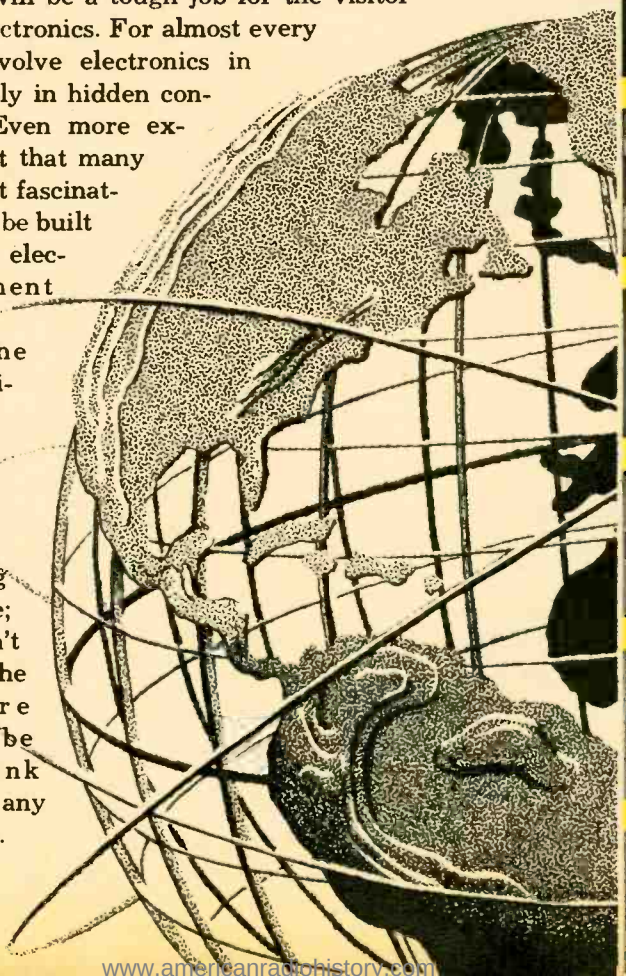
ELECTRONICS ILLUSTRATED
MARCH 1964

electronic wonders at the WORLD'S FAIR

By Ken Gilmore

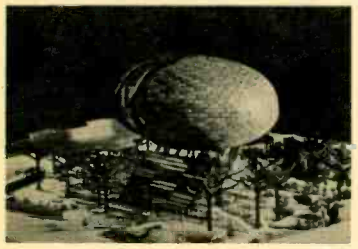
ENGINEERS, construction crews, even computers are working round the clock these days on Long Island, and with good reason. Their goal: to make certain that the 1964 New York World's Fair will be ready for opening-day crowds, come April 22. Displays at this mammoth exhibition will cover just about every area of human activity . . . from art to zoology, geology to space travel, fashion to fusion. But the field of electronics will be responsible for some of the most spectacular exhibits at the show.

Unless you have three weeks to spend (about the minimum it would take to see everything), you'll have to select the exhibits you most want to see, then work in as many as possible. But this will be a tough job for the visitor interested in electronics. For almost every display will involve electronics in some way, if only in hidden control circuits. Even more exciting is the fact that many of the fair's most fascinating exhibits will be built entirely around electronic equipment and principles.



Here are the shows EI nominates for inclusion on every electronics enthusiast's must-see list. Obviously, no listing can be complete; space just won't allow it. But the exhibits we're about to describe deserve to rank high on most any visitor's agenda.

Electronic Genii. How do computers work? How can they help in traffic control, language translation, space guidance, information retrieval? *International Business Machines's* information machine —a display-packed, slightly squashed sphere some 90 ft. in height— will attempt to answer these questions.



IBM

To see the performance, take your seat on the People Wall. You and the other spectators are whisked upward hydraulically into an ovoid for the show. Pictures flashing on nine screens, music, narration, tricky lighting effects and other special techniques tell you the story of computers in the modern world.

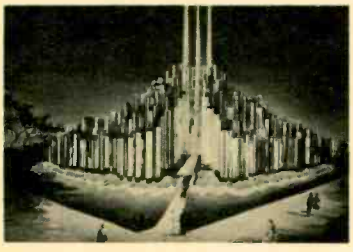
To dig deeper into the subject, go into the Pentagon Theaters— a series of smaller exhibits. There, a cast of mechanical, puppet-like actors demonstrate why high-speed computation is important, how computer logic works, how computer circuits are miniaturized, how information-handling systems are put together. Next, stroll into Computer Court where you'll witness a large-scale IBM computer in actual operation, demonstrating how it solves complex problems in today's complex world.

General Electric

Sorcerer's Progress. Step on a moving ramp at the entrance to the *General Electric* building and travel up to the second floor. There, take a seat and move automatically through a series of six theaters in which several short dramas show how electricity has affected the lives of Americans over the years.

If something about the actors doesn't seem quite right, don't be alarmed. They're really not people. Instead, they are complex, electronically controlled robots. Walt Disney, whose company built them, calls the robots Audio-Animatronic figures.

Though they move and talk much as people do, these robots can go from ten in the morning to midnight without so much as a coffee break. Their transistorized interiors include a tape programmer— the same kind used to generate electrical signals and put the Minuteman missile through its paces—and pneumatic muscles controlled by the tape.



Electric Power & Light

These pre-programmed people move so naturally they appear to be real. Electrical signals from the tape programmer turn hydraulic valves on and off to shoot compressed air through plastic tubes to the artificial muscles. The recorded voice track is on the same tape, so that movements—jaw movements in speech, for example—are synchronized precisely with the sounds.

On the next floor, your moving ramp lets you off in a huge, domed room 200 ft. in diameter. A deafening thunder storm is in progress

as you arrive. Hidden projectors throw realistic bolts of lightning across the dome, which appears to be the sky. The scene gradually changes and the seething surface of the sun appears. Then a complex show with pictures, narration and music explains where the almost unlimited energy of the sun and stars comes from and how man is attempting to tap this same source via thermonuclear fusion. But this exhibition is dwarfed by what is to come.

When the display is over, you descend to the ground floor for what may be the most spectacular exhibit in the entire fair. You watch actual fusion take place and see this awesome new source of power tapped to create electricity. The exhibit is not a simulated reaction but real controlled fusion, demonstrated to the public for the first time.

RCA

Lights Fantastic. Uncle Ben —a talking, animated, electronically controlled robot that looks strangely like a cross between a light bulb and Benjamin Franklin—is your guide through The Brightest Show on Earth, the exhibit of the *Electric Power & Light Companies*. Carried slowly around a circular display area on a moving ring, you learn how the complex network of power systems across the country operates, how various distribution nets are tied together into a complex grid. Separate displays show the latest research in the field and coming advances in electric power generation and distribution.

Bell Telephone

One of the most impressive parts of the exhibit (and of the whole fair) will be the Tower of Light. This obelisk of illumination will rise from the tip of the dramatic pavilion and soar into the night sky. Creating this brilliant bolt of light will be the greatest concentration of display lighting ever assembled anywhere in the world, a 12-billion-candlepower barrage of beams.

The luminous shaft will be comprised of twelve 1-billion-candlepower searchlights, each one chewing up more than 6 kw. Together, they'll produce as much light as 340,000 automobile headlights or 50 fully illuminated Yankee Stadiums. Engineers hesitate to predict how far away the beam will be visible on a clear night, but one source estimates that it may be seen from Washington.

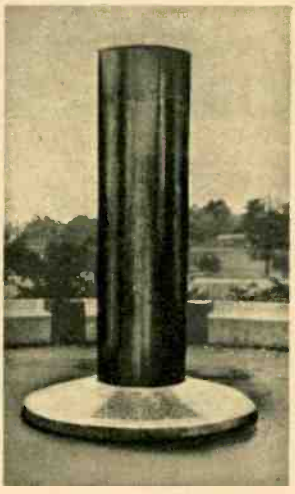
Chromatic Magic. Want to see yourself on color TV? Stroll into the *RCA* TV Communications Center and you'll be flashed

on the screen in living color. You'll also see a typical color TV station in full operation.

RCA will transmit color programs continuously to some 200 color receivers spotted around the grounds during the entire run of the fair. As you stroll about, you'll see films showing how some of the more interesting exhibits and pavilions were built. Other shows will feature interesting guests, unusual facts about the fair and many other features.

While at the Center, you can watch full-scale rehearsals and live shows in progress and learn how camera crews, technicians and directors put the show together. You'll watch the entire production live and, at the same time, you'll observe monitors to see what each camera picks up. Finally, you'll find out how the director weaves various shots and sequences together into a smooth-flowing show.

Sound Enhancement. At the *Bell Telephone* exhibit, you'll take a seat in a large, comfortable, wired-for-sound chair. Your mobile seat glides effortlessly through a door and gives you a front-row view of the first of a series of stages. Speakers built into the chair whisper to you, describing how man through the ages has improved his means of communicating from smoke signals and drums through today's complex radio networks and space communications techniques.

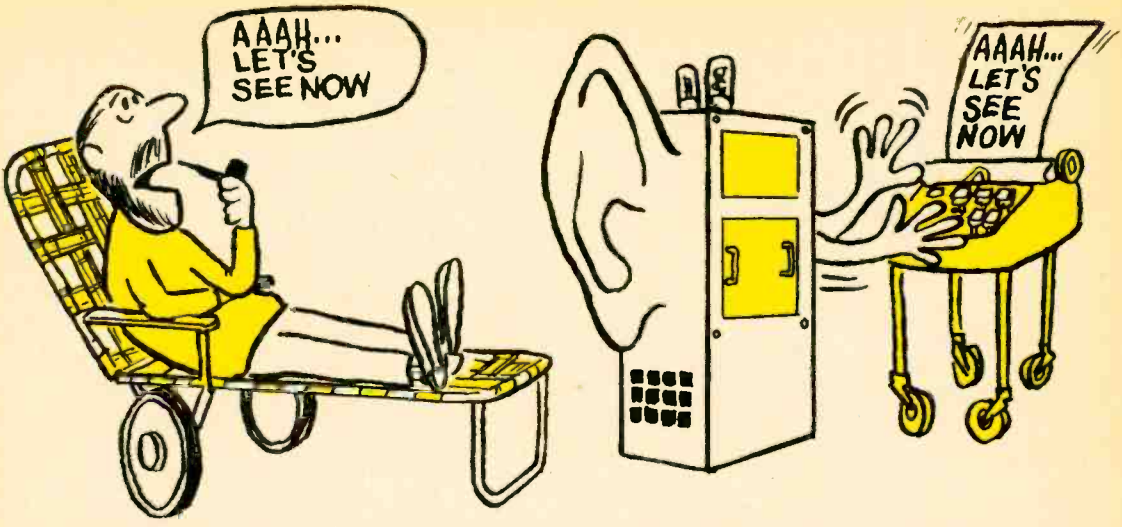


Westinghouse

At the end of the ride you pass through the "acoustical lock"—a kind of anechoic chamber—and have an opportunity to experience absolute silence. If this is something new to you, chances are you'll find it an eerie experience. You'll hear your own breathing, your beating heart and the sound of blood rushing through your veins—all loud and clear. Time and the world will all but stand still.

Then you move on to a series of exhibits again centered around communication. Mr. Bell's early experiments with voice transmission; methods that various insects, birds and animals use to communicate; solid-state developments; telephone manufacturing, and many other exhibits are on display. You also get a glimpse of advanced systems and techniques Bell scientists think we may use to communicate in the future.

Encapsulated Time. Though the main purpose of the fair is to tune us in on the future, at least one exhibit is intended to tell the future about us. During the 1939 World's Fair, you may remember, Westinghouse buried a time capsule. This cylinder contains several hundred items which tell of our culture, [*Continued on page* 118]



MACHINES THAT LISTEN

By J. K. Locke

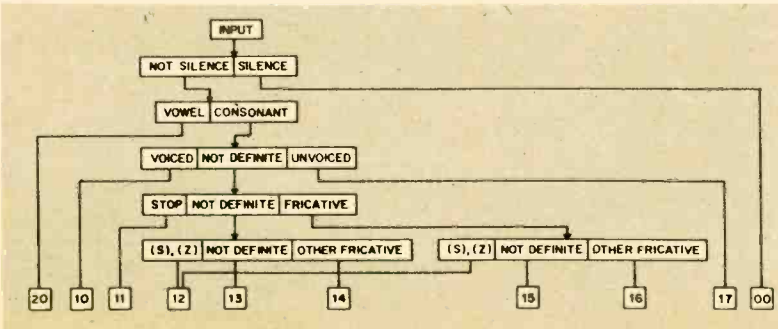
SCENE 1: a laboratory in Princeton, New Jersey. A scientist speaks into a microphone; a typewriter clatters to life and transforms his speech into written words—automatically.

Scene 2: another laboratory, this one in San Jose, California. A researcher says aloud: "One, three, five—add." An adding machine, attached to a small box, grinds its gears contentedly for a moment, then prints out a single digit: 9.

Scene 3: still another laboratory, this time near Great Neck, New York. In it, a research team is teaching an array of light bulbs, photographic plates, glass fibers and photocells to hear and understand the spoken word.

What have these three scenes in common? Just this: they are but a few of the dozens of attempts around the world to build electronic machines that understand what people say. Activities in the field are feverish, since the potential rewards are great. Some of the more obvious uses for such devices:

- Checkout clerks at your supermarket would read prices into the cash register rather than punch buttons. Such registers would be more accurate, and you wouldn't have to wait as long.
- Postal clerks could save time and money routing packages and letters by vocal commands.
- Your telephone dialing would be



One machine recognizes human speech by means of a decision tree. Decisions are passed along to coded numbers at machine's output. A computer then compares numbers with codes in its memory, eventually finds the proper match and identifies the word.

MACHINES THAT LISTEN

faster and more error-free if you simply spoke numbers into the receiver rather than dialing them.

• Businessmen could talk directly into a voice-operated typewriter. Their finished letters would pop out as fast as they could dictate.

Other uses might be even more spectacular:

• Airline and military pilots today and space ship commanders tomorrow could bark orders, switch radio channels and operate complex navigational and operational gear by voice, upping both efficiency and accuracy.

• Military commanders could control tanks, trucks and missiles by talking to them.

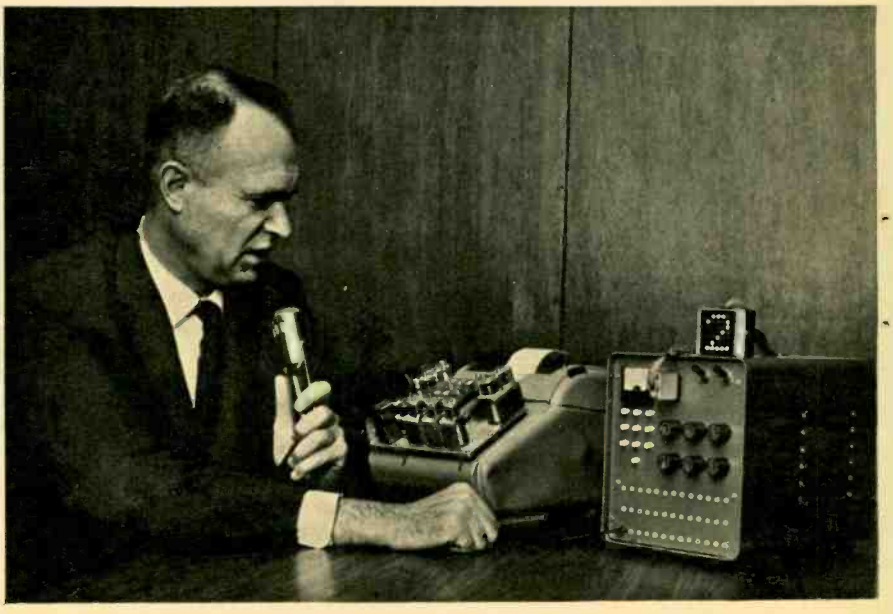
• Computer programming—now a slow, expensive process—would be both cheaper and faster if operators simply could tell computers what to do, instead of laboriously punching out instructions on cards or coding them on magnetic tape.

• Ultimately, perhaps, when language translators now being developed are perfected, completely automatic translation from one spoken tongue to another will become a reality. You'll speak into a machine in English, and your words would come out in French, German or Swahili, depending on the setting of the machine. And words spoken to you in foreign tongues would come out in precise English.

But if the usefulness of speech recognition equipment is great, so are the problems in building it. Human speech is complicated. We don't have one sound for one letter, or even for one combination of letters. Instead, we translate words and letters into a series of groans, snorts, grunts, clicks and gurgles. We pronounce some letters a half dozen ways or more, skip some and add others which aren't there at all.

Some speech scientists, therefore, throw out the alphabet altogether when they begin working on recognition systems. They turn to phonemes, the smallest bits of sound into which language can be broken. English contains about 40 phonemes; till and kill, for example, are identical except for one phoneme. T and K also happen to be letters, but other phonemes are not—the *ee* in

[*Continued on page* 38]



Shoebox, an experimental machine developed by IBM, does arithmetic on voice command. It recognizes 10 digits in all, as well as six control words such as plus, minus and total. Secret of operation lies in fact that each word in Shoebox's vocabulary differs from all others in its peculiar combination of frequencies and amplitudes. By analyzing these waveforms, Shoebox determines identity of word.

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Practical Telephony
Principles of Radio-Electronic Telemetry
Principles of Semiconductor-Transistor Circuits
Radio Servicing with Radio Equipment Training
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feed, the *sh* in *sh*ort or the *th* in *th*in.

Fine. Let's build a phoneme spotter. Only problem is how?

Paul N. Scholtz and Raimo Bakis, two scientists at the IBM Research Center in Yorktown Heights, N. Y., tried one approach. They had 50 subjects read words into a tape recorder, then fed the tapes to a bank of 40 bandpass filters to determine how much acoustic energy the sounds contained in various frequency ranges.

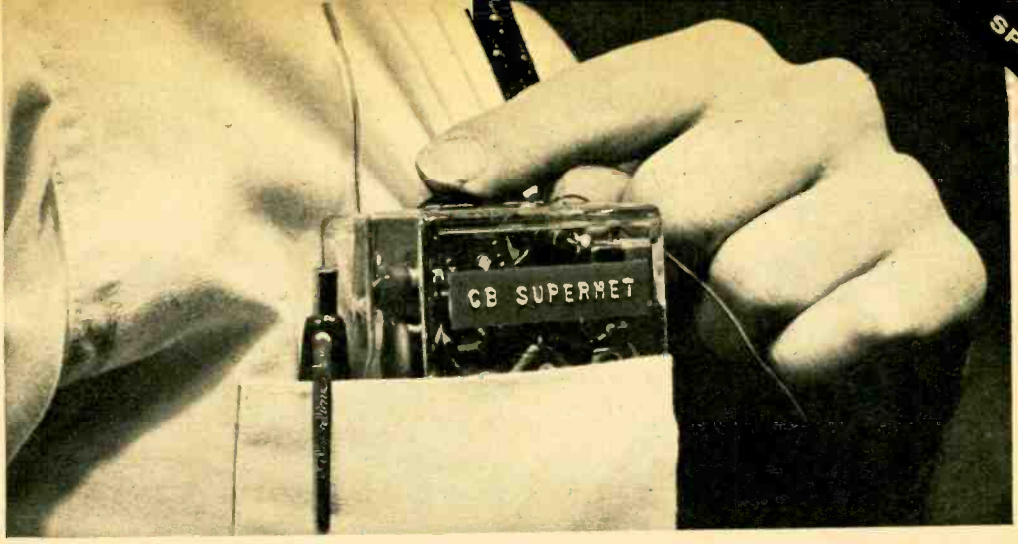
They found that the hissing "s" phoneme, for example, is composed mostly of high frequencies, whether spoken by a high-pitched voice or a low one. The "o" phoneme (as in home), on the other hand, is comprised chiefly of low frequencies.

The output of the filter bank is applied to what engineers call a "decision tree" (see illustration on page 33). At each point, the tree makes a decision and sends the output to one of two branches, depending on the amount of high- and low-frequency power it detects at that point.

While this system shows promise, it has limitations, too. Main one: speakers must pause between words—unnatural in regular speech—or the machine can't tell where one word stops and the other starts. Second, the machine was designed to recognize only the ten words: "zero," "one," "two" and so on, through "nine." A similar system could be designed to identify more words, but it would be far more complex and less accurate. [*Continued on page* 103]

Sperry Gyroscope's Sceptron can listen to, understand and react to human commands. Mask which programs machine is interchangeable, so device can be made to recognize most any word.

Phonetic typewriter developed by RCA's Dr. Harry F. Olson identifies words by breaking sounds into component frequency bands, then determining the duration of the sounds in each band. Though its vocabulary is limited to 100 syllables, this experimental machine is capable of typing words spoken into the microphone. System functions much like a human ear and brain in analyzing the sounds that it hears.



POCKET SUPERHET

By Vernon Simms

NEXT TIME your CB club gives a picnic *you* can be the real major-domo of the affair. How? First thing to do is give every member of the social activities committee an EI fixed-tuned CB pocket-superhet receiver.

Then perch yourself atop a ladder and transmit directions with your 5-watt rig about where to park the cars and how and where to distribute the beer and sandwiches. Since each receiver is tuned to the one channel you're on, everyone will know what to do and what's going on elsewhere. There won't be any lost motion or time.

A really hot, one-channel, crystal-controlled, five-transistor job, the pocket superhet is way up there in terms of size versus sensitivity. It costs about $15 and there's nothing like it available commercially. In addition to fun-type activities, such as described above, of course, the little rig has many possible serious applications because it's highly dependable and anyone within miles who carries one tuned to your channel will receive your messages or orders.

Construction. The heart of the receiver is a ready-made printed-circuit board that is available from Lafayette Radio. We've cut away a piece of the board and designed and laid out a circuit to fit on the remaining portion.

Since our layout must be followed carefully, we've set up a special assembly procedure by assigning numbers (see the Parts List) to all holes. The photo on page 3 of this article is of the etched-foil side of the board. All parts except R12 and C14 are installed on the *other* side of the board. You'll have to keep turning the board over but after you've installed a few parts, this won't be a problem. All components are installed by referring to the Parts List, which includes an extra column with each part's hole number.

Large components, such as antenna transformer

SPECIAL CB SECTION

It was only five short years ago that the FCC quietly created a service that was to prove one of the biggest boons in the history of radio. Its growth has been nothing short of phenomenal. For the Class-D Citizens Radio Service provides low-cost, speedy communications to citizens in every walk of life. Today, new equipment and new techniques promise to make the service more valuable than ever. To help make it so, EI herewith presents a Special Section devoted to CB Radio. We hope that you will find it interesting and useful.

POCKET SUPERHET

T1, oscillator transformer T2, and IF transformers T3, T4 and T5 must be installed first. Their positions are easy to determine. Though the hole numbers don't indicate which way the transformers are mounted, you'll see that they can be installed in only one way.

The transistors are next. Watch yourself here to be sure you get the leads in the right holes. Take a look at the Parts List for transistor Q3. The hole numbers are followed by the letters E, B, and C. This means that the emitter lead goes in hole 113, the collector lead goes in hole 110 and the base lead goes in hole 117. The leads for the electrolytic capacitors have been identified in the same way.

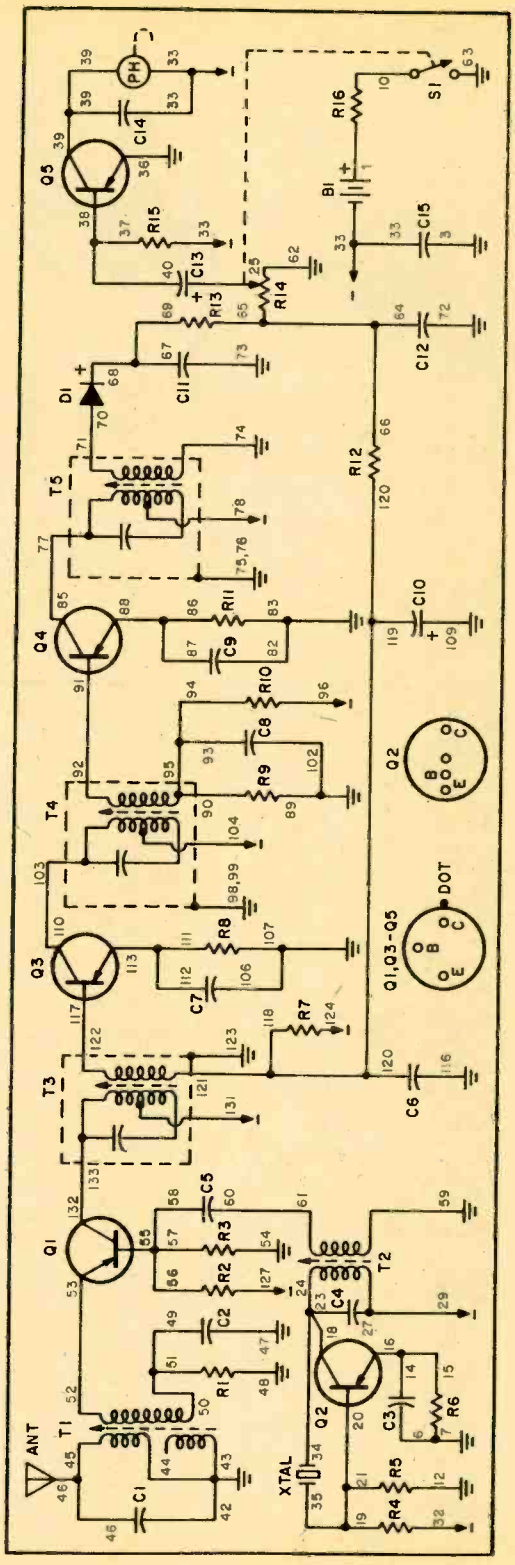
After installing the transformers and transistors, go back to R1 and work your way down the Parts List. In order to get the resistor leads in closely-spaced holes, bend one lead back against the resistor's body and mount the resistor upright on the board.

And it's a good idea not to solder any leads until you're sure all are in the right holes and there is enough space for nearby parts. At any point where there's a chance of the leads touching, cover them with spaghetti.

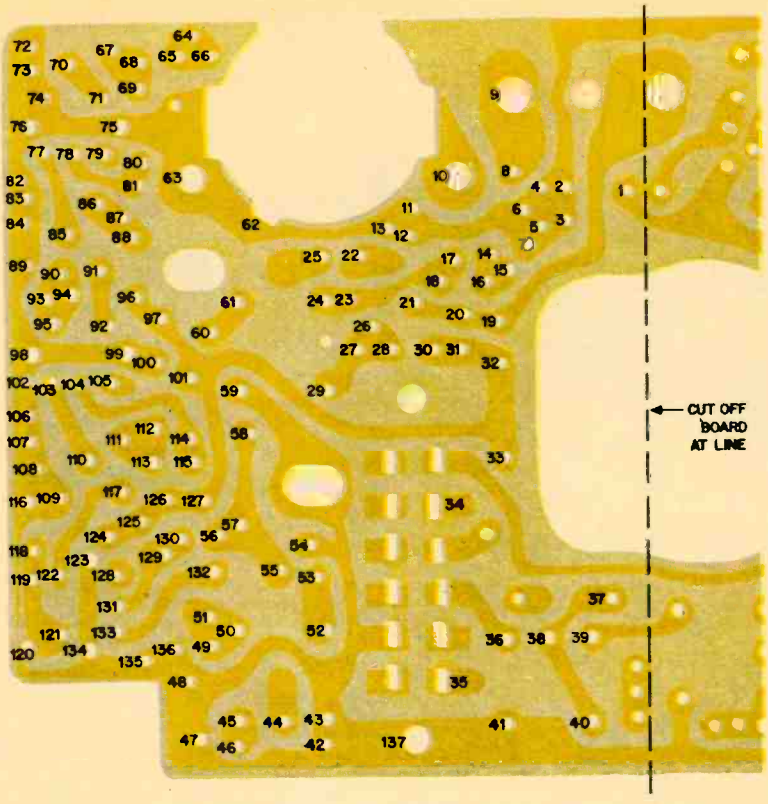
Our model was built with ½-watt resistors. Your receiver will be much easier to put together if you use 1/10-watt resistors. They cost a few cents more but will reduce crowding. And their smaller-diameter leads will slip through the holes easier.

The volume control is fastened in place by the mounting screws that are supplied with it. One lead of R16, a resistor which lies flat against the board, is soldered directly to the volume-control mounting screw head at hole 10.

When you solder the center lug on the volume control to hole 25, be sure it clears the strip of ground foil that runs along the edge of the cutout at the top



No corners were cut in superhet's design. You've got a full circuit that includes two IF's, a diode detector and a stage of audio. Numbers in gray correspond to circuit-board hole numbers.



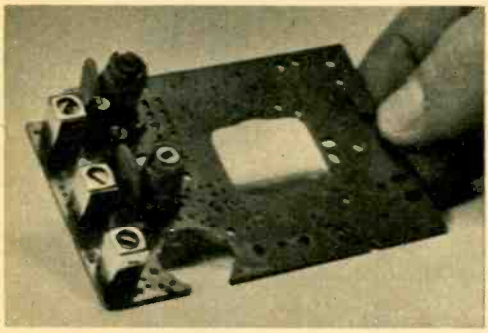
Left side of printed-circuit board is shown here approximately twice actual size, with foil side facing you. Orient the board by means of the notch in the lower left corner. Best way to cut off right side is with a fine-tooth hacksaw blade or a jeweler's saw. Before installing any parts, clean foil with steel wool. Because of limited space between foil strips, use a small-tip iron, apply heat sparingly and make sure there are no cold-solder joints or shorts.

PARTS LIST AND LOCATION CHART

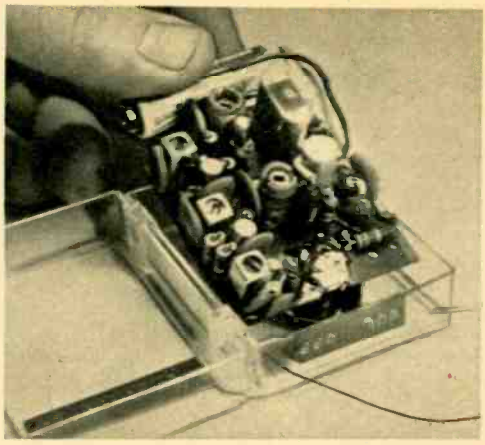
All resistors are 1/10 watt. All capacitors are 50-volt ceramic disc unless otherwise indicated. Lafayette part numbers appear where substitution cannot be made.

Part No.	Hole Nos.
R1—1,000 ohms	48,51
R2—68,000 ohms	56,127
R3—3,300 ohms	54,57
R4—150,000 ohms	19,32
R5—10,000 ohms	12,21
R6—1,000 ohms	7,15
R7—100,000 ohms	118,124
R8—1,000 ohms	111,107
R9—6,800 ohms	89,90
R10—56,000 ohms	94,96
R11—1,000 ohms	83,86
R12—6,800 ohms	66,120
R13—470 ohms	65,69
R14—5,000-ohm potentiometer (VC-62)	25 (center lug) 62 (left lug) 33,37 1,10 (vol. control screwhead)
R15—220,000 ohms	42,46
R16—330 ohms	47,49
C1—10 mmf	6,14
C2—.01 mf	23,27
C3—.01 mf	58,60
C4—20 mmf	116,120
C5—.005 mf	106,112
C6—.05 mf	93,102
C7—.05 mf	82,87
C8—.05 mf	
C9—.05 mf	
C10—10 mf, 6 V electrolytic	109 (+), 119 (—)
C11—.01 mf	67,73
C12—.01 mf	64,72
C13—4 mf, 6 V electrolytic	25 (+), 40 (—)
C14—.005 mf	33,39
Q1—A01 (Philco and Lafayette No.)	13(C),53(E),55(B)
Q2—2N1177	16(E),18(C),20(B)
Q3—2N1524	110(C),113(E),117(B)
Q4—2N1524	85(C),91(B),88(E)
Q5—2N406	36(E),38(B),39(C)
T1—Antenna transformer (HP-66)	43,44,45,50,52
T2—Oscillator transformer (HP-68)	24,29,59,61
T3—IF transformer (MS-776)	121,122,123,128,131,133,134
T4—IF transformer (MS-777)	92,95,98,99,103,104,105
T5—IF transformer (MS-778)	71,74,75,76,77,78,79
D1—1N60 diode	68 (band), 70
B1-9.8-V mercury battery (Mallory TR-177)	1 (+), 33 (—)
PH—3,000 ohm earphone (AR-50)	33,39
S1—On R14	10,63
XTAL—CB receive crystal (channel freq. minus 455 kc)	34,35 (enlarge holes)
Jumpers	129 to 125 114 to 101 80 to 97 65 to lug 1 (right), on R14 36 to 41 (foil side) 9 to 34 8 to 17 28 to 30 21 to 35 46
Ant.—24 inches enameled wire	
Misc.—Printed circuit board (HP-73), plastic case (MS-158)	

POCKET SUPERHET



Circuit board before being cut. IF's, oscillator and antenna transformers are mounted at the left.



Completed receiver and plastic case. There'll be less crowding if you use 1/10-watt resistors.

of the printed circuit board.

The wires from the battery's terminals should be soldered in holes 1(+) and 33(—). Watch the heat when soldering to the battery or you'll damage its cells.

The jumper leads are short lengths of insulated wire connected between the holes indicated in the Parts List.

Alignment. You can align the receiver by ear or with a VTVM. But either way you'll have to have a signal source, such as your CB transceiver or an accurately calibrated signal generator. Set the signal source to the channel (or frequency) the receiver is to monitor.

First step is to get the oscillator going. Feed a strong signal (*do not* connect the receiver's antenna to the transceiver or signal generator output) to the receiver and turn the slug of T2 until you hear the signal in the earphone. Turn the power switch on and off several times to make sure the signal comes through every time. If it doesn't, a readjustment of T2's slug should do the trick.

Next, reduce the strength of the signal by moving the transceiver away from the receiver. Adjust the slugs of T1, T3, T4 and T5 for loudest signal and re-peak them all. Then make another round of adjustments to T1, T3, T4 and T5 with an even weaker signal.

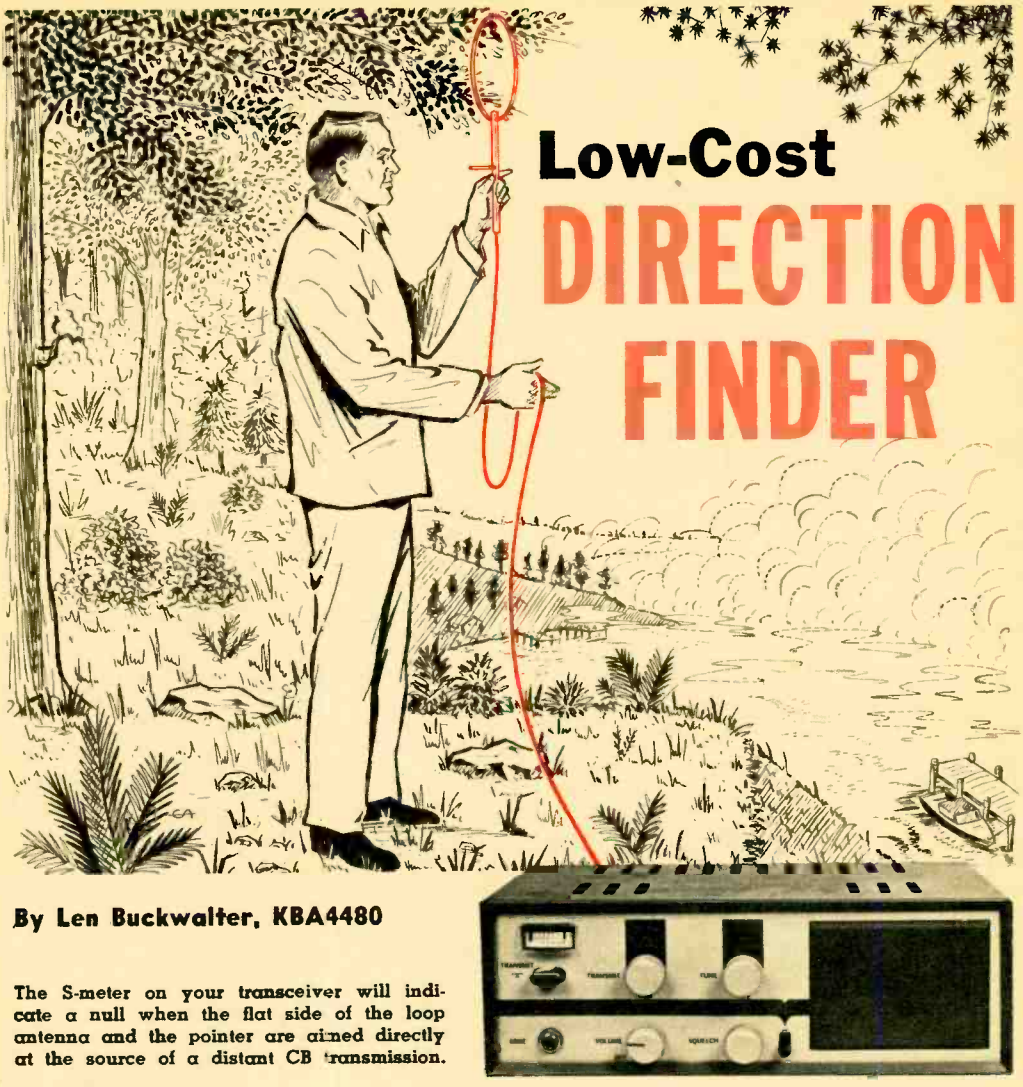
A VTVM will enable you to do a better job. Set the meter to its lowest DC range and connect the positive lead to the battery's positive terminal and the negative end to capacitor C10 (hole 119). Again, feed a signal to the receiver and touch up the slugs of T1, T3, T4 and T5 for *minimum* indication on the meter.

If the receiver oscillates (loud rushing or whistling sound) this can be remedied by increasing the value of resistor R16. The 330-ohm resistor we've used should result in stable operation. However, the value may have to be increased to 1,000 ohms to compensate for differences in transistor gain.

The plastic box specified in the Parts List will house the receiver and battery, though at first you may not think so. Slip the receiver into the box to determine the places that must be cut out for the volume control and its set screw. Start the holes with the soldering iron, then file them to shape.

Drill two small holes at the top of the receiver for the earphone and antenna leads. Don't make the mistake of soldering the phone lead to the board before installing the receiver in the box. Pull the phone lead through the cabinet before soldering it to the board. When the receiver is in place there will be just enough room for the battery of the size we've specified.

Low-Cost DIRECTION FINDER



By Len Buckwalter, KBA4480

The S-meter on your transceiver will indicate a null when the flat side of the loop antenna and the pointer are aimed directly at the source of a distant CB transmission.

A distressed mariner many miles from shore or in the middle of a pea soup fog blesses the CB rig on his boat when he calls for assistance. But a CB operator on land or another boat may not be able to offer much help since he can't always tell readily or exactly which direction the signal is coming from. For you to be of real assistance to water-borne CBers, a directional loop antenna is a must.

Designed for mobile use, our direction finder will zero in on a signal with pin-point accuracy. The Finder can also be used to locate a transmitter that's been causing disturbing TVI.

Construction. Start by building the one-transistor RF amplifier on a piece of 1⅛x5-inch perforated board, positioning the parts exactly as shown in the pictorial and photo. Before mounting trimmer capacitors C2 and C5, bend their connecting lugs upward and enlarge three adjacent holes in the perforated board for the mounting tabs and adjusting screw. C2 and C5 are held in place by bending their tabs flat underneath the board.

L2 and L3 are wound on 1-watt resistors rated at 1 megohm or higher.

CB SPECIAL

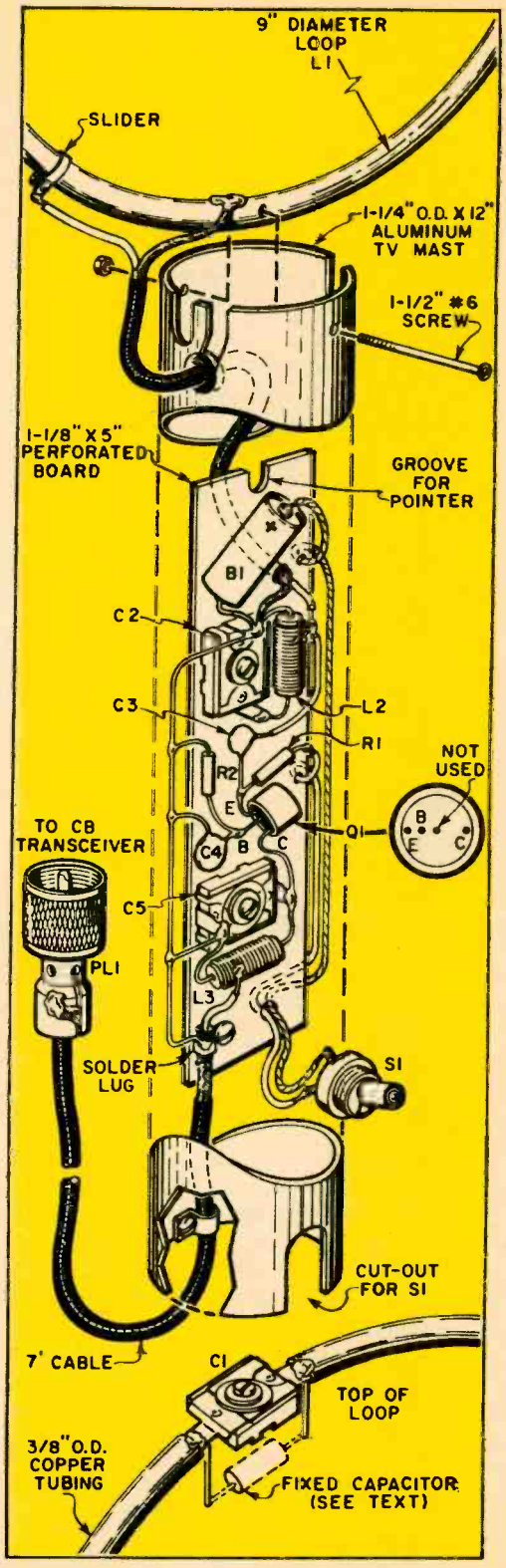
DIRECTION FINDER

Start with L2 by scraping clean the end of a length of No. 24 enameled wire and soldering it to the resistor lead. Wind five turns, bring out a half-inch loop and twist it. Wind 18 more turns, scrape the enamel from the end of the wire and solder it to the other resistor lead. The loop is the point to which C3 and the center lead of the coax from the loop (pickup coax) are to be soldered.

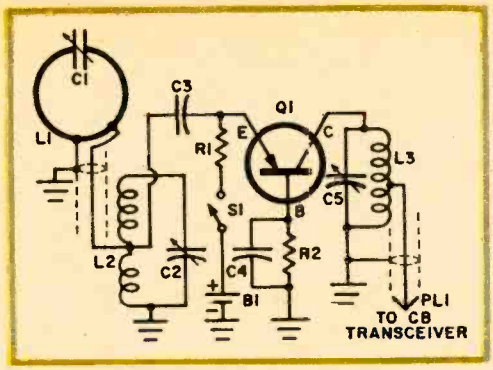
L3 has the same number of turns (23) as L2 but it has no loop. After L3 is installed, scrape the enamel from a spot on the fifth and sixth turns (from the ground end) and solder to this point the center lead of the coax that goes to the CB transceiver (feed coax). Q1's leads are soldered directly into the circuit, so take care not to apply too much heat to them. Cut short the lead between Q1's base (B) lead and collector (C) lead. Now install all other components.

The Finder's handle is a one-foot length of 1¼ OD aluminum TV antenna mast. Cut a notch for S1 at the bottom as shown in the pictorial and mount a cable clamp for the feed coax. Remove 3 inches of insulation from the feed coax so its shield will make good contact with the lug on the circuit board and handle cable clamp. For the loop, cut two slots ⅝-inch deep by ½-inch wide opposite each other in the top of the handle. For the pickup coax, cut a deeper slot.

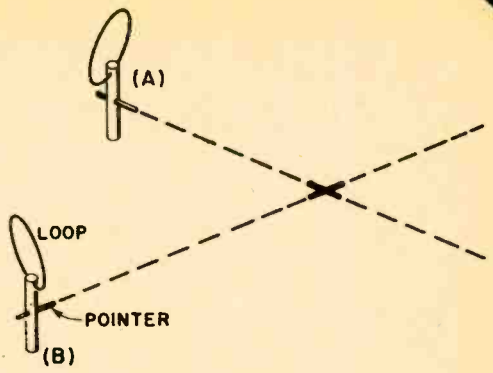
Make the 9-inch-diameter loop from a 30-inch length of ⅜-inch OD copper tubing (you can get this at a plumber's supply house). Remove a 1-inch section in the top, insert C1's mounting lugs in the open ends, crimp the ends of the tubing and apply solder. Position the loop in the notches in the top and drill a #6 hole through the handle and loop for a 1½-inch long #6 machine screw. Remove the loop and solder the shield of the 11-inch pickup coax to the bottom of it. Then, solder the center coax lead



Heavy wire at left of board is ground buss. Run it through top of C2, wrap it around battery and solder it to case. Shields of both pieces of coax also must be soldered to this ground buss.



When flat surface of L1 (tuned by C1) faces station, signal is equal at its sides and S-meter nulls. Q1 amplifies the signal when L1 is turned.



To find correct null, locate yourself on map at A, find null and draw line parallel to pointer. Drive to B and repeat. Signal's at intersection.

(3½ inches long) to a home-brew slider. Now connect the shield on other end of the pickup coax to ground (junction of C2 and L2) and the center lead to the tap on L2.

Insert the feed coax first, sliding the entire assembly into the handle (it does not matter if the pickup coax shield on the loop touches the handle) and then mount the loop. Insert the pointer and fasten the feed-coax *shield* to the bottom of the handle with a cable clamp.

Tune-Up. Connect the feed coax to a CB transceiver that has an S-meter. Having connected a dummy load (#47 pilot lamp) to the output of *another* CB transceiver (tuned to the same channel) to reduce its output power, set this transceiver to transmit. Move a distance away and adjust C1, C2 and C5 with a non-metallic alignment tool for a peak indication on the S-meter. Move the slider up and down on the loop to further peak the S-meter. There will be interaction between these adjustments so repeat them several times.

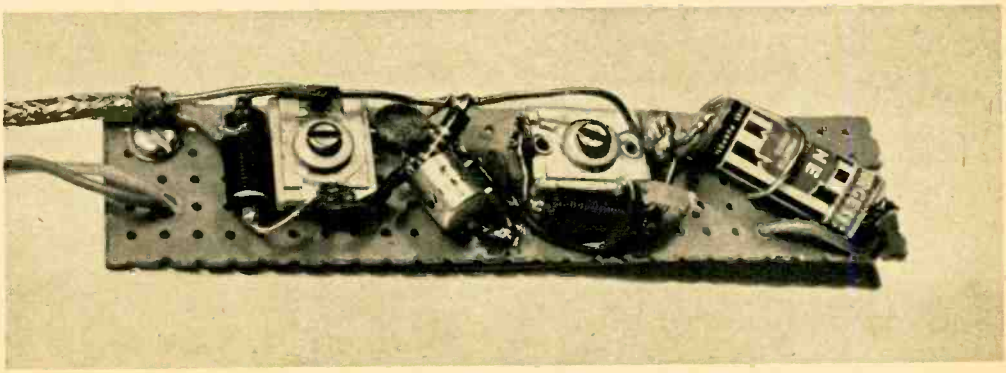
One or more adjustments may not produce peak indication. That is, tightening the screw on C1 all the way may make the meter needle rise but not fall. If this

[*Continued on page* 118]

PARTS LIST

R1—470-ohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
C1,C2,C5—3-30 mmf trimmer capacitor (Allied 13 L 511 or equiv.)
C3—100 mmf, 50 V or higher ceramic disc capacitor
C4—.01 mf, 50 V or higher ceramic disc capacitor
Q1—2N1178 transistor (RCA)
B1—1½-volt battery (Burgess NE or equiv.)
L1—9-inch diameter loop (see text)
L2,L3—23 turns No. 24 enameled wire (see text)
S1—SPST switch
PL1—Plug to match antenna jack on CB rig
Misc.—Perforated phenolic board, solder lugs, cable clamp, 8 feet RG58/U coax.

Leads (left) from switch go under board. One connects to R1 (near Q1), other connects to B1 (+).



CB SPECIAL

the OTHER citizens band

Class A is the FCC's official designation for that Citizens Band way

EVER ASK yourself what's happening on that *other* Citizens Band—the one way up around 460 mc? That one's the Class-A band, as you no doubt know. It's way off from what we usually think of as CB frequencies, though it does have a trifle in common with the Class-D band (the one we usually mean when we mention CB).

Well, there's a lot going on up at 460, especially in the big cities. But transmissions up there are so short and sweet you could monitor half a day and hear little. Class-A stations are on, then off, so quickly they make a three-minute phone call seem longer than a bicycle ride from San Francisco to New York.

The Facts. Nestled between VHF TV channel 13 and UHF channel 14, the Class-A band extends from 462.55 to 466.45 mc and is comprised of 48 channels. But hold on—though a 48-channel Citizens Band may sound like a bonanza for a CB channel-hopper, fact is that a Class-A station is assigned to only one of those channels. And it is there and only there that the Class-A CBer must conduct all communications.

It's not so much the number of channels but the equipment involved that places Class-A CBers in the elite category. Most Class-D operators feel their $60 to $250 investment in a transceiver is a major one. But Class-A CBers will do well to get off with a $600 rig. Matter of fact, they're likely to spend $1,200.

Class-A stations may run as much as 60 watts input with either amplitude or frequency modulation. And Class-A stations have more than a power bonus over Class-D stations. The Class-A installations aren't bound by the 20-ft. limitation on antenna height, either.

But Class-A CBers have little chance for homebrew equipment. Each and every piece of Class-A gear placed on the market must bear the hard-to-get "FCC Type Approval Seal." In order to obtain this seal, the manufacturer must send a prototype unit to the FCC labs in Washington. There it is subjected to any number of tests, including one for frequency tolerance.

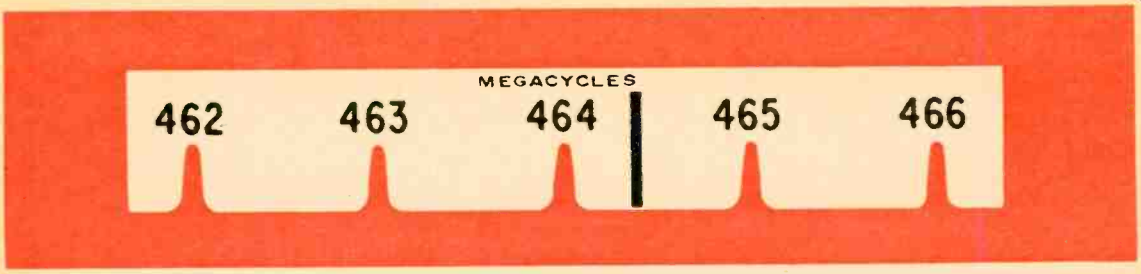
This latter test often proves the most difficult of all. Reason: Class-A base stations must maintain stability within 0.001% of their assigned frequency. Class-D stations, in contrast, can get by if they hold frequency variations within 0.005%.

Equipment manufactured to meet this standard and pass the FCC's other grueling tests must, of necessity, be designed and constructed under the most precise conditions. And it is partially because of these factors that the cost of the equipment is so high.

The Advantages. By now you probably are asking yourself, "Who needs it?" The answer is that many individuals and companies find that Class-A CB offers distinct advantages over Class-D.

If you're familiar with Class D, you'll appreciate the fact that Class-A operation virtually assures the user of his own "private" channel. One reason for this is that there are far fewer stations on 460 than there are on 27 mc. The other reason is that there are more than twice as many channels available.

When you apply for a Class-A license, you can request a specific frequency. And if you do some research and find out which channels still are mostly unused in your locality, chances are the FCC will approve your choice of fre-



up around 460 mc. Here is the story on who is up there and why.

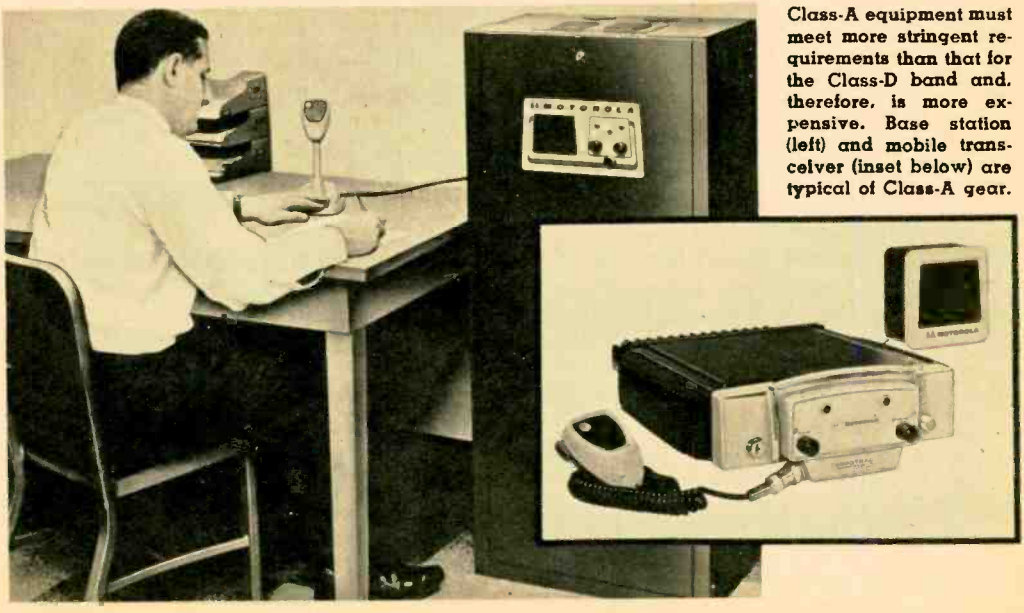
quency. This means there is little likelihood you ever will have to wait for someone to finish his five before you can transmit your message. There aren't any CB hobbyists on Class A, anyway.

The Differences. It's true that the FCC receives far fewer applications for Class-A than for Class-D stations. But a glance over the list of applicants reveals that they are surprisingly similar to Class-D users. We noted several exterminating companies, a few trucking outfits, a contracting company, eight individuals and a rubbish removal concern in a recent list. These stations receive call signs much like those for Class-D stations—the letter K followed by two letters and four numbers.

Call letters do give Class-A stations away, however, since all Class-A calls begin with KAA and KAB (Class-D stations, in contrast, receive a different prefix for each call area). In addition, Class-A stations keep their call signs at license renewal time.

To delineate a little more carefully between the Class-A and the Class-D CBer, you might describe a typical Class-A CBer as "a CBer with a need for more privacy than can be obtained on Class D, and with enough money to get what he needs."

After all, the Class-A CBer has what amounts to his own private communications system. And it has enough sock to make a Class-D station look like a 6146 turned 6C4. No wonder the *other* Citizens Band is called Class-A. Things being what they are, it deserves to be!
—*Edwin Frederick, 2W4580*



Class-A equipment must meet more stringent requirements than that for the Class-D band and, therefore, is more expensive. Base station (left) and mobile transceiver (inset below) are typical of Class-A gear.

CB SPECIAL

READY FOR RESCUE

By Alan B. Stewart

NOT LONG AGO, one of the boilers at a department store in Santa Cruz, Calif., exploded, creating what amounted to a disaster area. Among the first on the scene were members of the Volunteer Emergency Communications Squad of the Santa Clara County Citizens Radio League. They provided vital communications until adequate fire and police services could be established.

During a recent flood in Lubbock, Tex., members of the local CB club gave emergency first aid to flood victims. They then topped this off by organizing a clothing drive to aid the families left homeless.

Last summer, members of the Lycoming CB Radio Club in Montoursville, Pa., were called upon for three emergency blood donations. This was accomplished easily via the club's private blood bank.

As you can see, CB clubs are doing more than holding picnics and running jamborees—some of them, that is. But how about *your* club? Is your club ready to meet the needs of your community in a disaster or emergency? If not, now is the time to make ready for rescue. Regardless of the nature of the calamity, providing aid in times of emergency can be an interesting club project. But much more important is the fact that it will furnish a

worthwhile and necessary service to both your friends and neighbors.

You can make your club ready for rescue by placing one person in charge of a committee of three or four club members. This is the Emergency Corps, and the chairman is the Emergency Coordinator. The person picked for the coordinator's position should be a responsible and established member of the community who can represent the club during the necessary contacts with the police department, fire department and other governmental agencies.

The next step is to line up members who are willing to participate in the club's emergency program. (Don't expect each and every member to want to take the calculated risks involved with this type of work; they won't.) The participants should supply the Emergency Corps with home and business telephone numbers, details on the type of CB gear available to them, information on any special skills they possess (first-aid training and the like), details of their CB channel capabilities and, of course, their call signs. Obviously, it's wise to have licensed electricians, plumbers and mechanics on tap at all times.

Emergency Communications. Set aside one channel for emergencies, preferably one which is not in general use in your locality. Stress that club members should avoid utilizing this channel for everyday communications. However, try to see that all members can operate on the channel, even though they aren't involved directly in the emergency program. If possible, have base stations monitor this channel on a round-the-clock basis. Nobody can be expected to sit by a rig all day, though most members usually will accept the responsibility of monitoring for two- or three-hour shifts. Housewives or CB-equipped shops often can be counted on for daytime monitoring duties. And night-time work (at least the wee hours from 11 P.M. to 7 A.M.) sometimes can be divided among members who are night-owls or whose work keeps them on the night shift.

The best possible type of monitoring, of course, is a CB rig in the radio dispatching room of local police or fire department. This will assure you of a highly dependable 24-hour monitor, and such arrangements have been made by a surprisingly large number of CB clubs. One problem which

Police and fire departments often are willing to monitor a CB channel reserved for emergency communications, though their cooperation can't be expected unless the channel is kept free from idle chatter. Uniform and helmet give CBer at right a quasi-official appearance and help him stand out from crowd during rescue work.

CB SPECIAL

READY FOR RESCUE

Mobile first-aid kits needn't be obtrusive—the one pictured here has been tucked inconspicuously beneath the dashboard near the right car door. CB call sign posted in rear window of an Emergency Corps vehicle facilitates recognition by police and other authorities.

has come up in several instances is the incessant chatter on many CB channels. Such hubbub has irritated some police and fire departments after a few weeks and the service was discontinued. But therein lies one of the reasons why it is most important to keep non-emergency communications off the channel.

It must be remembered that no club can boast of membership consisting of 100% of the local CB population. Therefore, non-members will have to be asked *nicely* to avoid using the emergency channel, although they have every right to use the channel. Keep in mind that you can't *force* anyone off.

Being Prepared. One club, the Mobile Radio Association of Bridgeport, Conn., keeps ready for rescue by requiring each member to carry the following emergency gear in his vehicle: a first-aid kit, two flares, a flashlight, a blanket and a fire extinguisher. All members also have two red blinking lights on the rear of their cars.

It's interesting to note that the members of the Mobile Radio Association don't sit back and wait for emergencies to come to their attention. Instead, they are on constant patrol on the Connecticut Turnpike during blizzards. The group has distinguished itself in many instances, appearing on the scene of accidents and administering first aid long before regular emergency vehicles were notified and could reach the scene in the heavy snow.

Another club—the Lubbock, Tex., CB Club mentioned earlier—goes even further, furnishing distinctive white coveralls and helmets to members performing emergency duties.

Free Help. Training the Emergency Corps of your club can be done at little or no cost. The American Red Cross

[*Continued on page* 115]

A CB club can provide any number of services during and after a disaster. Here, a member sorts clothing for neighbors left homeless by a flood.

6-IN-1 CB SERVICE SET

Our complete tune-up laboratory fits into one small package!

WHAT MORE could you want for bench or field tune-ups than a complete lab in one neat package? Answer: nothing. And our 6-in-1 Service Set gives you a multi-function instrument that will permit you to do a full job on any Citizens Band transceiver. It's the most versatile, easy-to-operate piece of CB test equipment that you'll find anywhere. It's a snap to operate and will set you back only a few dollars. Take a look at what's in it and what it can do:

- Crystal-controlled IF oscillator (455 kc to 2 mc) for IF alignment.
- Crystal-controlled RF oscillator (CB channels 1 to 23) for front-end alignment.
- AF oscillator to modulate the IF and RF oscillators, and for checking the audio section of your transceiver.
- Third-overtone crystal checker.
- RF output meter for measuring the relative output power of your transmitter.
- VU meter for a visual indication of the receiver output level during alignment.

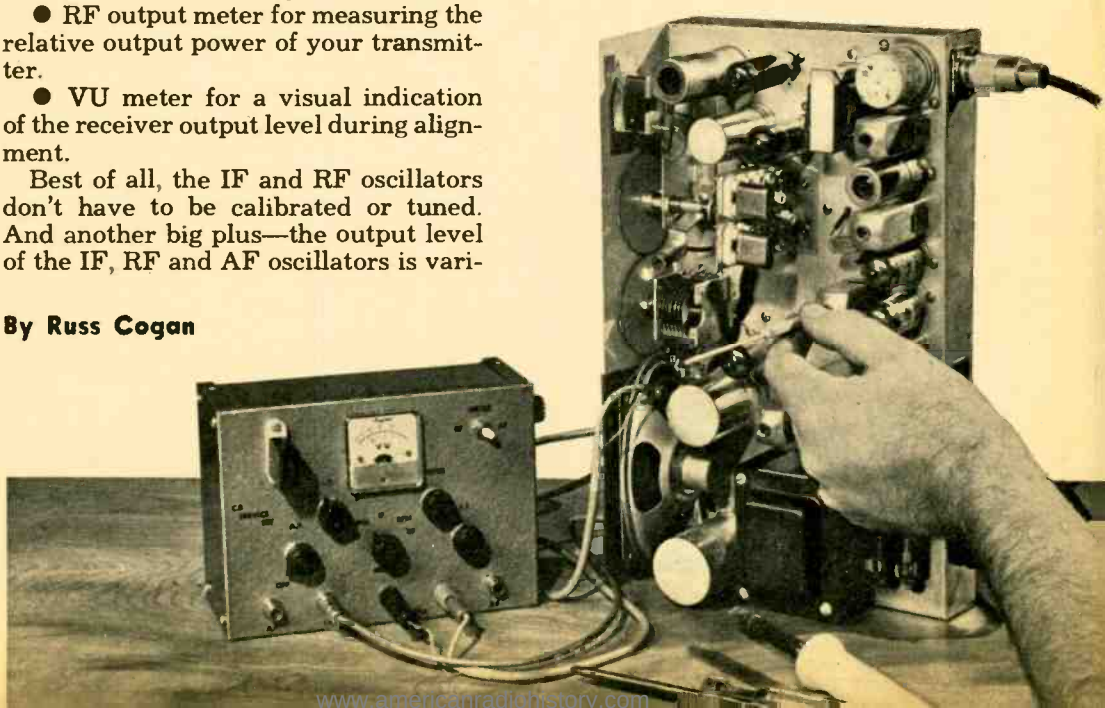
Best of all, the IF and RF oscillators don't have to be calibrated or tuned. And another big plus—the output level of the IF, RF and AF oscillators is variable. There are no shared components in the Service Set so you can eliminate any circuit you don't need.

Construction. A 3x5x7-inch Minibox will accommodate all parts without crowding. The IF, RF and AF oscillators are built as subassemblies on perforated phenolic boards; flea clips are used as tie points. Component values *are* critical and you should not make substitutions.

The Miller coil specified for L1 may not be available at all parts distributors. The printed-circuit equivalent (Miller 979) may be used instead, but it will have to be cemented in place. A Miller 954 would be a better choice. If you can't get Miller coils, use a Meissner No. 19-4551.

The IF and AF oscillators are built on

By Russ Cogan



CB SPECIAL

CB SERVICE SET

a 2½x4½-inch piece of perforated board, a close-up photo of which is on the last page of this story.

Cut Q2's and Q3's leads short and hold each with a pair of pliers to prevent heat damage when soldering.

Cover the right inside of the cabinet with electrical tape to prevent the flea clips protruding from the rear of the board from being shorted. A quarter-inch spacer or stack of washers will keep the board a safe distance from the cabinet. Center the board top and bottom so the Minibox cover will fit in place.

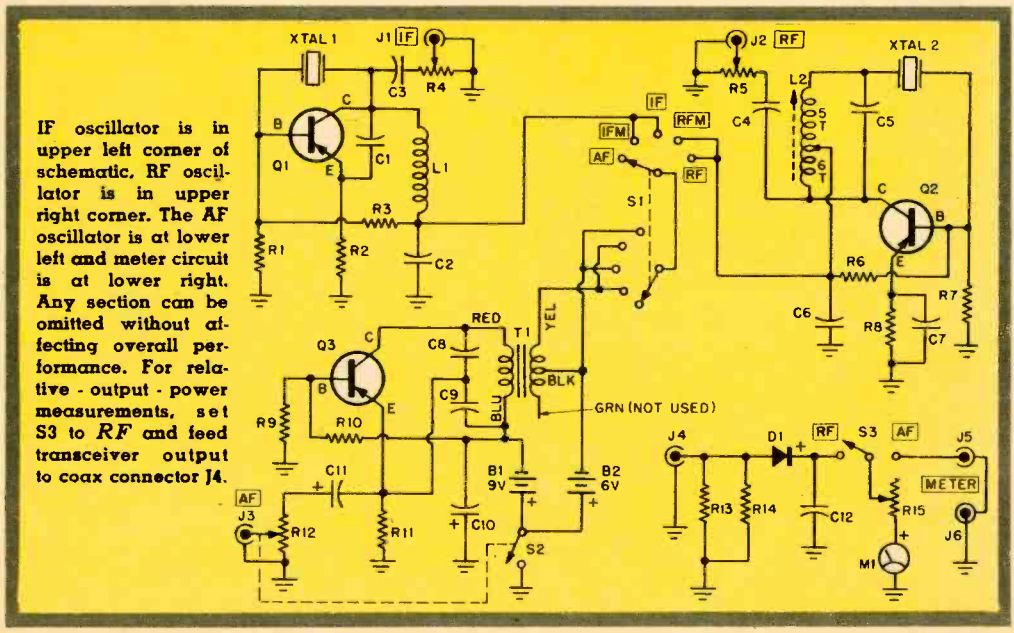
The IF-AF oscillator ground buss is connected to the cabinet through the board's mounting screws. To be sure of a good ground connection, scrape paint from the outside of the cabinet around the screw holes and use star washers under the screw heads.

The RF oscillator is built on a 1⅝x2¾-inch piece of perforated board. A photo of the board is on the last page of this story.

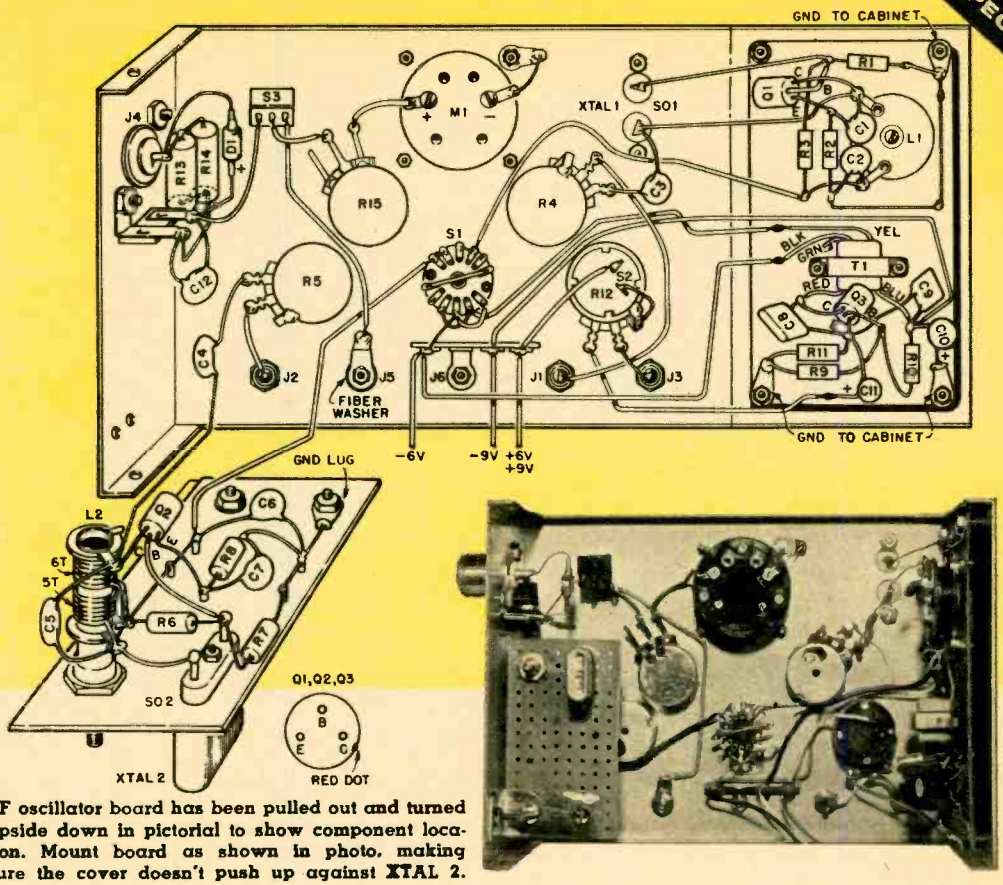
L2 is a home-brew coil and must be wound carefully. Scrape clean the end

PARTS LIST

Resistors: ½ watt, 10% unless otherwise indicated
R1—150,000 ohms R2—1,000 ohms
R3—2.2 megohms
R4,R12—50,000-ohm, linear-taper potentiometer
R5—25,000-ohm, linear-taper potentiometer
R6—270,000 ohms R7—33,000 ohms
R8—680 ohms R9—10,000 ohms
R10—15,000 ohms R11—4,700 ohms
R13,R14—100 ohms, 2 watts
R15—100,000-ohm, log-taper potentiometer
Capacitors: 500 V ceramic disc unless otherwise indicated
C1,C6—100 mmf C2,C12—.001 mf
C3—50 mmf
C4—5 mmf, silver mica
C5—20 mmf, silver mica C7—.01 mf
C8—.25 mf, 75 V
C9—.1 mf, 75 V
C10—30 mf, 15 V electrolytic
C11—4 mf, 15 V electrolytic
B1—9-volt transistor-radio battery
B2—6-volt battery (Burgess Z4 or equiv.)
L1—5 millihenry RF choke (Miller 650 or Meissner 19-4551. See text)
L2—RF oscillator coil. Wound on Cambridge Thermionic Corp. form No. 1534-2-2 (old No. PLS5-2C4L/B) Available from Newark Electronics Corp., 223 West Madison Street, Chicago, Ill. 60606. Stock No. 40F3370.
T1—Transistor driver transformer (Lafayette AR-109)
M1—VU meter (Lafayette TM-10)
D1—1N34A diode
Q1,Q2—2N274 transistor (RCA)
Q3—2N217 transistor (RCA)
J1,J2,J3—Phono jack J4—SO-239 coax connector
J5,J6—Insulated binding posts
S1—Two-pole, five-position rotary switch (Lafayette SW-78)
S2—SPST switch on R12 S3—SPDT toggle switch
XTAL-1—IF crystal. Available from Texas Crystals, 1000 Crystal Drive, Fort Myers, Florida. Prices are postpaid. 455 kc stock No. TX455; $1.30. 1,001 kc to 1,600 kc, $4.55; 1,601 to 2,000 kc, $2.80. Except for 455 kc, specify frequency. Order FT-243 holder.
XTAL-2—Third overtone CB transmit crystal
Misc. — Crystal sockets (SO1,SO2), perforated board, flea clips, RG58/U coaxial cable



IF oscillator is in upper left corner of schematic. RF oscillator is in upper right corner. The AF oscillator is at lower left and meter circuit is at lower right. Any section can be omitted without affecting overall performance. For relative - output - power measurements, set S3 to *RF* and feed transceiver output to coax connector J4.



RF oscillator board has been pulled out and turned upside down in pictorial to show component location. Mount board as shown in photo, making sure the cover doesn't push up against XTAL 2.

of a short length of No. 22 enameled wire and solder it to a lug on the coil form nearest the mounting nut. Starting ⅛-inch from the collar, close-wind five turns. Then, bring the wire out about two-inches from the form, fold it back to form a loop and wind six more turns in the *same direction* as the first five. Scrape the enamel insulation from the end of the wire and solder it to the bottom lug that is in line with the top lug. There should be about $\frac{3}{16}$-inch space between the end of the six-turn winding and the form's bottom collar.

Scrape the enamel from the loop to within ¼-inch of the form, twist and solder the leads together, and connect them to the other lug near the mounting nut.

Turn the slug-adjustment screw so the slug is a quarter of an inch in from the bottom of the coil form. The RF oscillator is now tuned and can be mounted to the cabinet with an L-shaped bracket.

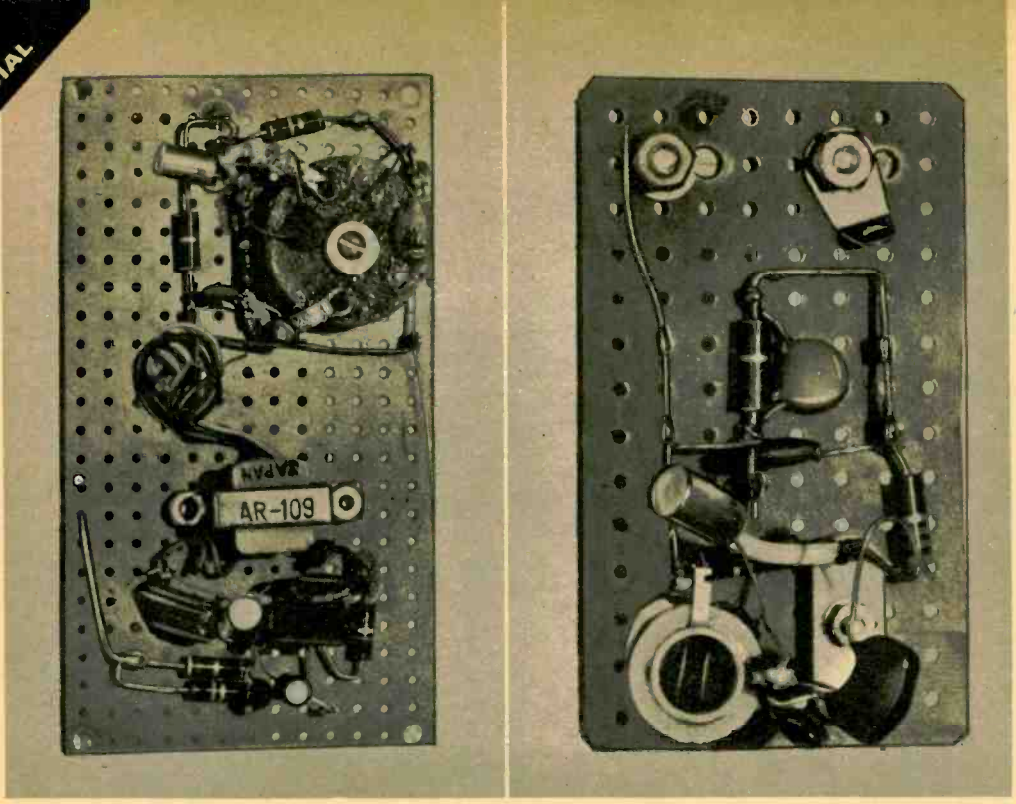
Put a crystal in SO2 to be certain that when the board is mounted, the cabinet cover fits in place.

Route the oscillator leads to the front-panel controls exactly as shown in the pictorial. Mount the batteries in the back of the cabinet and connect the leads to the terminal strip under S1. The IF and RF test leads should be about 3 feet long and must be made with RG58/U coaxial cable. The AF cable can be common shielded phono wire.

Using the Service Set. The RF crystal (XTAL 2), which goes in SO2 on the RF oscillator board, must be a third-overtone transmit type. It can be for any CB frequency, but we recommend a center channel such as 10 or 11.

The socket (SO1) for the IF crystal is on the front panel to make it easy to change crystals when working on transceivers with different IF's. Order a crystal with a frequency the same as your rig's IF and specify a FT-243 holder.

S2, which is on the AF output-level



IF oscillator is at top of left board; AF oscillator is below it. Board shown at the right is RF oscillator.

CB SERVICE SET

control (R12) supplies power to all oscillators. Mode switch S1, activates only the circuits for which it is set. Going clockwise these are S1's positions: AF (audio oscillator), IFM (modulated IF), IF (unmodulated IF), RFM (modulated RF), RF (unmodulated RF). S1 *always* should be set to AF when testing only audio circuits.

And do not connect the Service Set's test leads to the plate of a tube or any other point in a transceiver where DC is present. If you must connect to such a point, put a .05 mf, 500 V capacitor in series with the hot test lead.

The Service Set cannot check a crystal's quality but it can determine if it's the cause of intermittent transmitter operation. Plug the suspect crystal in SO2. If it has any life at all, you'll be able to pick up a signal on your receiver as our oscillator is guaranteed to start with a good crystal. If *our* oscillator works, better check your transmitter's oscillator for if it isn't tuned properly a crystal may not start.

Transmitter Tune-Up. Connect your transceiver to J4 (R13 and R14 provide a 50-ohm load), set S3 to RF and tune the final for maximum deflection on M1. Adjust R15 for a convenient dial indication. To calibrate M1 in watts, use your CB club's wattmeter for a reference.

Receiver Alignment. Dual-conversion rigs should only be touched by the advanced CBer. Transceivers with crystal filters, frequency synthesizers and sideband circuitry should be returned to the manufacturer. However, a routine alignment job is handled this way: Connect the IF output (J1) to the grid of the converter tube, set S1 to IFM and connect J5 and J6 to the speaker terminals. Set the transceiver's volume control and R15 full clockwise. Adjust R4 to feed in just enough signal for a readable indication on M1. Following the alignment instructions supplied by the manufacturer of the rig, adjust the IF transformer slugs for a peak indication on M1. As M1's needle goes upscale, reduce the IF-

[*Continued on page* 112]

Want new kicks from CB? Try code on the License Free Band. It's practice for a ham ticket and the transmission range beats a pair of walkie-talkies.

By Russ Cogan

Want to be a 'JUNIOR HAM'?

EVERY year thousands of Citizens Banders begin to feel cramped by the restrictions placed on them. They get the urge to experiment with their equipment, would like to chew the rag on the air, and may even want to try code. Obviously, CB isn't for them any more.

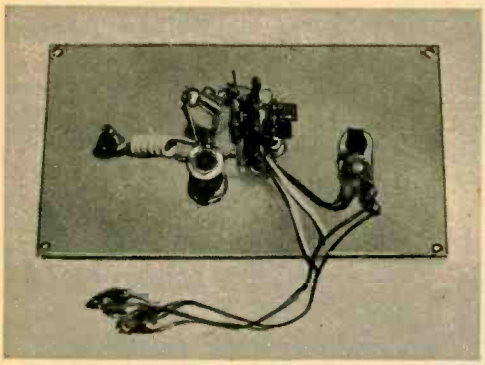
Ham radio is the answer—but for some, getting a ticket may seem to be too big a step. The easiest way to bridge the gap is with transitional equipment —and EI's Junior Ham Station is just that.

The two-transistor station consists of a 100-milliwatt CW (code) transmitter and a beat-frequency oscillator (BFO). You strap the BFO on any walkie-talkie (you don't have to modify the walkie-talkie in any way) with a 455 kc IF, enabling it to receive code. The advantage of learning code for your ham ticket this way is that you get a chance to practice on the air through hash and noise.

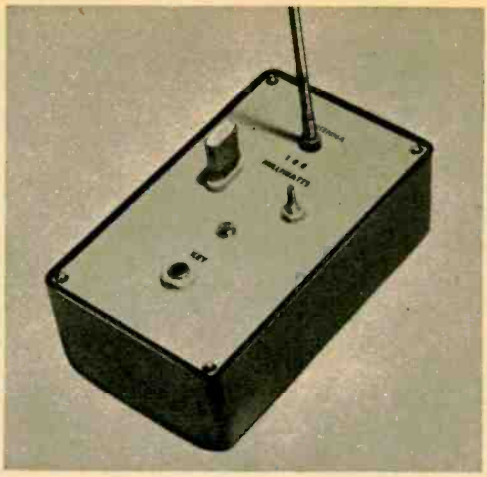
And the Junior Ham Station is perfect for new kicks (code) if you're tired of the same old CB routine but don't want a ham license.

CB SPECIAL

JUNIOR HAM



Transmitter takes little space on back of cabinet panel. Coil L2 is at left. J2 is at right.



Transmitter is a neat package. Be sure antenna is extended fully before starting the tune-up.

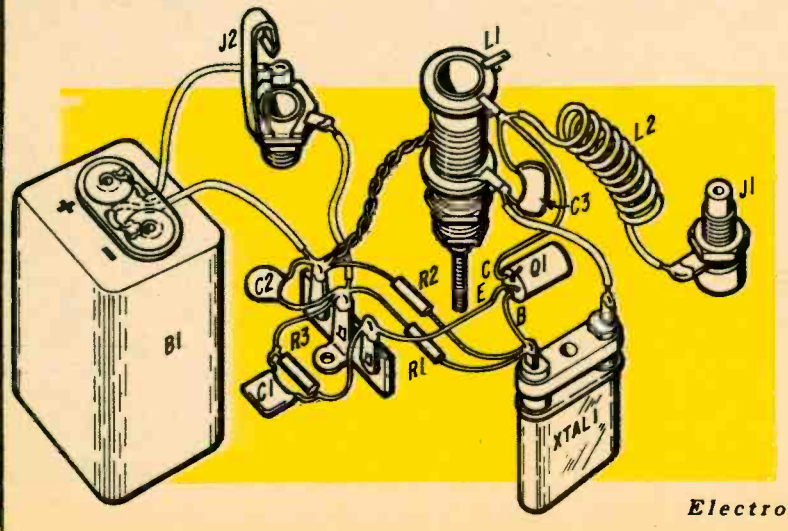
CW has a much greater range than voice, too. At the distance where 100-milliwatt walkie-talkie voice communication becomes unintelligible, a CW signal will come through loud and clear.

The Junior Ham Station operates on the License Free Band (see THE LICENSE-FREE BAND, May, '62 EI), so you don't need a CB license to get on the air. Just paste the Certificate of Compliance on the last page of this story on the back of the transmitter and you're in business.

One thing, though. You'll need a call. It isn't a legal requirement but it's a quicker way to identify yourself than by using your name. Make up any number—it could even be your age or house number. But use a *number only*, no letters.

Construction. The transmitter can be built on the top panel of a 6¼x3¾x2-inch Bakelite box. The parts layout isn't critical but try to follow the pictorial as closely as possible. The parts specified must be used to comply with the conditions of the Certificate of Compliance.

Begin with coil L1, which is wound on a Cambridge Thermionic Corp. form (see Parts List). Scrape the enamel in-



Before you mount L1, connect C3 across it and solder the lead which goes to crystal socket to lug near L1's mounting nut. L2 is ten turns of #22 insulated solid hookup wire close-wound on a ¼-inch-diameter alignment tool or a pencil. Note in schematic (right) that oscillator is turned on by the key (J2) when it closes, grounding battery's positive terminal.

sulation from the end of a piece of #22 enameled wire and solder it to one of the lugs near the mounting nut. Starting about an eighth of an inch from the form's collar, wind six closewound turns. Bring the wire out about three inches from the form, fold it back to form a loop, and wind six more turns in the *same direction*. Connect the end of this second winding to the lug at the bottom of the coil in line with the top lug you used.

Scrape the insulation from the loop back to a quarter inch from the form, twist the loop and apply solder. Further information about L1 and L2 is in the pictorial's caption.

The jack supplied with the antenna should not be used as it is not sturdy enough for even routine use. Instead, substitute a banana jack (J1) for it. Fill the hole in the back of a banana plug with solder and, while it is still hot, force the antenna into it as far as it will go.

The BFO is built on a 2¼x3⅛-inch piece of perforated phenolic board. Flea clips are used for tie points. Parts values and layout are critical so don't make changes.

When you've finished wiring the BFO (connect C4 to L3 with #18 wire), glue grommets to the underside of the board at each corner. Temporarily fit the board in a *plastic box* to determine exactly where to drill a hole opposite C4's adjustment screw. After drilling the hole, put a little glue on the back of the grommets and mount the board in place. Use electrical tape to hold the battery in position.

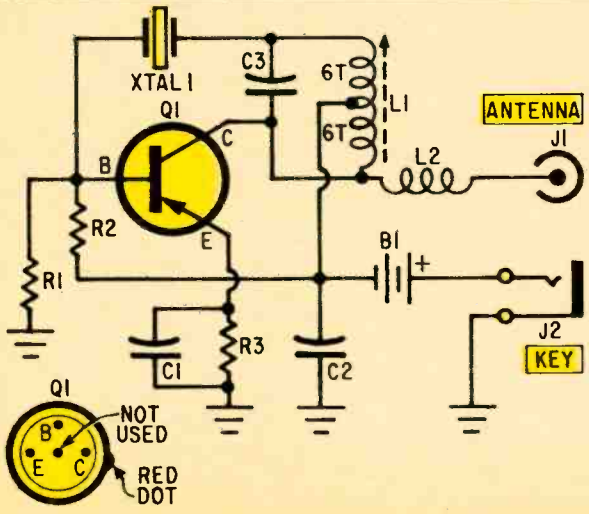
Transmitter Tune-Up. Install a third-overtone CB transmit crystal (same channel as the walkie-talkie's channel) and plug in the fully-extended antenna, making sure its tip isn't near metal. Turn L1's slug-adjustment screw full clockwise and plug a 15-ma DC milliammeter in J2. If the meter deflects to the left, reverse its leads.

Using a plastic alignment tool, turn L1's slug-adjusting screw counterclockwise. The current will rise to about 3 ma. Continue to turn the screw until the meter jumps to about 9 ma. Then give it another slight turn until the current rises to 11 ma.

Warning! Don't let the current go higher than 11 ma or the input power will exceed the 100 milliwatt legal limit. And Q1 will be damaged, too.

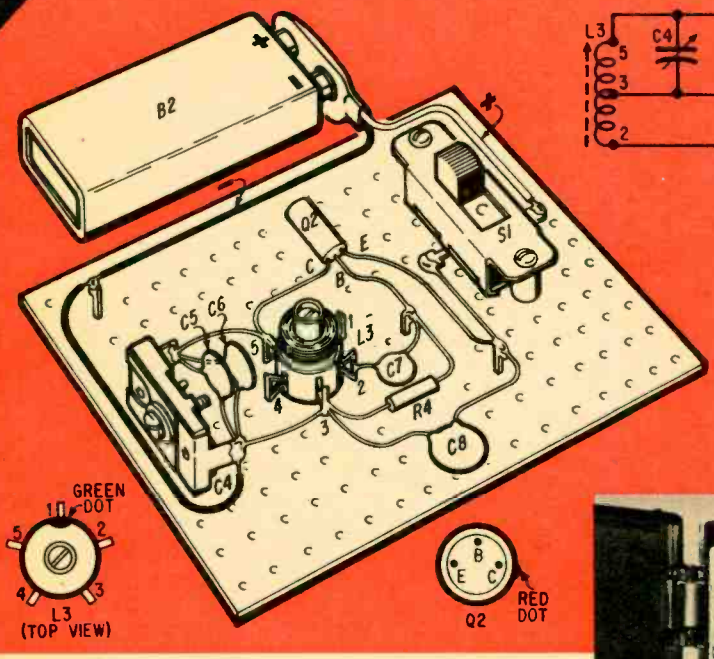
Remember, L1's adjustment always must be started with the adjusting screw turned full clockwise. If tune-up is started with it set elsewhere, the current will be the same but the crystal may start intermittently when you key the transmitter. Remove the meter, plug in a key and you're ready to send.

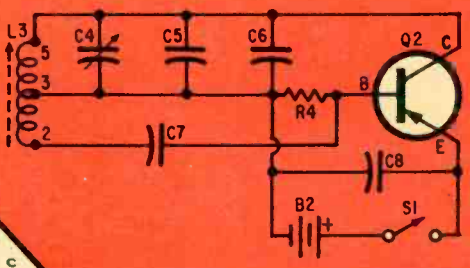
For best results use only quality crystals. The transmitter may fail to operate with off-brand crystals. We recommend crystals made by the James Knight Co., and those sold by Allied and Lafayette Radio for their own transceivers.



PARTS LIST

Resistors: ½ watt, 10%
R1—27,000 ohms R2—220,000 ohms
R3—47 ohms R4—47,000 ohms
Capacitors: 15 V or higher, ceramic disc unless otherwise indicated
C1—.01 mf C2,C7,C8—.001 mf
C3—15 mmf silver mica
C4—9-180 mmf trimmer capacitor (Lafayette C-733)
C5—470mmf C6—47 mmf
L1—Transmitter oscillator coil wound on Cambridge Thermionic Corp. form No. 1534-2-2 (old No. PLS5-2C4L/B) Available from Newark Electronics Corp., 223 West Madison St., Chicago 6, Ill. Stock No. 40F3370
L2—Antenna loading coil (see text)
L3—Transistor oscillator coil (Lafayette MS-957)
Q1—2N274 transistor Q2—2N412 transistor
B1—9-volt battery (Eveready 246 or equiv.)
B2—9-volt battery (Eveready 206 or equiv.)
S1—SPST slide switch
J1—Banana jack J2—Phone jack
XTAL.I—Third-overtone CB transmit crystal (see text)
Misc.—Telescoping antenna (Lafayette F-343), plastic box (Lafayette MS-216), perforated phenolic board, flea clips





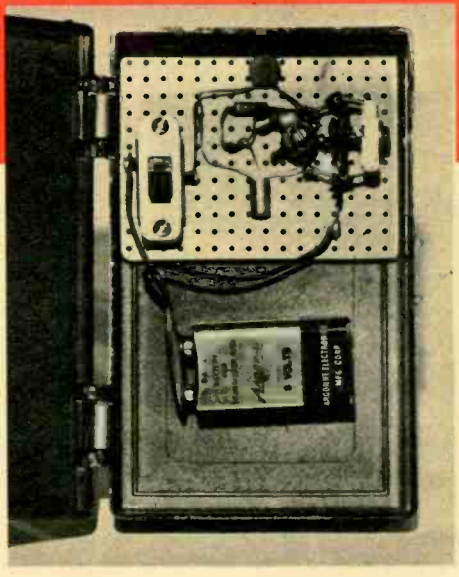
BFO schematic is above. Glue L3 to board with strong cement so it won't pull loose when connections are made to it. Mount S1 above board with ¼-inch spacers or stack of washers. Do not mount the BFO in a metal cabinet. If you do, signal won't get out.

JUNIOR HAM

BFO Tune-Up. Using a plastic alignment tool, tighten C4's screw, then back off a half-turn. Attach the BFO to the walkie-talkie with a rubber band, near the speaker opening. Fasten down the transmitter key and adjust L3's slug until you hear a tone (beat note). Next, move the BFO around the walkie-talkie until the tone is loudest. This should be the BFO's normal operating position. Adjust C4 to change the frequency of the beat note.

Remember, when you operate on the License Free Band you can contact only other 100-mw stations. You *cannot* use the Junior Ham Station to work Class D (licensed) stations.

In a suburban area, the range of our station was about three or four blocks. And that was when the transmitter and antenna were in the basement.



Before permanently mounting BFO board, drill hole in cabinet opposite C4 (upper right).

CERTIFICATE OF COMPLIANCE WITH FEDERAL COMMUNICATIONS COMMISSION REGULATIONS, PART 15, PARAGRAPH 205

ELECTRONICS ILLUSTRATED certifies that this low-power transmitting device can be expected to comply with the requirements of Paragraph 15.205 of the FCC Regulations under the following conditions:

(a) When this device is assembled with components of the specified values and according to the diagrams and instructions published in this magazine.

(b) When used for the purpose and in the manner indicated in the instructions.

(c) When operated on a frequency between 26.97 and 27.27 megacycles and using an antenna limited to a single element not more than 5 feet long.

Robert H. Beason

ELECTRONICS ILLUSTRATED, New York, N. Y.

dated: November 11, 1963

I hereby certify that I have assembled and adjusted this device in strict accordance with the above.

Owner's signature .....

Date .....

Cut out this certificate, sign it and paste it on back of transmitter before you go on the air.

CB SERVICE INSTRUMENTS

A Survey

ANY Citizens Bander who glances through an electronics catalogue may become confused when he hits the pages listing service or test instruments. On one page he may find a $5 meter which, it is claimed, is *the* required gear for optimum CB communications. On the next may be a $50 test set that, the CBer is told, he can't do without.

Exactly which instruments you really need is not so much a question of money as personal requirements, which you can determine only by knowing what each rig can do for you.

Simplest of all test gear is the field-strength meter, running from about $5 to $25. All FSM's available to CBers are indicators of *relative* signal strength. They do not give you actual power output. Chief value of the FSM is its ability to indicate whether changes you make in your antenna system result in changes in your radiated signal. In addition, some FSM's provide a monitor jack which enables you to ride herd on your signals with a pair of headphones.

FSM's usually are priced according to the size of the meter face. If you want to make readings from a distance, get a rig with a large face. Even the cheapest FSM is adequately sensitive for CB work. However, if you go in for gnat's-eyelash tuning, buy a super-sensitive, transistor-amplified FSM.

The standing-wave-ratio meter (SWR), which actually is a *voltage* standing-wave-ratio meter (VSWR), is the best indoor tune-up meter available and it also tells you how much of your transmitter's power is getting to your antenna. Both the low-cost rigs and the most expensive give you the same information. Since these meters range in price from about $10 to $50, you might wonder what the difference is. It's mainly a fancier cabinet, a built-in power-output meter, a larger meter or the ability to give remote readings.

From these fairly simple instruments, CB test equipment moves into *test sets*, fancy rigs that, the makers say, will help you locate breakdown points or peak-tune your transmitter. Chief feature offered by them is a modulation meter, which can be extremely useful. If you experiment with speech clippers, compressors or boosters, you likely will have more microphone preamplification than you need and you might easily overmodulate unless you have some means of checking the per cent modulation. In addition, some CB transceivers have more modulation than is necessary, and if you normally speak in a loud voice you might overmodulate. A modulation meter insures that your modulation always will be at optimum level, regardless of the gear at hand.

There are differences among the test-set modulation meters, however. Some indicate 100% "when the meter rises 22%." These are tricky to use and of questionable value because, at that rate,

Field-Strength Meter

Lafayette Radio

CRYSTalignMETER

SECO Electronics

Signal Optimizer

GC Electronics

you'd be overmodulating at 23%, and it would take a mighty sharp cookie to even guess the difference. The best bet is a *calibrated* meter, not a relative-value indicator. Test sets are likely to have a slew of other features, including a crystal checker, FSM, SWR bridge, oscillator and so on. Each manufacturer has his own idea of what you need.

Among the earlier test sets was SECO's Model 510 CB Transmitter Tester and Model 500 CRYSTalignMETER. The 510 is aptly named. It measures RF power output into a built-in dummy load and checks positive and negative modulation, giving percentage readings. The 510 is unusual in that it can check walkie-talkie transmitters, though it indicates *relative* power output. More importantly, it indicates a walkie-talkie's percentage of modulation. The set has an output for headphone or oscilloscope monitoring.

The CRYSTalignMETER is essentially a crystal checker designed to handle any CB crystal, whether overtone or fundamental. While it has a calibrated Good-Bad scale, we recommend using reference crystals, as outlined in the CB CRYSTAL CHECKER elsewhere in this issue. The device also can be used as an unmodulated or modulated RF signal generator and as a low-sensitivity FSM.

The Signal Optimizer by GC Electronics has the usual power output meter and also a VSWR meter. Its modulation meter is of the relative type and includes a headphone jack. The crystal checker is for the overtone type and can be used to produce a crystal-controlled, unmodulated RF signal. The Optimizer features a highly-sensitive, transistorized FSM, complete with collapsible antenna.

ECI's Port-A-Lab equips you to measure power output, positive and negative modulation percentages and VSWR. A headphone output is provided, along with an FSM of medium sensitivity.

Allied Radio's Knight-Kit Model Ten-2 C.B. Checker is one of the more elaborate test sets. In addition to a power-output meter, it contains a true SWR bridge capable of giving precise readings. It indicates percentage of modulation and includes an audio oscillator for modulation tests and troubleshooting. The Ten-2's crystal checker tests impedance, rather than output, which is the better way. The crystal test circuit can be used as a modulated or unmodulated RF signal generator. An output cable on the RF generator permits you to pump a blasting signal into the receiver if you happen to feel the need. A sensitive, transistorized FSM is included, along with a code-practice oscillator, the latter being as useful to a serious CBer as leftover cat whiskers. Knight-Kit, in adding features, forgot where to stop.

There is little apparent relationship between a test set's functions and its price. Since a power meter is a power meter and one VSWR is like any other when it comes to CB, we recommend that you get a rig with the functions you need at the lowest price possible.

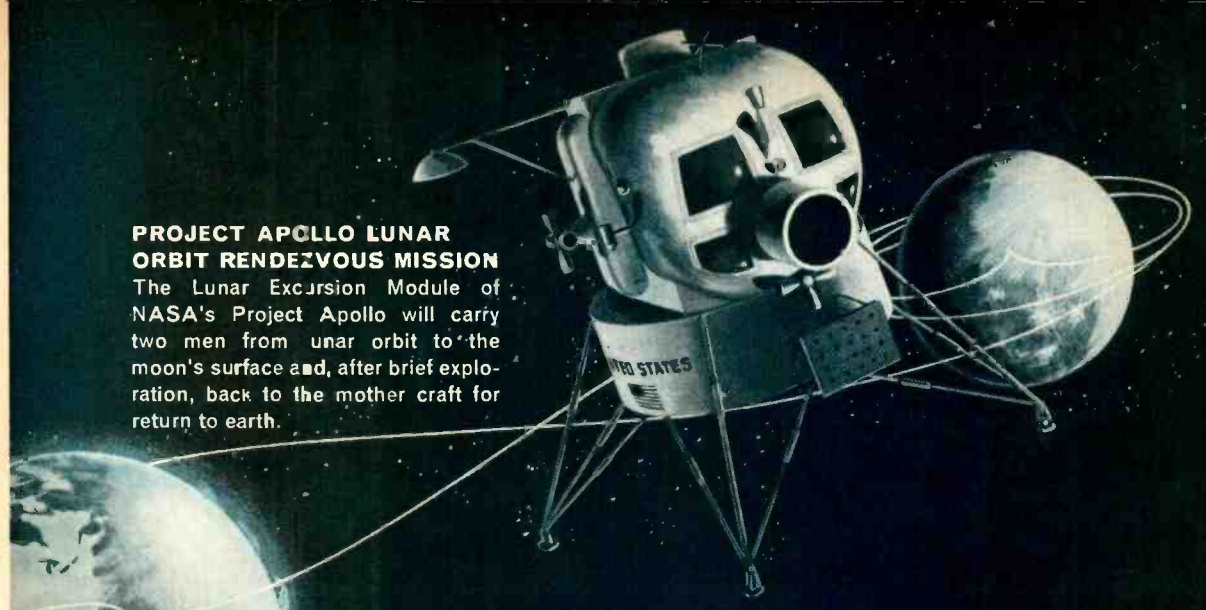
—*Bert Mann*

Port-A-Lab **Ten-2 C.B. Checker** **510 Transmitter Tester**

ECI

Allied Radio

SECO Electronics



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HIKE THAT Q

By Herb Friedman, 2W6045

SELECTIVITY—the ability of a receiver to reject a signal whose frequency is close to the one you want to listen to—is an absolute must for top quality Citizens Band reception. Many low-cost transceivers which are excellent in all other respects lack this one important feature which could make them hot performers all the way down the line. There are many ways to improve selectivity, but often they require major modifications to the receiver.

EI's Q-multiplier does a perfect job of narrowing your window on the band with the addition of only a capacitor and phono jack to the transceiver.

The multiplier is designed for transceivers whose IF frequency is between 1,200 and 1,800 kc. Other Q-multipliers often achieve so much selectivity (because they're designed for code reception) that speech is turned into mere mumbles. Our rig gives just enough to reduce adjacent-channel interference without destroying speech intelligibility. And you need only a broadcast receiver to align it.

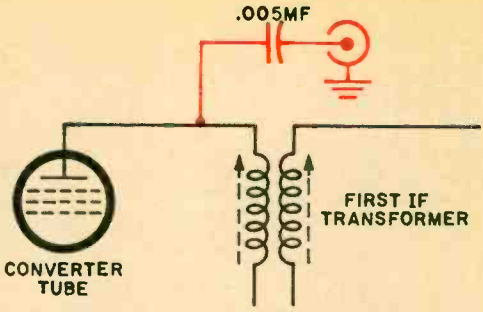
The multiplier can be used with any of your transceivers by simply plugging its connecting cable into a specially installed connector on the rear of the transceiver chassis. The rig's performance will be normal when the accessory is disconnected.

Construction. The multiplier will fit in the U-section of a 4x5x6-inch Minibox. Wiring and parts layout are critical. Follow the plan shown in the photo of the inside. Further construction details are explained in the caption near the pictorial.

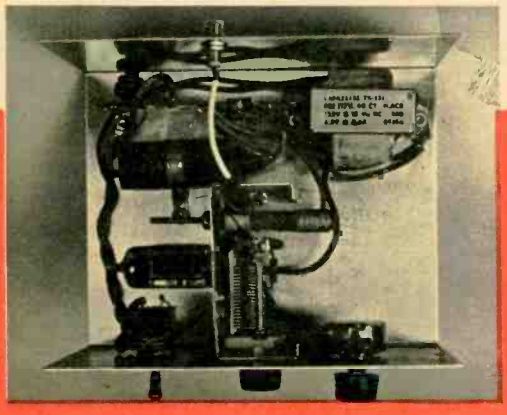
Drill a 5/16-inch diameter hole in the oscillator chassis and push L1 into it until its mounting tabs snap into place. The oscillator chassis is held in position by C3's mounting studs and screws.

Only the capacitor specified in the Parts List for C3 will fit in the chassis. Do not substitute a different type.

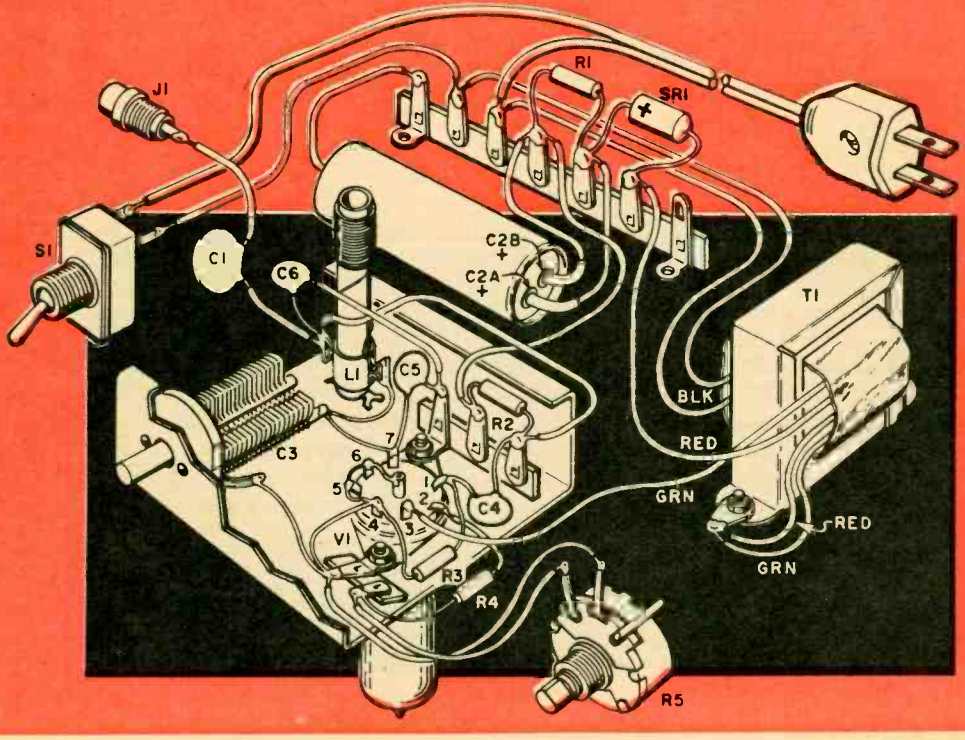
Transceiver Modification. Mount a phono jack on the rear apron of your transceiver's chassis close to the first IF transformer. Connect a .005 mf, 500 V capacitor from the center lug on the jack to the IF transformer lug that is connected to the plate of the mixer tube. Keep the capacitor away from the

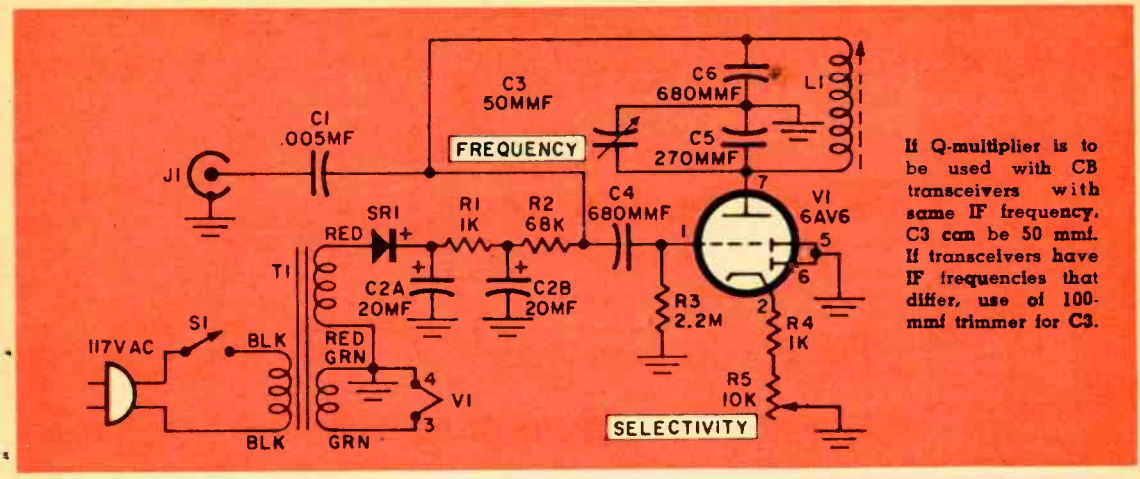


Portion of typical CB transceiver mixer/IF stage. Modification (color) requires a .005 mf, 500 V capacitor be connected from plate of mixer to jack on chassis.



Wiring and parts layout are critical and should duplicate our model. Oscillator, built on separate chassis and held in place by C3, was turned upside down in pictorial to show parts location. Wire chassis first, then install it on its side as shown in the photo.





If Q-multiplier is to be used with CB transceivers with same IF frequency, C3 can be 50 mmf. If transceivers have IF frequencies that differ, use of 100-mmf trimmer for C3.

chassis and the transceiver bottom plate.

The cable to connect the Q-multiplier to the transceiver is made of two short lengths of insulated hookup wire (not shielded or coax cable) spread apart and terminated with standard phono plugs.

Aligning and Using the Multipler. Set C3 so its plates are ¾ meshed. Turn L1's slug and R5 full *clockwise*. With the connecting cable plugged in the transceiver, turn the multiplier on but leave the transceiver off.

Place a broadcast or short-wave receiver tuned to about 1,600 kc near the connecting cable. Using a thin-blade screwdriver, turn L1's slug *counter-clockwise* until the radio becomes quiet.

PARTS LIST

R1,R4—1,000-ohm, ½-watt, 10% resistor
R2—68,000-ohm, ½-watt, 10% resistor
R3—2.2 megohm, ½-watt, 10% resistor
R5—10,000-ohm, linear-taper potentiometer
C1—.005 mf, 500 V ceramic disc capacitor
C2—Dual 20 mf, 150 V electrolytic capacitor
C3—3.2-50 mmf trimmer capacitor (see text). Hammarlund MAPC-50B (Lafayette HP-37)
C4,C6—680 mmf, 500 V ceramic disc capacitor
C5—270 mmf, 500 V ceramic disc capacitor
L1—Ferrite loopstick antenna (Lafayette MS-11)
T1—Power transformer: primary 117 VAC; secondaries, 125 V @ 15 ma, 6.3 V @ .6 A. (Lafayette TR-121 or equiv.)
V1—6AV6 tube
S1—SPST toggle switch
SR1—100 ma, 400 PIV silicon diode
J1—Phono jack
Misc.—4x5x6-inch Minibox, 2⅝x2¾x1¼-inch aluminum chassis (Premier ACH-1350)

Turn off the radio, set R5 full *counter-clockwise* and turn the transceiver on. Slowly adjust C3 for loudest sound or maximum S-meter indication. Then retune the transceiver and C3. Don't worry if the sensitivity appears to drop.

Next, advance R5 slowly. Eventually the multiplier will break into oscillation, causing a growl or whistle. Selectivity is maximum just below this point. Remember that while a Q-multiplier sharply reduces adjacent-channel interference, it can't eliminate interference from stations on the *same* channel.

In sharpening the selectivity, the circuit cuts off the received signal's sidebands, making speech sound muffled. When the received signal is in the clear, reduce the selectivity with R5 to restore sound quality.

Advancing R5 also increases the receiver's gain. As a matter of fact, gain may be greater than without the unit. After the multiplier is installed and you get the hang of using it, adjust the slugs of your transceiver's first IF transformer to further improve sensitivity.

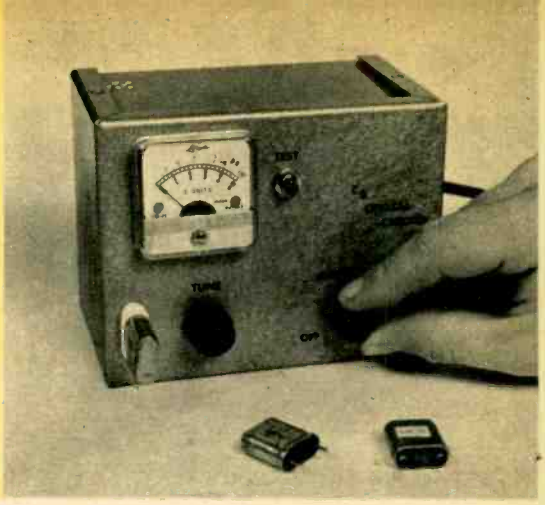
It is not necessary to adjust L1 each time the Q-multiplier is used with a different rig. Simply adjust C3 for loudest signal and the Q-multiplier will be aligned to the new IF frequency. But remember, the multiplier can be used only with transceivers whose IF is between 1,200 and 1,800 kc.

CB SPECIAL

CB Crystal Checker

Sure-fire gadget spots sluggish crystals in a matter of seconds.

By Herb Cenan

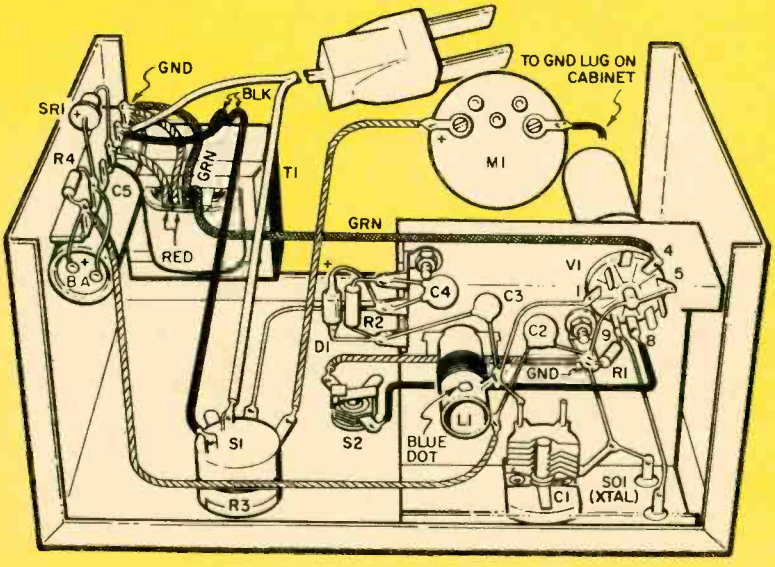


EVERY Citizens Bander knows his transmitter's gotta have a crystal because of that .005 per cent frequency-stability requirement. But crystals do more than establish frequency. To a degree, they also determine output power and receiver sensitivity. Best way to find out how good they are in this respect is to check what's called their *activity*.

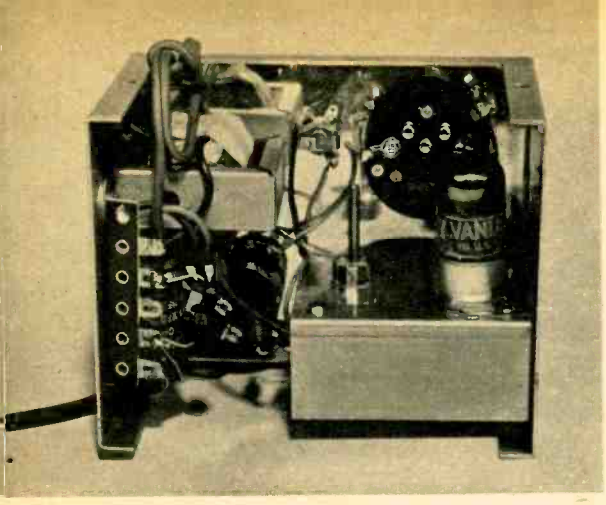
EI's checker puts third-overtone crystals through their paces in a commonly used transmitter oscillator circuit which gives a visual indication of their condition. Construction details are explained in the captions for the pictorial and the photo of the inside of the unit.

Adjustment and Calibration. Turn L1's slug full *counter*clockwise and close C1's plates. Install a knob on C1's shaft so the pointer is at the 9 o'clock position. (C1's plates should open when the knob is turned clockwise.)

With C1's knob set at 9 o'clock, turn R3 three-quarters clockwise, insert a crystal you know to be good in SO1 and turn on power. After a one-minute warm-up, *slowly* turn C1 clockwise until M1 jumps to some peak value. Then carefully turn C1 counterclockwise until M1 peaks again, but at a point higher on the scale. If you miss this point—that is, if the needle falls back to zero—start all over again to get the needle to stay



Oscillator, built as subassembly on a 2 5/8 x 2 3/4 x 1 1/4-inch chassis, is mounted in main section of 3x4x5-inch Minibox. Chassis is held in position by C1's and SO1's mounting screws. Mount it so top of V1 will not prevent cover from being slipped in place. Layout is not critical but lead from pin 9 on V1 must be kept away from chassis. Drill a few holes in cabinet above V1 and opposite its base for proper ventilation.



Many parts must be squeezed in tight quarters so install the transformer, filter capacitor, rectifier, terminal strip, meter and potentiometer in Minibox first. Build oscillator on chassis and install last.

at the higher peak. Push S2. The needle should fall back to zero and remain there after S2 is released. Continue to turn C1 clockwise a bit until the needle jumps to a peak again. This is your reference point on the scale for a good crystal. Adjust R3 for any other convenient reference point around midscale.

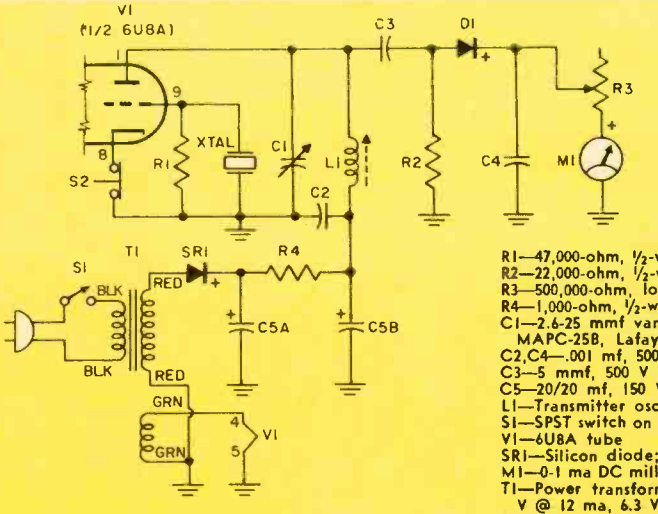
Operation. Insert a crystal to be tested and repeat the entire procedure—turning C1 clockwise for a peak, backing C1 off for a higher peak, pressing S2 to zero M1 and turning C1 clockwise for another peak.

If the indication is close to the reference, the crystal is good. If not, the crystal may be the cause of lowered transmitter output power or poor receiver sensitivity.

When C1 was first turned clockwise M1 peaked, if you recall, at a slightly higher point than it did after S2 was pressed. The first indication is not meaningful since the oscillator has not yet proved itself able to start dependably. For this reason, the reference point is established after the oscillator is stopped by pressing S2.

Pressing S2 simulates what happens when component aging detunes the transmitter's oscillator, causing it to start intermittently. If the crystal is good, the oscillator may be detuned.

Always check transmit crystals against transmit crystals and receive crystals against receive crystals—not against each other. And don't use a receive crystal from one manufacturer's rig as a reference for a receive crystal from another manufacturer's equipment. While it is wise to do the same with transmit crystals, many transmitters have the same oscillator circuit, sometimes allowing crystals to be interchanged.



Only triode half of V1 is shown; pentode section is not used. Full-scale deflection can be obtained with 0-1 ma meter. A 25 mmf capacitor for C1 will check any 20-30 mc crystal. A 15 mmf capacitor for C1 will provide less-critical check of any rock between 25-29 mc.

PARTS LIST

R1—47,000-ohm, ½-watt resistor
R2—22,000-ohm, ½-watt resistor
R3—500,000-ohm, log-taper potentiometer
R4—1,000-ohm, ½-watt resistor
C1—2.6-25 mmf variable capacitor (Hammarlund MAPC-25B, Lafayette HP-35. See schematic caption.)
C2,C4—.001 mf, 500 V ceramic disc capacitor
C3—5 mmf, 500 V ceramic disc capacitor
C5—20/20 mf, 150 V electrolytic capacitor
L1—Transmitter oscillator coil (Lafayette HP-60)
S1—SPST switch on R3 S2—SPDT push-button switch
V1—6U8A tube D1—1N34A diode
SR1—Silicon diode; 100 ma, 400 PIV or higher
M1—0-1 ma DC milliammeter (Lafayette TM-11 or equiv.)
T1—Power transformer: 117 V primary; secondaries, 125 V @ 12 ma, 6.3 V @ .6 A (Lafayette TR-121 or equiv.)
SO1—Crystal socket (Allied Radio 72 S 075)
Misc.—3x4x5-inch Minibox, 2⅝x2¾x1¼-inch aluminum chassis (Premier ACH-1350), terminal strip

CB SPECIAL

KIT EI REPORT

1-WATT

HEATH GW-52

NEWEST thing in Citizens Band equipment is the 1-watt walkie-talkie. The natural outgrowth of its 100-milliwatt baby brother, the 1-watter's power is ten times as great, and the cost is roughly three or four times more. But the 1-watter's useful-communications range is so superior (in the country we got five miles out of them) it makes the 100-mw jobs look like toys. But don't forget, you need a CB license for a 1-watter. EI here reports on two kits now on the market.

The Heath GW-52's $74.95 price ($124.95, assembled) includes a rechargeable nickel-cadmium battery, built-in charger, earphone, transmit and receive crystals and a cable for charging the NC cell from an automobile's 12-volt battery via the cigar-lighter socket.

On all counts the GW-52 is a top performer. Its size, shape and weight (2½ pounds) make for easy handling. In addition to keeping the weight down, the NC battery gives greater operating economy than would conventional batteries. More importantly, the NC battery insures uniform operating performance over its discharge cycle.

To charge the battery from house current you just pull a built-in cord out of the bottom and plug it into an AC outlet. If the 12-volt car-battery charging cord is connected the wrong way, a pilot lamp lights to warn you. A meter on the front shows the charge on the battery when the transmit button is pressed. (Heath claims the battery life is 1,500 hours—10 per cent transmit, 90 per cent receive-duty cycle.)

It took about seven hours to build the GW-52. There were no major problems as most of the parts are mounted on an uncrowded printed-circuit board. However, the button on the transmit-receive switch did not clear the hole in the side of the case. This put a heavy strain on the switch's phenolic wiper arm and on both units the arm broke almost immediately after being used. We suggest you enlarge the hole's diameter to about one-half inch with a file.

After the board is installed, things get a bit crowded around the battery and the charge switch. Take care and use a small-tip iron and you'll stay out of trouble. And don't out of curiosity remove what appears to be a protective plastic cover around the battery. It's actually the battery's case and, once removed, like Humpty Dumpty, the battery can't be put back together again. Following the instructions in the manual, you'll get hundreds, possibly thousands of charges out of the battery.

We checked the GW-52 and found the transmitter input power was 1.44 watts, almost 50 per cent more than claimed, when the battery was fully charged. In terms of operating range, in a populated suburban area we were able to get a solid signal through without splatter at about 2½ miles. Intelligibility was good, even at five miles.

The receiver is extremely sensitive. We measured a usable sensitivity of .7 microvolts. (By usable sensitivity we mean the minimum signal in microvolts that is required at the antenna to maintain speech intelligibility.) Audio quality was excellent and the squelch works effectively and does not cause distortion. Alignment of both the re-

Walkie-Talkies

KNIGHT-KIT KG-4000A

THE Knight-Kit KG-4000A sells for $59.95. A nickel-cadmium battery and charger kit costs $19.95 extra. Add to this $3.90 for crystals and $1 for a 12 V adaptor/charger cable and you're up to $84.80. You could use C-size flashlight batteries to keep the cost down to $64.95. However, we don't recommend using these batteries; we'll explain why later. Assembled, the KG-4000A and NC battery and charger are $89.95 and $29.95, respectively.

The KG-4000A is relatively easy to build. Though most parts are mixed together in bags, we got it together in about nine hours. All resistors are attached to marked cardboard strips. The construction manual and pictorials are clear and the transistor and crystal sockets, coils, IF transformers, diodes and push-to-talk switch are mounted on the printed-circuit board. Reversing the last two steps on page 7, and steps 5 and 6 in the right column of page 11 will simplify construction. Assembling the battery chassis was a bit of a chore and will take more than average patience.

The receiver section of the KG-4000A did not work when we turned it on. After an hour or so of troubleshooting we located the trouble—a defective RF transistor and IF transformer.

With a new set of batteries we found the final RF stage's input power to be 1.06 watts. The power falls quickly after a relatively short period of use. Here's why. In the transmit mode, the current drain is almost 100 ma at rated input power. Add to this the current required for the oscillator and modulator (which may go as high as 200 ma) and you end up with an average current drain of about 130 ma.

With this great a drain, the voltage of C-size flashlight batteries will drop to about 80 per cent of its initial value in less than three hours. Such a 20 per cent drop in battery voltage will cause the final's input power to drop 40 per cent.

Knight states that battery life is based on a transmission duty cycle of 10 per cent. In use, a more realistic figure is 40 per cent. Operated on this basis, the input power will drop after seven hours. Actually, it will fall somewhat sooner because of the 12-20 ma receiver drain. The more practical battery is a rechargeable NC. Its output voltage remains fairly constant over the discharge cycle and it can be recharged many times. The KG-4000A may also be operated from your car's 12-volt system.

With fresh batteries, the KG-4000A punches out a strong signal. Audio quality of the received signal is good and there is little splatter.

The receiver has a usable sensitivity of 1.5 microvolts. The audio gain of the receiver is a bit low. The squelch and noise limiter are effective.

The transmitter section consists of a crystal-controlled oscillator which drives the RF power amplifier directly. The output of the final is coupled to the 52-inch telescoping whip antenna via a pi-network. The combination of the pi-network and 52-inch whip results in a highly efficient antenna system. Both the oscillator and RF final are modulated by a class-B push-pull modulator, which doubles as the audio amplifier in the receive mode.

The KG-4000A uses a sep-

HEATH GW-52

ceiver and transmitter without instruments is easy, effective and not critical.

The receiver, which has ten transistors and two diodes, includes an RF stage and push-pull audio output.

The transmitter is composed of a crystal-controlled oscillator whose output is fed through a driver amplifier to the RF output stage. The driver stage insures frequency stability and suppresses spurious harmonics. Both the driver and the final RF stage are modulated. This produces an excellent, low-distortion signal that is free of splatter. The output of the transmitter final goes through a toroid coil which matches it to the 35-inch whip antenna, in effect, adding electrical length to it. There is a trap coil tuned to 54 mc which suppresses second-harmonic radiation. The output is also fed to a jack to which a 50-ohm external antenna can be connected for greater transmission range.

If you have been struggling to get workable range out of a pair of 100-mw walkie-talkies, it would pay you to consider using a pair of 1-watters such as the Heath GW-52.

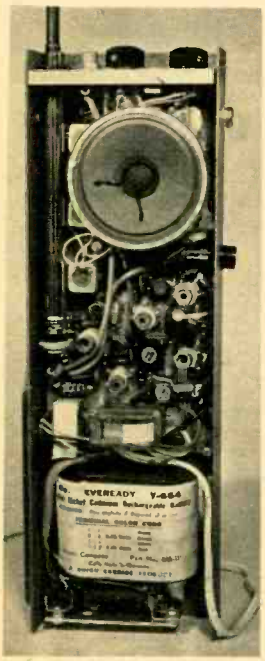
KNIGHT-KIT KG-4000A

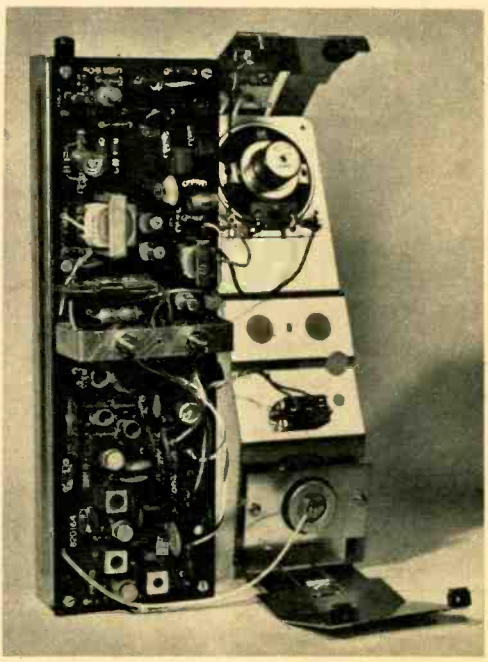
arate speaker and microphone. The only advantage we could see to this is that you can hold the unit (it's a handful) as you would a telephone handset.

The local/distance switch reduces receiver sensitivity and should be set to *local* when operating the units at close range. Knight recommends the squelch be used at all times and the local/distance switch left in the *local* position whenever possible to reduce battery drain in the receive mode.

Inside is a pilot lamp that limits the final RF's current. It lights when you transmit, indicating a carrier is present. But, because of the location, it is difficult to see. And replacing the batteries is a big job; the entire unit must be disassembled. So another advantage of using an NC battery is that you won't have to disassemble the unit as often.

Operating range was excellent. We were able to maintain contact with satisfactory speech intelligibility up to five miles. All in all, the KG-4000A is a good kit and will earn its keep—if you use a NC battery.





The Heath (left) can be operated from AC power by making a simple circuit modification. Jack on the top at the right of the whip antenna is for an external antenna. Controls are for volume and squelch. Knight-Kit (right) has speaker and microphone mounted on separate chassis. Batteries fit in compartment behind printed-circuit board. The jack for an external antenna is at the bottom rear at the back of the unit. Squelch and volume controls are mounted on bracket in the center of the unit.

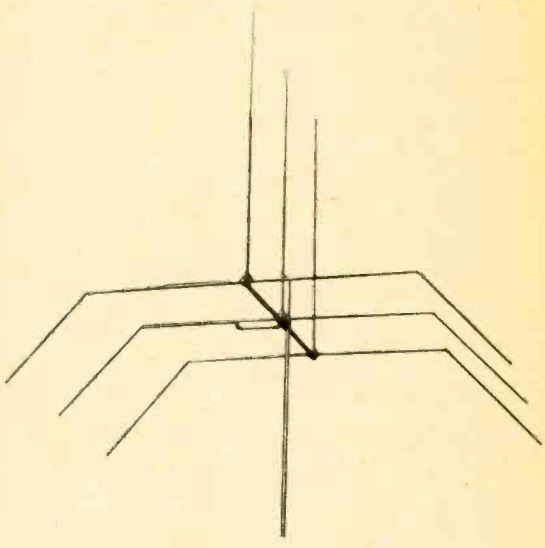
ODDBALL ANTENNAS

NEARLY everyone who has an interest in Citizens Band doings becomes an antenna-watcher. On a cross-country trip you'd see mostly standard models but every so often an odd-looking rig pops up and you wonder how well it works.

The answer, almost without exception, is that the oddballs are not as efficient as the standard models. But they do offer special features. The most efficient mobile whip is a 108-incher but if lowering and raising it gets you down, the answer is a less-efficient but handier loaded, shortened whip. Similarly, oddball base antennas may offer both horizontal and vertical polarization or extra-easy mounting at some loss in efficiency.

Three of the oddest antennas ever to come down the pike no longer are in production, but you still see one once in a while. One was a little structure that looked like a ring on short posts that mounted on a car's roof. It had a slot in the ring which faced forward. The Stinger was a tiny loaded whip less than 30 inches tall and mounted in the center of a car roof. The same company once brought out a discone model that looked like an upended funnel capped by a pie pan.

Loaded whip for rear-cowl mounting has a rakish look. It's made by Antenna Specialists.



The odd-looking MR77 Match-Maker beam combines both horizontal and vertical polarization.

In base antennas, the duo-pole ground plane with its folded-over driven element has an unusual appearance and is seen everywhere. Two other strange-looking rigs are beams featuring both horizontal and vertical polarization. The Match-Maker has three vertical elements and three horizontal rods with drooping ends. The Gizmotchy features nine elements in three sections. Three elements point upward, three down and to the right, three down and to the left.

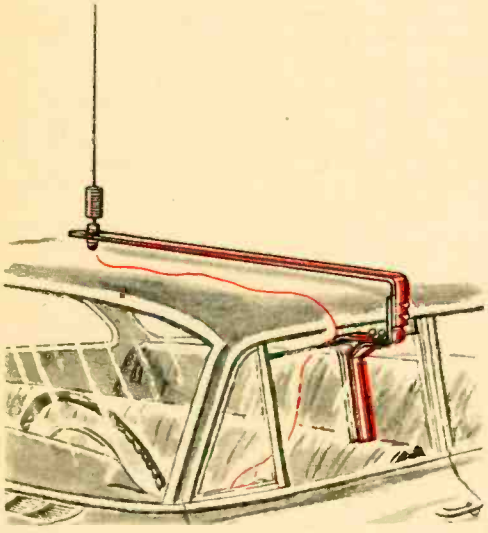
Many shortened, loaded mobile whips

CB SPECIAL

ODDBALL ANTENNAS

are on the market, some pretty odd, some less so. One little job that mounts in the crack between the trunk lid and the rear cowl has the advantages of little height, good ground-plane action from the car's body and no interference with the trunk lid.

Amongst unusual whip mountings is



Window bracket puts whip in center of car roof, yet requires no holes; Technical Industries.

one that clamps onto a car window on either side. The assembly extends over the center of the roof and accepts nearly any antenna element. A slightly different version folds so the driver can reach out and lay the antenna itself back on the roof when he comes to a low overhead.

The Mac-Whip is a full-length job, but with a twist—a real one. It goes up a while, then turns down and finally points upward again. It looks a little like a snake that changed its mind.

—*Charles Tepfer, 2W4223*

The Forester

THE business of antenna-watching, as we've hinted in the adjoining article, is an occupational hazard of CBing. So you're bending around a curve in a rainstorm at 85. What catches your eye? Could be a truck careening down the road in your direction, but if you really have the bug you're also sure to notice the way that smart dairy farmer put his ground plane on his barn to gain an extra 20 feet.

To us dedicated observers of the spreading antenna forests, political or economic surveys that we read about are piddling short-term jobs. Our canvasses last a lifetime. They may not be as accurate as the toothpaste type or as much fun as Kinsey's, but it's hard to keep us from talking about them.

Without consulting a single datum guaranteed by Good Housecleaning, we'd say the most popular CB antenna for home installation is the ground plane. In our travels, we've spied at least five GP's for every one of any other type. In second place would come the coaxials, with a cubical quad thrown in here and there for decorative effect.

In business installations, the leader seems to be what we once dubbed the non-directional beam, for want of a better term (CB manufacturers, presumably for the same reason, also now use the name). The N-D beam is the rig with the long half-wave vertical driven element and four little cat-whisker radials at the bottom. Coaxes also seem to run second with the commercial boys.

Directional beams are found now and again peeping above the landscape. Below may be either a business house or a dwelling. Which reminds us of a three-element beam that has been bugging us for months. It's painfully visible from our office window, sitting there about four blocks down the avenue and hard by Rockefeller Center. We've wondered what it's used for. Now's the time to find out. . . —*R. G. B.*

CB CORNER

BY LEN BUCKWALTER KBA4480

what's ahead for the CITIZENS BAND?

WASHINGTON

MORE CHANNELS to relieve crowding on the band? Forget it. How about those monetary fines that are hitting CBers around the country—will they increase? Hold your pocketbook; they've only started. And equipment specifications—will they tighten up? The matter is under more serious consideration than generally is believed. And what about sideband?

This sampling of key questions and answers that touch on CB's future didn't materialize in any crystal ball. They're the thoughts, educated guesses and informed opinions of CB's most highly placed official—Ivan H. Loucks, Chief of the Amateur and Citizens Radio Division. In a talk with this corner at the Commission's Washington offices, Loucks stroked in a graphic picture of what he believes is ahead for CB.

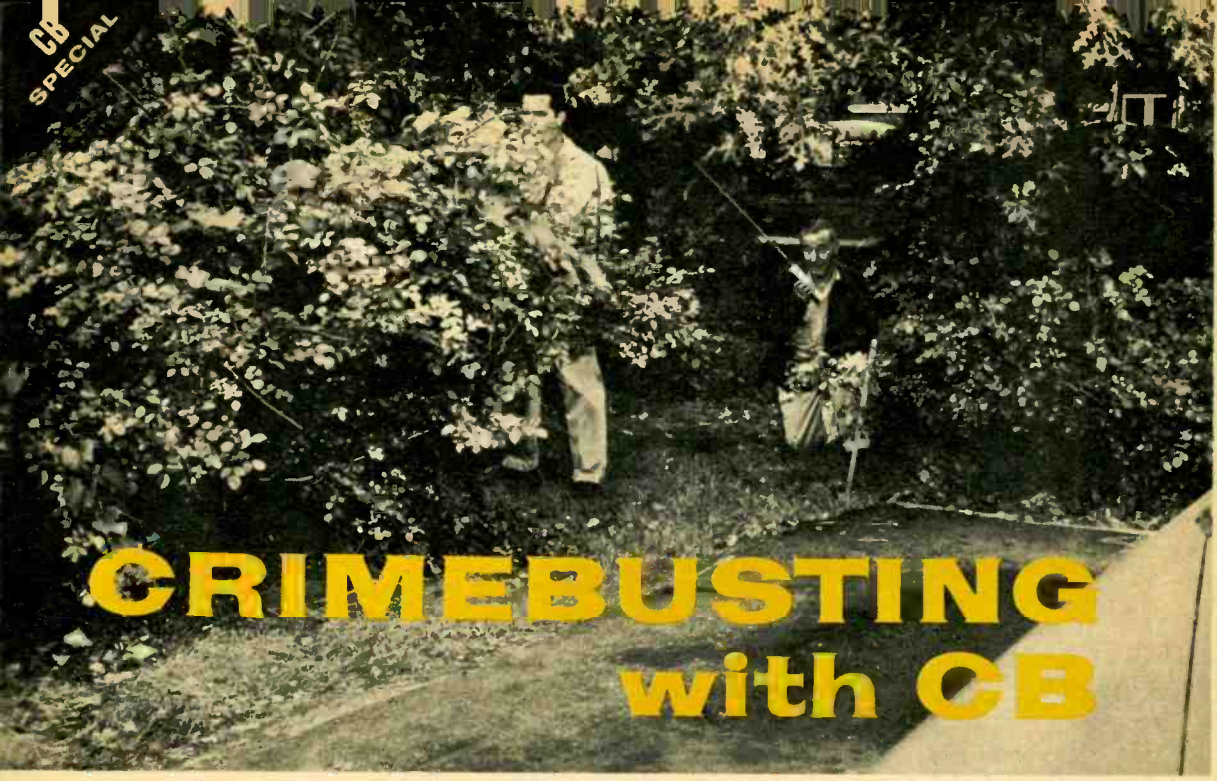
Tight Spectrum. On the touchy issue of more channels, the chief was rock-rigid in his reply: "Not a ghost of a chance." Back some half-dozen years ago when the Commission was trying to search out a suitable spot for CB, it found no openings. Unbelievable in a spectrum running from about 10 kc to millions of megacycles? Hardly. Most frequencies already had been set aside for protected services—those stations that could stand no interference (aircraft, police, etc.).

The only possible allocation for CB was the internationally recognized ISM (Industrial, Scientific, Medical) band on 27 mc. Populated by the buzz-saw hash of the diathermy machine, the band also was ridden with heavy interference from big industrial RF heating systems. Small wonder, then, that even hams, who had privileges on the band, shunned it like the plague. But in September 1958 the amateur allocation was withdrawn and 23 CB channels were shoe-horned into 27 mc.

There is no indication that the tight-spectrum situation will change. On the contrary, the protected services are bursting with growth, even "splitting" some of their channels to get more stations on the air. Thus, Louck's reaction to a past petition to create a "hobby" band is that such space would have to come from today's 23 channels. And he punctuated his remarks with a card bearing his ham call (he's W3GD). His thinking on this subject is contained in one brief statement: "Over 200,000 people have managed to pass the ama-

[*Continued on page* 116]

The FCC's Ivan H. Loucks (right) gives his views on what's ahead for CB in an exclusive interview with EI's KBA4480. CB is here to stay, says the Chief, and it's going to stay on those same 23 channels. But this is about all that won't be in for some changes in the days and years ahead.



CRIMEBUSTING with CB

Umpteenth in the ever-growing number of unusual uses for CB, here's how 2-way radio helps police crack down on crime.

THOUGH THE POLICE always get their man, the problems of law enforcement are a little rougher than the typical cops-and-robbers TV show would suggest. Put yourself in the boots of a foot patrolman on the beat in a waterfront area late at night and you'll get some idea of what a policeman can be up against.

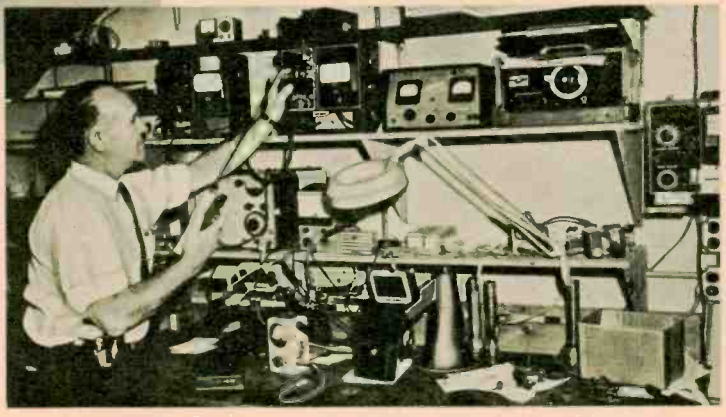
But something new can be found in the police officer's bag of tricks, as evidenced by an electronic tool recently purchased for the Confidential Squad of the Elizabeth, N. J., Police Department. That something is Citizens Band transceivers, and the cops say they work just fine.

The Elizabeth police obviously can't divulge precise details on how the CB equipment is being used, since this might tip off the members of the underworld they most want to catch. But some aspects of the operation can be described to give you an inkling of how CB is clashing with crime.

In a nutshell, the CB transceivers have been assigned to members of the department's Confidential Squad—the group which deals with crimes involving narcotics, gambling, alcohol and other breaches of the hard-to-crack variety. The transceivers enable all patrolmen on a given assignment to keep in touch with one another and with headquarters.

Made by the Cadre Industries Corp., the transceivers feature two-channel selectivity, which gives the police some important advantages. For one thing, they can reserve one channel for their own communications, yet they easily can monitor another channel if they discover someone is using CB equipment to help perpetrate a crime. In addition, the two-channel option lessens the probability of their transmissions being picked up by the wrong party, as frequently happens with the usual type of police calls transmitted on a fixed frequency.

Elizabeth police map out every action well in advance. Here, Sergeant Alfred Goegelman details an operation and explains how CB transceivers will be used to coordinate the movements of two other officers.



Crimebusting is a chancy business, but the Elizabeth police do their level best to leave as little as possible to chance. A well-equipped test lab, manned by Sergeant John A. Tordik, the department's Signal System Superintendent, helps insure that every CB set is in top working order.

Police Chief William J. Mulkeen (right), CB transceiver in hand, keeps in touch with two plainclothesmen who are on a surveillance assignment elsewhere in the city.

CB SPECIAL

CB EQUIPMENT

Yesterday Today Tomorrow

By David Walker

BACK IN 1959 a group of us huddled over a new kind of radio. It bore the cryptic model number CRM-P2A-5, but its purpose was no secret. For this was among a major company's first entries into a field that was almost as new as the rig itself.

RCA's Radiomarine division had moved fast in marketing a transceiver for the new Class-D Citizens Band, created only a few months earlier. And within minutes we had laid the rig bare for an anxious look into its circuitry. Would it prove to be a bust—like the handful of ineffective sets on the older Class-A band?

The answer is history; Class D is now the FCC's largest single division. With an allocation on lower frequencies, CB shed its erratic, limited-range coverage and took off.

That primitive RCA unit, along with other pioneers—International Crystal's massive Citizens' Bander and Heath's CB-1 Lunch Box are two notable examples—led the way. Today, of course, one can point to dazzling improvements in current CB transceivers. And the reasons aren't hard to find.

It isn't that the CRM-P2A-5 didn't do its job well; it worked fine in 1959. But the ensuing years produced a population explosion on Class D. The sheer force of numbers was mainly responsible for the sophistication that marks CB equipment today.

More Selectivity. One of the earliest facts of life CB manufacturers had to face was this one: a cheap-to-produce superregenerative receiver simply couldn't survive the battles of a crowded band. As CBers grew more experienced —and numerous—the thrill of talking to Filbert down the street began to pall. Now they wished to reject Filbert's signal with sharper, more selective receivers. As a result, the three-lung superregen soon was eclipsed by the superhet, whose prowess under adjacent and co-channel interference sets today's standard.

Even now, with the transition in basic receiver type nearly complete, the demand for a tight receiver is unremitting.

One approach to greater selectivity relies on low IF's: the farther down in frequency the signal is converted in a receiver, the better the rig's selectivity. Thus, most current high-quality receivers employ dual conversion. An incoming signal on 27 mc may be shifted down to 10 mc, then to 455 kc before it's turned into audio.

But why stop there? Designers have tried triple conversion and emerged with a receiver that's sharper than a Krona edge. In fact, some sets even provide a fine tuning dial to snare those stations that drift slightly (but legally) out of the receiver's thin tuning slot.

Dual and triple conversion aren't the only expedients now being used for sharpening a receiver's selectivity. Some sets feature crystal filters for truly hair-thin bandpass. And watch for the newest component being spotted in

Frequency synthesis is featured in Hammarlund's CB-23 all-channel CB transceiver. Operator first dials channel range, then selects specific channel.

transceiver circuits for improved selectivity. It's the Transfilter, a solid-state, low-cost ceramic filter made by Clevite. Knight-Kit used one in a recent handie-talkie; Vocaline has incorporated four Transfilters into its new ED-276 rig.

More Sensitivity. Hot on the heels of more selectivity is the quest for more sensitivity. With CB power fixed at 5 watts, any increase in receiver sensitivity tends to boost operating range. And here is where the Nuvistor has been able to make its mark in receiver front-ends.

Chief asset of this tiny tube is that it generates less internal noise than the conventional RF amplifier. In some circuits you'll find two Nuvistors in a cascode arrangement. This remains one of the most satisfactory of all front-end configurations.

In short, then, the guts of the CB receiver have become increasingly complex, hotter and more expensive—and quite unlike the early superregenerative types that inhaled every strong signal in the vicinity. Thankfully, most manufacturers now realize that it's folly not to provide a handy push-to-talk button on the microphone for mobile operation. And, like windshield wipers and headlights on today's automobiles, squelch and noise limiters are just about standard.

On the whole, these advances can be considered necessities. But what's being done to meet the insatiable CB appetite for more accessories, features and convenience?

More Channels. These demands also have been met. S-meters are as common as volume controls (they also double as indicators of RF power, a far more valuable function). Spotting switches permit a tunable receiver to be set with the same accuracy as a crystal. And two of the latest advances strike squarely at the CBer's persistent plea: "More channels, more power!"

Trend toward transistors in CB equipment is typified by Vocaline's ED-276. Transistors appear in receiver circuit, tubes in audio and transmit sections.

Each year, new-model CB sets sport more channel positions. It's no trick for the manufacturer. He simply adds more terminals on the selector switch and more crystal sockets. This approach works well, up to a point. But what about CBers who need a full house (23 channels)? A grand total of 44 transmit and receive crystals (assuming one pair comes with the unit) tallies to something like $130. And no matter how you look at it, that's an awful lot of rocks in your rig.

But there is another way out: frequency synthesis. Instead of 46 crystals, FS requires a mere 11. Crystal frequencies are selected so a process of mixing will combine them (by electronic adding and subtracting) enabling you to receive and transmit on any channel.

More Power. Easily the most glamorous development to hit CB concerns transmitter power. And no wonder. Stories run rampant about the CBer who hoisted his antenna with a helium-filled balloon, juggled resistors in his rig and threw in hotter tubes—in a bold effort to get out farther.

Illicit operations aside, there is a valid desire by many operators—not to increase range—but to fill in shadowed, obstructed areas in existing coverage

First commercial single-sideband CB rig is Mark's Sidewinder. Switch at lower center of front panel provides for selection of lower or upper sideband.

CB SPECIAL

CB EQUIPMENT

✓ Yesterday ✓ Today ✓ Tomorrow

patterns. Strapped with a 20-ft. limitation on antenna height, the answer simply is more power. And that answer has arrived in the form of CB sideband. (See the May, 1963 EI for an explanation of how sideband operates.)

Sideband probably would die an early death in CB if it served only to push signals beyond the usual 10- or 20-mile range. The resulting glut of interference between towns and cities could make local communications a nightmare. The appeal of high power is strong, but you can't eliminate the basic reason for keeping CB on a short-range basis: there simply isn't enough space in the radio spectrum to serve thousands of AM-FM-TV stations, several million commercial and government stations, a quarter-million hams and a half-million CBers.

This accounts for the FCC's approach to CB and most other services—limit range so the same frequencies can be used simultaneously throughout the country. If sideband upsets this balance, the Commission probably would abandon its present wait-and-see attitude and rule sideband out of existence on 27 mc. But so far, sideband is earning an untainted reputation in CB. Talks with engineers and operators point to a significant conclusion: sideband is more of a range "fill-in" technique than a mileage multiplier.

Most current sideband equipment makes use of double sideband with reduced carrier. One example is Regency's Range Gain transceiver. The unit transfers a portion of power, normally wasted in the RF carrier, to the sidebands that are the actual carriers of intelligence. Any CB receiver can pick up and reproduce the sideband signal. Olson Electronics markets virtually the same set under its own name.

General Radiotelephone also utilizes double sideband in its SBT-3 sideband generator, though the signal isn't compatible with conventional CB receivers. However, the company markets an adaptor to modify receivers for DSB reception.

The CB power jackpot would be SSB —single as opposed to double sideband. Given the 5-watt power limitation, more talk power is possible with SSB than with any other system. Many pooh-poohed the possibility of SSB for CB at a CB convention back in March 1962. "Too expensive," was the argument advanced by a good many experts only two short years ago. After all, "It might cost $500 to produce."

But the armchair prophets were wrong. Today, we have a commercial CB rig fitted with all the appurtenances of true SSB operation. In the Mark Sidewinder, carrier and one sideband are suppressed nearly out of existence.

HE-75 walkie-talkie by Lafayette includes a crystal-controlled superhet receiver. Transmitter is rated at 1 watt.

And Tomorrow? Along with major trends, a myriad of minor advances touch CB: the hybrid transceiver that combines the best features of tubes and transistors; the ruggedized rig built for rough commercial service; 1-watt walkie-talkies that lift portables out of the novelty class; and selective call.

But where, if at all, has CB equipment design faltered? True, the pressure of competition, demands of CB operators and advances in electronics all have worked to refine today's transceivers. And from a technical standpoint, CB has realized much of its early promise—to provide a low-cost method of communication.

[*Continued on page* 112]

NO DOUBT about it—so many hams are working phone these days that it's impossible to get a *clear* word in edgewise. SSB notwithstanding, CW is the only way out—or should we say in—for more contacts. But going back to code isn't going to be easy for many hams whose fist has grown heavy from holding a mike instead of working a key. And while the hope of going back to CW may be great, the effort required to send code again may seem insurmountable.

EI's Automatic Code Sender is the easiest way for you to recapture the thrills of DX—with less power, on wide-open CW channels and without painfully pounding out each dit and dah. Just press a microswitch button on the sender's typewriter-like keyboard for the character you want and presto!—you'll get a perfectly timed string of crisp dits and dahs.

While automatic code senders aren't new (commercially-made senders can be purchased starting at about $300) you can build this one for about $50. With components of the values specified, it will send 16 words per minute—if you can type that fast.

The sender is a project for an experienced builder. A lot of parts and time go into it and you have to watch what you're doing every step along the way. Con-

AND NOW, FOR THE FIRST TIME!

AN AUTOMATIC CODE SENDER YOU CAN BUILD

By Morris Grossman

You type... It sends code!

CODE SENDER

struction can't be rushed. We estimate it will take about 20 hours to build. But when you're finished you'll have a shack accessory to be proud of.

Construction. Rome wasn't built in a day and the sender can't be, either. One careless goof along the way may take hours to find after the job is completed. Take it slow! We have broken construction down to five major steps which should be followed in order:

(1) *The diode matrix*—A large perforated board with 17 vertical columns and 40 horizontal rows to which are connected 80 diodes. The matrix is on the left side of the top of the sender in the photo on the first page of this story. A section of the matrix is on our cover.

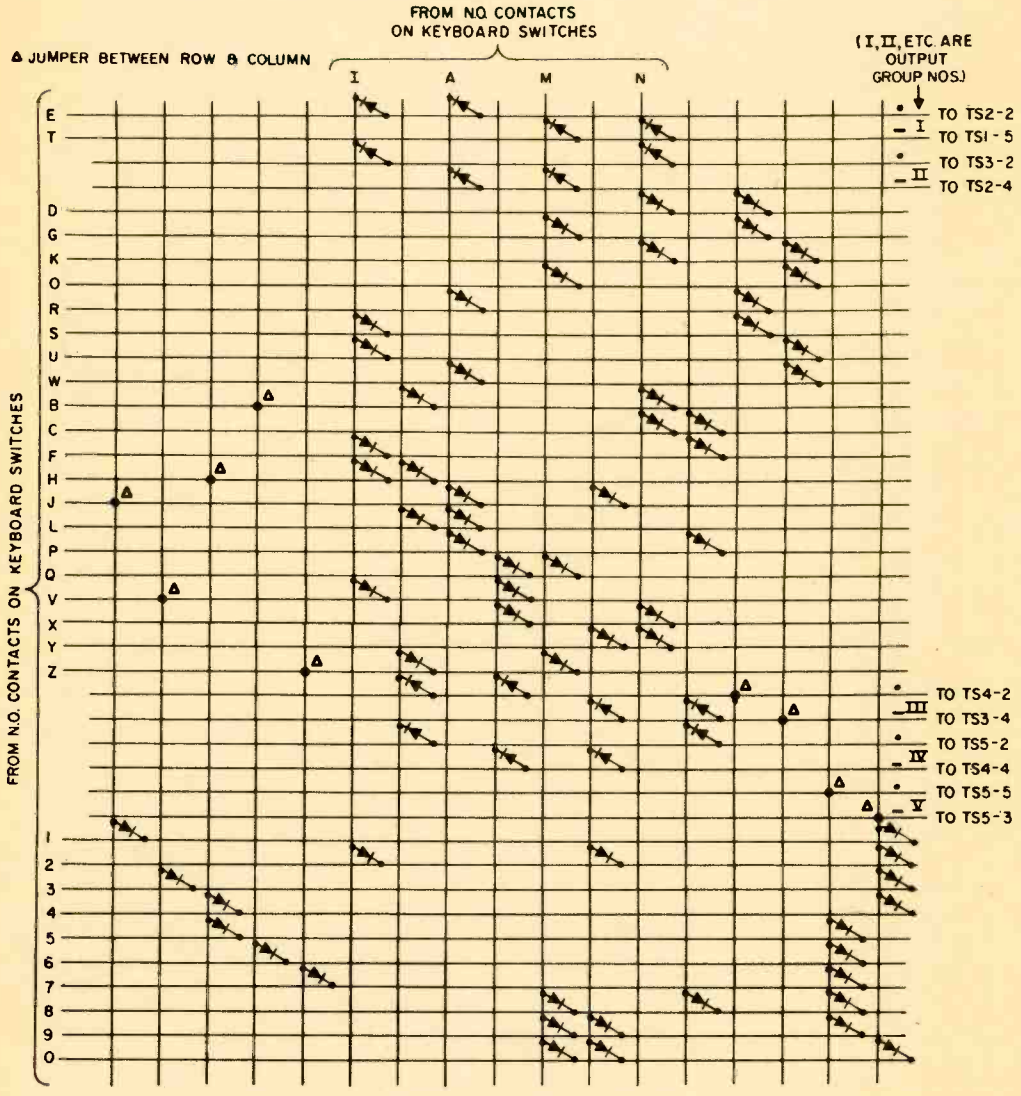


Fig. 1—Diode matrix. Be absolutely sure polarity of all 80 diodes is correct. Start at left column and work from top to bottom and left to right; 9 triangles mean there is a jumper between the row and column.

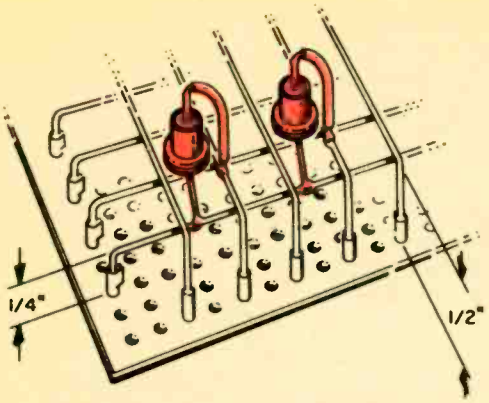


Fig. 2—Closeup of matrix shows diodes' cathode lead connected to column buss wire, spaghetti-covered anode lead connected to row buss wire.

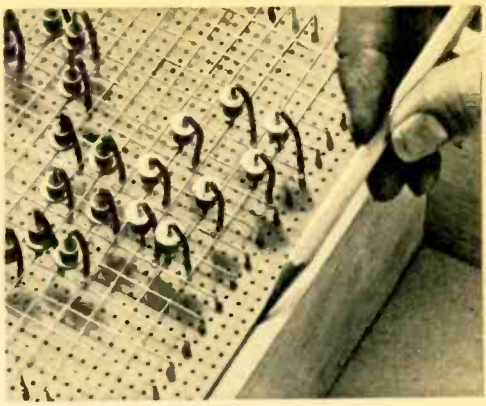


Fig. 3—Portion of completed diode matrix. Note unused rows of holes. Put a few wood screws through perforated board to hold it in frame.

(2) *The wood frame and keyboard switches* (Figs. 7, 9 and 10).

(3) *The relay and components chassis* (Fig. 5).

(4) *Wiring to and between all relays* (Fig. 5 and table, Fig. 12).

(5) *Connections to and between the matrix, relay and components chassis and keyboard switches.*

• **The diode matrix** is built on a 16⅝ x $7\frac{5}{16}$-inch piece of perforated phenolic board. When the board is cut to this size there should be 87 horizontal rows of holes from top to bottom and 38 vertical columns of holes from left to right.

In the third row down from the top and third row up from the bottom, insert a flea clip in *every other* hole, beginning at the second column in from the left. You should end up with 17 flea clips across the top and bottom rows.

In the fifth row down from the top and second column in from the left (and first column in from the right), insert a flea clip in *every other* hole down to and including the fifth row up from the bottom. There should be 40 flea clips in both the left and right columns. The margins at the top, bottom and sides are necessary.

The 17 vertical buss wires are next. They are made of #18 solid wire and are 15⅜ inches long. Cut seventeen 16⅜-inch lengths of wire, roll them flat between two pieces of wood and bend a half inch at each end 90 degrees. Insert the ends of each buss wire in the flea clips at the top and bottom of the matrix so they're about ¼ inch above the board, as in Fig. 2.

The 40 horizontal buss wires are 6¾ inches long and are made from 8¼-inch pieces of the same gauge wire. Bend ¾ inch at each end 90 degrees. Push the wires in the flea clips on the sides so they're ½ inch above the perforated board, as in Fig. 2. Inspect all the buss wires to make sure they don't touch each other and that they are parallel. Now apply solder to each of the 114 flea clips. Mark each row and column on the left, top and right with the letters and numbers shown on the matrix schematic in Fig. 1.

Before installing the 80 diodes, check each with an ohmmeter set to its lowest

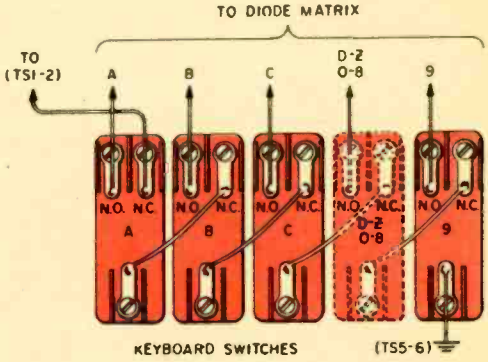


Fig. 4—If switches are arranged like typewriter keyboard, connect lead from N.C. lug to wiper lug on adjacent switch, not alphabetically as here.

CODE SENDER

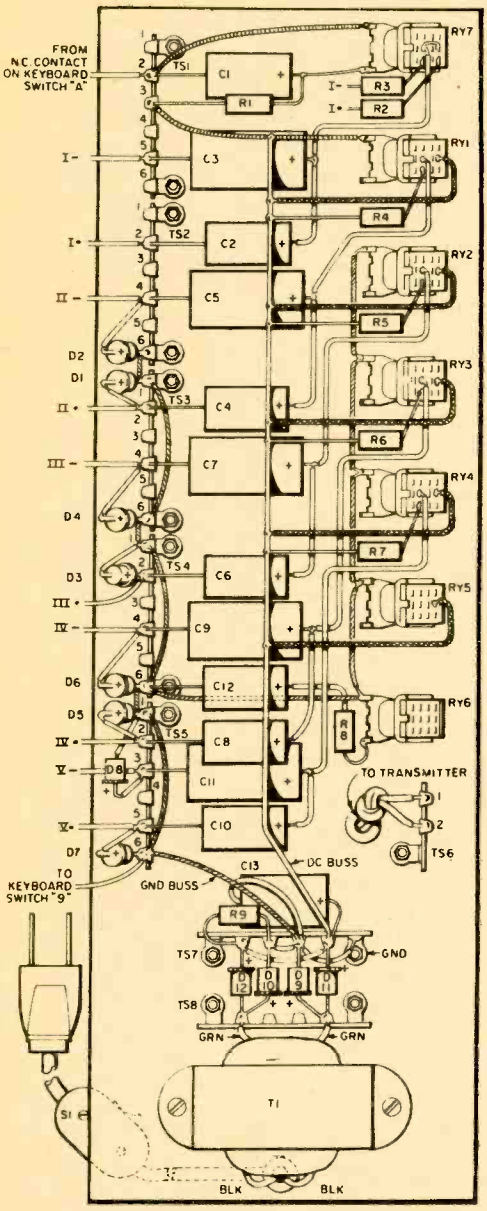


Fig. 5—Relay and components chassis. All relays, capacitors, resistors, the terminal strips and power transformer are mounted on a piece of 16½x3⅜-inch aluminum. Drill all holes before mounting anything. Drilling holes after the relays are mounted may leave chips in their contacts. After all parts have been installed, make the connections between them as shown. Mark top relay RY7 and number other relays in order from RY1 to RY6. Balance of wiring is covered in Fig. 12.

(R×1) range. Connect the negative lead to the cathode of the diode (see sketch at the right of Fig. 11) and connect the positive lead to the anode. The resistance should be less than 20 ohms. Reverse the leads. The resistance now should be high (over 100,000 ohms). Since diodes are non-linear, you'll measure a different forward resistance on other meter ranges and, for that matter, with different ohmmeters. The forward resistance of 20 ohms, therefore, is only approximate.

If the diode is good, connect it between the vertical and horizontal buss wires, following the schematic in Fig. 1. For example, the diode between the vertical column marked I and the horizontal row marked E has its cathode lead connected to the I buss and the anode lead connected to the E buss. Figure 2 shows exactly what the diode looks like installed. Several places will be crowded so watch for shorts between cases.

After all diodes are installed connect the negative ohmmeter lead to the row marked E at the left of the matrix. Connect the positive lead to the dot line (top) of the group I output at the right of the schematic (marked TS2-2) in Fig. 1. You should measure continuity.

Then connect the positive lead to the dash line in the group I output and to each of the other dot and dash output lines in the four other output groups marked II, III, IV and V. You should get an open-circuit indication on *all other* output lines. Using a chart of the code, go through the alphabet and numbers 0 through 9, checking every letter and number line on the matrix.

Here's how it's done for a five-character number. For the number 2, connect the negative ohmmeter lead to the 2 buss at the left (32nd row down). You should measure continuity on the *dot* lines *only* in output groups Nos. I and II and the *dash* lines *only* in output groups III, IV and V.

Where there should be continuity the resistance should be under 75 ohms (again, this will depend on the meter). Where there shouldn't be continuity, the resistance should be more than 100,000 ohms. If there is trouble, go over the connections of all diodes and look for:

(1) open or shorted diodes, (2) diode connected in reverse, (3) diode connected to the wrong buss wire, (4) missing diode or, (5) extra diode.

• **The Frame and Keyboard Switches.** All dimensions and construction details for the frame appear in Fig. 10. While the paint is drying, solder a short length of wire to the normally closed lug on each of the microswitches before installing them. Refer to Figs. 7 and 9 for installation details.

Turn the frame over and connect the leads soldered to the normally closed lug on one switch to the wiper lug on the adjacent switch, as in Fig. 4. We have shown the hookup between alphabetically arranged switches merely to indicate electrical connectors.

When finished, turn the frame right side up and mount the matrix with the diodes facing up, as in Fig. 3. Connect the wire from the normally open (N.O.) lug on each switch to its corresponding letter or number buss (flea clip) on the left side and top of the matrix. The leads from the normally closed lug on switch A and the wiper lug on switch 9 will be connected later.

• **Relay and Components Chassis.** Details about mounting relays RY1 through RY7, capacitors, resistors and the power transformer are explained in the caption for Fig. 5. Before installing the relays, inspect their springs to see whether they allow the contacts to make good connections in the energized and de-energized positions. The armature should move freely when depressed with your finger. Closed-contact resistance should be 0.1 ohm. The coil resistance should be about 700 ohms.

• **Wiring To and Between Relays.** After all wiring to the relays has been completed, using Fig. 5 as a guide, refer to the table of Fig. 12. Start with RY7 and go down the line one lug (numbers at left) at a time both to make sure a connection *has been made* to that lug and to find out what connection must be made *from* that lug to another relay.

For example, under the column for RY7 there should be no connection to or from lug 1. For lug 2 there is the notation 7-8. To save space, we used shorthand and left out only the letters RY. In other words 7-8 is an abbreviation for RY7-8. Since this is in the box opposite lug No. 2 it means there should be a jumper from lug 8 on RY7 to lug 2 on RY7, the same relay.

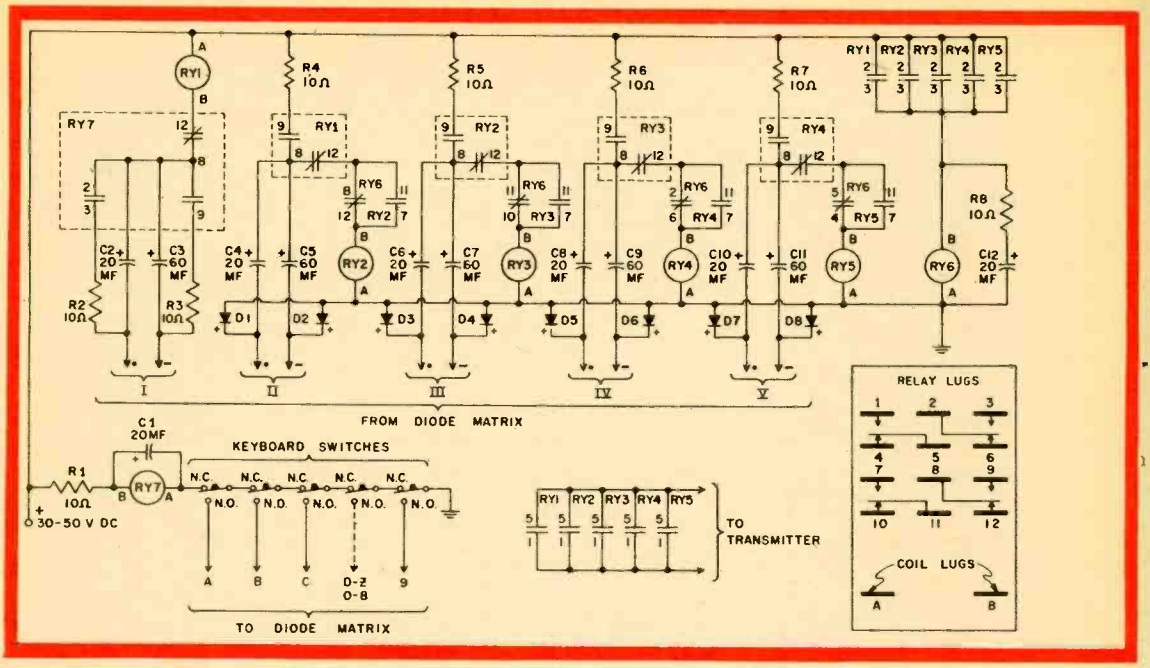
Let's try another. Go down the RY2 column to lug 7. Here you see 2-B and 6-12. Again, this is shorthand for RY2-B and RY6-12. This step tells you to connect a wire from lug 7 on RY2 to lug B on RY2 *and* to lug 12 on RY6. The table is set up so you *must* work from left to right, starting with RY7. Don't start in the middle. In some places you'll find the number of parts you installed earlier when wiring from Fig. 5. This is a good check on what you've done.

After all relays have been wired, install the chassis on the right side of the frame and connect the outputs (Group I, II, III, IV, V) on the matrix to terminal strips TS1 through TS5. Connect the wire from the normally closed lug on keyboard switch A (Fig. 4) to lug 2 on terminal strip TS1 and the lead from the wiper contact on keyboard switch 9 to lug 5 on terminal strip TS5. Build the power supply and connect a wire from TS6, lugs 1 and 2 to a plug to match your transmitter's input jack.

Operating Speed. Capacitors C1 through C11 determine the sender's operating speed. By doubling the value of the 20 mf capacitors (with the exception of C1 and C12) to 40 mf and the 60 mf capacitors to 120 mf, the speed will be about eight words per minute. By

PARTS LIST

R1-R8—10-ohm, 1-watt resistor
R9—5,000-ohm, 1-watt resistor
C1,C2,C4,C6,C8,C10,C12—20 mf, 50 V electrolytic capacitor (Lafayette C-100 or equiv.)
C3,C5,C7,C9,C11—60 mf, 50 V electrolytic capacitor
C13—100 mf, 50 V electrolytic capacitor
D1-D12 and 80 matrix diodes—750 ma, 100 PIV silicon top-hat diodes. Available for 9¢ each plus postage from Warren Electronics Co., 87 Chambers St., New York, N. Y. 10007.
S1—SPST feed-thru switch
T1—Power transformer: primary 117 VAC; secondary 25 V @ 1 A (Allied Radio 61 G 421 or equiv.)
RY1-RY7—4PDT relay, 24-volt DC, 700-ohm coil. Allied Control Co. # TAT-4C. Available for $3.21 each plus postage from Newark Electronics Corp., 223 West Madison St., Chicago, Ill. Catalog No. 59F481.
Keyboard switches—SPDT microswitches. Available at 5 for $1 plus postage from Herbach and Rademan, Inc., 1204 Arch St., Philadelphia, Pa. 19107. Catalog No. TM-7059.
Misc.—130 flea clips (Lafayette MS-263), 18x7-5/16-inch perforated board (Lafayette MS-916), #18 buss wire (Belden 8019 or equiv.), terminal strips.



CODE SENDER

Fig. 8—Schematic of sender. Because of complex relay wiring, we used industrial symbols. Fig. 11 shows how these symbols are related to the type normally used in EI schematics. Use this schematic as a final check on all wiring.

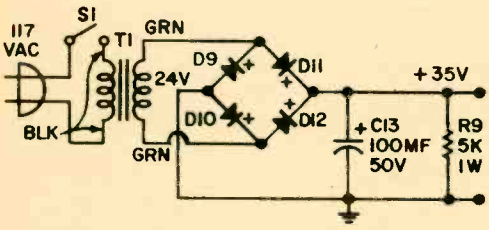


Fig. 6—Power supply. Full-wave bridge rectifier will provide a stable 35-volt output for sender.

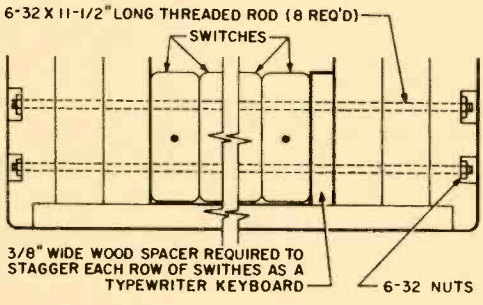
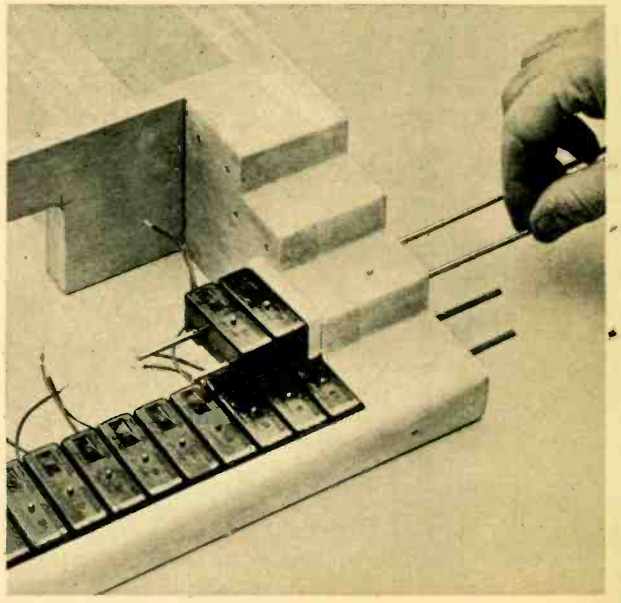


Fig. 7—Cutaway view of keyboard shows how the microswitches are mounted and are held in place.

Fig. 9—Notice how the microswitches are stacked one row above the other and offset slightly so keyboard will resemble that of a typewriter.



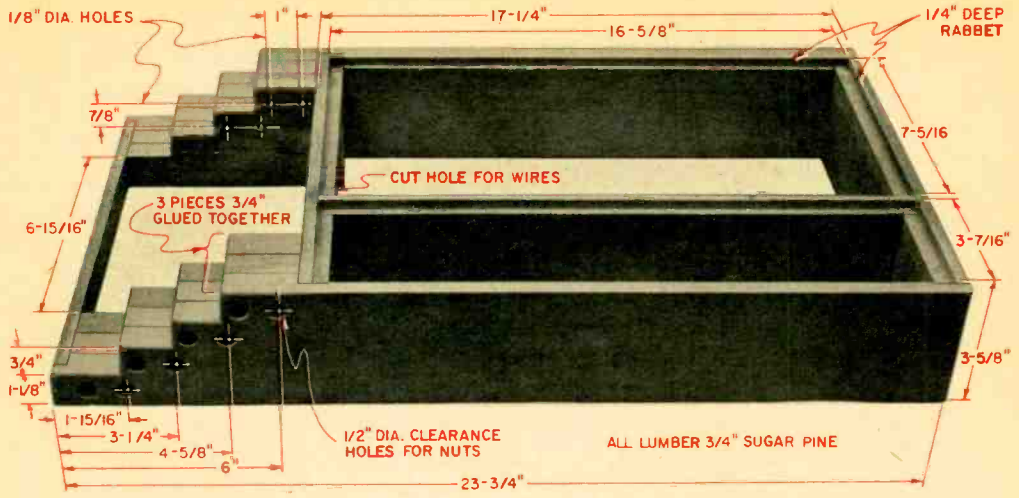


Fig. 10—Frame for the sender is built entirely of ¾-inch-thick sugar pine. Check switches before installing. It will be a big job to remove one of the dowels from the ½-inch-diameter nut-clearance holes if switch has to be taken out. Matrix and relay chassis can be covered with 12x17x4-inch chassis.

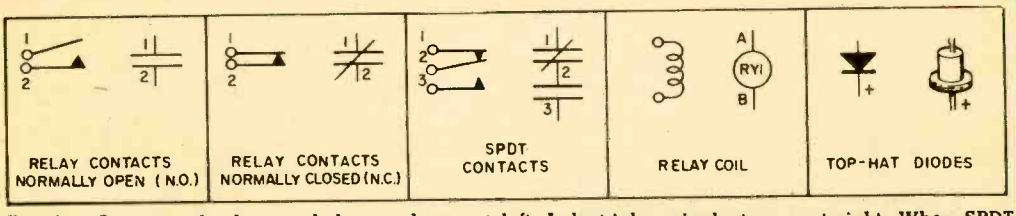


Fig. 11—Our normal relay symbols are shown at left. Industrial equivalents are at right. When SPDT relay armature transfers, think of diagonal line moving from contacts 1 and 2 to contacts 2 and 3.

LUG NOS.	RELAY NOS. RY7	RY1	RY2	RY3	RY4	RY5	RY6
1	-	2-1	3-1	4-1	5-1	TS6-1	-
2	7-8	B+	B+	B+	B+	B+	-
3	R2	2-3	3-3	4-3	5-3	6-B	-
4	-	-	-	-	-	-	-
5	-	2-5	3-5	4-5	5-4	TS6-2	-
6	-	-	-	-	-	-	-
7	-	-	2-B,6-12	3-B,6-10	4-B,6-6	5-B,6-4	-
8	C2,C3	C4,C5	C6,C7	C8,C9	C10,C11	-	-
9	R3	R4	R5	R6	R7	-	-
10	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-
12	1-B	2-11,6-8	3-11,6-11	4-11,6-2	5-11,6-5	-	-
A	TS1-2	B+	GND	GND	GND	GND	GND
B	R1,C1	7-12	2-7	3-7	4-7	5-7	R8,5-3

Fig. 12—Connections to and between relays. Empty boxes (especially RY6) don't mean there are no wires on lugs. Connections may have been made before and when working right from RY7.

halving the value of the capacitors to 10 and 30 mf, the speed will be about 25 words per minute. Always keep a 3-to-1 relationship or the dashes won't be three times as long as dots. Don't use capacitors smaller than 10 mf and 30 mf.

The capacitance of electrolytics, especially cheap ones, often is different from what's printed on the label. A variation of ± 20 per cent won't matter. But if the dashes sound like dots, connect a small-value capacitor in parallel with C3, C5, C7, C9 or C11, depending on which dash in a string of five is too short. Capacitors C2, C4, C6, C8 and C10 determine the length of the dots. C2 and C3 are the first dot or dash in a string of five.

The sender's speed also is affected by

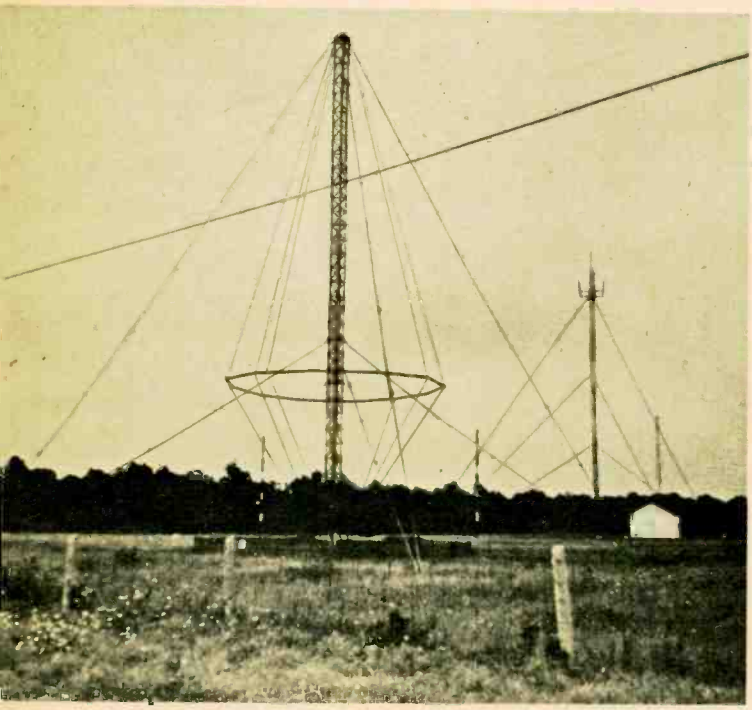
[*Continued on page* 112]

THE LISTENER

SWL-DX NOTES

BY C. M. STANBURY II

LONG WAVE . . . The low frequencies always have possessed a mysterious attraction for a relatively small group of serious DXers, this corner included. And, thanks to this interest, low-frequency receivers now are readily available. For example, the R. E. Goodheart Co., Box 1220, Beverly Hills, Calif., still has a few BC-453 receivers on hand for $12.95 plus shipping charges. Further, while the majority of stations on the low-frequency bands still are CW beacons, a number of voice broadcasters now can be logged and verified.



Stations below the broadcast band make use of some unusual antennas. This array belongs to the Aeradio outlet at Wiarton, Ontario.

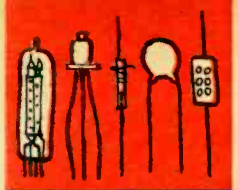
Many of these stations are operated by the Federal Aviation Agency and describe weather conditions at every major air terminal 24 hours a day. Identification, usually made every six minutes, consists simply of the location—"Cleveland Radio," "Detroit Area Radio," and so on.

If you pick up one of the stations and want to try for a QSL, address your report to Officer in Charge, Aeradio, Federal Aviation Agency at the appropriate location. Many will verify via letter. In the event that the stations you hear don't reply to your first report, a self-prepared card for them to sign and mail back likely will do the trick.

Our illustration, incidentally, shows the Aeradio transmitting antennas at Wiarton, Ont. This station operates on 326 kc, with weather broadcasts scheduled for 22 and 52 minutes past each hour.

Another type of long-wave broadcast station, much more difficult to hear, is that species located in Europe and intended for the general public. Fortunately, the current low sunspot count means that DXers east of the Mississippi have a real chance at them. Best bets are theBBC facility at Droitwich, England, on 200 kc (one of the world's oldest broadcast stations) and Radio Luxembourg on 233 kc. The English station relays the BBC's Light Program, feeding 400 kw into an antenna some 700 feet high.

British Honduras and Up . . . BCB DXers now have a first-class source for Central American "research" right on their favorite [*Continued on page* 114]



BEGINNERS PAGE

Multiplying a Meter

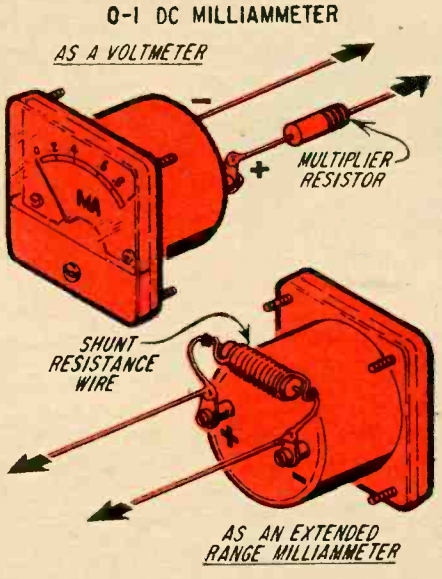
HAVE you wondered how you could use the 0-1 ma DC milliammeter we've often mentioned in this series to measure voltage or higher currents? It's easy. *Multiplier* resistors will convert it to a voltmeter and *shunt* resistors will extend its range to 10 or 100 ma, or even to several amperes.

We'll tackle converting it to a voltmeter first. For a 1 ma milliammeter to indicate 10 volts full-scale, just connect a 10,000-ohm resistor in series with either of the meter's leads. How'd we get this value? By using our old friend Ohms Law ($R = E/I$) and dividing the full-scale voltage desired by .001, the meter's present full-scale current range in amperes ($R = 10/.001$).

The original scale markings must now be multiplied by 10 and read as volts. That is, 1 ma now represents 10 volts, .5 ma is 5 volts. The resistor value for other ranges is obtained the same way. For a range full-scale of 1 volt, use a 1,000-ohm resistor. One hundred volts full-scale requires a 100,000-ohm resistor. For 500 volts full-scale, use a 500,000-ohm resistor and multiply each scale number by 500. If the needle points to .5 ma, you're measuring 250 volts. For greatest accuracy, use 1 per cent resistors.

A bit more work and arithmetic are required to adapt a 1 ma meter to measure higher current. First thing to do is look in a parts catalog to get the internal resistance of your meter. Generally it's between 50 and 100 ohms for 1 ma meters.

Then use this formula to determine the shunt resistance: $R_s = R_m/(M - 1)$. R_s is the shunt resistance desired, R_m is the meter's internal resistance and M is what's called the multiplying factor. Here's the way R_s is determined to convert a 1 ma meter with an internal resistance of 100 ohms to make it indicate 100 ma full-scale:



Since 100 ma is 100 times the meter's original full-scale current range, M is 100. R_m, we'll assume, is 100 ohms. Putting these values into the formula gives us $R_s = 100/(100 - 1)$, which equals 100/99, or 1.01 ohms.

Precision resistors of this value are available but it's more practical to wind your own on a piece of wood or on a high-resistance, 2-watt carbon resistor. For ranges up to about 200 ma, use No. 32 enameled copper wire, which has a resistance of .167 ohms per foot. To find the exact length for the 100 ma range, divide the resistance required by .167. The answer is 6.04 feet, but 6 feet will do. Connect the shunt resistor *across* the meter's terminals.

For current ranges between 200 ma and 1 ampere, use No. 24 wire; its resistance is .026 ohms per foot. For information about other wire sizes, refer to the wire tables in electronic reference books.—*H. B. Morris.*

CB

A CBer who has constructed much of his own equipment, Lee Marks, 8W2086, is equally handy with a hammer. Three EI projects—a modulation meter, a tune-up meter and a power-output meter—are visible in this photo, and Lee himself built the 12- x 20-ft. shack during his vacation. Lee hails from North Little Rock, Ark., where he is active in Civil Defense work. What little spare time he has goes into repairing neighbors' radio and TV sets.

PRIZE SHACKS

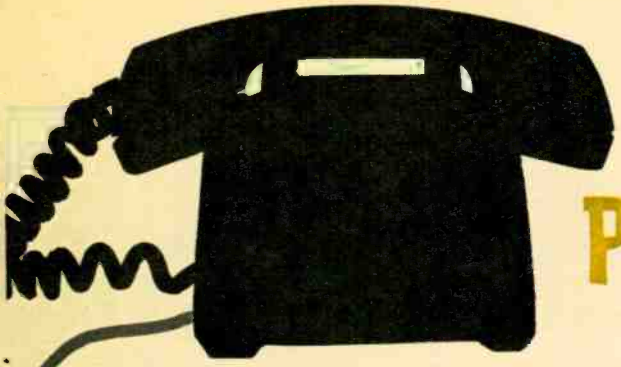
PROUD of your ham, CB or SWL shack? Want to win $20, and see a photo of you and your shack in EI to boot? You can—if your photo is one of the lucky winners in EI's Prize Shacks contest. Just send your photos to EI Prize Shacks, 67 West 44th St., New York, N.Y. 10036. Include some information about yourself, your equipment and your activities, and write your name and address on the back of each photo. We prefer 8x10-inch glossies, and non-prize-winning entries will be returned. All set? Then let's see those Prize Shacks photos roll in!

HAM

Only 17 years old, Joseph Brunke, W9ACG, of Junction City, Wis., has over three years of hamming behind him, and he says he thinks ham radio is the finest hobby in the world. Equipment in his small but cozy shack includes a Hallicrafters HT-37 transmitter as well as National NC-270, Hallicrafters SX-111 and Lafayette HE-50A receivers. W9ACG is the proud possessor of a WAS certificate, which perhaps bears out his nickname—Skip.

SWL

The young SWL in this photo is none other than Bob Wood, whose QTH is Tilbury, Ont., Canada. Bob has been an SWL for a little over a year and a half and he has dozens of QSL cards in his collection. A member of the Canadian DX Club, Bob also edits the Buyer's Guide section of the CDXC paper. Bob relies on an RCA Q33 receiver for the bulk of his SWLing, but he also keeps a Westinghouse 750T5 BCB receiver on hand for standby use. His antennas include a 50-ft. inverted-V and a 50-ft. long-wire. Soon to be added is a loop for BCB DXing.



TEN BUCK PHONE PATCH

By Herb Friedman, W2ZLF

WHY let your fellow hams get all the kicks from handling phone-patch traffic (and collect those rare QSL's) when for a ten-dollar bill you can join the fraternity?

In case you're not familiar with "handling phone-patch traffic," here's what it's all about: a patch connects the input of your transmitter and the output of your receiver to your telephone line. Anyone who can be reached by phone can carry on, via your station, two-way radio communication. If *you* want to get in on the conversation you listen and talk with your telephone handset.

Sound like fun? It is, and handling phone-patch traffic can serve a useful purpose. For example, it enables a serviceman overseas to talk with his family at home—at modest rates.

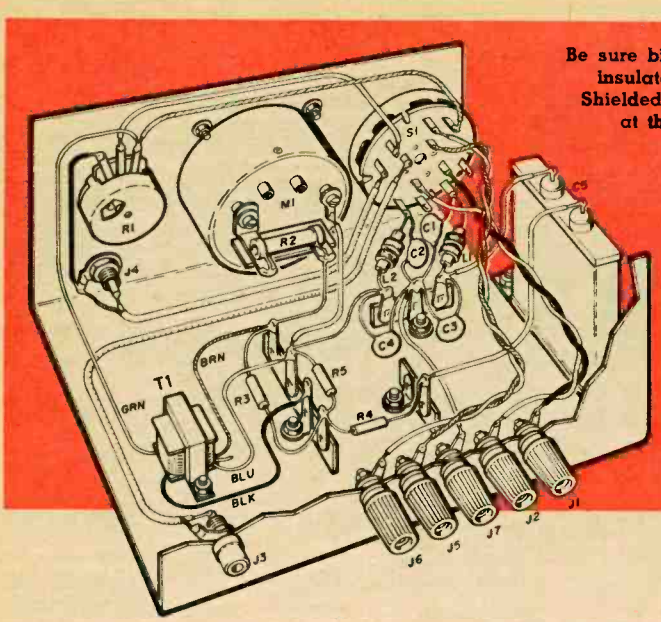
Our phone-patch has all the important features—an RF filter to prevent your transmitter's output from jamming the neighborhood phones, a calibrated VU meter that indicates zero VU (not 10db down) when you feed the maximum permissible signal into the telephone line and a level control which governs how much your transmitter will be modulated by the incoming signal on the phone line. Our patch *cannot* be used for VOX operation.

For reasons we won't go into, you rarely can modulate a transmitter 100 per cent with a VOXed patch. Sometimes it is even difficult to achieve 25 per cent modulation. You can modulate right up to 100 per cent with our patch, but you'll have to switch from transmit to receive manually. If your transmitter is equipped with VOX, you still can use the patch but, of course, you must switch manually.

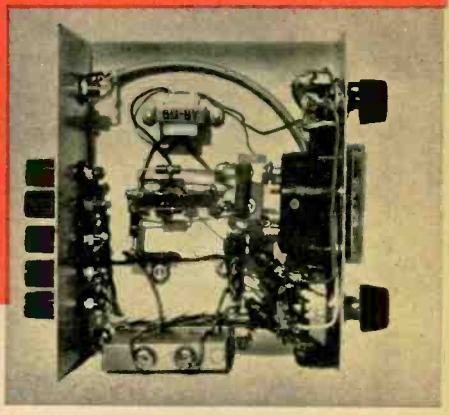
Construction

Our model is built in the U-section of a 3x4x5-inch Minibox. Wiring and parts placement are somewhat critical, so your layout should follow the pictorial as closely as possible.

You'll have no difficulty in seeing when the signal into the phone line is about to exceed a safe limit: our patch is designed so 100 per cent, or zero VU, corresponds to maximum level.



Be sure binding posts J1, J2, J5, J6 and J7 are insulated from cabinet with fiber washers. Shielded leads from J3 and J4 are grounded at the jacks only. The unused lead from T1 should be cut short and taped.



TEN BUCK PHONE PATCH

Note that the shielded leads from J3 and J4 to S1 are grounded at J3 and J4 only. To prevent a clipped strand of the shield from shorting S1's contacts, dress the ends at S1 with tape.

The hole for M1 can be made with a 1½-inch chassis punch. Since the hole in the mounting foot on the terminal strip at the rear of M1 is larger than M1's stud, place a #4 internal star washer on both sides of the mounting foot.

C5 must be a non-polarized capacitor. Do not use an electrolytic.

M1's location in the circuit differs from that in other patches. It is connected on the receiver side of the T-pad (R3,R4,R5,) rather than on the telephone-line side. This causes M1 to indicate zero VU, or 100 per cent, rather than a mere wiggle around —10db, when the maximum permissible signal is fed into the phone line. R2, a 3,600-ohm resistor, is supplied with M1.

Running a Patch

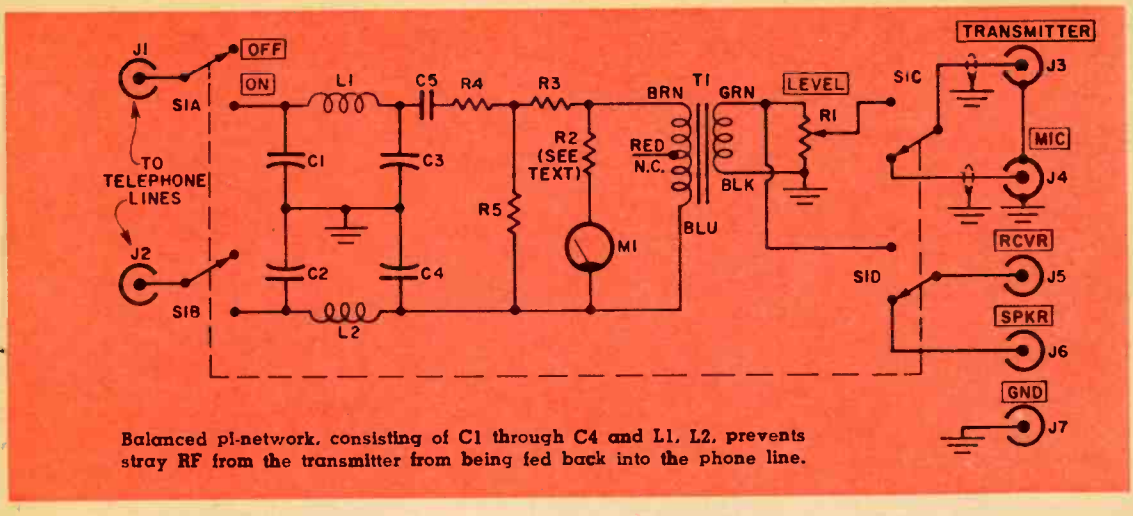
Connect your mike to J4 and your transmitter's input to J3. Connect the receiver's speaker-output leads to J5 and J7 and connect the speaker to J6 and J7 (J7 is the common-ground terminal).

If your telephone has a two-wire circuit (private ringing) connect J1 and J2 to the two wires in the phone company's connecting block (usually mounted near the baseboard). If you have a three-wire circuit (party-line ringing) connect J1 and J2 to the talking pair—usually the red and green wires.

When S1 is in the *off* position, station operation is normal; that is, your mike is connected to the transmitter, the speaker is connected to the receiver and the patch is disconnected from the phone line. When S1 is set to *on*, the mike is disconnected from the transmitter, and the transmitter input and

PARTS LIST

R1—100-ohm potentiometer
R2—3,600-ohm resistor (supplied with M1)
R3,R4—270-ohm, ½-watt, 10% resistor
R5—360-ohm, ½-watt, 10% resistor
C1-C4—.001 mf, 500 V disc capacitor
C5—4 mf, 150 VDC non-polarized capacitor (Lafayette CF-115 or equiv.)
L1,L2—50 microhenry RF choke (National R-33, Allied Radio 61 G 116 or equiv.)
M1—VU meter (Lafayette TM-10)
T1—Transistor output transformer: 500-ohm primary, 3.2-ohm secondary (Lafayette TR-95)
J1,J2,J5,J6,J7—Insulated 5-way binding posts
J3,J4—Jacks to match existing microphone connectors
S1—4PDT rotary switch (Mallory 3242J)



Balanced pi-network, consisting of C1 through C4 and L1, L2, prevents stray RF from the transmitter from being fed back into the phone line.

the receiver output are connected to the phone line.

When handling patch traffic, always make the telephone contact *before* you set S1 to *on* and explain to the party being called that only one person can speak at a time. (Don't dial the number with S1 *on* or the dial pulses may damage the VU meter.) Tell the person on the phone that when he wants you to switch to listen he should say *over*. This will be your cue to switch from transmit to receive. Do not broadcast these preliminary instructions, the dial tone or conversation with the operator. After your instructions have been understood set S1 to *on* and start the air contact.

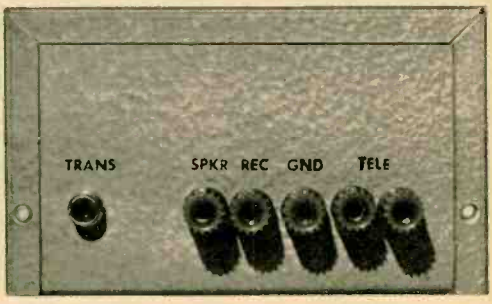
Adjust the level of the signal from the receiver into the phone line with the receiver's AF or RF gain control so M1 indicates zero VU (100 per cent) on speech peaks. The signal should not cause M1's needle to go beyond the 100 per cent mark or the phone line will be overloaded and crosstalk will result. (Don't bother the phone company and they won't bother you.) Keep your hand on the receiver's gain control during the conversation to prevent fading from dropping the signal in the mud.

When transmitting the incoming telephone signal, adjust R1 for maximum modulation on the opening words. Since your mike is disconnected when you use the patch use your phone's handset to get in on the conversation if need be.

As the level of your voice may be 30db or more higher than the level of the voice on the phone, you must speak in practically a whisper. On the other hand, if you adjust R1 for maximum modulation with your voice, the voice on the line will hardly be audible.

If the person you want to contact by phone isn't available, you can record the message from your receiver on tape if you have a recorder. Later, connect the tape recorder's speaker output to the patch's receiver terminals (J5 and J7) and feed the taped message over the phone line.

The patch has a speaker input impedance (at J5 and J7) of 3.2 ohms, so it can be connected to any recorder with an output impedance of 3.2 to 8 ohms. You *cannot* feed the preamp output of the tape recorder into the patch.



Lead from jack marked "trans" (J3) goes to transmitter modulator input and should be shielded.

THE HAM SHACK

BY ROBERT HERTZBERG W2DJJ

BIG DOINGS. . . Now's the time to flip your log book ahead five or six pages and make a notation: "1964 National ARRL Convention, August 21, 22 and 23; Hotel New York Hilton." Since it will be celebrating a half-century of amateur radio, this promises to be a bang-up affair. Naturally, there'll be plenty of exhibits, demonstrations, technical sessions and—you name it.

Herb Hoover, Jr., W6ZH and League president, will be toastmaster at the Saturday night dinner. What's more, Senator Barry Goldwater, W7UGA/K3UIG, will be featured speaker. With the New York World's Fair in full swing by August, what could be a better time to load the XYL and harmonics into the family car and head for little ol' New York?

All In The Mind. . . A recent visitor in my shack was a ham who's on phone exclusively. He seemed much impressed as I carried on a CW interchange with another operator without writing down any of the latter's transmissions.

"How can you remember what he's saying?" he asked.

"Dunno," I replied, "I just listen." Then I ventured, " 'Copying in the head' becomes natural after a while, like learning a language by living where it's spoken. Besides, if I wrote down what the other chap actually sent I'd be confused by his little errors. You just get the sense of Morse, but that's what counts."

Couple of days later I was startled to hear my friend on CW.

"This is more fun than just gassing into a mike," his key stuttered out, more or less accurately. "Having a ball. Also working all kinds of DX."

QRP . . . To go on the air with a full kilowatt takes only money. But to work consistent DX with a tenth of that power takes skill—and luck. This challenge appeals to so many hams that a private organization called the QRP Amateur Radio Club already has enrolled 700 members in all parts of the world.

You, too, can join if your input is 100 watts or less (200 watts PEP on sideband). And, once a member, there's a chance of winning certificates for operating achievements. For more dope, send a stamped and addressed envelope to Jim Perry, K4WVX, 2691 56th St., St. Petersburg, Fla. 33710.

Those strange noises you sometimes hear when W2KR is on the air may be Caesar's efforts to get into the act. Raised from puppyhood in Mort Kahn's shack, this ferocious-looking but surprisingly gentle dog is almost W2KR's second op. Mort, by the way, is a real old-timer, having had the same call since 1921. Gear in his impressive shack at Great Neck, N. Y., includes an Eldico 1-KW transmitter and a Collins KWM2 driving a 30L1 1-KW linear. Well known as a consultant on SSB, Mort recently jetted around the world testing out SSB equipment.

GOOD READING

By Tim Cartwright

SILICON CONTROLLED RECTIFIER HOBBY MANUAL. Edited by T. O. Reich. General Electric Co., Auburn, N. Y. 70 pages. $1

GE's publications for hobbyists usually are excellent, and this little book is no exception. Its pages contain several good (and fairly simple) projects for anyone who likes to tinker with semiconductors. And they provide enough material to keep a hobbyist busy for a long, long time.

The useful gadgets you can build include a regulated battery charger, a Variac, a plug-in speed control for portable tools, a control center for a model railroad, an enlarger photo timer and several kinds of flashers. Our illustration, below, taken from the book, shows one of the more novel items: a hookup which enables you to light an electric bulb with a safety match.

A STRESS ANALYSIS OF A STRAPLESS EVENING GOWN And Other Essays for a Scientific Age. Edited by Robert A. Baker. Prentice-Hall, Englewood Cliffs, N. J. 192 pages. $3.95

If the scientific world is just a bit too much for you at times, dip into this book for some fast, fast, fast relief. Here are some fine spoofs (many of them pretty savage) aimed at some vulnerable targets. Unlike some satire on scientific and technical subjects, this anthology doesn't fall flat from too much "in" jargon. The contributors, ranging from physicist Leo Szilard to novelist John Updike, write for anyone with a sense of humor and an eye for what's going on in the world.

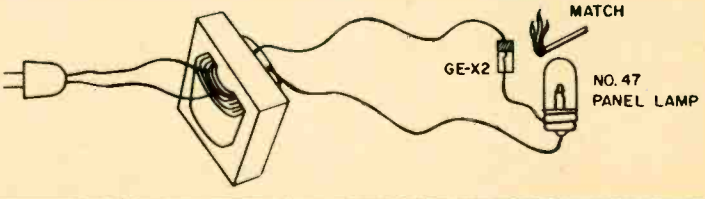
Though the book pokes fun at every*one* from archaeologists to AMA members and every*thing* from scientific progress to logic, the real targets (as always) are stupidity, stuffiness and our ever-growing tendency to take ourselves too seriously. Not all the darts hit home, of course. The title story is rather labored and so are a few other entries. But, by and large, this is a book you can take as a tonic any time the world of computers and rockets gets to be too much.

BASIC MATHEMATICS, Volume 4. By Norman H. Crowhurst. John F. Rider, New York. 138 pages. $3.90

No spoofing here. Math, we all know, is a deadly serious business. (Remember what it used to do to your high-school average?) This is the final volume of Mr. Crowhurst's re-education series, and by now he is a good way beyond the basic 2 + 2 stuff. In fact, this volume might be described as a collection of complex applications of complex formulas. But now seems a good time to say that the series as a whole has been a good attack on a subject that still scares some of the people who need it most. It's definitely worth looking over.

And make note of . . .

KNOW YOUR VOM-VTVM. By Joseph A. Risse. Sams. 144 pages. $2.50



This simple circuit from GE's SCR Hobby Manual should be a natural for party stunts. Built around one of GE's light-activated switches and a filament transformer, it permits you to light a panel lamp much as you would light a candle.

GLANCE at the merchandise-for-sale columns in the papers or look over the second-hand equipment shelves at a hi-fi dealer and you'll notice many quality mono amplifiers for sale. They've been traded in for stereo. And when you give second thought to their price you'll realize quickly it's possible to go stereo for a lot less than you imagined.

But two mono amplifiers are difficult to operate. For one thing, speaker switching and phasing will involve disconnecting and reversing a lot of wires. Our switch box coordinates the amplifiers conveniently at their outputs.

Set mode switch S2 to *stereo* and amplifier 1 and amplifier 2 will be connected to speakers 1 and 2, respectively. Set S2 to *stereo reverse* and amplifier 1 is fed to speaker 2 while amplifier 2 drives speaker 1. If you haven't gotten around to buying a stereo cartridge and must use a mono job for mono records, set S2 to *mono* and amplifier 1 will drive both speakers. (An 8-ohm load resistor is then connected to amplifier 2.)

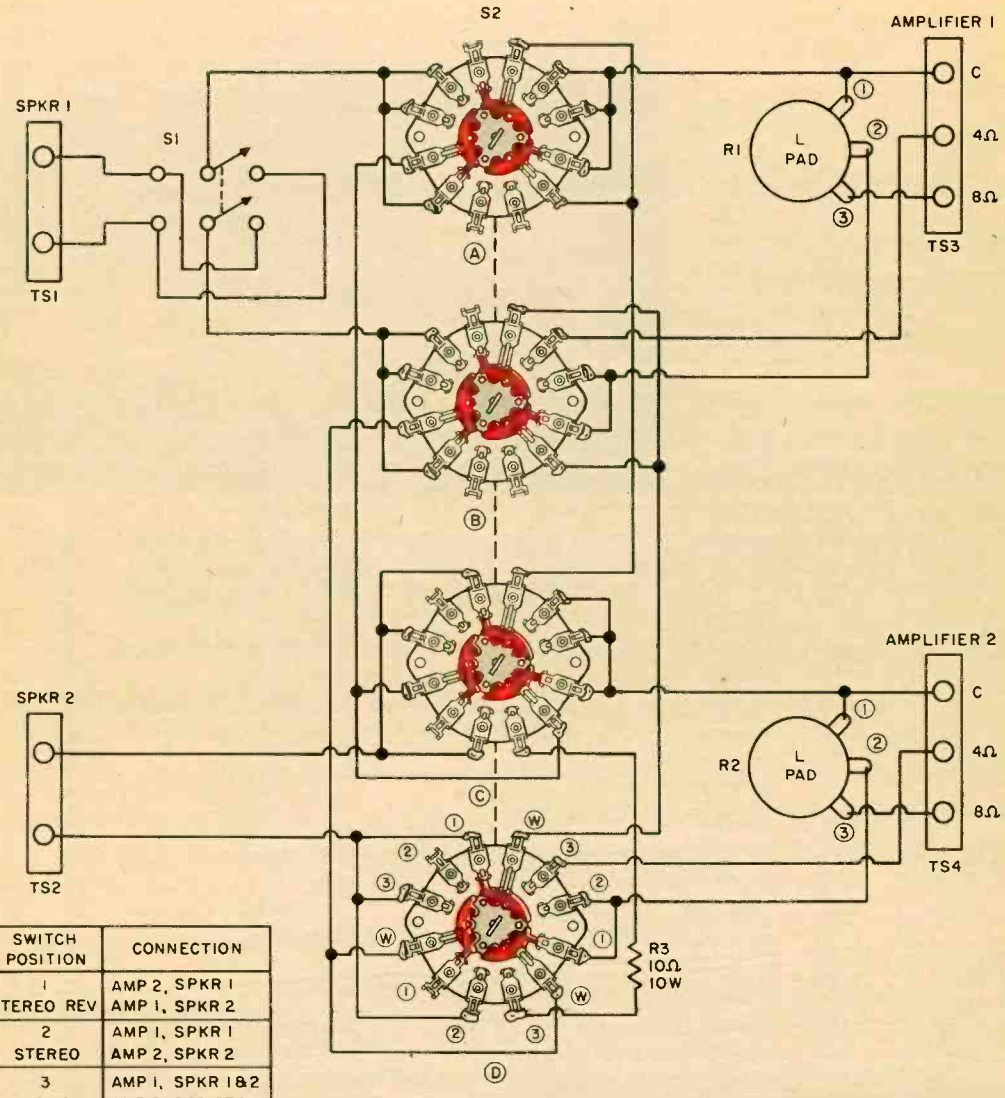
The two L-pads (R1, R2) come assembled together and have concentric shafts. This means you set the volume controls on both amplifiers to about the same position and adjust balance and volume to your own satisfaction with the easy-to-grip concentric knobs on the front of the switch box. Our model was built in a 9x7½x 4½-inch wooden box, but you could use a metal cabinet. Only complicated job is assembling switch S2. It is made up of a Centralab index assembly and four rotary-switch sections. Assembly hints are in the captions on the next page.

The diagram on the right is a combination pictorial and schematic. The switch sections are shown in exact detail. Section A is mounted at the knob end of the switch shaft. If the impedance of your speakers is 8 ohms, connect the inputs at TS3 and TS4 to the corresponding impedance taps on your amplifier. If your speakers are 16 ohms, move the leads on the 4-ohm taps to the 8-ohm taps, and move the leads on the 8-ohm taps to 16-ohm taps (not shown on the schematic).

If speaker phasing is incorrect, flip S1, which reverses the leads to TS1.

going STEREO the EASY way

By Erwin V. Cohen

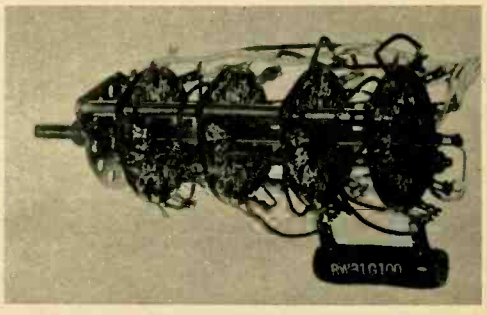


SWITCH POSITION	CONNECTION
1 STEREO REV	AMP 2, SPKR 1 AMP 1, SPKR 2
2 STEREO	AMP 1, SPKR 1 AMP 2, SPKR 2
3 MONO	AMP 1, SPKR 1&2 AMP 2, RESISTOR
SWITCH SHOWN IN POSITION 1	

Circled numbers are switch positions. Wipers (color) turn counterclockwise from position 1.

PARTS LIST

R1,R2—Dual 8-ohm L-pad (Lafayette VC-55)
R3—10-ohm, 10-watt wirewound resistor
S1—DPDT rotary or toggle switch
S2—Special switch made with Centralab P-271 index assembly (Allied Radio No. 35 B 498; $2.10) and four Centralab LD phenolic sections (Allied Radio No. 35 B 158; $1.05 each section) Stock numbers are from Allied Industrial catalog. Allow for postage when ordering.
TS1,TS2—2-screw terminal strip
TS3,TS4—3-screw terminal strip



Be sure when assembling S2 that none of the sections are turned around 180 degrees. Use the wiper lug (circled W), near screw hole in section D at bottom of schematic, to guide yourself.

By C. M. Stanbury II

DXing the SLIGHTLY SHORT WAVES

Many a rare foreign station can be yours for the tuning, on frequencies only a little above our broadcast band.

AS MOST ANY SWL is well aware, DXing the broadcast band often resolves into a war on two fronts. On one, you're fighting weak signals as best you can. On the other, you're calling up your reserves to battle enemy No. 2: static. All in all, BCB poses a tremendous DX challenge, especially in view of a third factor which steadily is strangling interest. Enemy No. 3 is interference—QRM. And you'd better spell it with a capital Q. After all, the number of BCB stations has more than doubled since the end of World War II, and the percentage of stations operating all night roughly has quadrupled.

Other Frequencies. So how would you like an interference-free broadcast band—or one that's almost that way? There is one, you know, and it's just now opening up. It's the 120-meter "tropical band," which you might put in the *slightly* short-wave category. Technically speaking, 120 includes those frequencies between 2300 and 2498 kc. According to international agreement, only broadcast stations in the tropics can make use of it. Elsewhere, it's open to utilities—marine, police, an occasional radioteletype. Few of these operate continuously and this accounts for that reduction in QRM.

Though the band has existed for more than ten years, it has generally been ignored in this hemisphere. Brazil ranks as pioneer user, with at least a dozen active stations. In North America, the veteran 120-meter broadcaster is the Dominican Republic; two Dominican stations currently on 120 are Radio Santa Maria (2380 kc) and Radio San Pedro (2400 kc). Over in neighboring Haiti, two missionary stations use the band: world-famed 4VEH at Cap-Haitien (2450 kc) and 4VU (Radio Lumiere) at Aux Cayes (2410 kc).

Other Voices. In Africa, two countries—South Africa and Southern Rhodesia—presently occupy 120-meter channels. Over on the other side

Interesting programs are the rule rather than the exception on 120-meter DX, and there is plenty of excellent fare to choose from. Ionospheric conditions will affect reception, but best listening periods usually will fall between sunset and sunrise.

of the world, Indonesia has taken up numerous 120-meter channels since becoming independent. Matter of fact, Indonesia doesn't have a single transmitter on the standard broadcast band!

Though 120-meter Indonesian stations seldom are heard in the U.S., HLK50 in Seoul, South Korea, operates on 2510 kc with 10 KW. And while technically not within the band or in a tropical location, HLK50 (originally HLKA) generally is considered one of 120's top DX catches.

Chances are, though, that the 120-meter stations you log first will be in Latin America and that you'll pick them up during evening hours. Our table provides you with some good targets, all well worth trying for.

With so many new clear channels at your disposal, now's the time to learn more about the fascinating phenomena of distant medium-wave reception. For instead of 106 BCB channels, you're now faced with a possible 126!

DX GUIDE TO 120 METERS

FREQ. (KC)	CALL	IDENTIFICATION	LOCATION	NOTES
2326		R. South Africa	Paradys	Afrikaans
2346		R. South Africa	Paradys	English
2350	YDW	R. Republik Indonesia	Pontianak, Borneo	Indonesian and other languages; rare
2376		Springbok R.	Paradys	English and Afrikaans (Commercial Service of Republic of South Africa)
2380		R. Santa Maria	Santa Maria, Dominican Republic	Spanish
2390		R. por um Mundo Melhor	Governador Valadares, M.G., Brazil	Portuguese; ID with chimes
2400		R. San Pedro	San Pedro de Macoris, Dominican Republic	Spanish
2410		R. Sirena	Santa Leopoldina, E.S., Brazil	Portuguese
	4VU	R. Lumiere	Aux Cayes, Haiti	French, Creole, English
2420	ZYJ2	R. Caraja	Anapolis, G.O., Brazil	Portuguese
2425			Gwelo, Southern Rhodesia	English
2450	ZYR63	R. Cultura	Aracatuba, S.P., Brazil	Portuguese
	4VEH		Cap-Haitien, Haiti	French, Spanish, English; drifts to 2430 kc
2460	ZYR99	R. Cacique	Sorocaba, S.P., Brazil	Portuguese
	YDR	R. Republik Indonesia	Jakarta, Indonesia	Indonesian and other languages; rare
2510	HLK50	K.B.S.	Seoul, South Korea	Korean; see text

The 'MINI R'

By Brice Ward

A palm-size resistance substitution box that goes from 1 to 1,111,110 ohms in 1-ohm steps.

CUT and try are the key words when determining the exact parts values required to get an experimental project to work properly. And when it comes to resistors, not only is it impossible to have *all* values at hand, it is a nuisance to keep trying different sizes until you find just the right one. Wiring a pot in the circuit, adjusting it, then removing it to measure its value isn't the fastest or most convenient way, either.

Solution—the Mini R—a resistance substitution box which, at the flick of a switch gives you resistance up to 1,111,110 ohms in 1-ohm steps. The Mini R, which uses 1 per cent, ½-watt resistors, isn't much larger than a pack of cigarettes and could easily get lost on your workbench.

To save time and money, you can purchase a complete kit of parts and assembly instructions for $18.95. The parts list gives the details.

How does it work? Simple! Take a look at the schematic and consider just the first decade, made up of S1 through S4 and the 1-, 2-, 3- and 4-ohm resistors, and assume J2 is connected to the bottom of the 4-ohm resistor.

When all switches are open the resistance between J1 and J2 is 10 ohms. Close S2, S3 and S4 and 1 ohm is left. Open S2 and you've got 3 ohms. Close S1 and S3, open S2 and S4 and you get 6 ohms. Close S1 and S2, open S3 and S4 and you've got 7 ohms. And so it goes right down the line with the five other decades which are connected in series.

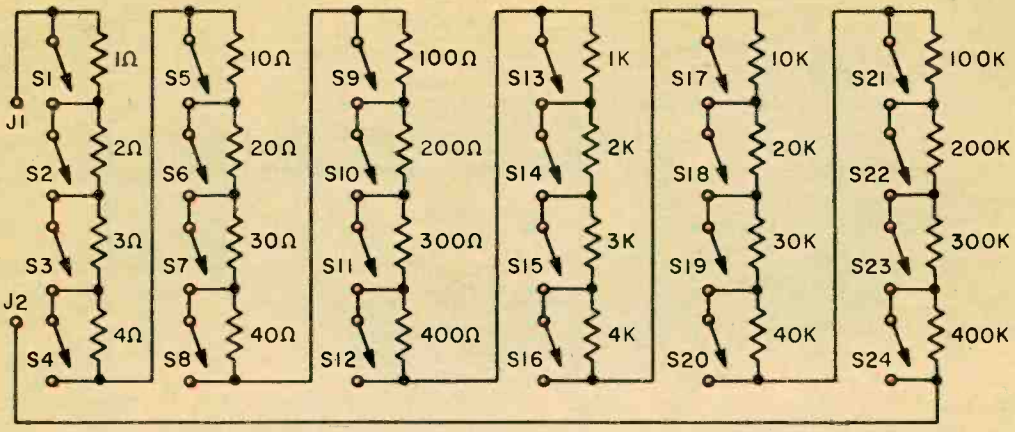
With all switches open, the resistance between J1 and J2 is 1,111,110 ohms. Start off with all switches closed and open only those that add up to the value you require.

Construction is a snap. We mounted all 24 switches on a 2-11/16x3¾x1/32-inch-thick panel. Further construction details are covered in the diagrams and captions on the opposite page.

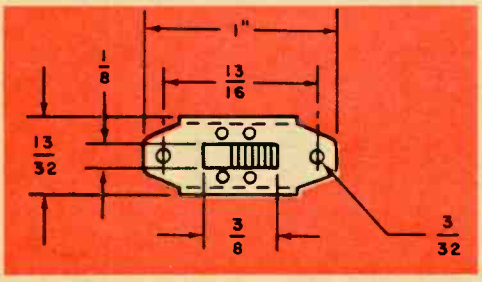
To save space only one 2-56x½-inch machine screw is used to hold two adjacent switches. Cut the rectangular hole for the switch slider by drilling two ⅛-inch holes and filing them out.

PARTS LIST

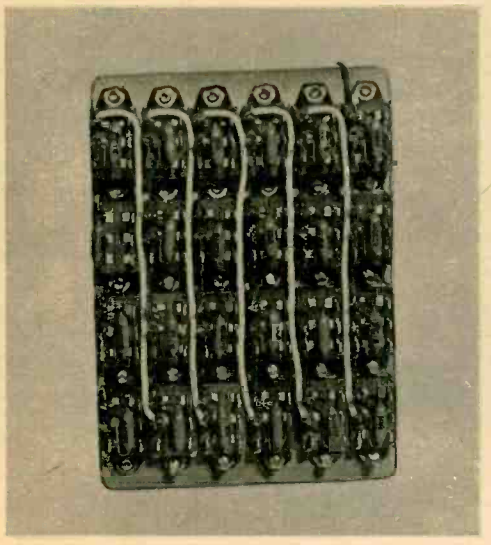
Resistors: ½ watt, 1%
1,2,3,4,10 ohms—Continental Wirt Type NA-15 (48¢ ea.)
20,30,40 ohms—Continental Wirt Type NA-15 (65¢ ea.)
100 through 400,000 ohms—Continental Wirt Type CF-15 (54¢ ea.) Resistors are available at prices listed above, plus postage, from Center Industrial Electronics, 74 Cortlandt St., N. Y., N. Y. 10007.
S1-S24—Continental Wirt Type G-126 midget DPDT slide switch. Available for 29¢ each for the lot from Newark Electronics Corp., 223 West Madison St., Chicago, Ill. Stock No. 23F527.
Kit of parts including case, punched panel, resistors, switches, wire and connectors is available for $18.95 postpaid from Techni-Kits, Inc., 350 Broadway, N. Y., N. Y. 10013.



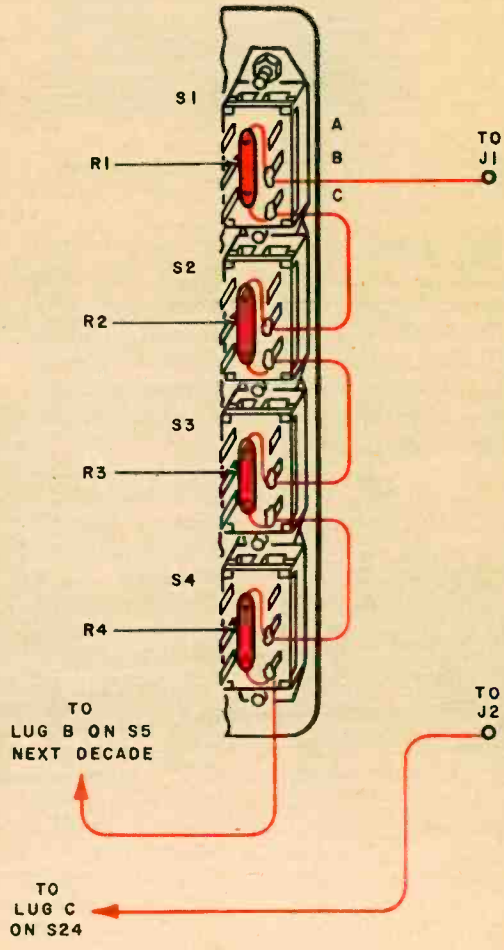
When all switches are open, resistance between J1 and J2 is 1,111,110 ohms. Closing a switch subtracts value of the resistor associated with it. Close S23 and resistance at J1, J2 is 811,111 ohms.



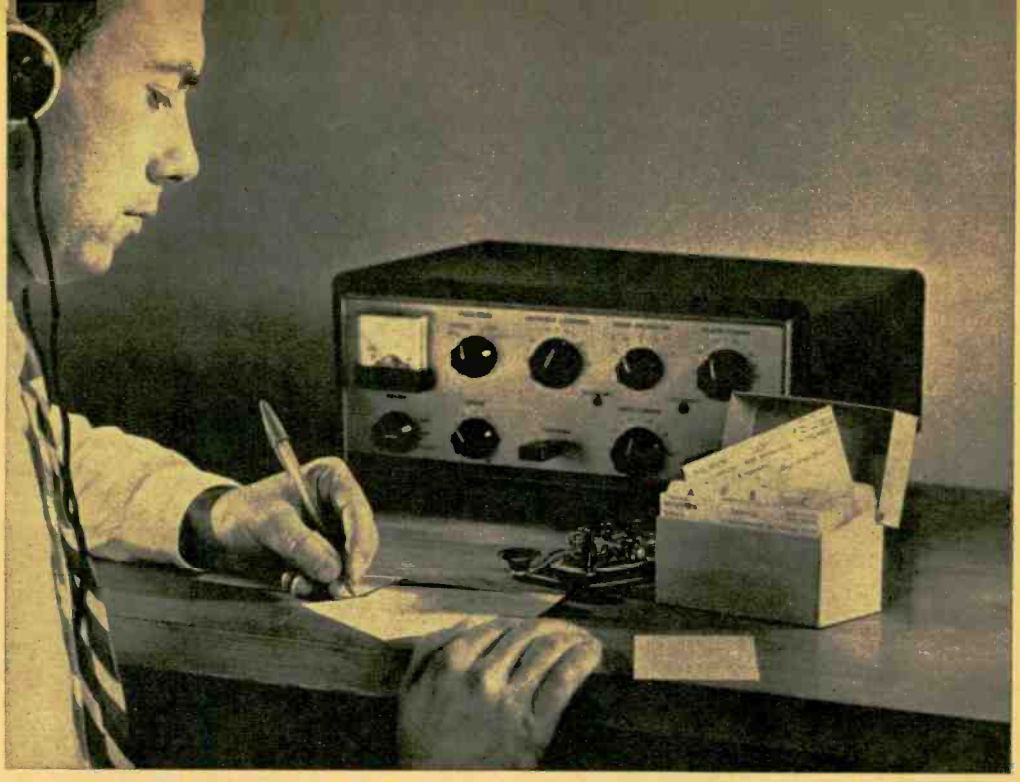
If you plan to cut and drill your own panel, use the dimensions above for the special miniature switches we have specified in parts list.



Space is tight so watch out for shorts. A small-tip iron will make the wiring job much easier.



R1, R2, R3, R4 correspond respectively to 1-, 2-, 3-, 4-ohm resistors. Wire other decades similarly.



MEMORY BOX FOR HAMS

ELEPHANTS have terrific memories, or so the story goes. We don't know of any elephants who are hams, but we have run into a few rare hams with elephant-like memories. We also have come across ham after ham with perfectly normal memories, which is to say that theirs are pretty much like ours—about as good as a sieve. But that's where EI's Memory Box comes in.

Let's say the call letters of the station you're working are familiar to you and that you're super-certain you've worked the station before. But dollar-for-doughnut or kilowatt-for-key, you can't remember the other ham's handle, QTH or anything else about that previous contact. Solution? Easy—just call on EI's Memory Box.

As you can see from the photo, the Memory Box is nothing more than a common recipe holder which you can pick up at most any variety store for about 35¢. Inside are some ordinary 3x5 file cards and alphabetical index dividers. What you put on the cards is up to you, but call letters, name, address, telephone number, date, if and when QSL cards were sent and received, and the like are all mighty useful bits of information.

The way you arrange the cards also is up to you, but it will depend in part on the type of operating you do. If most of your contacts are within the U.S., a straight alphabetical listing by call (ignoring the first letter and call area number) seems best. However, if you work a lot of DX, you might use a completely separate section of the Memory Box or even another Memory Box for foreign stations.

When establishing a contact or hearing a CQ, immediately flip through your Memory Box. If you haven't worked the station before, make out a new card as you're listening. And, if it's a station you've worked before, sit back with the assurance that you'll startle the guy at the other end with your marvelous memory. Meanwhile, of course, you can be adding more notes.

In short, nibble a few peanuts, and an elephantine memory is yours—if you have EI's Memory Box handy.

—Fred Blechman, K6UGT

Machines That Listen

Continued from page 38

Dr. Harry F. Olson of RCA's Princeton Laboratories thinks maybe we hear by syllables rather than phonemes. His voice-operated typewriter identifies syllables by checking the frequency, duration and position in the word of each sound it contains. From that information, it identifies the word.

Olson's equipment works this way. The sounds from the microphone are fed into a compressor-amplifier and come out all at the same volume level. This constant-amplitude signal then goes to eight filters, each of which detects sound within a certain frequency band.

Following each filter is a timing device which measures the duration of the sound. Each of the eight timers then turns on any of five relays connected to it, depending on how long the sound lasts. A light bulb hooked to each circuit shows which relays are on.

Speak words into the analyzer and a pattern of lights determined by the frequencies of the sounds spoken and the duration of each appears on the panel. Each different word switches on a different pattern of relays.

To make the machine operate a typewriter, Herbert Belar, who works with Olson, spoke the phoneme "i" (as in *ice*) into the microphone 100 times. Although there were some variations in the light pattern depending on Belar's inflection, he found that relays 1, 2 and 5 closed every time. These, he decided, were those essential in the recognition of the sound "i."

Therefore, he wired the contacts of these three relays in series so that every time they closed simultaneously, the "i" signal appeared at the output. (The actual circuitry is much more complex, but this illustrates the principle.) The "i" signal energizes a solenoid under the "I" key of the typewriter which raps out that letter. Other sounds were wired to special circuits which type out syllables that require more than one letter—"the," for example.

The machine works beautifully now, but with a few limitations. First, it works reliably only for Belar. Other voices vary too much in quality for the machine to know for sure what they're saying. And second, it recognizes only about a hundred syllables.

That's a good start. You might operate a machine with it that needs only a limited number of sound inputs—a cash register, for example. But to be really practical for a wide range of uses, a machine would have to recognize just about anything said. And two new machines demonstrated within the last year show promise of some day being equal to that challenge.

First of the new systems is Sceptron. At Sperry Rand's laboratories in Great Neck, N. Y., I recently saw Sceptron inventor Robert Hawkins speak this sentence into a microphone. "Every time we say the number five the Sceptron will recognize it." As the "five" was spoken, a small luminous board flashed the digit "5."

Sceptrons, according to Sperry, can recognize words spoken by a wide variety of speakers. Only problem is getting enough of them hooked up together to recognize a sufficient number of words to be practical. Each word takes a pair of Sceptrons. Complex words take more. And right now, considering the fact that it takes thousands of different words to adequately express a number of ideas, connecting up enough Sceptrons may take some doing.

Meanwhile, RCA scientists in Camden, N. J., are working on what could turn out to be another extremely fruitful approach to voice recognition. The best speech analyzer known, reasoned T. B. Martin and J. J. Talavage, is a human ear hooked to a human brain. Why not try to build a machine to operate as much like this super-efficient device as possible?

Figuring out what goes on in a man's ear and what signals the ear sends to the brain isn't simple. But investigators in bionics—the science of studying living systems to see how their principles can be applied to machines—are learning more about hearing every day.

The ear, they found, responds to sounds in many different frequency

[*Continued on page* 119]

HI-FI TODAY

By John Milder

- *News and views re transistor sound*
- *A second look at frequency contouring*
- *Vacuum tubes in kits without frills*

A **FEW WEEKS** ago, I shelled out a dollar for gas and putted off in my Volkswagen for a grand tour of hi-fi plants in Boston, New York and Philadelphia. Objective? Some first-hand information on transistors. After reading all the fine print in many a test report, I still wasn't sure what solid-state stereo had to offer. I particularly wanted to find out: (a) whether *transistor sound* really is as new and different as they say it is, and (b) whether it is better or worse than *tube sound*.

So off I went to see a few engineers. Back I came with: (a) a lot of interesting information, and (b) a lot of conflicting opinions about the advantages and drawbacks of transistors. Here's a quick rundown.

First of all, I'd better point out that everyone I met wanted to talk almost exclusively about *amplifiers*. As for transistor tuners, most designers seemed quietly intent on equalling what they already had done with tube units.

Nobody needed to point out, of course, that solid-state diodes are naturals for the switching circuitry of multiplex equipment; after all, the diode has long since taken over this function in tube tuners. But beyond that point, no one really made clear what transistors had to offer in tuner circuits (except for the traditional promises of low-heat operation and long life).

Everybody, though, was eager to talk (and argue) about transistor amplifiers. One idea had almost unanimous support: for a given power rating, transistor amplifiers seem to offer higher effective power than tube amplifiers.

Why? Well, without getting too technical, one explanation might go this way. Unless checked by an amplifier's power supply, transistor output stages can keep putting out the watts until they merrily destroy themselves. Instead of clipping a few watts above rated power, they keep going for quite a distance with only a gradual rise in distortion. Their distortion does jump eventually, but it's all different from the behavior of tube amplifiers.

Here, of course, we can begin to see why the test labs keep reporting that transistor amplifiers pack a surprising punch. Here, too, we pin down another characteristic of transistor sound—that unstrained quality people keep talking about. But is that the whole story on transistor sound? Not by a long shot.

By now, practically everybody has pointed out that transistor output stages operate in a modified Class B. That is, only half of an output circuit is connected to the speaker at a given moment; the signal is shuttled back and forth between the two halves of the circuit. This *can* lead to what some engineers dub switching distortion—a distortion component that creeps in during the actual switchover process and that may remain fairly constant at all power levels.

This kind of distortion may read as intermodulation on test instruments, and its percentage obviously rises as power output goes down. And this may be part of the reason for something else the test labs have been reporting—high IM distortion in some amplifiers at low volume and (sometimes) an unpleas-

[*Continued on page* 120]

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CASTRO SPEAKS

Fidel Castro, once a star pupil and a star athlete, today ranks as one of the world's most ballyhooed dictators. His government has executed hundreds of dissidents, and many thousands of Cubans have made their way to freedom outside Cuba. A Communist in the Khrushchev camp, Castro warmly embraces the Russian concept of Marxism and depends on full-fledged support from Comrade Khrushchev & Co. for the very life of his regime. Castro airs his views on the short-wave bands via Radio Havana Cuba. In addition, a number of Cuban broadcast-band stations can be heard throughout much of the United States and Canada. Why not give a listen?

SINCE THE ADVENT of a Communist Cuba just a stone's throw beyond the Florida Keys, the North American broadcasting picture has changed radically. True, Castro's voice on the short-wave bands—Radio Habana Cuba (RHC)—usually gets most of the headlines. But in many areas of the U.S., Red propaganda in both Spanish and English can be heard on any broadcast radio. And, with all due credit to SWBC, a Red broadcast on BC is considerably more effective than any of the Red SW transmissions.

Most Cuban broadcasting organizations nominally maintain their individual identities. But all use the slogan, "Cuba, Territorio Libre de America," and all serve primarily as government propaganda outlets. On the other hand, three (in addition to RHC) can be singled out as major projects in themselves. These are Radio Free Dixie, station CMCA and Circuito CMQ.

Radio Free Dixie uses facilities of the Radio Progreso network and is an attempt to exploit the current civil rights campaign here in the U.S. In this regard, Radio Free Dixie provides ammunition for both the ultra-right and the ultra-left.

The key R. Progreso transmitter is powerful CMBC at Havana on 690 kc. However, CMBC suffers strong interference from station WAPE in Jacksonville, Fla. (which for some mysterious reason has been granted a full-time license). Further west, station WTIX in New Orleans gives CMBC a real run for its money. But all is not lost, for R. Free Dixie is provided with alternate channels via lower-powered relays on 670, 680 and 700 kc.

Station CMCA transmits both English and Spanish every evening as The Friendly Voice of Cuba on 730 kc. Aimed at the highbrow, it mostly features classical and semi-classical music, with an occasional Castro-style newscast.

By and large, CMCA seems to be out to build an audience now for some strategic moment later on. Therefore, don't be surprised to find R. Free Dixie suddenly appearing on 730 kc.

Circuito CMQ broadcasts entirely in Spanish, and its chief task is to sell Communism on an international scale to the Cuban people themselves. This is accomplished via a nightly program at 2200 EST. Produced alternately by various European and Asian Communist governments (Russia, North Korea, East Germany and Czechoslovakia, among others), these transmissions consist of music from the featured country interspersed with what you might call chamber-of-commerce type propaganda.

In pre-Castro times, at least, CMQ itself operated with 50 KW from Havana on 630 kc; its primary relay, CMHQ at Santa Clara, was a 10-KW outlet on 640 kc—a clear channel in the Eastern U.S. Now some listeners believe that CMQ and CMHQ have swapped frequencies, but there is no real proof of this.

Both CMBC and CMQ claim the same SW affiliate—station COCO. This transmitter was last listed on 9530 kc, and it still occasionally is reported as on the air. However, consensus among most SWL's is that the announcements and reports are erroneous.

On the other hand, Radio Habana Cuba is certainly no short-wave myth. Its basic installations are Czech-built and apparently consist of three transmitters. However, additional frequencies often are added, probably via former private SWBC facilities, such as COCO.

RHC has four English transmissions daily. Broadcasts to Europe are scheduled at 1520 EST, those to South America at 1600 and those to North America at 2200 and 2400. Our chart lists probable frequencies, but keep in mind that they change constantly.

The RHC programs have two major aims —sell Communist Cuba (at our expense) and promote Moscow's international poli-

Smoking one of the cigars that have made his nation famous, the bearded bully of Cuba holds the dubious distinction of being the world's most colorful Communist. Fidel Castro was born in 1927, raised in upper-middle-class surroundings. As a law student at the University of Havana, he first coupled his phenomenal drive with his interest in politics by leading a student revolt against Cuba's former ruler, Fulgencio Batista y Zalvidar. Dictator since Batista's banishment in 1959, Castro makes no bones about his own political philosophy. Mr. Castro puts it this way: "I am a Marxist-Leninist and will be one until the day I die."

....TO US

cies. The latter usually are put forward in tougher language than that used by Radio Moscow itself, thus suggesting that some of Castro's propaganda reflects a Chinese influence.

Over half of RHC's schedule is in Spanish for Latin America, where Castro hopes to export revolution. This involves supporting such Marxist allies as British Guiana's Cheddi Jagan (THE LISTENER, November 1963), Venezuelan revolutionaries (THE LISTENER, January 1964) and so on.

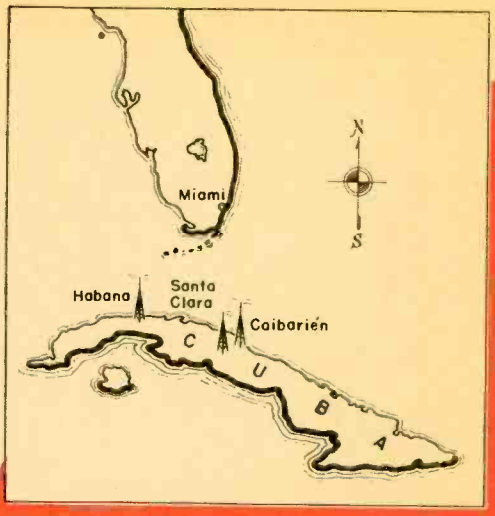
As evidenced by R. Free Dixie, Castro's propagandists are extremely sharp. An example is their handling of the Haitian crisis. In this Caribbean republic, "Papa" Duvalier is absolute dictator, and dictatorships are excellent breeding grounds for Communism. But Duvalier differs from other Latin American strongmen in one important respect. He does not use the threat of Communism as an excuse for his totalitarian methods.

Castro apparently sees in this a chance to enter Haiti via the front door. RHC does have a nightly broadcast to Haiti in French (1200-2200 EST on 6060 kc), but it was *not* lengthened during the crisis last May. Nor does RHC disguise itself as a "Radio Haiti Libre" or another similarly inflammatory pseudonym.

An interesting sidelight to this situation is furnished by the Haitian government station, Radio Commerce at Port au Prince, operating on 5985 or 9545 kc. This station, in effect, seems to be playing the game with Castro. Throughout all its propaganda broadcasts, Cuba almost never is mentioned.

Radio Habana Cuba also has French for Europe and the Near East every day, Italian irregularly for Europe, Arabic to the Near East and Portuguese for South America. Finally, Castro has made yet another contribution to North American broadcasting—jamming of the noise-maker variety. Like RHC frequencies, Cuba's jamming deployment varies. But primary targets are Miami's WGBS (710 kc) and WMIE (1140 kc), as well as Radio Americas.

—*C. M. Stanbury II*



Map shows sites of major Cuban transmitters; table below gives full information on Cuban stations now on the air. Frequencies vary, as explained in text.

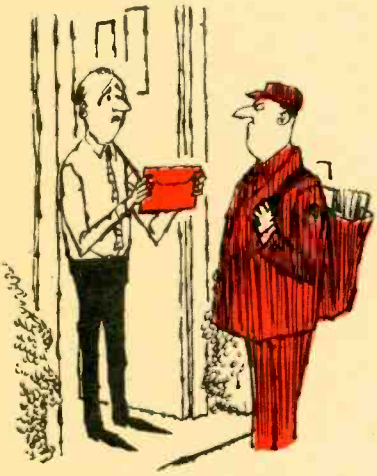
CASTRO SPEAKS TO US

CUBAN RADIO AT A GLANCE

FREQ. (KC)	CALL	LOCATION	ID
630	CMQ	Habana	Circuito CMQ
640	CMHQ	Santa Clara	Circuito CMQ
670			R. Progreso
680			R. Progreso
690	CMBC	Habana	R. Progreso R. Free Dixie
700			R. Progreso
710	jammer		
730	CMCA	Habana	The Friendly Voice of Cuba
830	CMBZ	Habana	R. Salas
1010	CMBP	Habana	R. Musical Nacional
1060	CMBI	Habana	R. Encyclopedia Popular
1140	jammer		
1160	jammer	Caibarien (?)	
6000	jammer		
6060			R. Habana Cuba
6135			R. Habana Cuba
9530	COCO	Habana	
11715			R. Habana Cuba
15135			R. Habana Cuba
15225			R. Habana Cuba

OVER AND OUT

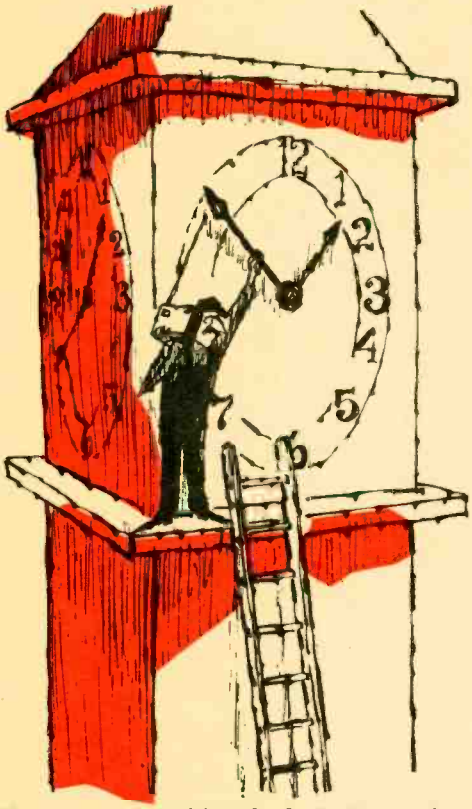
BY Rodrigues



"Sure, I meant to give him my zip number, but there was a lot of QRM that night . . ."

"You know, Charlie, I think you're pulling my leg."

"From Ceylon. He won't QSL . . . runs only 10 watts . . . says he knows I'm lying. . . ."



"National Bureau of Standards, WWV . . . when the tone returns the time will be . . ."

"I don't care if it is raining cats and dogs. The sunspots are still spoiling reception."

CB Equipment

Continued from page 78

But improvement is an open-ended process. There's always room for more. Quite understandably, there isn't too much that can be done with the foundations of any good rig: sensitivity, selectivity and power. As we've seen, the state-of-the-art has brought about significant advances in these areas. But what about such homely items as:

• Transmitter Filament Switch. Why be compelled to keep transmitter tubes lighted when you're listening most of the time? Too few rigs provide the inexpensive switch that permits the mobile operator to conserve his car battery while monitoring.

• Test Jack. Instead of the usual jack for checking plate current, what about an octal socket that would permit fast readings of all principal circuits?

• Standard Antenna Connectors. Pity the poor fellow whose system is composed of products by several manufacturers.

• Mobile Mounts. Shock-mounting is barely known in CB. The lack of it can mean shorter component life, premature breakdown. And rare are the mounts that let the operator pull his rig quickly for service. How about more thumbscrews, wing nuts or other quick-release fasteners?

• Better AVC. The marginal AVC circuits in many mobile CB rigs demand that the driver adjust volume frequently under varying signal conditions. Greater driving safety alone is reason enough for AVC circuits that would keep speaker output reasonably constant.

• Remote Control. Only one manufacturer offers an under-dash control head for a rig mounted in the trunk. Small control boxes would be a boon to limited space installations.

• Audio Punch. Once the basics are taken care of, speech compression circuits are the simplest way to add punch to intelligibility. Why have they been largely ignored by original equipment manufacturers?

• PA Feature. Whether you're running a club picnic, jamboree or aiding a parade, the several watts of audio in your rig could come in very handy.

What lies ahead for CB equipment? Our guess is that it probably won't escape total transistorization. After all, CB is primarily a mobile medium and solid-state devices neatly solve problems of size, weight, power drain, heat and shock. However, except for low-power walkie-talkies, CB largely has eluded the transistor because of cost.

But the picture is changing. From an operational standpoint, the idea of a pocket unit equally suitable for home, car and field isn't too fanciful. Armed with his miniature rig and its selective call and paging alarm, the CBer will be able to say, more aptly, that he truly has a telephone without wires.

CB Service Set

Continued from page 54

signal level with R4. If the signal level is too great, the receiver's AVC will counteract your adjustments making correct alignment impossible. If your rig has an S-meter, set S1 to IF and adjust the IF transformers for peak S-meter indication.

To align transceiver front ends, set S1 to RFM, use the lowest possible input signal (control it with R5) and using the manufacturer's instructions, work for peak meter indications.

For additional information about alignment and troubleshooting, see CB SERVICING MADE EASY, May, July and September, '62 EI's.

An Automatic Code Sender

Continued from page 85

the power-supply voltage. Increasing the voltage to 50 volts will reduce the speed approximately 20 per cent. Reducing the voltage will increase the speed somewhat. Don't raise the voltage above 50 volts or the PIV of all the diodes may be exceeded.

Before going on the air, operate all switches in random fashion for a while, holding the key down until all the code components in a character have been produced.

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The new Heathkit 16-watt Stereo Amplifier (illustrated above) represents not only "extra savings", but a superbly designed unit with plenty of versatile high fidelity/stereo capabilities for all-around performance.

Versatility!...has four stereo inputs for *magnetic phono* as well as ceramic phono cartridges, tuner and an auxiliary source such as a tape recorder. Ideal for use in a "second" music system, or for the beginner who wants an inexpensive, yet "up-to-date" unit.

Performance!... delivers a *continuous* power response of ± 1 db from 30 to 30,000 cps at 8 watts per channel! In addition, there's a mono/stereo switch; a dual concentric volume control for adjusting the level of both channels individually or simultaneously; full-range tandem-type controls for simultaneous adjustment of both channels; 7-tube amplifying circuit consisting of two 4-stage preamplifiers; and two push-pull power output stages. The power supply is a complete transformer operated full-wave silicon-diode circuit.

Styling!...the compact, "fit-anywhere" steel cabinet is richly fashioned in a new Heathkit color styling of mocha brown with black accents and beige trim.

Easy-to-build!... with simple-to-follow instructions and point-to-point wiring.

Extra Savings!...costs just $39.95—compare it to units costing twice this low price.

Kit AA-32..15 lbs.....$39.95

SPECIFICATIONS—Simultaneous power output per channel: 8 watts (16 watts total); IHFM music power output per channel: 10 watts (20 watts total). **Frequency response:** ± 1 db from 30 cps to 30,000 cps at rated output. **Harmonic distortion:** (at rated output) 2% @ 20 cps, 0.7% @ 1000 cps, 2% @ 15,000 cps. **Intermodulation distortion:** (at rated output) Less than 3% using 60 and 6000 cps, mixed 4:1. **Hum & noise:** Mag phono input 48 db below rated output. Aux. input, 65 db below rated output. **Channel separation:** 42 db @ 30 cps, 45 db @ 1000 cps, 30 db @ 15,000 cps. **Input sensitivity:** Mag phono, 6 mv; Cer. phono, 250 mv; Tuner, .25 V.; Aux. .25 V. **Input impedance:** Mag phono, 47 K ohm; Cer. phono, 2.2 meg.; Tuner, 470 K ohm; Aux. 470 K ohm. **Outputs:** 4, 8, and 16 ohm. **Damping factor:** 9. **Feedback:** 18 db. **Tube complement:** 3-6EU7 and 4-ECL-86 (6GW8). **Power requirements:** 105-125V. 50-60 cps AC. 85 watts at 120 volts. **Dimensions:** 13¼"W x 4-11/16"H x 9¾"D.

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HF-156R

The Listener

Continued from page 86

band. The station is Radio Belize, recently moved to 835 kc, where it often provides U.S. listeners with a highly respectable signal.

British Honduras, which is still recovering from 1961's devastating hurricanes, is due for partial independence shortly. However, this process is complicated by Guatemalan claims on the territory. About ten years ago when Guatemala was saddled with Latin America's first Communist dictatorship, these claims were pressed vigorously. Today, Guatemala has an anti-Communist regime, but it still is after some territory in British Honduras—especially the Caribbean port of Belize. Listeners will be able to keep tabs on this situation via Radio Belize's local newcast at 2000 EST.

In the event you haven't already caught on, this LISTENER has been devoted to frequencies *below* short wave. Even so, all three of the stations we've mentioned can be heard on the SW bands. Radio Belize uses 3300 kc, and the BBC has more frequencies than you can count. Radio Luxembourg is heard most often on 6090 kc from 0000 until approximately 0200 EST.

Notes . . . To further prove that we aren't neglecting good old SWBC, we'll let you in on something new in short wave, too. For one thing, R. Caribe in the Dominican Republic has been taken over by Radio Santo Domingo-Television. The station's anti-Communist broadcasts, aimed at Cuba, still are carried at 2245 EST (on 9505 kc), but there now is a broadcast for Haiti at 2100 and English news at 2200 . . .

Here's something for all West Coast SWL's: South Vietnam has been in the headlines for quite a spell and promises to stay there even longer. If you want to tune in direct, you'll find that the government SWBC station has English news at 0600 PST (0900 EST) on 7273 kc. While you certainly couldn't call it accurate, the point of view at least will be "original." Why not give it a listen and judge for yourself?

Ready For Rescue

Continued from page 50

furnishes all manner of booklets and courses on emergency practices and procedures. In addition, it sometimes is possible for the Emergency Corps to tie in with a local drug store to obtain first-aid kits or emergency medicines at cost or even free. Remember, this is good publicity for a drug store.

Speaking of publicity, it is always wise to get some publicity for the services which your club members are giving to the community. One method is to post signs along the highways which lead into your area, announcing the club monitoring channel. Other methods, such as newspaper publicity, have been discussed at length in previous issues. Publicizing the club's activities paves the way for closer cooperation between the club and community officials.

Bowing Out. One thing which is extremely important to remember is that there often comes a point in a specific emergency situation where the services of the club no longer are required. It might be that the situation has reached proportions which make it hazardous for the members to remain on the scene. Or perhaps the authorities have the situation well under control.

In any event, when the club has been notified that it's time to pack up and go home, do so—and pronto. Don't wait around for thank you's. And don't be offended if officials seem somewhat brusk in their manner. It isn't that the assistance of the club is not appreciated; it is just that at times such as these authorities have more on their minds than social amenities.

Several days after the help is given, the club often will receive a cordial letter from the police or fire department offering thanks for services rendered. But whether the thank-you letter arrives or not isn't important. You are offering the facilities and services of your club as an aid to the community. Satisfaction in having done a good job certainly is thanks enough.

CB Corner

Continued from page 73

teur test and enjoy radio as a hobby."

How Big? Just how big, then, will CB grow? If the pace of applications keeps up, can 23 channels hold a staggering number of licensees in, say, five years' time? Loucks predicts that without any additional space, the existing band could contain *three* times as many CB licensees. There's an important proviso attached to his estimate: all CBers would have to stick strictly to legitimate operations. There'd be no room for chatter or hamming.

That CB is rushing headlong toward well over a million licensees is apparent from charts hauled out during our talk. The statistics tell the story: from a handful of applications in early 1958, the curve fairly flies upward. By the end of 1960, applications were reaching the Commission at about 10,000 per month. The year 1961 saw monthly rates as high as 14,000; 1962 crested at 19,623 during October. The figures show similar vigor for much of 1963, with a whopping 25,241 applications received in September. As this is being written, the total number of CB licensees stands at over a half-million.

Loucks himself believes that several factors will effect a levelling off in CB applications. For one thing, some ex-CBers have found a haven on the 6- and 2-meter ham bands where talking and testing are virtually unrestricted. Many business users, discovering the high value of 2-way radio through CB, might convert to one of the more protected frequencies, e.g., the Business Radio Service. Also, many current licenses will expire in a few years and produce a number of drop-outs.

Will the $8 license fee deter new applicants? The Chief doesn't think so. His view: "If a man can afford several hundred dollars worth of equipment, the license fee won't stop him."

Other Prospects. There is no safe prediction on how monies—from fees and fines—will affect law enforcement and other activities at the FCC. According to law, revenue simply is deposited in

the U.S. Treasury. Appropriations for the FCC still have to follow the usual route. In other words, the Agency submits a budget to Congress which does the actual doling out of funds.

Nevertheless, you can expect heightened FCC action in several areas. An electronic data processing system will slash the waiting period for licenses (and renewals) from months to one week. The average of six fines a week for CB violators definitely will increase. Reason: fines are relatively new to CB and the machinery is just swinging into high gear.

You also can expect to see the first CBer sued in Federal Court for not paying his fine. FCC hearings now in progress could lead to a court case.

On the technical side, Loucks sees no difficulty in the introduction of sideband for CB as long as it remains within existing rules. Shoddy equipment, on the other hand, may be up for closer scrutiny by FCC engineers.

In the past, the Commission has notified some manufacturers that their units did not comply with regulations. But now it is taking a hard look at the possibility of imposing the "Type Acceptance" requirement on all equipment makers. The manufacturer would have to take measurements on his product and certify to the FCC that it meets the specs. The process could eliminate marginal, poorly designed equipment.

In summing up his opinions on what's ahead for CB, Ivan Loucks probably reflects the thinking of many manufacturers, operators and organizations. In short, CB is here to stay. One encouraging sign is the ability of many clubs to help members "clean their own house" without an assist from the Commission. Loucks feels that a national CB organization with good leaders and a representative membership could make a similar contribution.

CB, after all, is needed from cradle to grave, as suggested by Chief Loucks' final observation. His comment: "It's being used by everyone from a diaper service operator to an undertaker." And therein lies the biggest hope that the road ahead, though rocky, will lead ever upward.

Electronic Wonders

Continued from page 32

society, science and history. The capsule is scheduled to be opened nearly 5,000 years in the future, in the year 6939.

While less than 25 of the 5,000 years have elapsed since the capsule was buried, Westinghouse officials feel that enough has happened in the intervening years to add a PS to the 1939 version.

Consequently, they're building another capsule to be buried next to the first. Among man's accomplishments not included in the 1939 capsule are atomic power, man in space, wonder drugs, polio vaccine, and so on.

At the exhibit, you'll see a full-scale replica of the original capsule and its contents, as well as the contents of the new capsule. And if you're not planning to be there to find out for yourself, you'll be interested in still another display. That one will show what Westinghouse scientists think life will be like when the time comes to open the capsule. What's your best guess at the nature of life among the earthlings come the year 6939?

Direction Finder

Continued from page 45

happens, solder a 10 or 20 mmf capacitor in parallel with C1. You should now be able to make the S-meter needle rise and fall by adjusting C1. If C2 or C5 doesn't produce a peak indication, try adding 10 or 20 mmf capacitors in parallel with them as described above. If this doesn't work, rewind L2 or L3, adding a few turns at the top or hot ends.

Except for the slider, tune the loop with C1 when you change channels and prior to each use. Another check on circuit performance can be made by connecting a milliammeter across S1 with the power turned off. You should get a reading of 1 to 2 ma.

Do not use the direction finder within close range of a 5-watt transmitter or it may be overloaded and Q1 will be damaged. In strong signal areas, there will be enough leakage through Q1 for the direction finder to work with the power off. And **never** use the direction finder for transmitting. It is intended for receiving only.

Using the Finder. Aim the flat surface of the loop in the general direction of a signal and rotate it for a *null* S-meter indication. In this orientation the wood pointer indicates a line along which the station lies. Since you'd also get a null with the loop rotated 180 degrees, you'll have to pull out a road map, a compass and take two fixes as shown in the diagram on the third page of this story. The transmitter is located where the lines cross.

Get plenty of practice before attempting serious work. A car's regular CB or broadcast antenna may cause unreliable results and will have to be lowered or tied down. Since the loop must be held above a car, signal sleuthing is a two-man operation.

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I certify that the statements made by me above are correct and complete.

(signed) GORDON W. FAWCETT

Machines That Listen

Continued from page 103

bands, and each band activates a set of neurons—nerve cells. Each neuron generates a series of digital pulses. And the louder the sound, the faster the pulses.

The neurons are interconnected in a highly complex way. The output from one neuron, for example, can keep another from reacting at all to its normal signal, or it may reinforce the response. The ear, in other words, is a complex data-processing device. The neurons react to a sound and extract tremendous amounts of information: which frequency bands contain the most and the least amounts of acoustic energy, how steep the slope is between high and low level areas, whether a plosive sound (p, let's say) precedes a fricative (s, for example) to give the "ps" sound or whether they switched around to "sp."

Innumerable facts about the sounds being detected by the ear are translated into a kind of digital code and routed to the brain. This computer-like device analyzes the signals and identifies the words being spoken from their characteristics.

Martin and Talavage have wired together hundreds of artificial neurons—small transistorized electronic circuits which react as much like living neurons as possible—into an ear-like circuit. Although it is still in a developmental stage, the bionic ear can already recognize the difference between such tough-to-distinguish sounds as "taw" and "kaw." Say them aloud and you'll see how little difference there is between them.

More complicated circuits, built on the same principle, may eventually form the basis for machines that hear and analyze the spoken word as readily as human listeners. For the Martin-Talavage artificial neurons have proven themselves capable of recognizing a wide variety of speech sounds. In time, they may well be able to do what people do: pinpoint a word's identity almost immediately, independent of pitch, inflection, expression or accent.

Continued from page 104

ant, spitty sound quality at low levels.

But just a minute. Many of the amplifiers that show high IM at low volume *don't* sound spitty. According to some engineers I've talked to, this is proof that switching distortion isn't critical.

Others say that high IM readings may not come from pure switching distortion. Instead, they suggest, they may stem from a failure to match the two halves of an output circuit in all respects—including the current gain of all transistors and their input impedances over the whole frequency range. The problem, they argue, stems from bad design, not limitations of Class-B operation itself.

But let's get away from harsh adjectives like spitty for a moment. How about words like crisp, bright and sharp that sometimes describe transistor sound? Here we get into interesting territory. The best transistor amplifiers definitely have a crisp, detailed sound. Some designers say it's due to razor-sharp square-wave performance and ultra-wide frequency response—both of which in turn are due in part to transformerless output stages.

There's also speaker damping to consider. Without output transformers, transistor amplifiers can damp a speaker heavily all across the frequency range. In other words, they can grab hold of and control a speaker as never before.

Frankly, I don't know if all of these factors contribute to the excellent sound of some transistor amplifiers. And I'm not qualified to mediate the arguments over the value of square-wave tests and the effect of wideband (2 or 3 cps to you-name-it) frequency response. What I do know is that some transistor amplifiers sound superb—not only crisp and clean, but transparent and uncolored.

What bothers me, though, is that other transistor amplifiers with mediocre or downright poor measurements also sound crisp and definitely different from tube amplifiers. The added punch of transistor power makes a difference, of course. But the crisp, bright quality I'm talking about is nothing to rave over. To be blunt about it, it is distortion—perhaps from non-linear frequency response at high volume, failure to cancel the high-order harmonic distortion in the output stage and possibly quite a few other factors.

I'd hate to see anyone buy one of these amplifiers because he confuses their crispness with the tight, detailed quality one expects in any good amplifier—or because it sounds dramatically different from tube amplifiers. For this reason, I'd advise you to take the time to make certain whether a given transistor sound is better than—or just different from—tube sound. And if you're ready to put cash on the barrelhead, make sure you pay for performance instead of novelty.

Now to admit a goof. When I saw the advance specs on KLH's Model Fourteen speaker, I assumed—and said here—that the company was building a transistor amplifier (like J.B. Lansing's) into the system to provide frequency contouring. But when a pair of Fourteens arrived at my home I took one apart. And I promptly discovered the KLH was carrying out its contouring technique through a passive treble-loss network.

Other impressive items I've seen recently include Dynaco's new Stereo 35 amplifier kit and EICO's new Classic line, both of which stick to tube design. The Stereo 35 (which took fumble-fingered me less than four hours to build) is a clean, transparent-sounding power amp with much more sock than its rating (35 watts rms in stereo) indicates.

As for EICO's new line, what strikes me about the prototypes I've seen is that every nickel's worth of design seems to have gone into performance. There isn't a control frill in sight, and you don't pay for features you may not need. The company says the new line is an experiment to see whether bargain-hunting audiophiles will give up knobs for top value in performance. Among other things, I'm impressed with the line's *mono* FM tuner/amplifier—something I think makes a lot of sense. All in all, the line is noble venture, and I hope it pays off.

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___	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	.65	___	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	.59	___	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

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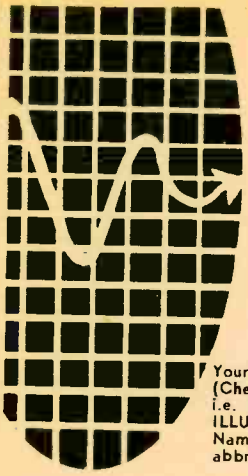
___	5BK7	.86	___	6CY5	.70	___	12AF3	.73	___	18FW6	.49
___	5BQ7	1.01	___	6CY7	.71	___	12AF6	.67	___	18FX6	.53
___	5BR8	.83	___	6DA4	.68	___	12AJ6	.62	___	18FY6	.50
___	5CG8	.81	___	6DE6	.61	___	12AL5	.47	___	19AU4	.87
___	5CL8	.76	___	6DG6	.62	___	12AL8	.95	___	19BG6	1.39
___	5CQ8	.84	___	6DJ8	1.21	___	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	.94	___	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
___	6AQ5	.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	___	6JSGT	.51	___	12CN5	.56	___	117Z3	.85
___	6AU6	.52	___	6J6	.71	___	12CR6	.67	___	807	.75



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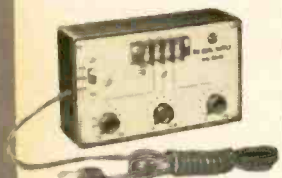

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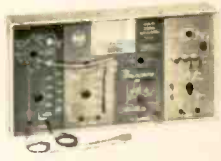

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