NOVEMBER · 35¢

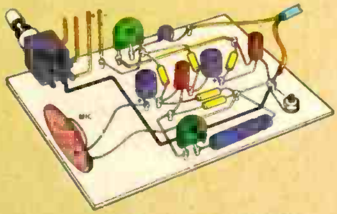
ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

ELEVEN projects in this issue.

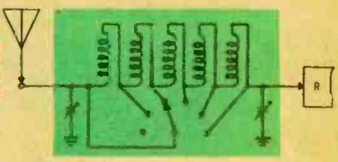
Easy-to-build COM-VOX

provides automatic switching for hams.



The AMPLI-MIKE gives real punch to CB signals via tone & gain control.

Build our SWL ANTENNA TUNER

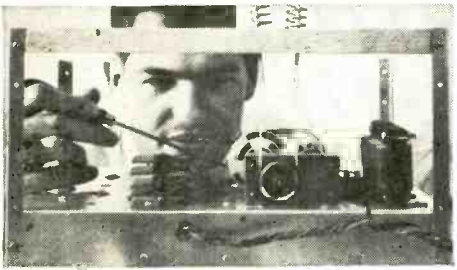


for more S-9 readings. Plus reports on 4

TRANSISTOR AMPLIFIER kits.

AN ISSUE YOU'LL NEVER FORGET!

RI has been the ome for Radio-TV



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 special training Kits NRI furnishes *at no extra cost.* Use equipment you build to work experiments, learn-by-doing. NRI equipment is designed to bring to life the things you read in illustrated, easy-to-read texts. And all equipment is yours to keep.

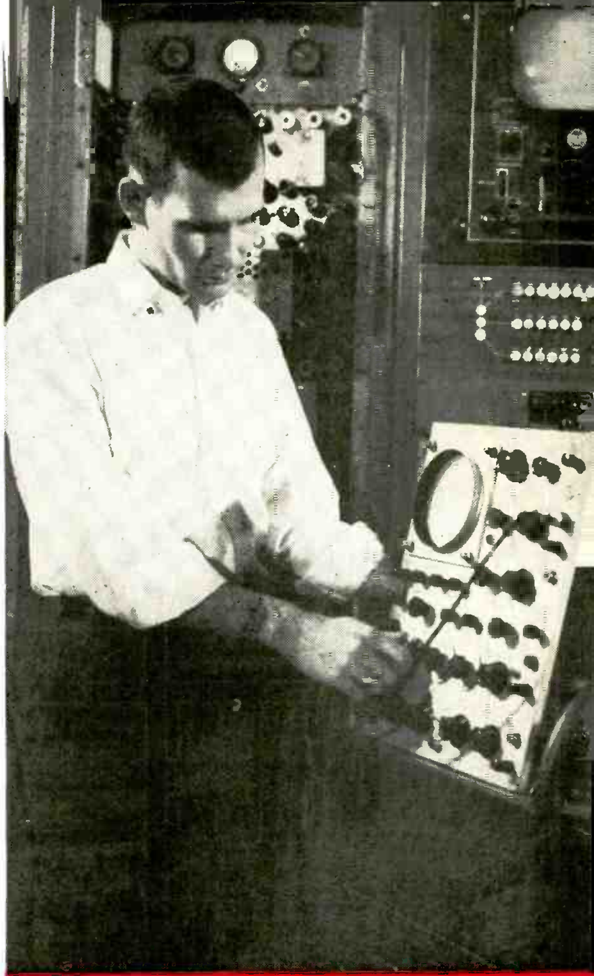
These Men Trained for Success With NRI—YOU Can, too

"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

NINE SPECIALIZED INSTRUCTION PLANS

offered by NRI—
oldest and largest
school of its kind

HOW THE NRI CANCEL-AT-ANY-TIME AGREEMENT TAKES THE GUESSWORK OUT OF TRAINING

As a reader of this magazine, you realize what a growing and expanding industry Electronics is today. That's why so many ambitious men are enrolled for NRI's specialized instruction plans. If you are asking yourself, "Am I capable of learning Electronics at home?" or "Does NRI have the exact training plan I need?"—NRI now makes it possible for you to get the answers—**without risk.** NRI's special Cancel-At-Any-Time agreement lets you enroll and start your training **without** obligating you to continue. With NRI you sign an agreement—not a **contract.** If for any reason you decide you do not want to continue your training all you do is notify NRI and you are not obligated for payments beyond that time. Mail the postage-free form for complete information about NRI's specialized instruction plans and NRI's exclusive Cancel-At-Any-Time agreement. Do it today. NATIONAL RADIO INSTITUTE, Washington, D. C.

nri

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. **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.

6. **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.

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

8. **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.

9. **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.

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Washington, D.C.

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ELECTRONICS ILLUSTRATED

November 1963 A Fawcett Publication Vol. 6, No. 6

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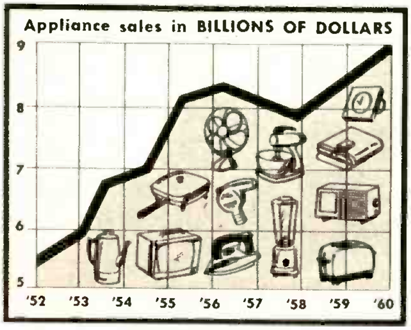
MPA

COVER — Illustrations by David Lockhart. Amplifier design based on Realistic 208

Record-Shattering Boom in Electrical Appliances Opens Up Exciting Profit Chances for Men Who Can Repair Them

OVER FOUR HUNDRED MILLION electrical appliances are in use right now in American homes—and are increasing at the rate of 76 MILLION a year! No wonder that men who know how to service them properly are making $3 to $5 an hour—in spare time or full time. FREE BOOK tells how you can quickly and easily get into this profitable field.



(Above) Based on chart in Electrical Merchandising Week Magazine.

Just look at how dependent American homes have become on electric appliances!

Here are some of today's common appliances, and the number of U.S. homes containing each.

Air Conditioners (Room)	6,500,000
Bed Coverings	10,800,000
Clocks	40,268,000
Coffee Makers (automatic)	27,000,000
Freezers	11,200,000
Frypan Skillets	20,600,000
Heaters, Portable (Elec.)	14,415,000
Heating Pads	19,925,000
Hotplates	12,105,000
Irons (Standard)	44,850,000
Steam Irons	28,200,000
Mixers	27,000,000
Ranges	17,200,000
Refrigerators	49,605,000
Sandwich-Waffle Comb.	17,615,000
Shavers	34,500,000
Toasters	40,195,000
Vacuum Cleaners	36,700,000
Washers	47,100,000

EARN WHILE YOU LEARN

with this APPLIANCE TESTER

—Yours at No Extra Charge

Course includes all parts to assemble a portable, sturdy Appliance Tester. Use it to locate faulty cords, short circuits, poor connections, etc. in a jiffy; find defects in house wiring; measure electricity used by appliances; many other uses. Helps you earn while you learn.

THE "ELECTRICAL APPLIANCE BOOM" is in full swing. For example, annual sales of coffee makers have zoomed in the last decade from 900,000 to 4,750,000. Room air conditioners have gone from 200,000 a year to 1,800,000 a year. In just the last five years Americans have bought 26 million electric fans, 9 million electric heaters, 5 million deep-fat fryers!

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

We Tell You Everything You Need to Know

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

You can handle this work anywhere—in a corner of your basement or garage, even on your kitchen table. And you can earn $3 to $5 an hour—get back the cost of the course before you finish it. No technical experience, or

higher education necessary. We tell you and show you everything you need to know, in plain English and clear pictures. And the training costs you less than 20¢ a day!

FREE BOOK
and Sample Lesson

Our 24-page Free Book tells about America's "Electrical Appliance Boom"—how we train you to "cash in" on it. Free Sample Lesson shows how simple and clearly illustrated our instruction is—how it can quickly prepare you for a profitable future. Mail coupon, letter, or postcard to: *National Radio Institute, Dept. KM3, Washington 16, D.C.* (No obligation—and no salesman will call on you.)

NATIONAL RADIO INSTITUTE
Dept. KM3, 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.

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Address...

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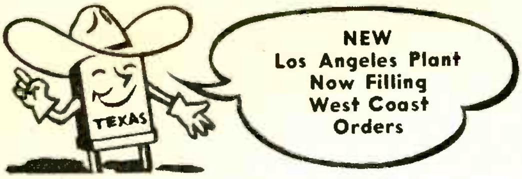

Citizen Band Class "D" Crystals

CITIZEN BAND CLASS "D" CRYSTALS

3rd overtone — .005% tolerance — to meet all FCC requirements. Hermetically sealed HC6/U holders. ½" pin spacing. .050 pins. (Add 15c per crystal for .093 pins).

$2.95 EACH

All 23 channels in stock: 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225, 27.255.

Matched crystal sets for ALL CB units (Specify equipment make and model numbers) .... **$5.90** per set

CRYSTALS IN HC6/U HOLDERS

SEALED OVERTONE .486 pin spacing — .050 diameter — .005% tolerance
15 to 30 MC .... **$3.85** ea.
30 to 40 MC .... **$4.10** ea.
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FUNDAMENTAL FREQ. SEALED From 1400 KC to 2000 KC .005% tolerance .... **$5.00** ea.
From 2000 KC to 10,000 KC, any frequency. .005% tolerance .... **$3.50** ea.

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All crystals made from Grade "A" imported quartz—ground and etched to exact frequencies. Unconditionally guaranteed! Supplied in:

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Pin diameter .093

MC-7 holders
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Pin diameter .125

CRIA/AR holders
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Pin diameter .125

FT-171 holders
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Banana pins

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1001 KC to 1600 KC: .005% tolerance .... **$4.50** ea.
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Amateur, Novice, Technician Band Crystals

.01% Tolerance . . . **$1.50 ea.** — 80 meters (3701-3749 KC) 40 meters (7152-7198 KC), 15 meters (7034-7082 KC), 6 meters (8335-8650 KC) within 1 KC
FT-241 Lattice Crystals in all frequencies from 370 KC to 540 KC (oll except 455 KC and 500 KC) .... **50c ea.**
Pin spacing ½" Pin diameter .093
Matched pairs — 15 cycles **$2.50** per pair
200 KC Crystals, **$2.00 ea.**; 455 KC Crystals, **$1.25 ea.**; 500 KC Crystals, **$1.25 ea.**; 100 KC Frequency Standard Crystals in HC6/U holders **$4.50 ea.**; Socket for FT-243 Crystal **15c ea.**; Dual Socket for FT-243 Crystals, **15c ea.**; Sockets for MC-7 and FT-171 Crystals **25c ea.**; Ceramic Socket for HC6/U Crystals **20c ea.**

IF YOUR PARTS DEALER DOESN'T STOCK Texas Crystals, order direct and send us his name.

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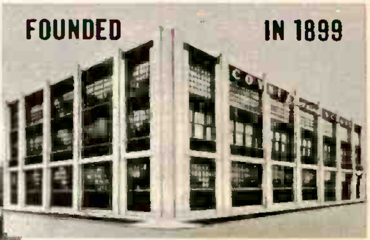
You Have Aptitude for Electronics

...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!*

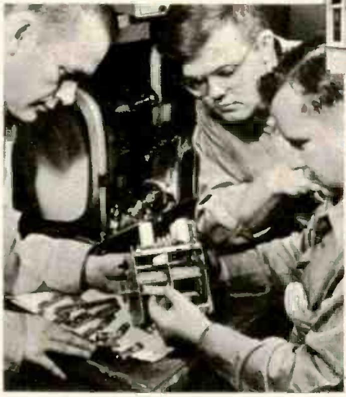


No matter what branch of electronics you prefer, you'll have no trouble landing just the job you want—*provided you get the right kind of training.*

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.

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FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th Street, New York 36, New York

Flap-Jack Tapes

I think RCA's idea of selling pre-recorded tape cartridges is great. Playing them is like tossing flapjacks on a griddle. Why haven't other manufacturers got on the pre-recorded-cartridge bandwagon?

Jim Chase
Des Moines, Iowa

Just wait a little longer, Jim. You're going to find a lot of people on that bandwagon—and soon.

Heady Question

I'm setting up a stereo system. How far apart should I put my speakers?

Peter Billera
Fair Lawn, N. J.

There's an invariable rule, Pete: cut and try. But keep headphones 6 inches apart.

Licen$e Fee$

I can think of better things to do with $8 than shell it out to the FCC every time I change addresses or renew my CB license. The only thing you get for nothing now is an extra half-inch of lead on resistors, transistors and the like.

P.D.B.
Duluth, Minn.

CB and other FCC licenses always cost somebody something. The guy who paid used to be the taxpayer. Only difference is that now the payer is the user.

Bang!

I liked your July issue until I came to The Big Bang (CB CORNER). Technically, the article is correct. However, it indirectly indicates that CB radio is the *only* type of two-way radio which can set off dynamite charges accidentally. The author neglected to add that *any* two-way radio is capable of doing the same thing.

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

We restricted our comments to CB because that's what CB CORNER is all about.

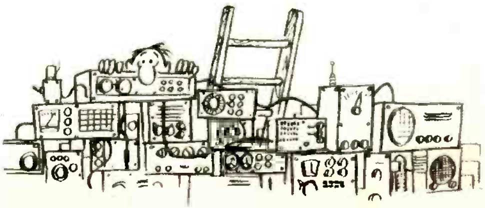
Unlisted

Your Directory of CB Clubs (July EI) had a serious omission: The Delaware County Citizens Radio League. Can we get on the list?

Charles Matson
Box 523
Havertown, Pa.

Watch EI for an updated Directory with a serious addition.

Stacked



I've reached the point where I've got so much equipment I can hardly see over the top. Why doesn't someone invent something to help people in my predicament?

Dolf Myers
Pacific Palisades, Calif.

Ever hear of a rack panel, Dolf?

[Continued on page 8]

Cast your ballot for a successful future!

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Commercial Cartooning
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Show Card & Sign Prod.
Show Card Writing
Sign Painting & Designing
Sketching & Painting

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Automobile Body Rebuilding & Refinishing
Automobile Electrical Tech.
Automobile Engine Tune-Up
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Automotive Mechanic
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Principles of Surveying
Reading Structural Blueprints
Sanitary Engineering
Sewage Plant Operator
Structural Engineering
Surveying and Mapping
Water Works Operator

DRAFTING
Aircraft Drafting
Architectural Drafting
Electrical Drafting
Electrical Engineering Drafting
Electronic Drafting
Introductory Mechanical Drafting
Mechanical Drafting
Sheet Metal Layout for Air Conditioning
Structural Drafting

ELECTRICAL
Electric Motor Repairman
Electrical Appliance Servicing
Electrical Contractor
Electrical Engineering (Power option or Electronic option)
Electrical Engineering Tech.
Electrical Instrument Tech.
Electrical Power-Plant Engineering (Steam option or Hydro option)
Industrial Electrical Tech.
Industrial Telemetering
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Practical Electrician
Practical Lineman
Reading Electrical Blueprints

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High School Mathematics
High School Secretarial
High School Vocational

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Basic Supervision
Industrial Foremanship
Industrial Supervision
Personnel-Labor Relations
Supervision

MATHEMATICS
Advanced Mathematics
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Mathematics and Physics for Engineering
Modern Elementary Statistics

MECHANICAL
Industrial Engineering
Industrial Instrumentation
Machine Design
Mechanical Engineering
Quality Control
Safety Engineering Technology
Tool Design

PETROLEUM
Natural Gas Production & Transmission
Oil Field Technology
Petroleum Production
Petroleum Production Engineering
Petroleum Refinery Oper.
Petroleum Technology

PLASTICS
Plastics Technician

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Air Conditioning Main.
Domestic Heating with Oil & Gas
Domestic Refrigeration
Gas Fitting
Heating
Heating & Air Conditioning with Drawing
Plumbing
Plumbing & Heating
Plumbing & Heating Contractor
Plumbing & Heating Estimator
Practical Plumbing
Refrigeration
Refrigeration & Air Conditioning
Steam Fitting

PULP AND PAPER
Paper Machine Operator
Paper Making
Pulp Making
Pulp & Paper Engineering
Pulp & Paper Making

RAILROAD
Car Equipment Fundamentals
Motive Power Fundamentals
Railroad Administration

SALESMANSHIP
Creative Salesmanship
Real Estate Salesmanship
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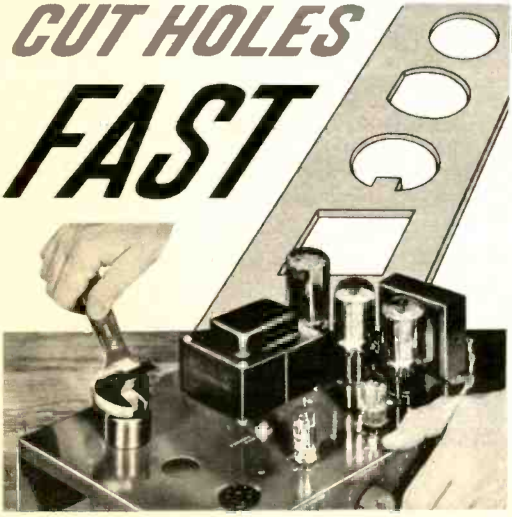

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FEEDBACK

Continued from page 6

● *Stuck*

You're saying a mouthful when you imply that persistence is all that's needed to learn the code (THE CODE, Sept. EI). I've been persisting for weeks and I'm still on a 10-wpm plateau. What do I do now? Go Novice?

Harry Marcus
Atlanta, Ga.

No, just go persist some more.

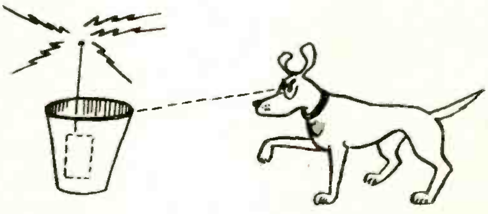
● *Rolling Shack*

You took us all right along in the back seat of that Volkswagen on the HAM SHACK'S grand tour (Sept. EI). I realize most Europeans roll their own gear, but I was a little surprised at the elaborateness of the German shack you showed. Are there many like that over there, do you suppose?

Howard Jay
Detroit, Mich.

Quite a few, Howard. Continental homebrewers have formulas we've either forgotten or never learned.

● *Canine Counterspy*



Your article, WANT TO BE A COUNTERSPY (July EI), was excellent. I recently read about how a dog belonging to a U.S. diplomat overseas succeeded in uncovering a bugging device planted in the embassy. The gadget was triggered by a high-frequency signal that the dog could hear. The high pitch led the mutt—and his master—right to the hiding place. This ought to encourage a new department for the CIA—canine counterspying.

Dan Vogel
Seattle, Wash.

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men 17-55

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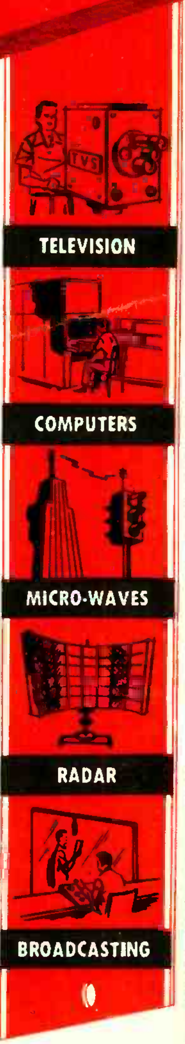

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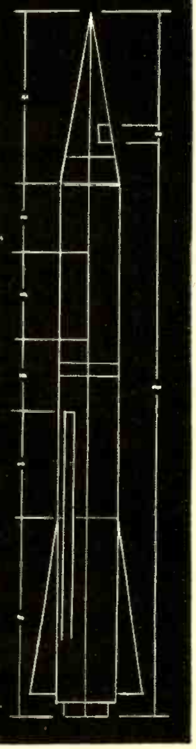

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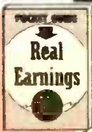

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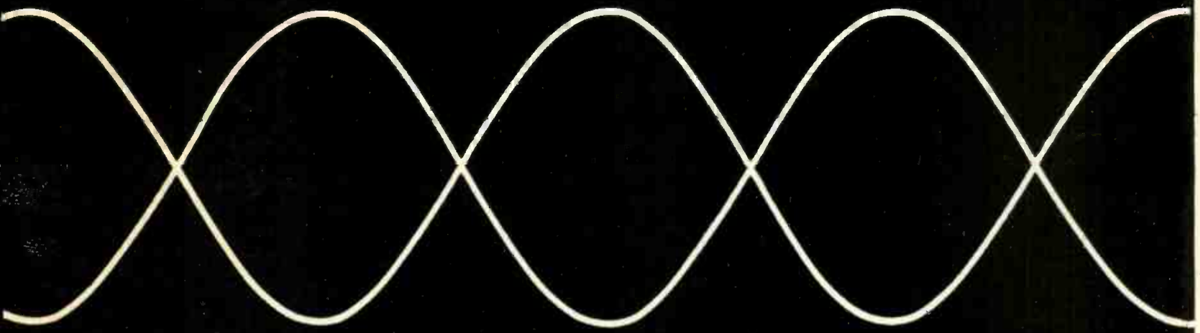

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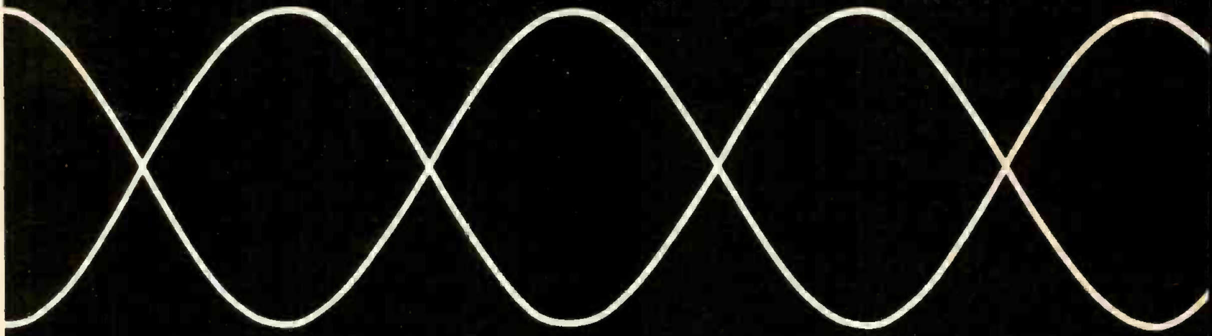

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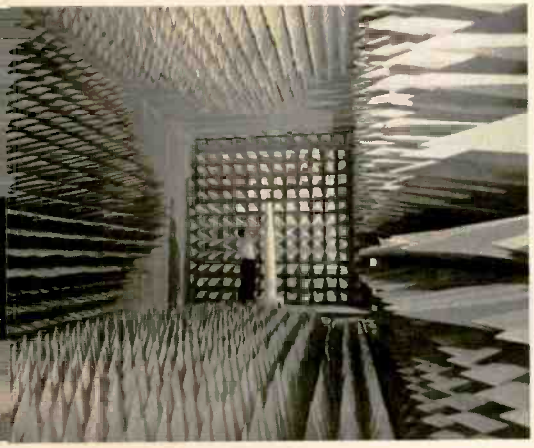
BEP-84

. . electronics in the news

HAVING A BALL. . . That little black-and-white dot on top of the big ball represents two people who are having a breath-catching look at a 150-foot radome put up in Massachusetts to house experimental radio antennas. The ball's skin is made of thin plastic-glass fiber and has a cross-hatching of geodesic-dome-type supports. It is similar to many of those built on the DEW Line in the Far North. One of its special features is a rubber-base covering, Radalon, which was developed by B. F. Goodrich. It is weather-resistant but has no effect on radio waves.



Dead, Dead, Dead. . . Most anyone could guess that the photo at left shows an anechoic chamber. Matter of fact, it does, but it has nothing to do with sound. The room is being used by Sperry Gyroscope to test radar equipment because it offers no echoes to high-frequency radio signals. The RF energy is absorbed by some 2,500 urethane foam spikes when it hits the wall. The end goal is information helpful in the design of electronic countermeasures techniques; in short, how to jam enemy radar looking for our missiles. The white post in the background is a polystyrene pedestal which holds test targets. An engineer is putting up a baseball-size test sphere.

S-9 Canine . . . Mucho and his buddy, Pvt. Eugene Yoakum of the Alexandria, Va., Police Department, opened a new frontier in radio control last year. The dog is shown wearing a radio receiver on which he receives commands from his master. The RC dog takes his orders and carries them out as much as a mile from base. At one point, experiments were run wherein other cops tried to jam the radio and then gave their own commands, badman-style, to the pooch. He ignored them and listened to his master. Result: a shake and Dog of the Year Award.

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Harold F. DeBruin, 1621 N. Morrison St., Appleton, Wisc.	1st	12
Floyd R. Henderson, 3219 Andrita St., Los Angeles. Calif.	1st	24
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Alexander Mikalaski, 4510 Rittenhouse St., Riverdale, Md.	1st	30
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John L. Marlow, Box 384, Umatilla, Oregon	1st	12

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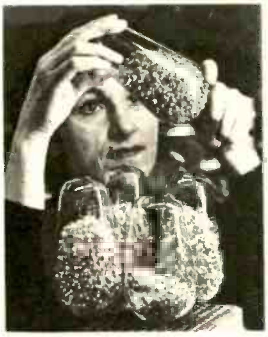
38-S

...electronics in the news

Filmy Feature . . . A thin coating of fiber glass is being put on the picture surfaces of TV tubes these days by Westinghouse. It eliminates the laminate panel or the thick hunk of plate glass that used to protect the viewer in case of a sudden implosion of the tube.

The glass-fiber film, being held up here by a Westinghouse worker, makes the tube lighter and shorter and is just as safe, the company claims. Viewing is said to be improved by the reduction in reflecting surfaces, and dust can be wiped off directly.



How Many? . . . You might think the lady in our photo is about to make a guess at how many beans there are in the jar, and that she's at the local candy store. In point of fact, she works for Western Electric's factory in Allentown, Pa., and the jars happen to be filled with transistors. The company places the tiny components in vacuum jars to prevent moisture or contamination from reaching them prior to installation. The protection pays off in much longer life for the transistors when they are operating in such impossible-to-reach locations as orbiting satellites and other exotic equipment.

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12V6GT
12W6GT
12X4
12Z3
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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.

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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."

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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.

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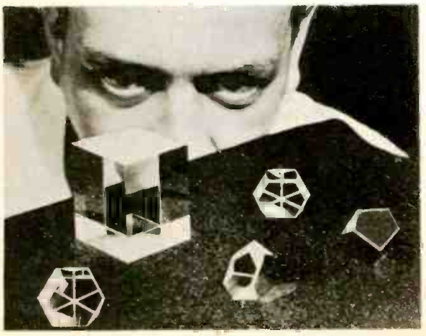
. . .electronics in the news

Diamonds in the Sky . . . The four polyhedral forms in the foreground of the photo below are like 360 which are being put into the S-66 satellite. They are corner reflectors and in the experiment they will pick up the light beam from a pulsed ruby laser and reflect it back to earth. Each one contains three 90-degree angles. Boxton-Beel, Inc., fabricated the reflectors from cubes of fused silica like that shown above.



Powerful Punch . . . A new type of gallium-arsenide junction laser developed by General Electric researchers can be operated continuously at a power output of more than 1 watt—highest yet achieved by any comparable model. The two men who designed the laser, William E. Engeler (left) and Marvin Garfinkel, are shown looking at it. The device, besides putting out a hefty wallop of power, has proven relatively efficient. Put in 5 or 6 watts and you get 1 watt out, for a 20-30 per cent efficiency.

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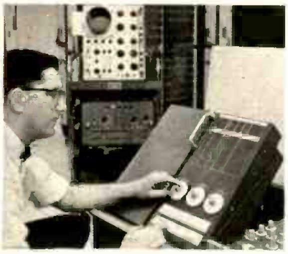

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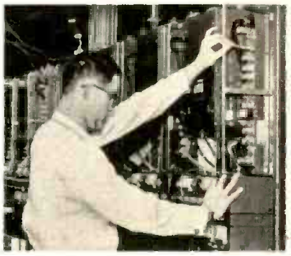

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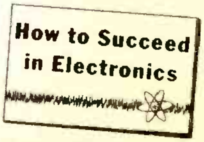

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Electronic Marketplace

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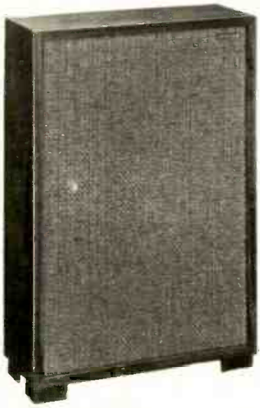

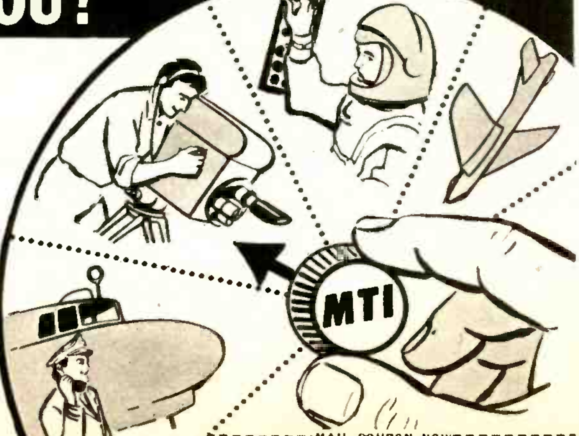

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The new C-75, weighing less than 2 lbs; provides clear, reliable 2-way communications up to 5 miles and more. All solid state design creates an extremely rugged transceiver to absorb rough handling, stays on frequency. Two crystal-controlled channels spell perfect communications contact everytime. Sensitive superhet receiver (1μv for 10 db S/N ratio) brings in signals in poor reception areas. Powerful transmitter has one watt output to the antenna. Adjustable squelch silences receiver during standby. AGC assures proper listening level. In a word, the C-75 has all the features you'd look for in a quality full size CB unit.

The C-75 has all the portable conveniences you'd want, too: operates on alkaline or mercury penlite cells (8-hour rechargeable nickel-cadmium battery available); earphone and antenna jacks; built-in retractable antenna; jack for base operation while recharging.

Use the Cadre C-75 anywhere in the field, for vehicle, office, boat or plane. Use it constantly too, because its all-transistor modular circuit (11 transistors and 2 diodes) is virtually maintenance free. $109.95. Recharger and 2 nickel-cadmium batteries $31.85.

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CADRE 515 Has a power supply for 110 volt AC and 12 volt DC. 5 crystal-controlled channels. $194.50

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CADRE 525 In portable case with built in battery power supply, recharger, AC cord, telescoping antenna. $269.95

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Marketplace

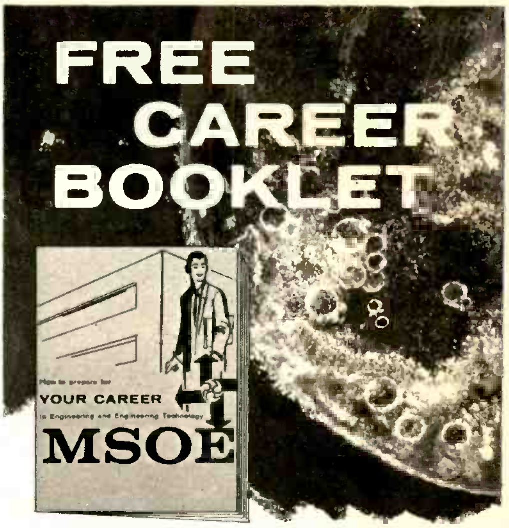
SSB on 3 . . . If you're ready to go SSB on 80, 40 or 20 meters, the HW-12 series of transceiver kits might be items to put on your shopping list. Designed for mobile or fixed operation, the 200-watt rigs feature PTT, VOX and 2-kc dial calibration. The 80- and 40-meter models operate LSB; the 20-meter model works USB. The kits have provision for linear amplifier and 100-kc crystal calibrator hookups, and they're furnished with an under-dash mounting bracket. $119.95. Heath Co., Benton Harbor, Mich.

Look, No Tools! . . . In less than twenty minutes—with not a tool on hand—the Coronet speaker kits can be constructed and ready to play. Three semi-assembled versions differ only in the quality of the 8-inch extended-range speaker they use. All have ducted-port enclosures that make use of interlocking joints, wing-nut fasteners and gasket tapes for tool-less construction. And, in case you want to extend the high-frequency response, an optional add-on kit paves the way. The Coronet model I is $39; Coronet II, $43.50; the III, $54. Electro-Voice, Inc., Buchanan, Mich.

Marketplace

CB Transceiver . . . The rig is the Realistic TRC-8 for mobile or fixed operation. The features are many: eight crystal-controlled channels from 26.9 to 27.3 mc, built-in S-meter/power input meter, automatic noise limiter, tuned RF stage, universal pi network, and smooth planetary drive tuning. The TRC-8 comes equipped with a high-impedance PTT ceramic microphone and one transmit crystal for channel 11. The kit price is $109.95; factory wired, $139.95. Radio Shack Corp., Boston, Mass.

Tilt! . . . No, not a pinball machine, but a VTVM kit that tilts to any desired position for easy meter reading. Thumbwheel nuts hold the meter in position. Equally important, the IM-13 features a 6-inch 200 ua meter with a multicolored scale, standard 11-megohm DC input for low circuit loading, vernier-driven zero and ohms adjust controls, a single AC-ohms-DC test probe and brackets for mounting anywhere—on the bench or on the wall. Less a standard C-cell, but including test leads, the kit sells for $32.95. Heath Co., Benton Harbor, Mich.



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Marketplace

Hand-held CB . . . Cadre's C-75 portable CB transceiver puts power in your hand with its 1.5-watt transmitter input. Packed into the two-pound unit are 11 transistors, two diodes, two crystal-controlled channels, adjustable squelch, automatic gain control, external speaker and earphone jacks and an external jack for temporary base operation. Either penlight cells or rechargeable nickel-cadmium batteries can power the rig. And, if NC's are used, the C-75 can serve as a temporary base station while the batteries are being recharged. Supplied with a convenient carrying case, the C-75 lists at $109.95, less batteries. With two nickel-cadmium cells and a recharger, the price is $139.95.

Converter Plus . . . The Precon HE-73 is a crystal-controlled, dual-function converter/preselector covering the 80, 40, 20, 15 and 10-meter amateur bands. On 80 and 40 meters, the unit acts as a preselector only, improving image rejection and sensitivity. As a converter, the unit provides dual-conversion operation or extends receiver tuning range to 30 mc. The Precon operates on 117 VAC, and its $49.50 price includes crystals for 20, 15 and 10 meters. Lafayette Radio, Syosset, N. Y.

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Marketplace

License-Free . . . The HE-100L walkie-talkie uses a 12-transistor, crystal-controlled circuit for license-free (Part 15) operation on the Citizens Band. Eight penlight batteries and crystals for channel 10 come with the compact 3x9x2¾-inch unit. Sensitivity of the receive section is better than 1 uv for a 10db signal-to-noise ratio, and there's also a variable squelch to cut down background noise. Other features include separate microphone and speaker, push-to-talk switching, an earphone for private monitoring, a 44-inch telescoping whip antenna and a leather carrying case. The HE-100L is $39.95; optional power pack costs $7.45. Lafayette Radio, Syosset, N. Y.

Get Ready . . . to do-it-yourself with GE's new transistor portable radio kit. Ready Set, as GE has dubbed it, uses five transistors and one diode and is housed in a black carrying case. Pre-aligned IF amplifiers, a tuner, a ferrite antenna and a 3½-inch speaker complete the circuit. All components are pre-assembled into three factory-wired sub-units that merely have to be soldered to a printed-circuit board by the builder. Ready Set costs about $21.95. General Electric, Syracuse, N. Y.

Marketplace

Wet Noodle . . . Engineers at Sonotone Corp., Elmsford, N. Y. have come up with a phonograph needle so flexible that it can do just everything but deep-knee bends. You can knock it, bend it, flick it, even twist it into a 360-degree circle and the Sono-Flex will spring right back into shape and go on playing its record groove. The secret? A special kind of rubber expansion link which connects the stylus and the lever arm of the needle assembly.

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

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

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

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

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

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

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

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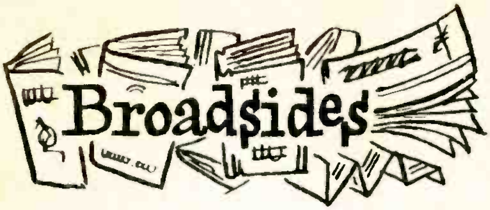

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

Understanding and Using Citizens Band Radio is for those who ask: What is CB? Am I eligible to use the band? How can I get my license and set up a station? For a copy of the booklet, send 50 cents to Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Are you seeking a unique career but running out of prospects? **The Electric Organ—Key to Careers** outlines ways in which the organ can be part of an unusual career in the performing arts, teaching, selling or manufacturing. Free copies are available from Hammond Organ Co., 4200 Diversey Ave., Chicago 39, Ill.

If you're in the market for meters, you'll want to see **Metermaster 63**—a catalog listing technical data and prices on the products of every major U.S. meter manufacturer. For a free copy write Ed Winters, Metermaster Div., Quality Electric Co., 3700 S. Broadway, Los Angeles 7, Calif.

Edmund Scientific Company's catalog 635 is packed with unusual and hard-to-find **industrial and scientific instruments,** such as microscopes, telescopes, measuring devices, etc. For a free copy, write the company in Barrington, N. J.

A chart describing the electrical and mechanical characteristics of **silicon rectifiers** is available free from National Transistor, 500 Broadway, Lawrence, Mass. Ask for catalog B-105.

Application Note AN-197 explains how to put RCA's new high-gain pentode tubes (6HR6, 6HS6) to use in the IF amplifier and limiter stages of FM tuners. The new tubes' characteristics are discussed in terms of circuit requirements. Free copies are available from RCA's Electron Tube Div., Harrison, N. J.

Sylvania is offering a free brochure describing its nickel cadmium **rechargeable batteries.** The address is 1100 Main St., Buffalo 9, N. Y. ◆

Let's start with scopes—essential for the experimenter. EICO has an excellent variety to choose from. The new full performance 430 General Purpose compact with 3" flat-face CRT; the 427 General Purpose DC scope; and one of the best thought of scopes in the DC wide band field, the 5" CRT 460.

If you work with transistor circuits, EICO has the team for you: the 1020 Power and Bias Supply with 0.005% ripple; and the 680 Transistor & Circuit Tester which combines transistor parameter measurements with a 20kΩ/V multimeter for dc voltage (to 50v) and resistor measurements.

If you're interested in RF you'll need a good, wide coverage RF signal generator with built-in audio modulation such as the EICO 324 (150 kc-435 mc), and a good VTVM such as the EICO 222 or peak-to-peak VTVM the 232. Use either one with RF VTVM probe PRF-11.

If you're interested in audio, EICO has an excellent Sine and Square Wave Audio Generator ranging from 20 cps to 200 kc, the 377. You'll also need an AC VTVM. The 12-range EICO 250 (measures 100 μV to 300V) is an excellent choice. It has a panel switch that converts it to a broadband amplifier with 60 db gain and over 5V undistorted output. The EICO 261 AC VTVM and Wattmeter has 11 ranges (measures 1 mv to 1000V) and it includes a tapped 4, 8, 16 and 600 ohms power resistor handling up to 80 watts as well as load compensated wattmeter ranges. In general you will need an EICO 222 or 232 VTVM as well, for measuring up to 1500 VDC or AC, and for resistance measurements.

If you like to draw materials from a "junk" box, you'll need a Resistance-Capacitance Bridge, EICO 950B, which measures capacity from 10 μμf to 5000 μf, resistance from 0.5 ohm to 500 meg., and contains a continuously variable 0-500 VDC supply for a sensitive capacitor leakage test. Complementing it is the 955 for in-circuit capacitor short—open testing, and capacity measurements with unique shunt resistance balancing.

For trouble shooting audio, IF, and RF circuits, the 147A Multi-Signal Tracer has both RF & audio inputs with demod & direct probes, noise locator circuit, wattmeter, substitution tests, & eye-tube and speaker monitors. And for testing tubes nothing beats the economical EICO 628 Emission Type Tube tester. The new 667 Dynamic Conductance Tube and Transistor Tester is the best in the field. Both test all the new tube types including Nuvistor, Novar, 10-pin, Compactrons, etc.

Other handy items are EICO substitution and decade boxes: EICO 1100 covers EIA resistance values from 15 ohms to 10 meg.; the 1120 EIA capacitance values from 100 mmf to 0.22 mf. The 1140 combines both 1100 and 1120 in one box and permits series or parallel combinations as desired. The 1171, a Precision Decade Resistance Box, covers 1 to 99,999 ohms in 1-ohm steps; and EICO 1180, a precision Capacitance Decade Box, covers 100 mmf to 0.111 mf in 100 mmf steps.

If you want to know how a circuit performs with varying line voltage, or to correct for varying line voltage during an experiment, the EICO 1078 Metered Variable Auto-Transformer AC Bench Supply provides 0-140 VAC continuously variable, from 120 VAC line input with a 7½ amp. current rating. Output current and voltage are separately metered.

If you're an experimenter or technician, you'll find that EICO test equipment can make any job easier. You can also be sure, that when you select EICO instruments, as a kit or factory-wired, you get the most performance for your dollar.

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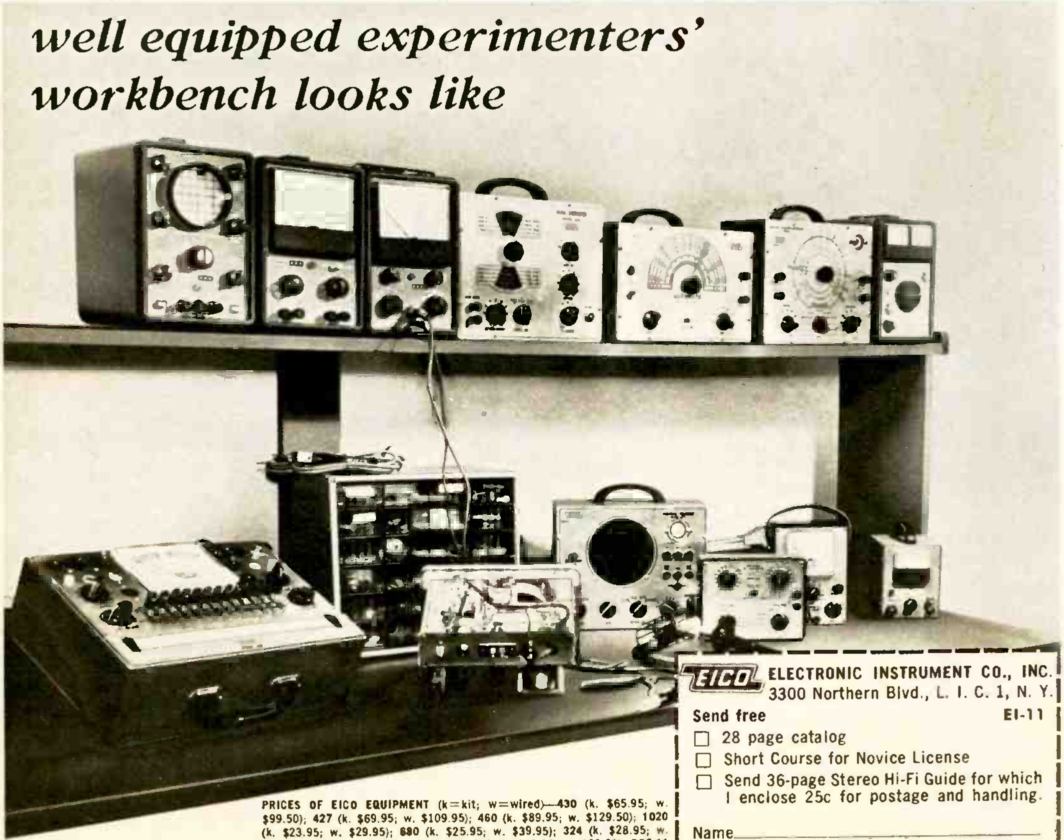
A guide to what the well equipped experimenters' workbench looks like



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ILLUSTRATED
NOVEMBER 1963

what's wrong with
transistor amplifiers?

TRANSISTORS have precious little to do with children's stories, except maybe one. That story's about a puny little train that got over a great big hill by having faith in itself. "I think I can, I think I can," it assured and reassured itself, over and over. And, of course, in the happy no-distortion, no-phase-shift, no-hum world of the 4-year-old, the little train did get to the top—thanks, we are told, to the fact that it knew it could all along. What's the parallel? Just this: the transistor has been saying much the same thing for a good many years now. In its own adult, grown-up way, the transistor has been saying that it can make a better amplifier than the vacuum tube. □ □ But can it? Facts are hard to fudge in the no-wool-over-the-eyes world of the professional stereophile. Curves and graphs can pinpoint an amplifier's deficiencies plain as the nose on your face. Worse yet, even those elusive somethings that can't be measured readily will show up in the severest test of all—ordinary, hour-by-hour, day-by-day listening. Let an amplifier produce enough of the wrong kind of sound, and some keen-eared concerti-grossi or late-quartet fan will spot it, sooner or later. □ □ When you come right down to it, an amplifier must be as good as modern-day components and know-how—plus money—can make it. In fact, the ideal amplifier would be a perfect amplifier, a device whose output would be an absolutely perfect replica of its input . . . *would be*, for the simple reason that a perfect amplifier, like a perfect anything else, is a critter that's not to be found. □ □ But it can be approached. The quest for perfection is never-ending, and the art of sound reproduction has come a long way since Edison recited Mary Had a Little Lamb into his talking machine and Poulsen turned the same trick by recording sound on wire (which later succumbed to tape). Recording sound was their problem; reproducing it is an amplifier's. And for years there was only one kind of amplifier—the vacuum-tube type. From the advent of the first electrically recorded disc back in 1925, the vacuum-tube amplifier established itself as the *sine qua non* of high fidelity. Through the decades that followed, countless engi-

"It all depends on what you're trying to amplify"

gineers, experimenters and technically minded music lovers spent countless hours working to perfect that instrument. ☐ ☐ Their task was simple, in theory, at least. The job was to build an amplifier that did precisely what an amplifier should do: amplify the sound that is fed into it without adding anything or taking anything away. And, through the years, designers have come closer and closer to that goal. When coupling networks between the many vacuum-tube stages were recognized as a source of distortion, direct-coupled amplifiers, such as the Loftin-White one, were perfected to have almost no coupling networks at all. Push-pull circuitry replaced the simpler, less-critical-to-adjust, single-ended hookups for much the same reason: balance a push-pull stage, designers found, and even-order harmonic distortion vanishes, nice as you please. Toss in something called an inverse feedback loop, they discovered, too, and you reduce gain—always cheap to get—but you also drastically reduce most every form of distortion at the same time. In fact, direct-couple enough class-A triodes in a push-pull circuit, toss in some cross-coupling to improve the balance, add heavy inverse feedback, and you come up with an amplifier that's well-nigh perfect. ☐ ☐ But not quite. For though the tube is a superlatively linear device, it's at its best in one particular chore—amplifying voltage. Feed 1 volt into its grid and you'll get 10, 100 or more from its plate, depending on the tube and its circuit. No one's going to deny that the tube makes a great voltage amplifier. It's the best *voltage* amplifier known, and there's nothing in sight, transistors included, that shows a ghost's chance of taking its medal away. ☐ ☐ But there's the one big rub. Tubes can amplify the miniscule output of a tape head or phono cartridge *ad infinitum* and do a first-class job at it, too. Thing is, that voltage eventually must be fed into a speaker. And a speaker is a current-operated device, not a voltage-operated one. About the only way you can match a high-impedance, voltage-amplifying tube to a low-impedance, current-consuming speaker is with an output transformer. And an output transformer, unlike a tube, is one of the most non-linear devices going. True, it's come a long way since it matched a pair of 2A3 triodes in that old console of the 1930's, but it's still a mighty weak link in the chain. So weak, in fact, that there even have been attempts to do away with the output transformer altogether. Some

"No one's going to deny the vacuum tube makes a

experimenters have tried hooking up enough tubes in parallel and enough speakers in series to get the right kind of impedance match; others have designed circuits which relied on special, high-impedance speakers that never have proven very practical in either design or operation. But neither of these circuits ever came to much because the problems they presented were too big and too many. Their designers were, in effect, beating against a brick wall. □ □ What has all this to do with transistors—and transistor amplifiers? A good deal, actually, and far more than most people ever have stopped to realize. For the fascinating truth is that transistor amplifiers, almost in spite of themselves, have succeeded in doing many of the things that designers have been trying to do with tubes all these many years. □ □ All of which isn't to say that the transistor is a superior amplifying device—it isn't. In fact, in several areas—dynamic range, ability to withstand heat, stability and uniformity of operating characteristics—the transistor must take a decided back seat. But it all depends on what you're trying to amplify—voltage or current. And the big advantage of the transistor, as an amplifier, at least, lies in the specific type of device it is and in the specific type of circuitry it makes practical. Because a transistor amplifies current, not voltage, the circuits associated with it are quite different from those involving tubes. But all the tricks such as direct-coupling, cross-coupling, heavy inverse feedback and so on, that designers applied to tubes also can be applied to transistors. And here's the real clincher: because of its very nature, a transistor can be direct-coupled to a speaker, too, making the heavy, expensive, inefficient, distortion-introducing output transformer completely unnecessary. □ □ All of this suggests that the transistor, like the little train, is likely to make it over the top. Whether it's at the top yet is for your ears to decide, but some people have been saying that the transistor amplifier represents the closest approximation to the ideal. Tubes haven't taken a back seat just yet, and some people believe they'll never have to. But one thing's for sure: when someone asks you, "What's wrong with transistor amplifiers?" the best answer is a qualified nothing—qualified, because no amplifier's perfect, and the transistorized variety, like the others, falls short of the ideal. But for clean, hum-free and transparent sound, for wider bandwidth, uniform phase shift, better transient response, uniform damping factor, the transistor amplifier stands ready to give the vacuum-tube version a real run for its money. —*Harry Kolbe.* ◆

great voltage amplifier. But that's the one big rub."

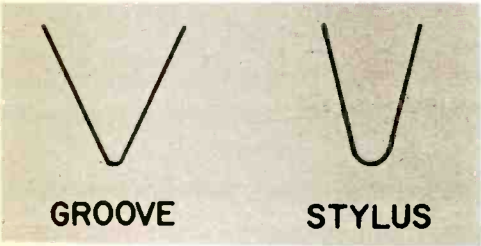
HI-FI TODAY

By John Milder

- ✓ New groove and new sound from RCA
- ✓ Designers try for a transistor pickup
- ✓ An end to the stylus-angle problem?

FOR MOST of us, the microgroove is where all the music comes from. And it looks like some new records and pickups are going to make a big difference in the kind of sound we get out of that groove.

Most controversial development in many a year is RCA Victor's Dynagroove record. Victor calls Dynagroove the biggest breakthrough since the LP; competitors have been calling it everything from a disappointment to a fraud. But what *is* it? Nobody, including Victor's ad man, really has said.



But one thing seems certain: heart of the Dynagroove *is* the record groove itself, a new and different kind of groove. Long as I can remember, experts have been saying that the standard record groove presents a problem for which there's no easy solution. Since it's cut by a chisel-like recording stylus, the groove has a V shape. But the stylus of a playback pickup looks more like a U than a V (see drawing above).

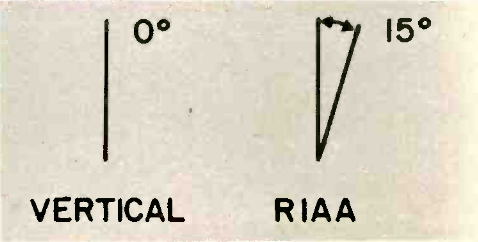
Here's why. The stylus must have a rounded tip to avoid recutting the groove as it plays it. This means there's never perfect contact between pickup and groove. Sure, it's close enough for most purposes. But there always are some losses and times when distortion is evident.

> *Beginning in this issue, an old hand at hi-fi puts his pen to a new EI column. Join seasoned audio expert John Milder for a critical once-over of the latest developments in the never-ending search for the best in sound reproduction.*

Dynagroove makes the first head-on attack on the mismatch between stylus and groove. By using a special corrective computer while cutting a master disc, Victor comes up with a groove that's said to look round-bottomed to a pickup. Whether it does or not, the new groove obviously looks better to a cartridge than any we've had up to now.

Proof is the fantastic volume level used on the first Dynagroove releases. And there's the rub. Fit between stylus and groove is so much better that Victor is using it for a *louder* record, one that'll have less surface noise and more oomph on a cheap record player.

A few minutes of listening tell you that the real highs (10,000 cps and up) have been rolled off on the first Dynagroove records—and sharply. The half-dozen or so I've heard have plenty of presence, all right. But they also have plenty of absence—the highs that make musical instruments sound like themselves.



There's also the matter of distortion. It's there despite the better groove, from about the middle of the record on. One

[*Continued on page* 113]

The COM-VOX

Amateurs or CBers can have automatic T-R switching with this voice-operated relay.

RELAX, fold your hands in your lap and let the Com-Vox switch your rig automatically from transmit to receive and back again. You're enjoying the ultimate in communications luxury with a gadget that takes the work out of the ham or Citizens Band shack.

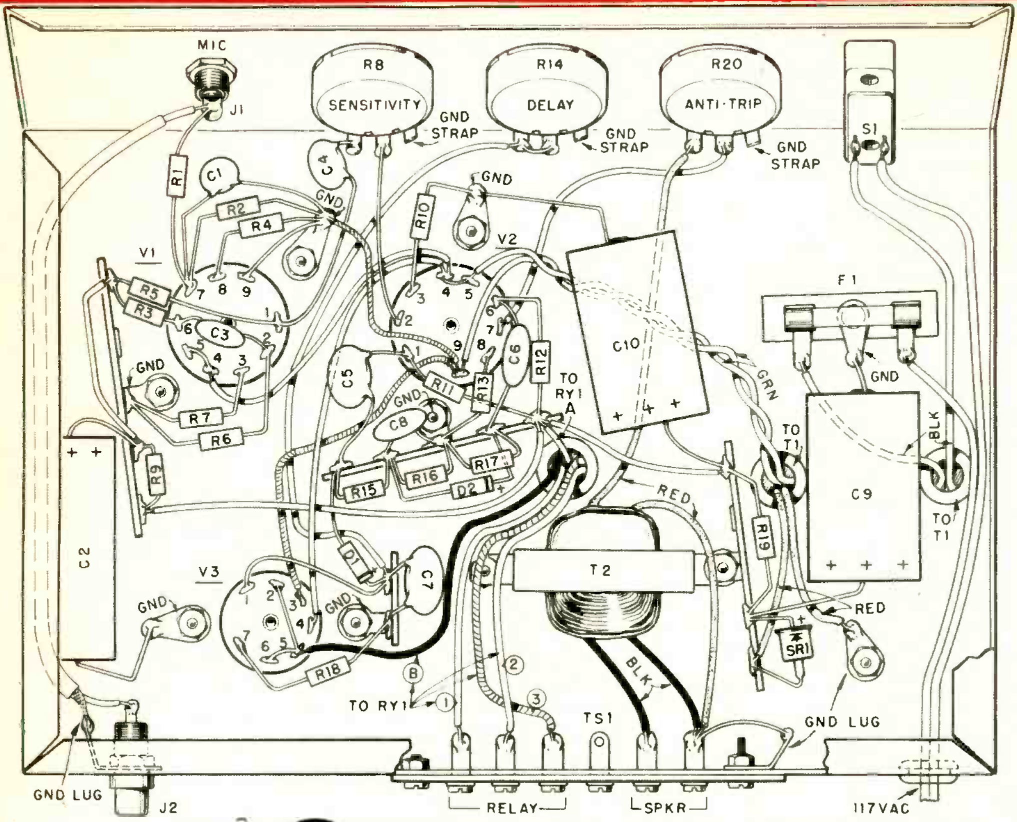
When people hear the term VOX (voice-operated transmit/receive switching) they usually think of high-priced, single-sideband equipment and immediately count themselves out. But EI's Com-Vox, which can be added to any transmitter designed for push-to-talk operation, puts the pauper into the prince's class.

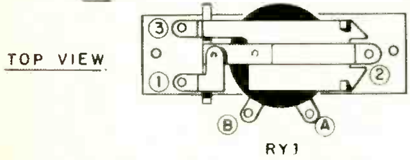
Here are some of the Com-Vox's features: Its sensitivity is adjustable. It has a time delay which can be set to turn the transmitter off between words, or keep it on up to 10 seconds after you stop speaking. And if your transmitter is shy on modulation, the Com-Vox can be used as a mike preamp. Best of all, the Com-Vox has an anti-trip circuit that really works. This means that you can raise the volume of your receiver's speaker till your ears hurt, but the Com-Vox will not operate until you speak into the mike.

Construction. Our Com-Vox is built on a 7x5x2-inch chassis. Shielded sockets must be used for V1, V2 and V3. Since space is at a premium, use ceramic disc capacitors. In order to keep down the physical size of C7 and C8, you may use 50- or 75-volt capacitors.

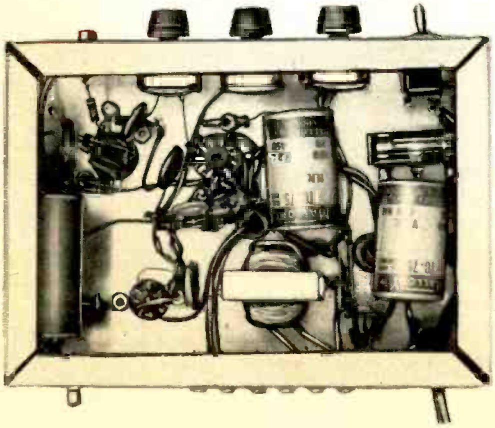
Since your mike's output is fed to both the Com-Vox and the transmitter, J1 is connected directly to J2 with shielded cable—only one end of which is grounded. If your transmitter requires a higher-level input signal to produce full modulation, connect J2 to

By Herb Friedman, W2ZLF





D1 and D2 have delicate leads, so handle carefully. Grip leads with pliers when soldering to prevent heat damage; and be sure the polarity is correct. Yellow band is cathode. Shield of cable from J1 to J2 is grounded at J2 only. Ground straps on R8, R14 and R20 are supplied with controls.



Space is at a premium under chassis. Wire the transformer, relay and all the filament leads first.

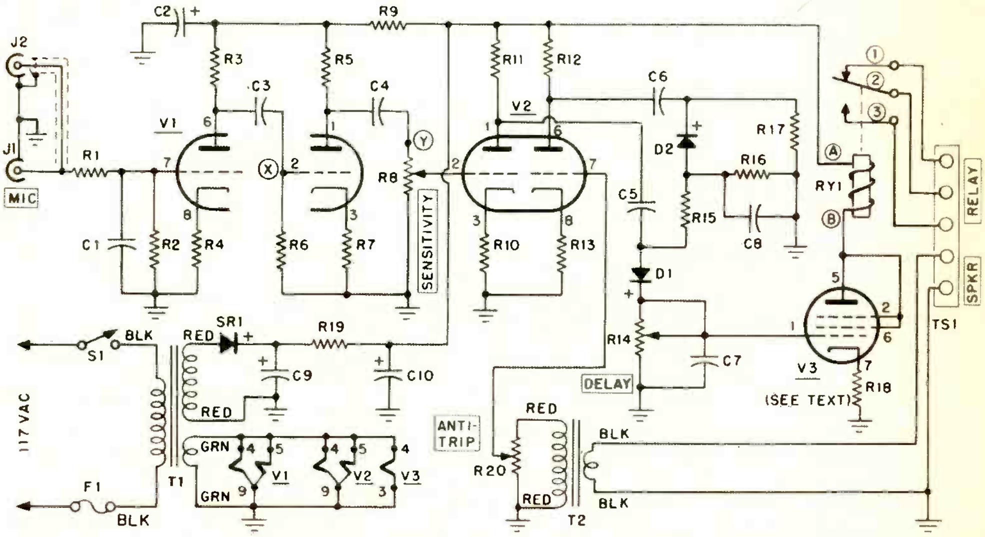
point X in the schematic. If even more gain is required, connect J2 to point Y in the schematic. In either case, ground only one end of the shielded cable. R1 and C1 are an RF filter and must not be omitted.

Twist and rout the filament leads as shown in the pictorial to keep down hum, and ground one of the filament leads to the chassis at V1. Connect two filament leads to all tubes. *Do not* use the chassis as common ground for one side of the filament line.

RY1 is an SPDT relay with a 5,000-ohm coil. We chose the contacts shown to illustrate typical connections. If you require additional contacts or use a different relay, be sure to use one that pulls in at about 4 to 6 ma. The pull-in current

PARTS LIST

Resistors: ½ watt, 10% unless otherwise indicated
R1—47,000 ohms R2—2.2 megohms
R3,R5,R6,R11,R12,R15,R17 — 100,000 ohms
R4,R7,R10,R13—2,200 ohms
R8—100,000-ohm, audio-taper potentiometer
R9—22,000 ohms
R14—7.5 megohm, audio-taper potentiometer
R16—4.7 megohms
R18—1,500 ohms (see text)
R19—470 ohms
R20—50,000-ohm, audio-taper potentiometer
Capacitors: Ceramic disc, 500 V or higher unless otherwise indicated
C1—.001 mf
C2,C9,C10—20 mf, 450 V electrolytic
C3,C4,C5,C6—.01 mf
C7,C8—.1 mf, 50 V or higher
D1,D2—1N463A diode (Sylvania)
J1,J2—Phono jacks
S1—SPST toggle switch
F1—1-amp fuse and holder
RY1—SPDT relay, 5,000-ohm coil (Potter and Brumfield LB-5 or equiv.; see text)
SR1—Silicon rectifier, 750 ma, 200 PIV
T1—Power transformer: 125 V @ 50 ma, 6.3 V @ 2 A (Allied Radio 62 G 411 or equiv.)
T2—Output transformer: 5,000-ohm primary, 3.2-ohm secondary (Allied Radio 62 G 064 or equiv.)
V1,V2—12AX7 tube
V3—6AU6 tube
Misc.—Chassis, cabinet, terminal strips



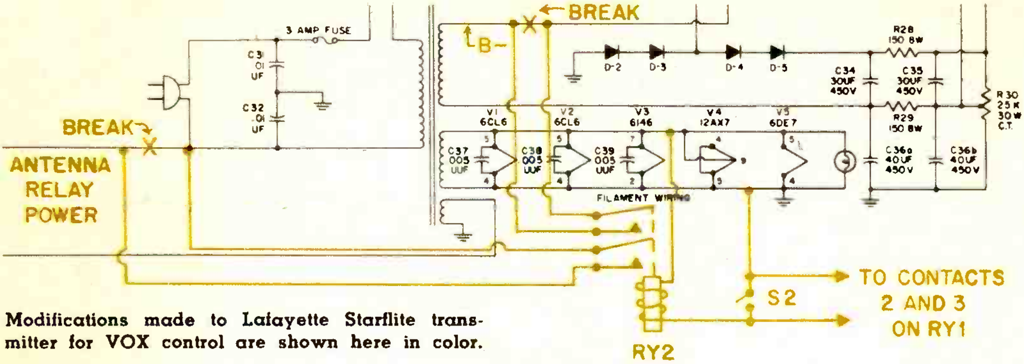
Mike voltage amplified by V1, V2 causes V3 to conduct, RY1 to close. R14, C7 time constant determines delay. Sound from speaker, amplified by right half of V2, rectified by D2, produces voltage at D2's anode offsetting mike voltage at junction of D1 and R15. This prevents RY1 from closing. Voltage at D1 when you speak in mike exceeds anti-trip voltage at D2, so D1, V3 conduct, RY1 closes.

determines the value of R18. For the specified RY1, R18 is 1,500 ohms. If you use a more sensitive relay with a pull-in current of about 4 ma, the relay may simply stay closed. If this happens, change R18 to 2,000 ohms. If RY1 still remains closed, change R18 to 2,400 ohms. But whatever relay you choose, be sure it has heavy contacts.

The voltage at RY1's terminals constitutes a shock hazard, so a cover should be put over the Com-Vox. The U-section of a 5x7x3-inch Minibox fits perfectly and can be held in place with small angle brackets. If you use a multiple-contact relay, replace TS1 with an octal socket.

Checkout. Connect a mike to J1, set R18 and R14 to mid-rotation and turn on the power. Allow about a minute for warmup and then talk into the mike. RY1 should close as soon as you speak; if it doesn't, rotate R8 and R14 fully clockwise. If RY1 still doesn't close, look for a wiring error. If the wiring appears to be correct, check the voltage between D1's cathode and ground with a VOM or a VTVM connected to the grid (pin 1) of V3. As you speak, you should get an indication of approximately +15 volts DC. If this voltage is not present, see whether there is audio at the junction of C5 and R15. If there isn't, check V1's or V2's circuitry.

Next, connect the leads from your receiver's speaker to the speaker terminal lugs on TS1. Rotate R20 fully clockwise and adjust the speaker level to normal

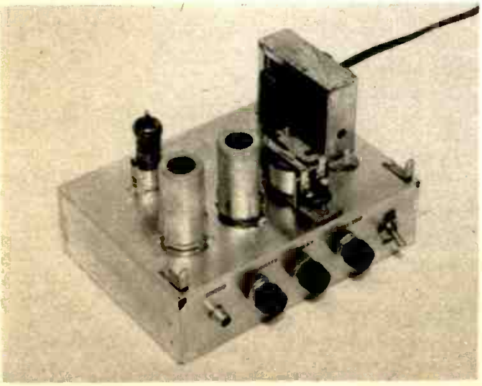


Modifications made to Lafayette Starflite transmitter for VOX control are shown here in color.

volume. If all is well you should measure between −5 and −15 volts DC between D2's anode (junction of R15 and R16) and ground. If voltage is not present, check for an audio signal at the junction of C6 and R17. If audio is present, the difficulty is in D2's circuit. If there is no audio, check the circuit around V2B.

Operation. Connect your microphone to J1 and, using a shielded cable, connect J2 to your transmitter's mike input. After setting R8 and R14 to mid-position, turn on the receiver and the Com-Vox. Adjust your receiver's speaker volume to slightly more than its usual level. Now turn R20 slowly until RY1 opens. Advance R20 an additional 1/16 turn. R20 is now set so the sound from your speaker will not trip the Com-Vox.

Speak in a normal voice and advance (or retard) R8 until RY1 closes. Then advance R8 1/16 turn and then slowly adjust R14 until RY1 stays closed one-half to one second after you stop talking (or you can set R14 for whatever delay you prefer). Since R8 and R14 interact slightly, you will have to juggle them a few times to get the correct setting.



Top view of Com-Vox. Protective cover is held in place with brackets at front of the chassis.

After all adjustments are made, connect contacts 2 and 3 on RY1 to your transmitter's PTT switch leads.

If your transmitter lacks a PTT switch but has a panel-mounted mode switch, you still can use the Com-Vox. Mode switches usually are wired to set up the operating mode (CW or phone). They also connect the transmitter's power transformer B— lead to the chassis, thereby energizing the transmitter. The Com-Vox is used to make or break the B— connection to ground and to switch the antenna. The schematic above shows how to make the connections.

Mount a DPDT, 6-volt AC relay (RY2) on the transmitter chassis, connect one side of the coil to the 6-volt filament supply and the other side of the coil to terminal 3 of RY1 in the Com-Vox. Connect the other lead of the transmitter's filament supply (actually ground) to lug 2 of RY1. RY2 will now close when you speak into the mike.

One set of RY2's contacts completes the B— circuit and the other set controls the antenna-relay circuit. To use the Com-Vox, set the transmitter to the desired operating mode and *leave it there*. Every time you speak into the mike RY2 will close, switching the antenna and energizing the transmitter. To simplify transmitter tune-up, connect an SPST switch (S2) across RY1 contacts 2 and 3 so the transmitter can be kept on permanently. ◆

THE HAM SHACK

BY ROBERT HERTZBERG W2DJJ

LONDON

COMING HOME . . . If you were with us last issue, you're aware that we were smack in the middle of a European ham expedition. Our last installment came from Rome, where we uncovered a little Italian ham lingo. This time we're writing from London, in which city (it says here) they speak the same language we do. London marks the end of our tour, and we'll soon be homeward-bound. But we have spent several days reviewing our 7,000-mile jaunt and jotting down our general impressions of European hamdom.

The Gals . . . YL's and XYL's are rare in Europe. The fact that my wife was able to decipher code and spoke the lingo was a topic of conservation everywhere we went. We began to realize that ham radio is strictly a man's game in Europe. If you doubt us, just stop to ask yourself how many YL's you've heard signing European calls.

The Guys . . . The ladies aren't the only ones excluded from the game—men-folk under 40 keep them company. At a ham-club meeting we attended here in England, we couldn't help noticing that the all-male membership was short on middle-agers, long on the white-hair set and had no real young'uns in sight at all. When some members spoke of their military experiences, they were referring to the 1914-18 war—which gives you an idea of their vintage.

Why the age disparity? Here in Europe, a great many young people, especially boys, spend much of their growing years at well-disciplined, regimented boarding schools. At the age when American youngsters are adding extracurricular activities to their schedules, European youths are working hard at their studies with a minimum of spending money in pocket.

When you come right down to it, the only one in most European families with the time and money for hamming is the guy who wears the pants. And unless he has one of those secret Swiss bank accounts, even his rig will be a modest one. We mean it when we say that price tags are high.

A Conclusion? . . . Maybe the old story about Europeans being conservative and Americans being impulsive applies to hamming. A U.S. ham plunges into the field fast and furious. He struggles through a simple Novice exam, then runs out and buys a transceiver without even bothering to find out its tube complement until he reads the instruction manual.

But a European ham goes about it gradually. Since most of his equipment is home-brew, he needs time to build up his shack. Once it's assembled, he's inclined to retain his equipment for a much longer period. All of which is quite in accord with his alleged conservativism, or so it seems.

Journey's End . . . We'll soon be off for the States-bound plane, raring to dust off the S-meter and get back on the air. When we do, we expect to reminisce with the G's, the F's, the DL's and the many other fine European ham friends we've made over here.

Easy way to meet fellow hams in Europe is to tape your QSL card on your car's rear window. W2DJJ, proprietor of EI's Ham Shack, points to card that did the trick for him during his Continental tour.

AWARD HUNTERS'

NATIONAL RADIO CLUB
INTERNATIONAL "DX" DIGEST

THAT SUCH AN HONOR HAS BEEN AWARDED HIM A POSITION OF
MONGST INTERNATIONAL "DXERS" OF THIS CLUB

THANKS to the phenomenal increase in short-wave listening (and listeners) over the past few years, SWLs and DXers have gained recognition as a major strain of hobbyists. Time was when the listener was dependent almost entirely on ham charity for trophies. But now there's a wide variety of awards just for him. Sponsoring organizations range from those like the Canadian DX Club, with a much-coveted certificate for all who can qualify, to the pioneer Newark News Radio Club, which gives out awards primarily to members.

First off, of course, comes EI's own DX Club, which offers a variety of awards, depending on the number of countries QSLed. To qualify for EI's Special Award, for example, you must have QSL's from ten different countries. The EI Broadcast Band Award goes to listeners who have QSL's from broadcast-band (535 to 1605 kc) stations in 15 different countries.

EI also offers two General Class Awards. One is for DXing stations on any frequency in 50 countries; the other, called the DX Century Award, is for DXing a total of 100 countries. Incidentally, applications for any of EI's Awards can be submitted only during Award Periods. Watch EI for an announcement of the next Award Period, which will appear in these pages soon.

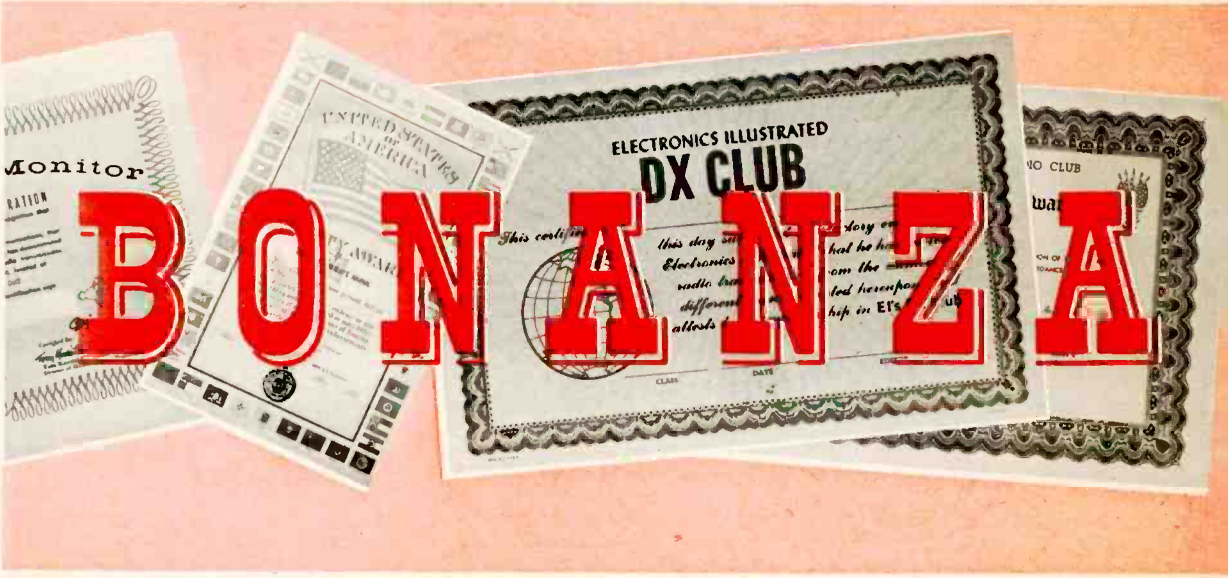
Also of prime interest to DXers is the Canadian BCB Award issued by the Canadian DX Club, 24 Briscoe St., W., London, Ont. To qualify, you must have QSL's from 40 Canadian broadcast-band (535-1605 kc) stations, including four of the co-sponsoring stations. The co-sponsors are: 1) Fredericton, N.B.'s CFNB on 550 kc, 2) Toronto, Ont.'s CKEY on 580 kc, 3) Regina, Sask.'s CKCK on 620 kc, 4) Winnipeg, Man.'s CKRC on 630 kc, 5) Verdun, Que.'s CKVL on 850 kc, 6) St. Johns, Nfld.'s CJON on 930 kc, 7) London, Ont.'s CFPL on 980 kc, 8) Calgary, Alta.'s CFCN on 1060 kc, 9) Vancouver, B.C.'s CKWX on 1130 kc.

Fortunately, since most of these stations operate all night, they can be picked up in many parts of the U.S. without much trouble. Even the tough-to-log outlets often can be snagged during the wee hours Monday morning when much of the American competition is off the air.

A Class-B seal can be added to the basic CDXC certificate when the 60-station mark is reached, while a Class-A seal requires 75 Canadian BCB verifications. Entrants must submit their QSL's, along with a listing of same, plus 50¢ for the basic certificate and 25¢ for each seal.

Awards issued by the North American Shortwave Association, 265 Stillwell Rd., Hamburg, N. Y., are for members only. Nevertheless, the association's goals are interesting and the $2.50 annual dues include a subscription to their monthly publication. You might send the association a stamped, self-addressed envelope and ask for full information.

The National Radio Club, Box 63, Kensington Station, Buffalo 15, N. Y., has annual contests for broadcast-band DXers, with certificates and postage stamps for the winners. Exact nature of the contests varies from year to year, and annual dues are $4.



An oldtimer among clubs, the Newark News Radio Club (215 Market St., Newark 1, N. J.) issues to members only an All Purpose Award. In other words, the certificate can be earned no matter what kind of DX you chase (SW, BCB, FM, etc.—but not CB). Dues are $5, and to obtain specific information on this award, members must send a stamped, self-addressed envelope to the Awards Committee at Route 2, Box 84, Vincentown, N. J.

Another award by the NNRC goes to anyone who can qualify. Known as the State Capitals Award, it's available in three classes—Class A for having "heard and confirmed" stations in 50 state capitals on any frequency, Class B for 40 state capitals and Class C for 30. More details on the SCA series of awards can be obtained from the address given above—but don't forget to enclose a stamped, self-addressed envelope.

Even the beginner hasn't been overlooked. He may become a Registered Monitor, complete with certificate and SWL "call letters." When ordered from Popular Electronics they'll cost you 10¢. The DXers Radio Club, 229 W. Chestnut St., Couderton, Pa., automatically issues calls to members. Dues at present are $1.50, but since this is a new organization we suggest you query before joining. As before, include a stamped, self-addressed envelope with your letter.

The Midwest DX-SW Radio Club, 2100 W. William St., Decatur, Ill., also issues calls. This is a growing organization with dues of $2.50. However, it's regional in nature, with membership open only to residents of Indiana, Illinois and Wisconsin.

Beginners also may receive awards for swapping SWL cards with all 50 states. The North American Shortwave Association requires that ten of the cards be from the NASA, but the procedure for obtaining this award is the same as that for other NASA awards.

Good hunting!

—*C. M. Stanbury II*

THE AMPLI-MIKE

...incorporates mike and preamp in one case
...tailors your voice with volume and tone control

By Herb Friedman, 2W6045

EVEN though somebody once told you that you'd make a good radio announcer, you can't necessarily depend on your voice to knife through the airwaves when you're calling CQ on the ham bands or summoning one of your mobile Citizens Band units.

Each person's voice has different volume and frequency characteristics, and it's unusual for these factors to be at optimum for transmission of intelligence via two-way radio.

Most of the *energy* of the average voice is in the range of 90 to 500 cps. However, most of the *intelligence* is carried by the mid-range frequencies, from 500 to 5,000 cps, whose energy level is much lower. And most CB and ham transmitters don't have tone control to boost the level of this important band of frequencies.

By using the Ampli-Mike, you'll be able to produce maximum modulation and make your voice more intelligible at the receiving end. The Ampli-Mike also is equipped to boost or cut the overall level of your voice in case you're a natural whisperer or loudmouth.

The Ampli-Mike consists of a microphone and transistor amplifier with volume and tone controls in one neat package. You can set the gain control for extra output if your voice is soft or if your rig is shy on modulation. Or, you can reduce the output if your voice is on the loud side. The frequency response can be adjusted to give you plenty of sock in the mid-range frequencies.

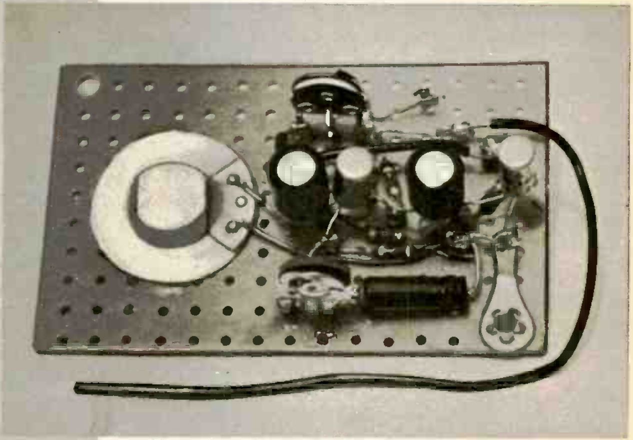
Construction. Our Ampli-Mike

PARTS LIST

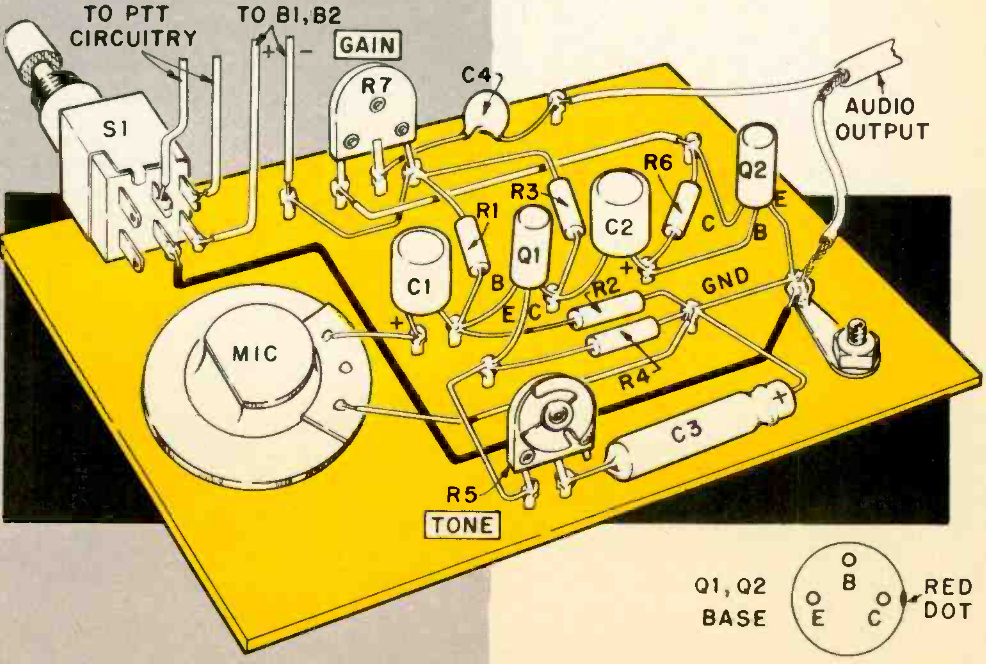
Resistors: 1/10 watt, 10% unless otherwise indicated
R1—47,000 ohms
R2,R3—4,700 ohms
R4—470 ohms
R5,R7—5,000-ohm potentiometer (Lafayette VC-58)
R6—100,000 ohms
Capacitors: 6 volts or higher
C1,C2—30 mf electrolytic (Lafayette CF-167)
C3—1 mf electrolytic (Lafayette CF-128)
C4—.1 mf
MIC—600-ohm dynamic microphone (Lafayette PA-74)
Q1,Q2—2N220 transistor
S1—DPDT subminiature push button switch (Lafayette SW-101)
B1,B2—1.5-volt size AAA battery
Misc.—Perforated board, flea clips, cabinet

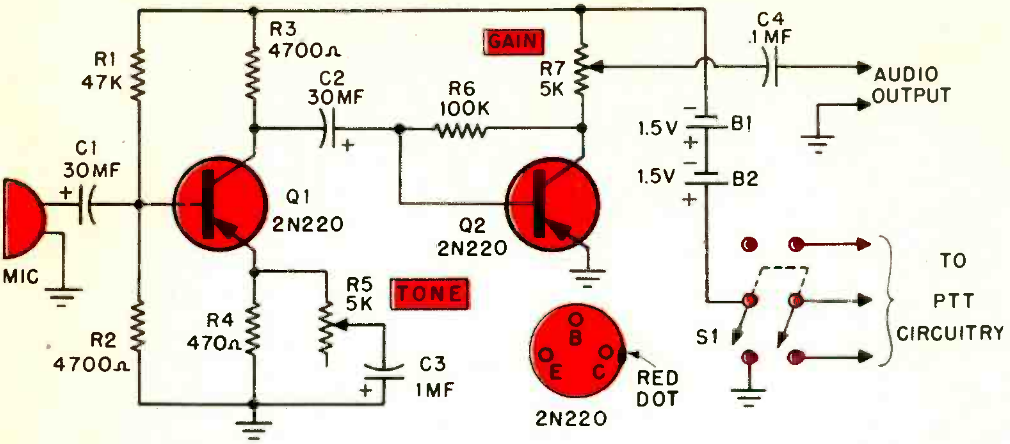
is built on a 1⅞x3-inch piece of perforated board which is mounted in the main section of a 3¼x2⅛x1⅝-inch Minibox. To keep the unit small enough to fit in the palm of a hand, we used miniature components throughout.

Use flea clips for all terminal points. Volume control R7 is a subminiature size intended for printed circuits. To mount it, insert three flea clips in a line (the tabs on R7 will line up perfectly with the clips) and press the tabs into



Microphone is mounted in 1-inch hole (cut with chassis punch) in perforated board. Secure microphone in place with a drop of epoxy cement at two points and let it set for 24 hours. Space is tight so use a small-tip iron and don't apply too much heat to the transistor or resistor leads.





Gain of the first stage of amplifier increases at high frequencies as wiper arm of tone control R5 is moved toward end of control at emitter of Q1. PTT connection depends on the circuitry of your CB transceiver.

the clips. Apply a drop of solder.

Tone control R5 also is subminiature and is mounted similarly. However, only two of its tabs are used. Install R5 exactly as shown. Its right-hand tab is not connected and is cut short. Substitutions should not be made for Q1 and Q2, which are low-noise transistors.

Punch a ¾-inch hole in the Minibox directly in front of the microphone and put a piece of grille cloth the same size as the perforated board on the inside of the Minibox. The cloth covers the microphone and acts as an insulator, preventing the flea clips from shorting against the metal cabinet when the board is mounted. Mount the board, using screws at diagonally opposite corners. A ¼-inch grommet over each screw will keep the board away from the cabinet.

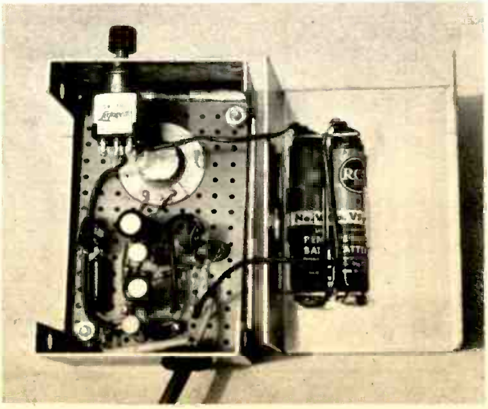
S1 is a miniature DPDT push button switch. Mount it on top of the Minibox so your operating finger rests comfortably on the button. One set of contacts applies power to the amplifier.

Use an ohmmeter to determine the other set of contacts that close when the button is depressed. These lugs should be connected to the PTT contacts in your transmitter's mike socket. If the PTT leads in your rig are disconnected when the PTT button is depressed, use a set of contacts on S1 that open when the button is pressed.

Drill ⅜-inch holes in the sides of the Minibox opposite R5 and R7 so they can be adjusted when the cover is in place. Be sure to use shielded cable to connect the Ampli-Mike to your transceiver. Connect the shield to the Minibox with a lug under one of the perforated board's mounting screws.

B1 and B2 are AAA penlight cells. Since the amplifier's current drain is low, the batteries will last many months, even with heavy use. Mount the battery holder on the Minibox cover, making certain it does not touch any of the components when the cover is in place.

Plug in the Ampli-Mike, depress S1, speak in a normal voice and adjust R7 to achieve as close to 100% modulation as possible. Set R5 for best tone.

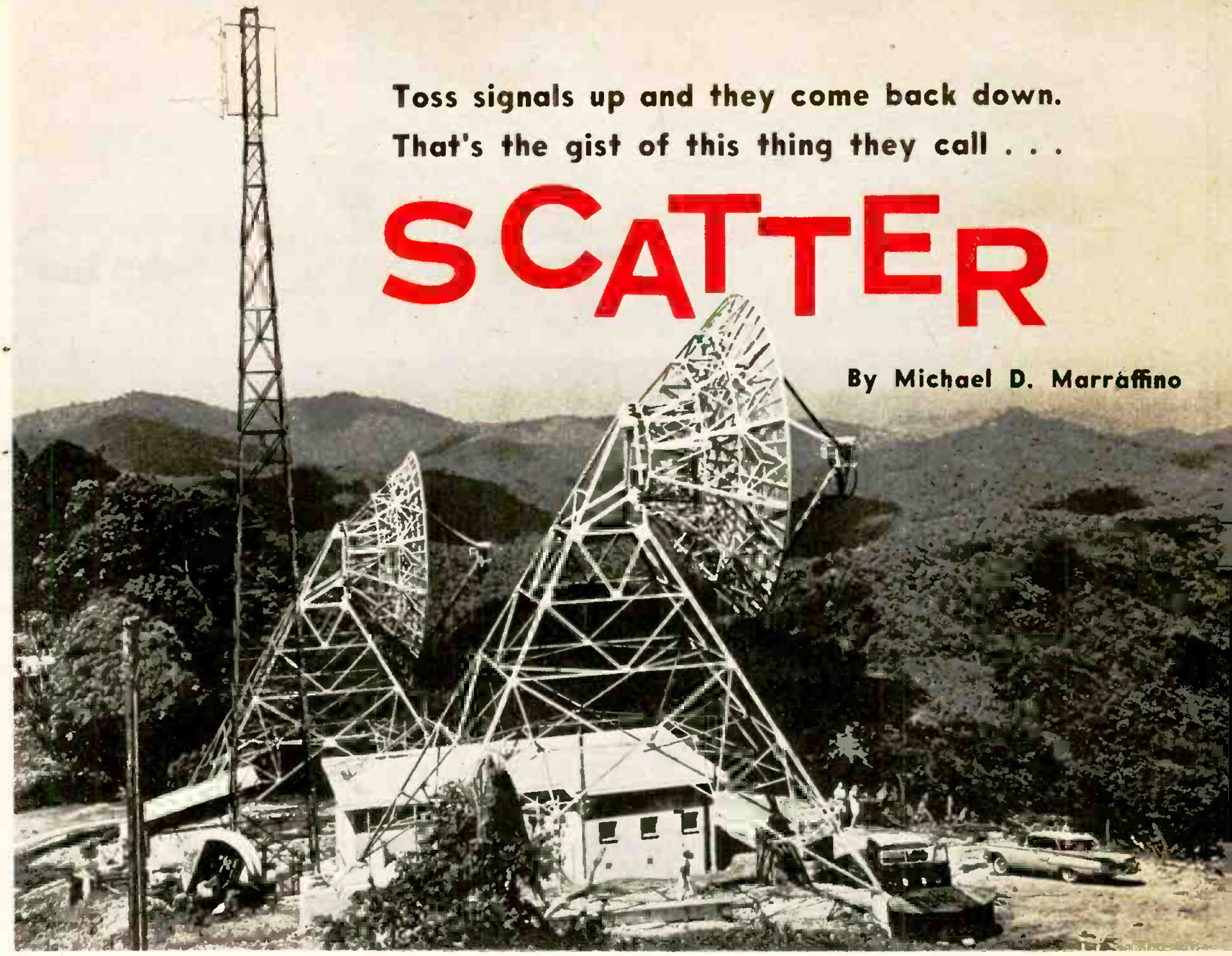


Batteries can be mounted on the back of the cabinet with a Keystone No. 138 battery holder.

Toss signals up and they come back down. That's the gist of this thing they call . . .

SCATTER

By Michael D. Marraffino



A VAST chain of telephone wires ties the United States together in a way that would dumbfound the average citizen, were he to learn all the details of its immensity and complexity. There's even a chain of microwave relay stations to carry television programs coast-to-coast and oodles of noodle-like transoceanic cables to link the U. S. with countries round the world.

Yet we still hear almost daily about experiments with new communications techniques. A satellite bounces a signal back to earth; other satellites record and retransmit the message. Even ionized meteor trails are being used to reflect radio waves.

Such new systems have been experimental for the most part and are hardly the kind that could be put into everyday use. But one new technique that quietly made its appearance a few years ago is finding more and more applications. That system is called *scatter*.

Why has scatter made the grade where other systems have failed? The answer lies primarily in the things it's been able to do. It's a highly secretive kind of communications system, and the military likes it for this reason. But there's more to scatter than the secrets it keeps. For scatter has opened up whole new bands of frequencies for voice transmission around the curvature of the earth. It's also given us a new means for long-distance transmission of television signals.

To understand why these feats are possible, let's take a minute to investigate how scatter differs from the ordinary garden-variety of short-wave broadcasting.

Standard high-frequency transmissions depend on a phenomenon called skip and take place in the frequency range from about 3 to 30 mc. When conditions are right, a signal sent up into the atmosphere is angled back to

SCATTER

Antennas for scatter systems are among the most photogenic going. The back-to-back pair above, located in the Aleutians, relay messages in opposite directions to points hundreds of miles apart. Designed for military use, the mobile antenna at left can be erected most anywhere. It's strong enough to withstand 120-mph winds, once it's anchored.

earth at points hundreds or thousands of miles distant.

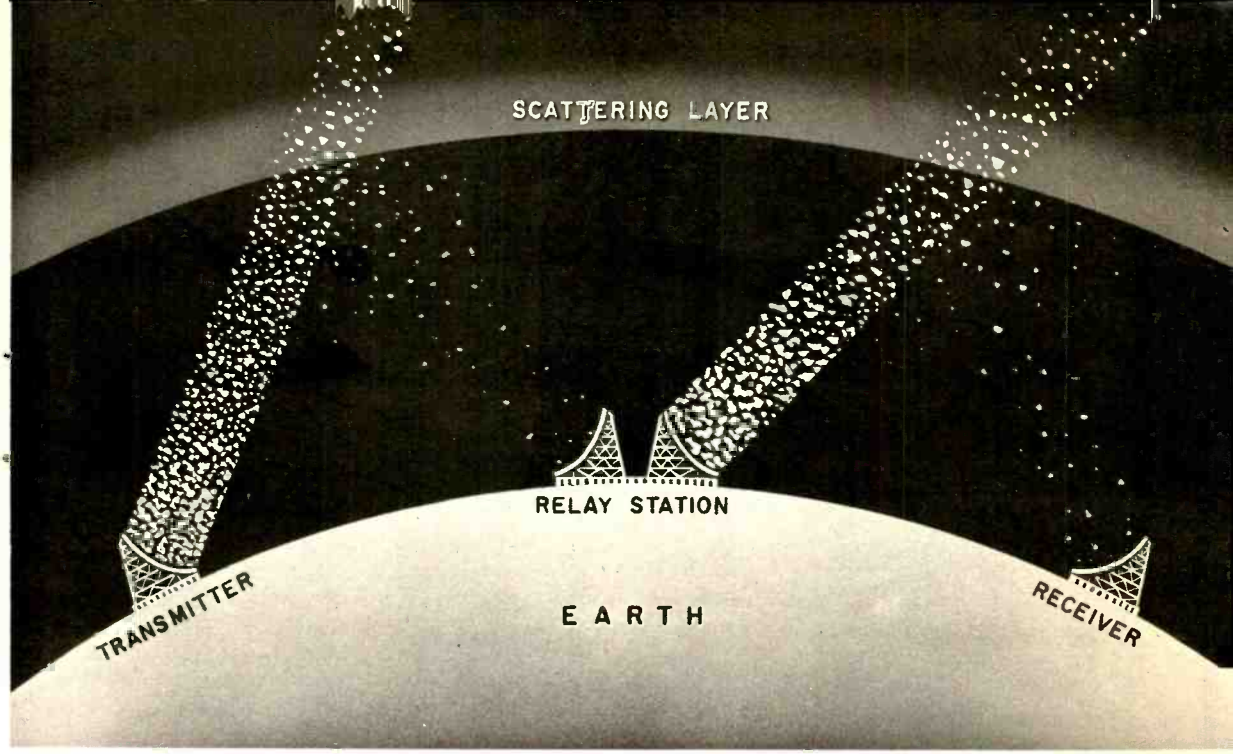
The thing that reflects the signal, if it's reflected at all, is a portion of the ionosphere known as the Heaviside, or F layer. This part of the atmospheric sandwich consists of a dense region of ionized particles which ordinarily bounce the signal back to earth so efficiently that London can talk to New York at practically any hour of the day or night.

As a general rule, the greater the number of charged particles present in the ionosphere, the higher the frequency that can be reflected. But frequencies greater than 30 mc usually are useless for skip transmissions because there just aren't enough charged particles to turn the trick at such short wavelengths.

The scatter systems, on the other hand, work by bouncing VHF (30 to 300 mc) or UHF (300 to 3000 mc) signals from various regions of the atmosphere back to earth. How? Well, they obviously can't operate on the same principle as ionospheric skip, because the Heaviside layer isn't charged strongly enough. Actually, no one is sure why reflection takes place at frequencies higher than 30 mc, any more than anyone knows exactly why the Indians parted with Manhattan.

One explanation has it that small points in the atmosphere become charged so strongly that they reflect a little bit of a VHF or UHF signal. If there are many of these small charged points, and if the transmitted signal is powerful, enough of it will be returned to earth to be received.

Assuming that this theory's right, it follows that the reflected signals never would make a Grand Army—they're too few in number and too widely dispersed. In this respect, they're more like handfuls of widely scattered Apaches screaming from behind every hill in sight. While they could never



Signals from scatter stations travel beyond earth's curvature in a different manner from those relying on ionospheric skip. Though only a part of the signal is received, systems are reliable and interference-free.

form the force Napoleon mustered, they get their business done just the same.

Because only a small portion of the signal is returned to earth by a great number of small reflections, the transmission is said to be *scattered* downward, rather than *reflected* as in the case of ionospheric skip. And that, briefly, is where scatter gets its name.

The differences in the method of bouncing the signal also cause a great difference in the efficiency of the two systems. Under the best conditions for skip, almost all of the transmitted signal is reflected. But in scatter, only a small portion of the signal ever gets back to earth—even under well-nigh ideal conditions.

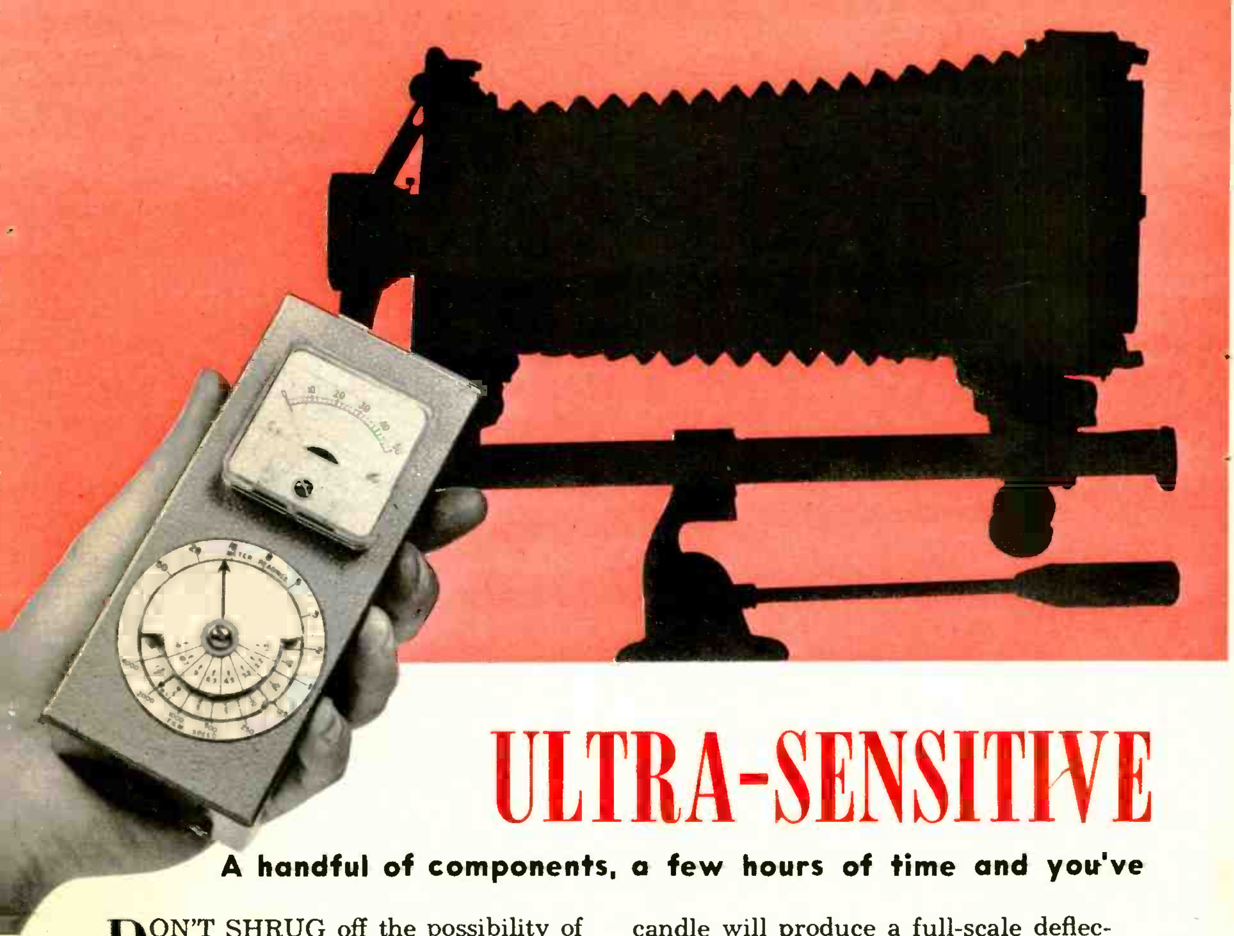
Since scatter is so much less efficient than the skip method of transmission, a scatter transmitter must be much more powerful. For example, one scatter transmitter built by the Radio Engineering Laboratories delivers an output power of 75,000 watts—enough to serve 260 average homes. Its output tube develops so much heat that 95 gallons of water must be pumped through every minute to keep it from burning up. Yet all of this power is needed to send 100 or so telephone calls a distance of 500 miles.

But those 500 miles may consist of rugged mountains, vast stretches of uncharted desert or the deepest ocean. All of these terrain features tend to prohibit the use of microwave relays. And it's primarily for this reason that so many scatter systems have been installed in the last few years.

Like microwave installations, scatter systems are highly directive. In other words, the signal that is sent up will be reflected down onto a small area of the earth's surface. And this feature provides a number of significant advantages.

For one thing, this directivity permits many stations to use the same frequency without danger of interference. Then, too, it means that the military can zoom messages straight to their mark, much like the arrows of those Apaches we were talking about. There simply isn't any chance of an enemy intercepting a scatter transmission, nor is there much possibility of anyone's jamming it. Rea-

[*Continued on page* 114]



ULTRA-SENSITIVE

A handful of components, a few hours of time and you've

DON'T SHRUG off the possibility of having to photograph a black cat in a coal bin. If the subject happens to be something like an entertainer in a dimly-lit night club, you're up against a cat-in-a-coal-bin situation.

Fast films with ASA ratings as high as 1,250 and a good lens would see you halfway through the job. But a successful shot using low-level light depends on the exposure meter. Most old-style, self-generating meters won't show enough life under available-light conditions to give you even a clue to correct exposure. What you need is a meter whose sensitivity matches that of the film.

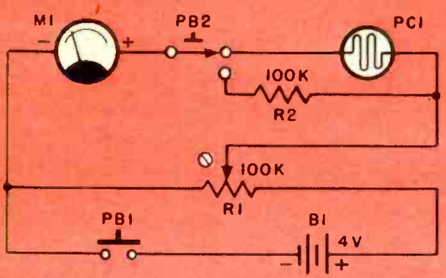
EI's Ultra-Sensitive Exposure Meter, which uses a cadmium-sulfide photoconductive cell, will tell you the correct exposure even when the illumination level is as low as 0.005 foot-candles. Compare this with some photogenerative meters that can't respond to an illumination level of 1 foot-candle. With our meter's front window wide open, a light intensity of one-quarter foot-candle will produce a full-scale deflection. The meter costs about $10 and can be built in an evening. Calibration is simple, requiring only a candle and a set of photographic neutral-density filters.

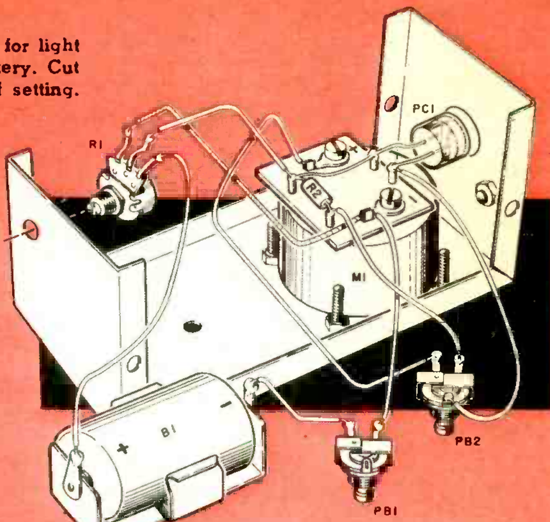
Since cadmium-sulfide cells require a source of operating voltage, the meter uses a 4-volt battery. A mercury type should be used because of its constant-output voltage and long life. However, to correct for battery deterioration, the meter includes a built-in voltmeter circuit and a calibrating potentiometer.

Another feature is that the light-acceptance angle of the meter (about 10 to 180 degrees) can be set during construction to match that of your camera's lens. If you mount the cell near the light window, the acceptance angle is greatest. If you mount the cell back from the window, the angle is narrower.

Construction. Our meter was built in a 2¼x2¼x5-inch Minibox. First, install the 50-microampere meter, then mount a small piece of perforated board on its terminal screws as shown in the pic-

Photocell is ⅛ inch behind window. Depress PB1 for light reading and depress PB2 with PB1 to check battery. Cut shaft of R1 short to prevent accidental change of setting.





PARTS LIST

- R1—10,000-ohm miniature potentiometer (Lafayette VC-34)
- R2—100,000-ohm, ½-watt resistor
- PC1—Photoconductive cell (Clairex CL-505)
- PB1,PB2—SPDT miniature push button (Lafayette MS-449 or equiv.)
- B1—4-volt mercury battery
- M1—0-50 microammeter (Lafayette T-200 or equiv.)
- Misc.—2¼x2¼x5-inch Minibox, battery holder, perforated board

EXPOSURE METER

By Harvey Pollack

got a meter that's right out front with the fastest films going.

torial. Put the meter's lugs on *top* of the board. Resistor R2 and the leads from the cell are mounted on the board with flea clips. Now that you know the position of the photocell, remove the entire assembly and drill a half-inch hole in the Minibox directly in front of the cell.

Using a 6-32 screw, install a small piece of aluminum on the front of the box so it can be moved in front of the photocell window when the meter is not in use. (The meter will be used with the window partially or fully opened, depending on the sensitivity desired.) Follow the pictorial and schematic for the location and connections of other parts.

Since an exposure meter normally is held in the left hand, the push-to-read button (PBI) should be located within reach of your left thumb. Battery-test push button (PB2) should be placed on the other side of the box.

Spray the inside of the Minibox with flat black paint or line it with dull black paper. Because the cell is extremely sensitive to light, all edges of the box should be sealed with black tape.

Calibration. Though we have supplied scales for the dials, it is necessary to verify their markings since your cell's characteristics may differ slightly from ours. This will require you to change the *meter reading* numbers (but not their location) on the top half of dial A (shown on the last page of this story). The calibration procedure also determines the exact window opening for lower-sensitivity operation.

In a room lit just brightly enough for you to see the microammeter needle, and with the meter window closed, press the thumb button (PBI) and note the current on the meter scale. If the current is about 1 microampere, bring the needle back to zero with the zero-adjust screw.

In a draft-free, dark room, put a ¾-inch diameter candle on a table exactly 2 feet from a large piece of white poster board as shown in the diagram. Light the candle and let it burn for at least five minutes. Open the meter's window

ULTRA-SENSITIVE EXPOSURE METER

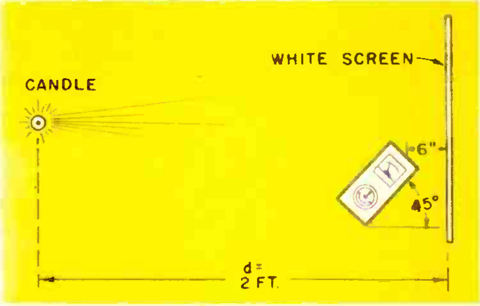
all the way to admit maximum light.

Set calibrating potentiometer R1 fully counterclockwise and position the window exactly 6 inches from the poster board, holding it at an angle of 45 degrees to the surface as shown. Press the thumb button only and adjust R1 for a full-scale deflection. Full-scale deflection now corresponds to a white-surface reflected illumination of 0.25 foot-candles. (Foot-candles = CP/D^2, where CP is candlepower and D is the distance from the poster board to the candle. Thus, 1 CP at 2 feet = $1/2^2$ = ¼ = 0.25 foot-candles.)

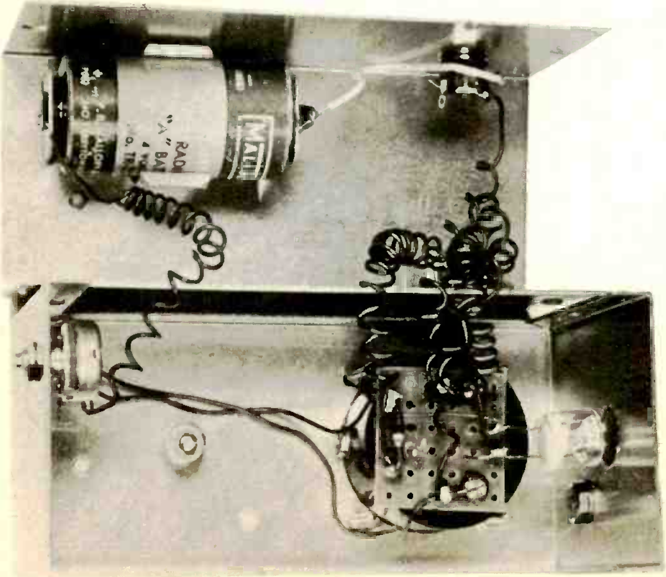
Now, press PB1 and PB2 *simultaneously* and jot down the current. This is the meter's standard current for a full-scale sensitivity of 0.25 foot-candles. To maintain this original calibration as the battery ages, adjust R1, with PB1 and PB2 depressed together, to obtain the same current.

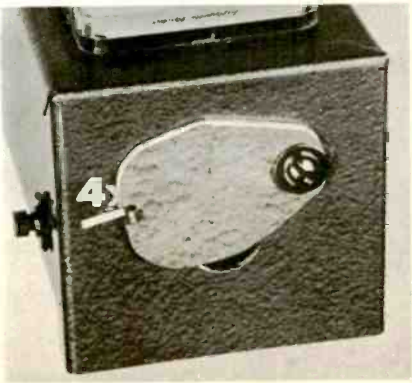
Next, place the *candle* exactly 1 foot from the poster board to produce a 1-foot-candle illumination intensity on the board. Close the meter window, and hold the meter in exactly the same position relative to the board as before. Slowly open the window until the meter again deflects full scale. For this window opening, the full-scale sensitivity is 1 foot-candle. Mark the position of the window on the front of the box. You now have two sensitivity ranges. The first, with the window wide open, is four times greater than when the window is partially open. When taking light readings of bright subjects, you may have to use the lower-sensitivity position to prevent the needle from going off scale.

To check the *meter reading* numbers on dial A, you'll now need those neutral-density filters. A 2X filter



Setup for calibrating the meter for quarter foot-candle sensitvity. Put candle 1 foot from white screen to calibrate the meter for 1-foot candle.





Inside of both halves of exposure meter (left). Cell is supported by its leads, which are soldered to flea clips on perforated board. Note mark near window (above) for lower-sensitivity operation.

ASA EXPOSURE INDEXES		
Film	**Daylight**	**Tungsten**
Panatomic-X	40	24
Plus-X	160	125
Tri-X	400	320
Royal-Pan	1,250	800
Verichrome Pan	125	84
Ansco All-Weather Pan	125	50
Ansco Super Hypan	500	400
Kodachrome II	25	—
Kodachrome II (Type A)	—	40
Anscochrome	32	—
Super Anscochrome	32	—
Ektachrome (Type E-2)	32	—
High-Speed Ektachrome (B)	160	125
Kodacolor	32	—
Agfacolor (CN17)	40	—

transmits 50 per cent of the light. Similarly, the light transmission of a 4X filter is 25 per cent, and the light transmission of the 8X filter is 12.5 per cent. By combining filters you can come up with more than enough readings to calibrate the dial.

Set the candle 2 feet away from the poster board, open the meter window wide and hold the meter 6 inches away from the board at a 45-degree angle, as before. Place the filters in front of the window and note the current on the meter.

We obtained the following current readings with our cell:

Filter	Foot Candles	Microamperes
none	.25	50
2X	.13	28
4X	.063	16
8X	.031	8
16X (2X, 4X)	.015	5
32X (4X, 8X)	.0075	3
64X (2X, 4X, 8X)	.0037	2

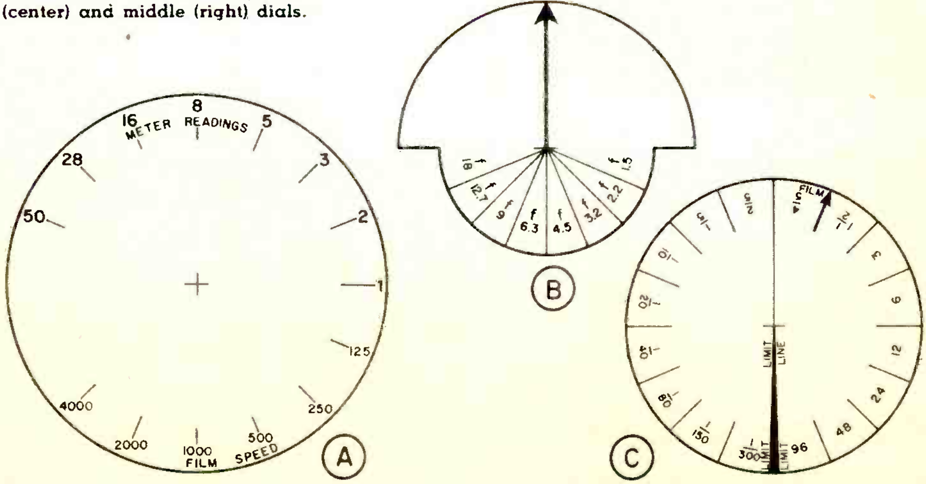
If your cell has characteristics slightly different from ours, your current readings will be different. In this case, use your figures instead of ours on the top of dial A. For example, when the 4X filter is in front of the window, your current may be 20 microamperes. Simply change 16 to 20 on top of dial A.

Preparing the Dials. Cut out the dial scales and glue A on the Minibox. Cement the other dials to thin sheet-metal discs and mount them with a 6-32 screw on the Minibox over dial A. Dial C goes over dial A and dial B goes on top. Use flat washers between the three dials and tighten the screw nut (it may be necessary to use two nuts, the second acting as a lock nut) so the dials move freely but do not rock on the pivot.

The markings on the dial scales are based on the meter's 0.25 foot-candle sensitivity condition (with the window

[*Continued on page* 117]

Scales for bottom (left), top (center) and middle (right) dials.



SWL

John Sullivan, Jr.'s neat SWL shack shows promise of things to come: the code-practice oscillator and key at the lower left bear out the fact that he is well on the way toward his Novice ticket. John has been an SWL for nearly three years. Currently, he receives on a 100-ft. long-wire antenna which feeds a Hallicrafters S-120 receiver as well as a Lafayette KT-135 receiver which he built from a kit. John is a student in East Greenwich, Conn.

PRIZE SHACKS

YOU CAN WIN $20 with a picture of your ham, CB or SWL shack! Just send the photo, along with a list of your equipment, to EI Prize Shacks, 67 West 44th St., New York 36, N. Y. We prefer 8x10-inch glossy prints. Negatives should be available if you send a snapshot. Color pictures cannot be reproduced. Pack your picture well to prevent damage in the mails and be sure to put your name and address on the back of each print. Enclose a note describing your activities in SWL, CB or ham radio. Unused pictures are returned.

CB

Union City, Ind., is home base for our Prize CB Shack—station 19Q1271. Its operator is none other than Louis Shannon, who is known to his friends as the Great Bald Eagle. Equipment at 19Q1271 includes an International 50 base station (at left) and an E. F. Johnson Messenger transceiver (center of desk). There also are a half-dozen pipes around the shack for Louis to smoke when the QRM tries to take over.

HAM

You don't need a fortune to become a ham, and the shack of Brian Hemmis, KN3USC, proves it. A 14-year-old Novice, Brian started out with a Knight-Kit Span Master receiver, which he got as a present. He constructed his own transmitter, and his power supply is built around an old TV transformer which he bought for a buck. Total cost of his 25-watt rig: $8, plus a few junk-box parts.

MEGA, GIGA and all that jazz

10^{12}	TERA	T
10^{9}	GIGA	G
10^{6}	MEGA	M
10^{3}	KILO	k
10^{2}	HECTO	h
10^{1}	DEKA	da
	UNIT	
10^{-1}	DECI	d
10^{-2}	CENTI	c
10^{-3}	MILLI	m
10^{-6}	MICRO	u
10^{-9}	NANO	n
10^{-12}	PICO	p

Because it's based entirely on multiples and submultiples of 10, the metric system of measurement has found its way into scientific circles the world over. In the table above, the metric prefixes appear in the center column, while the corresponding powers of 10 and the symbol for each prefix are in the curved lines at the left and right, respectively. As explained in the text, a negative prefix indicates 1 divided by that particular power of 10, so 10^{-3} becomes $1/10^3$ or 1/1000 or 0.001. Since any power of 10 is simply 1 plus the number of zeros indicated by the power concerned, 10^3 is 1 followed by 3 zeros or 1000; 10^6 is 1 followed by 6 zeros or 1,000,000, and so on.

ASK the average American how tall he is, and he'll probably answer in terms of feet and inches. Drop into a British supermarket and you'll find foods priced on the basis of how much they weigh—in pounds and ounces. Then why does a Dutchman measure his height in meters and weigh himself in grams? For the same reason that 100 (rather than 12 or 16) pennies make a dollar. It's easier that way.

Matter of fact, measuring anything in terms of 10's and 100's is a snap. That's why electronics employs the metric system for just about every measurement you can think of.

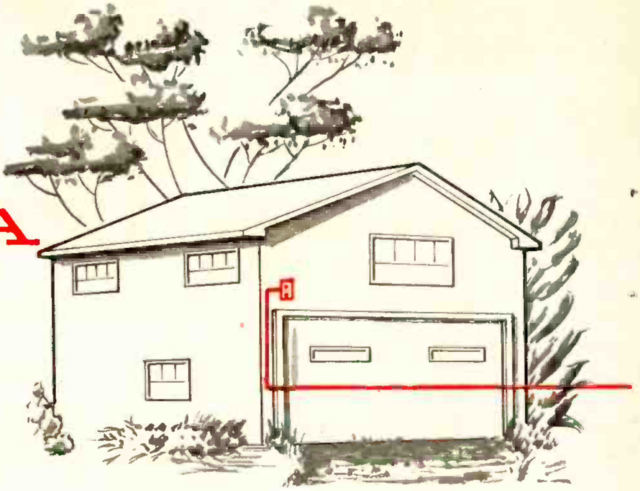
One of the nicest things about the metric system is the fact that you can refer to any unit in terms of multiples and submultiples. And, since every multiple or submultiple is a power of 10, it's simple to move from one to another with elementary mathematics.

Let's say we have a resistor which has a value of 680,000 ohms. Since it's as cumbersome to write this figure as it is to write 100 cents for $1, we can drop those last three zeros by using a symbol for 1000 or 10^3. That symbol, as you can see in the table at left, is *k*, and 680,000 ohms becomes 680 x 10^3 ohms, or simply 680k.

Similarly, instead of specifying that a small capacitor has a value of 0.00005 farads, we can use another symbol—μ—to indicate that the capacitor has a value of 50/1,000,000 farads, or 50 μf. Again, the table shows there's a power of 10 involved, but this time it has a minus sign in front of it. That minus sign indicates that the symbol stands for 1 over 10^6, or 1/1,000,000.

Study the table until you know what the metric system is all about, remembering that 10^1 is 10, 10^2 is 100, 10^3 is 1000, and so on, while 10^{-1} is 1/10, 10^{-2} is 1/100, 10^{-3} is 1/1000, etc. In almost no time, you'll wonder what you ever found so confusing about mega, giga and all that jazz! ◆

MASTER TV/FM ANTENNA SYSTEM



By Lon Cantor

IN a day and age when most homes have two or more TV sets, the problem of what to do about antennas can get pretty messy—at least if you want top-notch results. True, many people own portable TV's which they can move from room to room. And in areas where the "rabbit ears" type of indoor antenna works well enough, such sets can get by. Other TV sets rely on their own built-in antennas. However, in all but the best signal areas, rabbit ears and built-in antennas give you an inferior picture, if any picture at all.

To get maximum ejoyment from all your TV sets, you need a good outdoor antenna. After all, a TV set has but one thing to work with, and that's the signals its antenna supplies. Give it a poor antenna, and it'll more than likely give *you* a poor picture. But lend it a first-class antenna, and you'll be delighted with the results.

Same thing applies to an FM set. Rely on the set's built-in antenna or a little folded dipole tucked under the rug, and you'll miss a good many stations you might otherwise pick up. And you'll get less than maximum quieting all the way across the band.

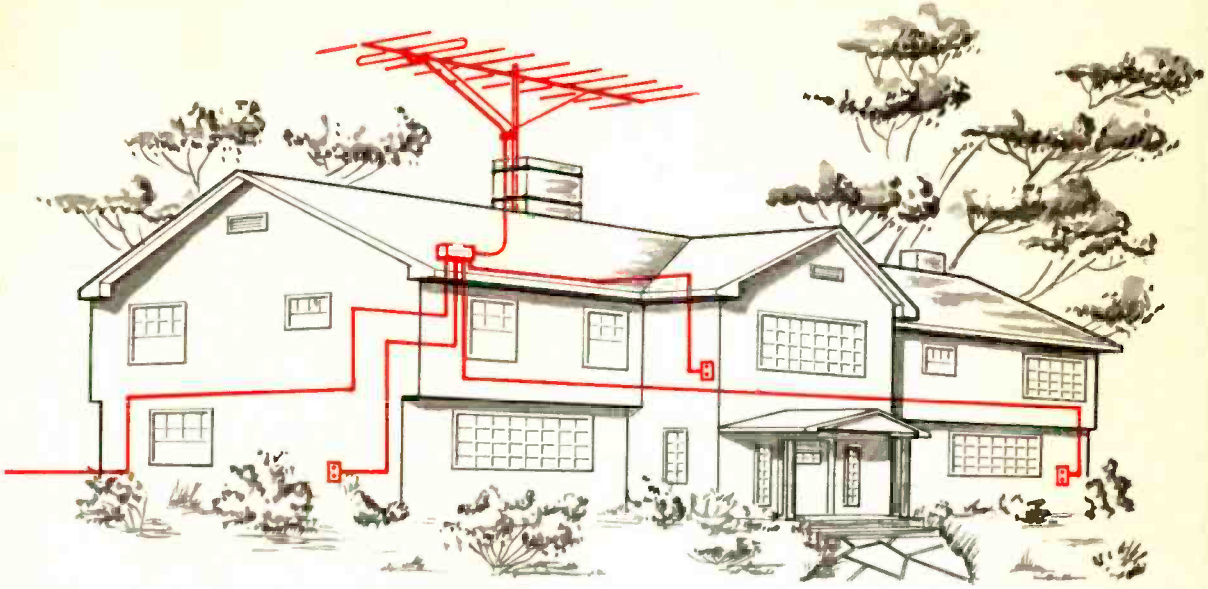
Since it's both impractical and needlessly expensive to install separate antennas for every TV or FM set you own, why not make a single antenna serve all of your sets? Our master TV/FM antenna system, shown in red in the drawing, uses a single, multi-channel TV antenna and can serve as many as four sets anywhere in the house.

Matter of fact, we've shown an extension into the garage just in case you'd like to watch your favorite show while fiddling with the car. Understandably, we've pictured a garage only for purposes of illustration: the fourth lead from the box in the drawing could go into yet another room in the house. Or it might feed an outlet in the patio.

As some tinkerers have discovered, it's impossible to hook up more than one TV or FM set to a single antenna and still get good results—unless you know how. Since most antennas and TV and FM sets have a characteristic impedance of 300 ohms, hooking up more than one set to the antenna will upset the impedance match.

For example, if you connect two sets in parallel, the antenna will see only 150 ohms instead of the 300 ohms it's supposed to. Similarly, connect two sets in series, and you'll force your antenna to look into 600 ohms. In either case, a serious mismatch occurs, and precious energy will be lost.

Even more important, standing waves likely will cause some of the signal to bounce up and down on the transmission line like a yo-yo, resulting in ghosts on the TV screen. Then, too, since every



TV and FM set has its own local oscillator, inter-set interference may result unless the sets are isolated adequately.

The simplest type of distribution system uses a two- or a four-set coupler. The coupler will perform the required functions of impedance matching and receiver isolation and thus enable you to use one antenna for from two to four sets. The lines which you see in red on the drawing represent standard 300-ohm TV twinlead and can be connected to an outlet box for each TV or FM set.

Coaxial cable is another possibility for feeding the signal between coupler and sets. Though it's more expensive than twinlead, it also picks up much less man-made interference. This is especially important in cities where auto ignition and diathermy machines can be real nuisances.

If you do decide to use coax, such as RG-11/U, the impedance problem again presents itself. Both the antenna and the various sets are 300-ohm devices, while the coax itself has an impedance of 75 ohms. However, there are suitable matching transformers—the Miller 6162 is one—on the market which will do the trick very nicely. You'll need one at the output of the coupler to step the impedance down from 300 to 75 ohms, and you'll need another at every set to step it back up to 300 ohms.

In areas with very strong signals, the 300-ohm twinlead between the matching transformer and the set itself must be kept as short as possible to prevent direct signal pickup. For this reason, it's generally best to mount the matching transformer right on the back of the set.

Now that we have the basic system firmly in mind, let's consider some of the other possibilities for a home TV/FM antenna system. In the installation just described, we've assumed that a single broadband TV antenna will be used, and that its performance will be adequate for all TV channels and FM as well. But this is a lot to expect from any one antenna, especially if the antenna has to be beamed in one direction for most stations and you're desirous of picking up a weak station on channel 5.

Actually, there's no reason why you can't install two or more antennas, each designed to cover a specific band or channel. If channels 2, 4, 7 and 9 happen to be the ones you watch most, it's entirely possible to mount four single-channel antennas on your roof, rather than one broadband array. Each antenna then can be beamed in the direction of the station you wish to pick up, and the outputs of the four antennas can be fed into a four-set coupler, connected in reverse (see drawing on top of the next page).

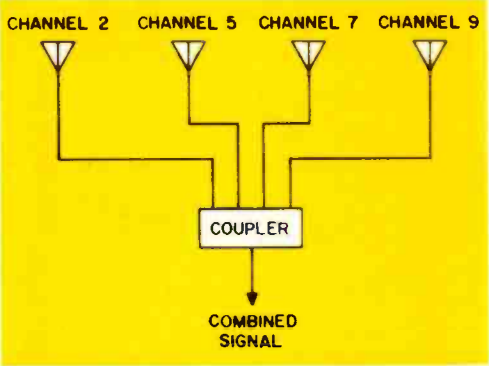
Similarly, by using a two-set coupler, again connected in reverse, you can

MASTER TV/FM ANTENNA SYSTEM

hook up a high-band antenna—one that picks up channels 7 through 13—and a low-band antenna, covering channels 2 through 6, to a single feed line. In this case, it again would be possible to beam both antennas for optimum signal pick-up of their respective channels, rather than be stuck with the compromise type of arrangement that a single broadband antenna necessitates.

In the event that you're trying to receive one particular channel and already own a broadband antenna, you might decide to purchase a single-channel antenna and hook it up to a two-set coupler as shown in our drawing. Because the single-channel antenna is cut for that specific channel, it should be much more efficient than the broadband array. Further, as in the case of the high-band and low-band antenna installation, you can aim the single-channel antenna directly at the station you wish to receive.

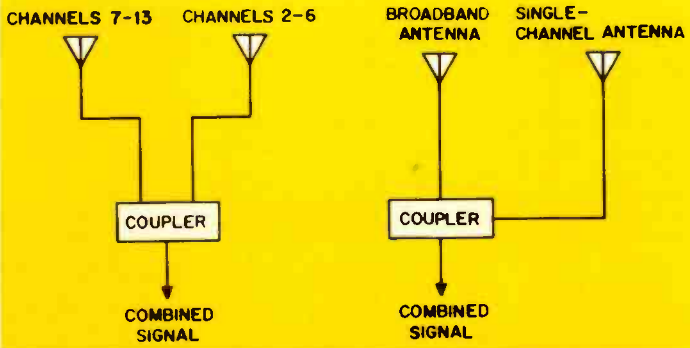
For listeners in fringe areas where getting any kind of decent image is rare as picture tubes in a trash can, there's another trick to hooking up any of these multi-set or multi-antenna systems. Though today's TV receivers vary widely in sensitivity, most require on the order of 300 to 500 uv. of picture carrier signal per channel. If your home is close to the transmitter, it's not unusual for your antenna to pick up 300,000 uv. of picture carrier. But let's suppose you live 30 miles away from the transmitters. You might pick up only 500 or 600 uv. of signal—enough for one TV set, perhaps, but hardly enough for four.



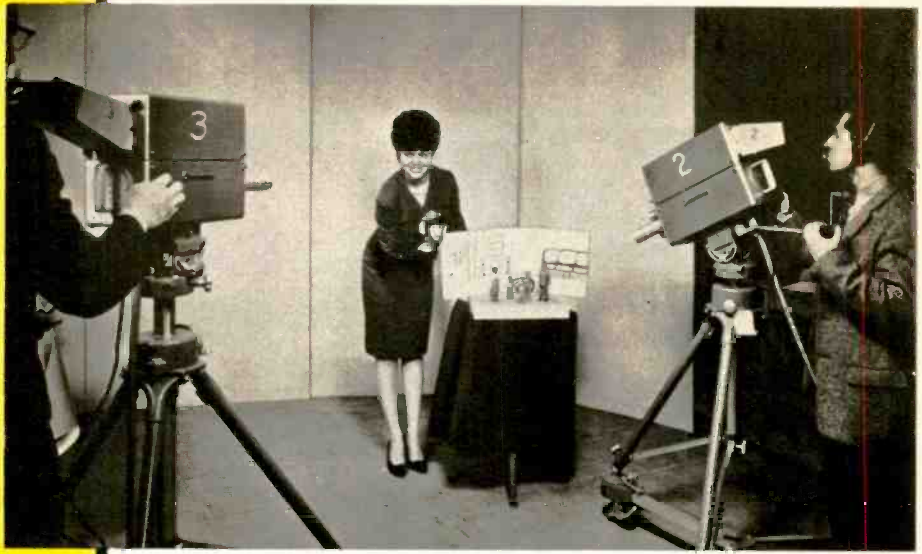
Separate, single-channel antennas beamed toward stations give best signals. Drawing shows channels 2, 5, 7 and 9, but any four channels can be included.

The answer in this case is either to use a high-gain antenna or, better yet, install a signal booster. Though it's a fairly inexpensive little gadget, a booster is actually a kind of RF amplifier which steps up the signal as it comes from the antenna.

Booster gain is expressed in decibels (db) and, for the record, a booster with a gain of 6 db will double the signal voltage, while one with a gain of 20 db will increase the signal tenfold. If you're in doubt about what kind of gain to expect from a booster, reference to a voltage/decibel conversion chart should clear up the problem.



Good reception of all 13 TV channels often requires separate antennas for specific frequencies. For lowest losses, the two antennas should feed into a coupler.



Schools are among top users of CCTV. Here, cameras at an elementary school in Chicago help speech therapist explain what good listening habits are all about.

FUN AND PROFIT IN CCTV

Closed-circuit television may be your answer to an electronics career.

By Jim Joseph

YOU DON'T have to be an actor—just a fellow who can read a schematic script—to star in one of the hottest fields going. Closed-circuit television, born just after World War II and grown to maturity in less than a decade, now ranks with computers, data-processing machines and other forms of automation as a major contributor to industrial efficiency and dollar savings. Thousands of firms have installed CCTV for uses that range from production control to order handling to plant security. And new CCTV applications are being found every day.

Typical of the electronics-minded men who design, install, service and rent CCTV setups is Dick Kaufman, a one-time radio repairman in Burbank, Calif. Working closely with CCTV equipment makers (among them: Blonder-Tongue, Dage, Dumont, Farnsworth, General Electric, General Precision, Motorola and RCA), Dick provides TV cameras and associated monitors that eagle-eye factory production lines (in their role as electronic foremen), act as bank tellers (visually verifying signatures), eavesdrop on hospital surgeries for the benefit of watching medical students, probe the interiors of

CCTV

Ex-TV-repairman Dick Kaufman is shown with a triple-lens CCTV camera which he designed and built. The camera sells for approximately $1,800, complete with power supply.

Though not an engineer, Dick Kaufman has years of practical experience in technical television. Engineers on his staff work with him in planning more complex installations.

sewers for leaks and even pipe the minister's sermons to his overflow congregation on Sunday.

Regardless of the application, most CCTV installations are remarkably similar. A Vidicon TV camera picks up an image which is then fed into a coaxial cable (rather than an antenna) and displayed on monitor receivers.

The camera is the most expensive part of the setup. The monitors closely resemble your home TV set, both in appearance and price.

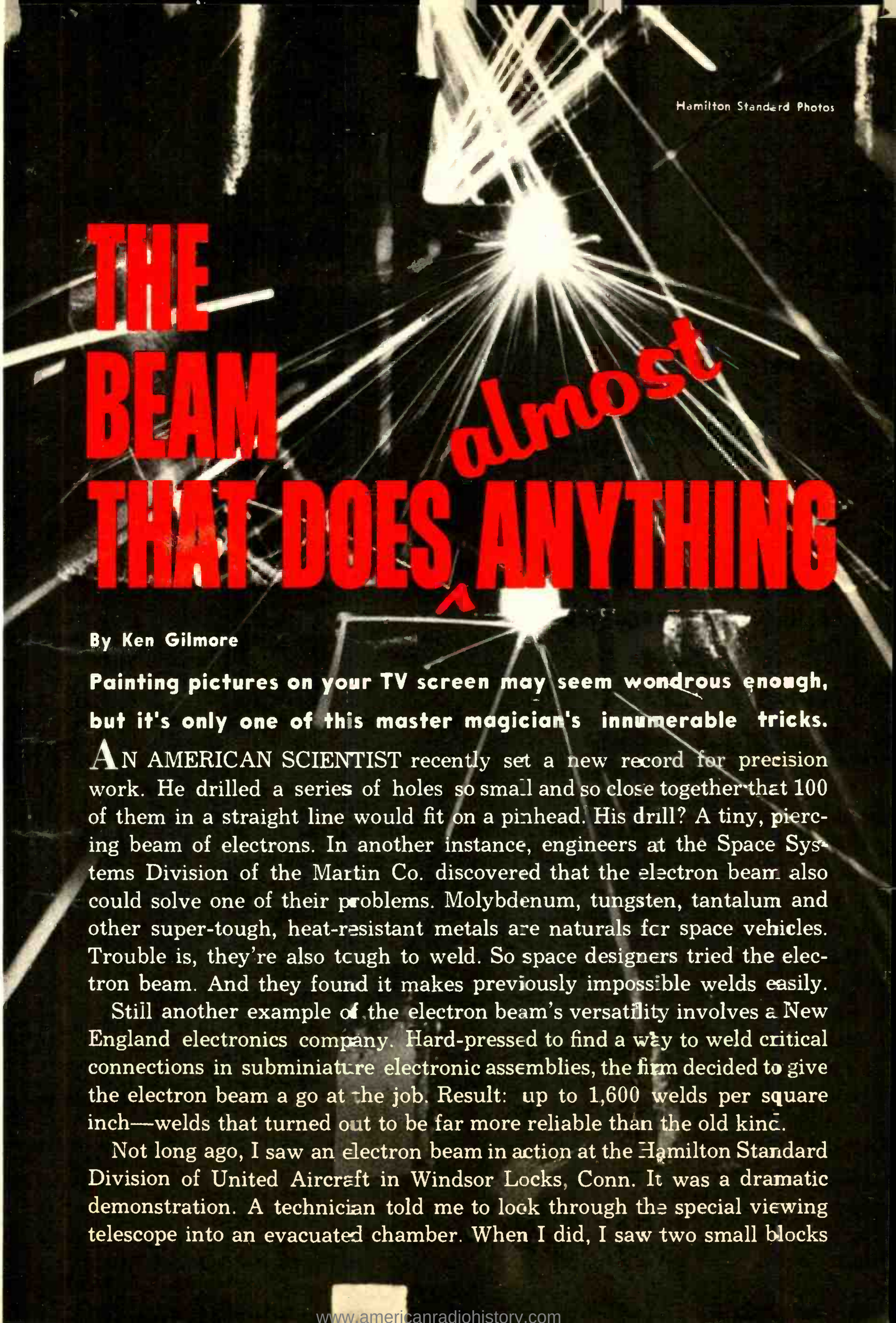
How do you, looking for a career in electronics, plunge into CCTV? First of all, an apprenticeship in some phase of technical television is practically a must. Dick Kaufman, for example, spent three years in Navy radar, a long stint at his own radio/TV repair bench and a goodly number of years as a technician with a telephone company's long-line TV division.

It's also best to locate where there's industry—the more of it, the better. Then, too, it's wise to be prepared for some lean years at first. After all, industrial and institutional TV buyers don't rush to closed circuitry. Some jobs—one for a big university's drama department, say—may be a year or more in the making.

Best CCTV prospects are schools (particularly colleges and universities), industries and institutions. But to turn mere prospects to profit, you must spell out the dollars-and-sense value of CCTV. In Dick Kaufman's words, "You must prove—beyond a doubt—that the $3,500 to $30,000 you're asking a client to shell out will be more than repaid in savings."

Called in by a plant with a problem, Dick recently came up with an $18,000 solution. A camera, watching the plant's production line, spots imperfections in the product, then triggers a mechanism that pushes the faulty item from the line. Result: a single Vidicon camera replaces six girls and annually saves the company more than the original installation cost.

Tell a prospect how to save (or make) a buck with closed-circuit television, and, like Dick Kaufman, you'll be on the road to stardom—in CCTV. ◆



Hamilton Standard Photos

THE BEAM THAT DOES almost ANYTHING

By Ken Gilmore

Painting pictures on your TV screen may seem wondrous enough, but it's only one of this master magician's innumerable tricks.

AN AMERICAN SCIENTIST recently set a new record for precision work. He drilled a series of holes so small and so close together that 100 of them in a straight line would fit on a pinhead. His drill? A tiny, piercing beam of electrons. In another instance, engineers at the Space Systems Division of the Martin Co. discovered that the electron beam also could solve one of their problems. Molybdenum, tungsten, tantalum and other super-tough, heat-resistant metals are naturals for space vehicles. Trouble is, they're also tough to weld. So space designers tried the electron beam. And they found it makes previously impossible welds easily.

Still another example of the electron beam's versatility involves a New England electronics company. Hard-pressed to find a way to weld critical connections in subminiature electronic assemblies, the firm decided to give the electron beam a go at the job. Result: up to 1,600 welds per square inch—welds that turned out to be far more reliable than the old kind.

Not long ago, I saw an electron beam in action at the Hamilton Standard Division of United Aircraft in Windsor Locks, Conn. It was a dramatic demonstration. A technician told me to look through the special viewing telescope into an evacuated chamber. When I did, I saw two small blocks

THE BEAM THAT DOES almost ANYTHING

of metal, with their edges touching.

The technician pressed a button and an invisible beam of electrons slashed down into the joint between the blocks. Where the crack had been there suddenly was a small puddle of glowing, liquid metal. It cooled rapidly, leaving a single metal bar, rigidly welded in the middle.

"You can think of an electron-beam welder as a big vacuum tube," John Sterling, Hamilton-Standard's program manager of electron-beam systems, told me.

In this tube-type setup there is a cathode which, when heated, gives off large numbers of electrons. These are accelerated to about 60% of the speed of light by applying as much as 150,000 volts between the cathode and a hollow anode a few inches away. A magnetic lens—similar in principle to that used to focus the beam in a TV picture tube—squeezes the stream of electrons rushing from cathode to the workpiece into a tight beam.

When these fast-moving electrons hit the metal to be cut or welded, they dissipate kinetic energy as heat. Hit the workpiece with enough of these electrons in rapid-fire succession, and it will heat up—fast.

"In this application," said Sterling, "we use a maximum beam current of about 20 ma. This means that about 124,800 trillion electrons hit the target every second. Further, we focus them into a spot 1/100th of an inch in diameter or even smaller."

That many electrons pouring into a pinpoint area is equivalent to a heating intensity of more than 37 million watts per square inch—enough power to melt or vaporize almost anything. And, because the beam is so narrow, it can be used to weld just about anything.

Say, for example, that you want to lay two 1-inch tubes together and weld them where they meet. You'd have a tough time squeezing any kind of regular welder down into the crack to do the job. But it's a cinch with an electron beam. The slender beam slithers down through the crack where the two pieces meet to make a solid weld all the way through.

Electron-beam welding has other advantages, too. Ordinary arc-welding techniques are so slow that impurities from the air and from the welding electrode are likely to sneak into the finished joint. But a super-powerful electron beam lifts the tough metals to 6000° F—welding temperature—almost instantly, producing a strong, clean weld.

One firm has cut welding time from 40 hours to four with the new process and slashed costs by $2,500 per unit. Further, a $2,000 X-ray inspection job that once was used to make sure the old-style joints were flawless isn't necessary anymore. The electron beam does a perfect job every time.

There is one drawback to electron welding, melting and cutting. Electron

Electron-beam welder has telescope-type viewer so operator can see what's happening to workpiece.

beams don't travel very well through air. They become scattered, losing most of their energy before they get to where the work is to be done. Consequently, large and cumbersome vacuum tanks are needed to hold the work. Westinghouse has one tank 25 feet long in which parts of atomic reactors are welded.

Engineers already are working on a method that will do away with the vacuum chamber entirely for some applications. They use a machine which shoots a stream of inert gas—such as nitrogen—out around the electron beam. A continuous flow of gas envelops the beam and the workpiece, shutting out air as effectively as a vacuum.

The electron beam not only is powerful and versatile, it's also easy to control. By applying the right kind of electrostatic or magnetic field, engineers can make the beam do everything but tie itself in knots.

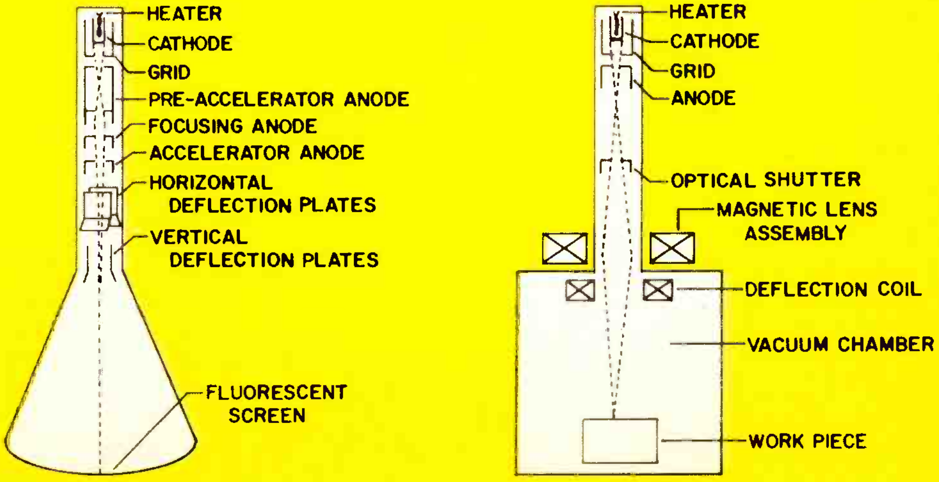
The beam in your TV set furnishes a good example of the precision with which a beam of electrons can be controlled. It travels across the face of the picture tube at about 32,000 mph—twice the speed of a high-power rifle's bullet.

It can start and stop pretty fast, too. In less than the 1/15,000th of a second that it takes to make a single trip across the tube, the beam can be turned on and off some 285 times. This enables it to sketch the fantastically detailed pattern of bright and dark spots which you see as a TV picture.

The beam in an electron welder or cutter is much the same. In addition, it can be beefed up with enough power to slash through the hardest metals. Such a combination gives engineers a tool for super-accurate drilling, cutting and welding with a precision and delicacy that were once undreamed of.

Top prize for fine work may go to a researcher from the University of Tubingen in Germany. He recently demonstrated an astonishing accomplishment to an electron-beam symposium in Boston. He had used the beam to write a series of tiny letters on a collodion plate. The letters, which had to be viewed through a high-power microscope, were ½ micron tall (a micron is 1/1000th of a millimeter). With letters of this size, he calculated, the entire Bible could be written on an area a quarter the size of a postage stamp.

Admittedly, there's not much demand for Bibles written on a postage stamp. But the precise control of the electron beam illustrated by such a trick *is* of great value in many fields. One special-



CATHODE RAY TUBE

ELECTRON BEAM WELDER

The cathode-ray tube in your TV set is remarkably similar to an electron-beam welder—in principle, at least. Because electrons aren't very happy in air, both devices contain a type of vacuum chamber.

THE BEAM THAT DOES almost ANYTHING

A crackerjack for fusing tough, hard-to-weld metals, the electron beam also is unequaled for making tiny, trouble-free welds in microminiature electronic subassemblies. Though components on these circuit boards are teeny enough for a Tom Thumb transistor portable, all were electron-beam-welded in a jiffy.

purpose resistor, for example, is made by depositing a 100-angstrom-thick layer of nickel-chrome alloy on a ceramic base. An electron beam then cuts microscopic grooves in it until its resistivity rises to the desired value.

Electron beams also are being used to make transistors so small that they have to be viewed through a microscope. As you no doubt know, transistors are made by mixing carefully controlled amounts of impurities with such base materials as silicon and germanium. In a micromanufacturing technique, a tiny chip of base material is coated with a minute amount of impurity in a vacuum. A super-fine electron beam smashes into the surface and raises the temperature so that the two materials melt and flow together in a microscopic area, forming the transistor.

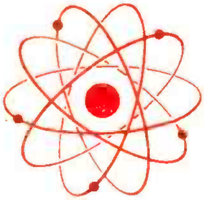
Microelectronic circuits, in which tiny chips of specially treated crystals are made to serve as whole amplifier strips, oscillators and other devices, also are made with the electron beam. So versatile is the beam that it can alloy, etch, melt, sinter, evaporate and weld tiny separate areas on a sliver of crystal.

Several companies now are working to produce machines which will do the whole operation automatically. Such a machine would need only a supply of raw materials fed in at one end. Inside, the electron beam would go to work and perform a pre-programmed sequence of highly complex and precisely controlled operations. At the other end, as one expert put it, out would pop "a complete, hermetically sealed, functioning, adjusted, measured and tested circuit."

While the high-power electron beam continues to take on cutting, welding and melting jobs, the lower-power version—such as the one in the cathode-ray tube—is finding an ever wider variety of tasks, too. One of the earliest uses—outside of the CRT itself—came in the early 1930's when scientists realized that they had reached the end of the line in microscope development. No further improvement in lenses would help to see smaller objects. The reason:

[*Continued on page* 116]

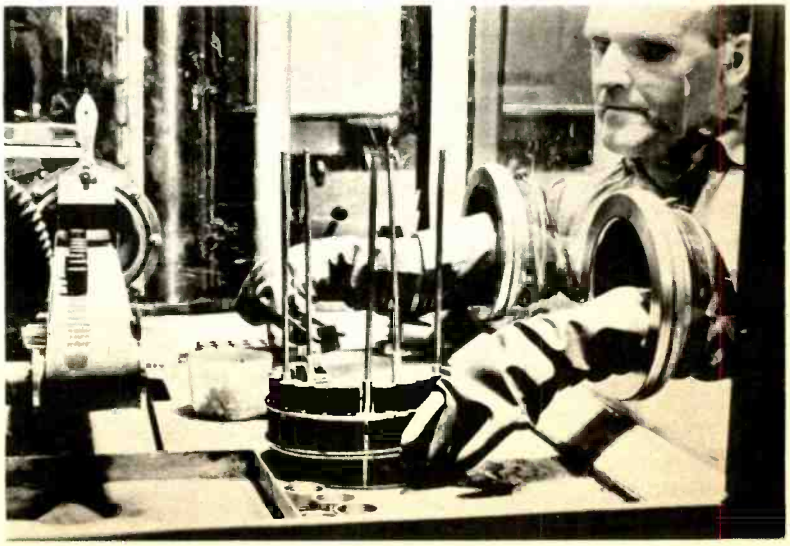
SWEDEN'S ALL-ATOMIC TOWN



JUMP on a subway in downtown Stockholm and you can be in the little Swedish suburb of Farsta in just 20 minutes. When you get there you can browse around in one of Farsta's three department stores or any of nearly 50 smaller shops. What's so great about all this? Nothing—except Farsta itself. For Farsta is about to become the first all-atomic suburb anywhere in the world. Although it isn't in full operation as yet, a newly built atomic power station soon will supply central heating, electricity and hot water for the town's 50,000 or so inhabitants. The result: Farsta's bedrooms, bubble baths and breakfasts will all be atomic-heated.

Tucked safely away in a huge, 40,000-cubic-yard cavern of solid rock some eight miles south of Stockholm, the Farsta power station contains Sweden's first energy-producing atomic reactor. Here's how it will work. An atomic furnace will heat water to power electricity-producing turbines. Then the same steam will be employed a second time to warm the water that furnishes central heating.

The experimental power plant cost over $40 million, and it took another $1.6 million to load the reactor with a seven-year supply of uranium and heavy water. But no one's unhappy about the price. Farsta's all-atomic power will cost a good deal less than other energy sources the little town might have used.



Frankenstein at work? Not exactly, but the radiation hazards from Sweden's first energy-producing reactor force technicians to adopt some pretty weird procedures.

Multi-Function Extension for your CB Transceiver

. . . enables you to receive and transmit from two places. It also turns the rig on and off.

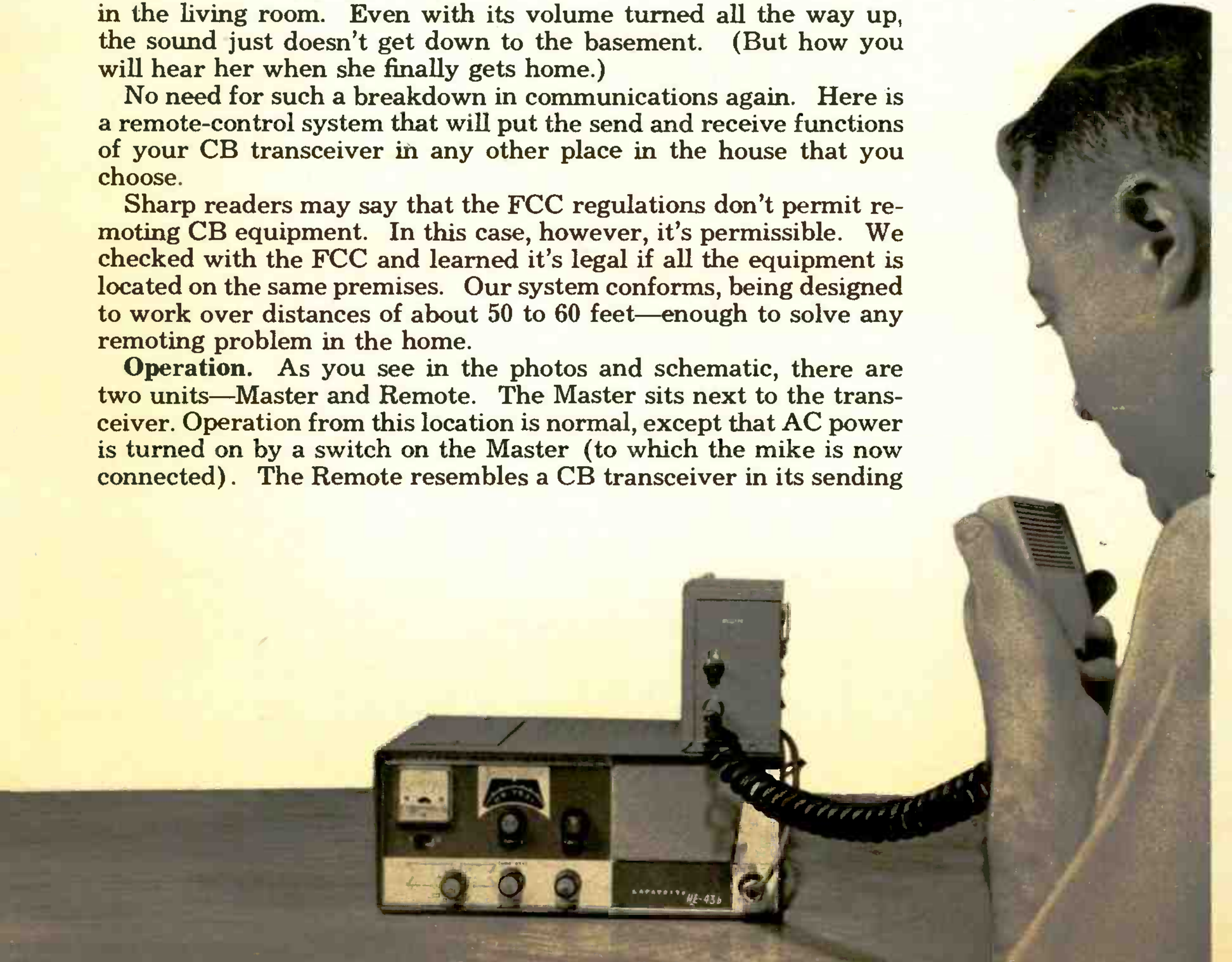
By Len Buckwalter, KBA4480

TRY to imagine what it's like to be in this spot. The night your wife goes to her canasta party you head downstairs to the shop to finish a project. As luck would have it, she gets a flat on the way back and tries to call you from the mobile CB transceiver in the car. But her calls for help are in vain because your CB rig at home is in the living room. Even with its volume turned all the way up, the sound just doesn't get down to the basement. (But how you will hear her when she finally gets home.)

No need for such a breakdown in communications again. Here is a remote-control system that will put the send and receive functions of your CB transceiver in any other place in the house that you choose.

Sharp readers may say that the FCC regulations don't permit remoting CB equipment. In this case, however, it's permissible. We checked with the FCC and learned it's legal if all the equipment is located on the same premises. Our system conforms, being designed to work over distances of about 50 to 60 feet—enough to solve any remoting problem in the home.

Operation. As you see in the photos and schematic, there are two units—Master and Remote. The Master sits next to the transceiver. Operation from this location is normal, except that AC power is turned on by a switch on the Master (to which the mike is now connected). The Remote resembles a CB transceiver in its sending



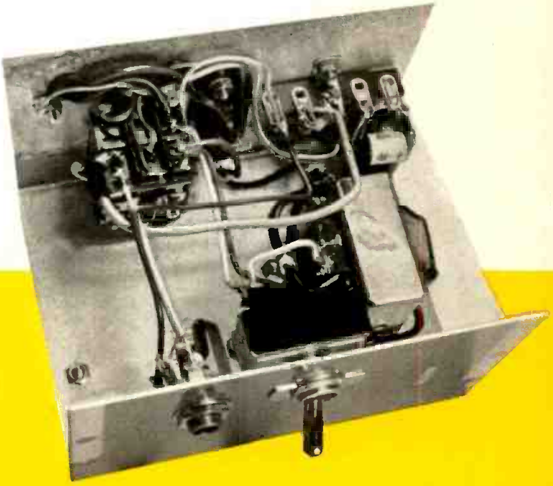
and receiving functions. Flip power switch S2 on the Remote to *on* and the transceiver will be turned on. Press the PTT button on the Remote's mike and you're on the air. It's just as easy to receive calls. All calls picked up by the transceiver will now come through the Remote's speaker.

Complete control remains at the Master at all times. Let's say you inadvertently leave S2 (on the Remote) in the *on* position and want to operate from the Master. By flipping power switch S1 at the Master, all functions transfer back to the Master.

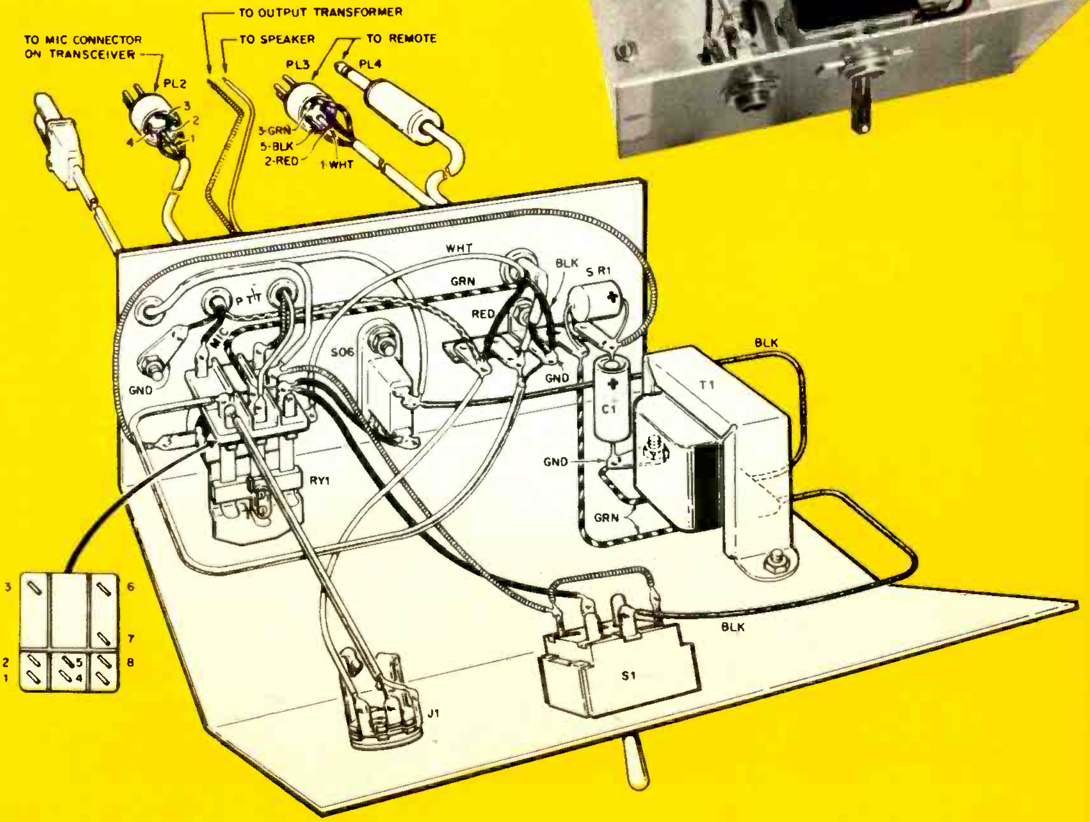
Squelch and channel-switching controls are not included at the Remote as they would require extra wiring. And you won't have to dig into the transceiver to install the system. There are just two connections—to the speaker and to the output transformer's secondary.

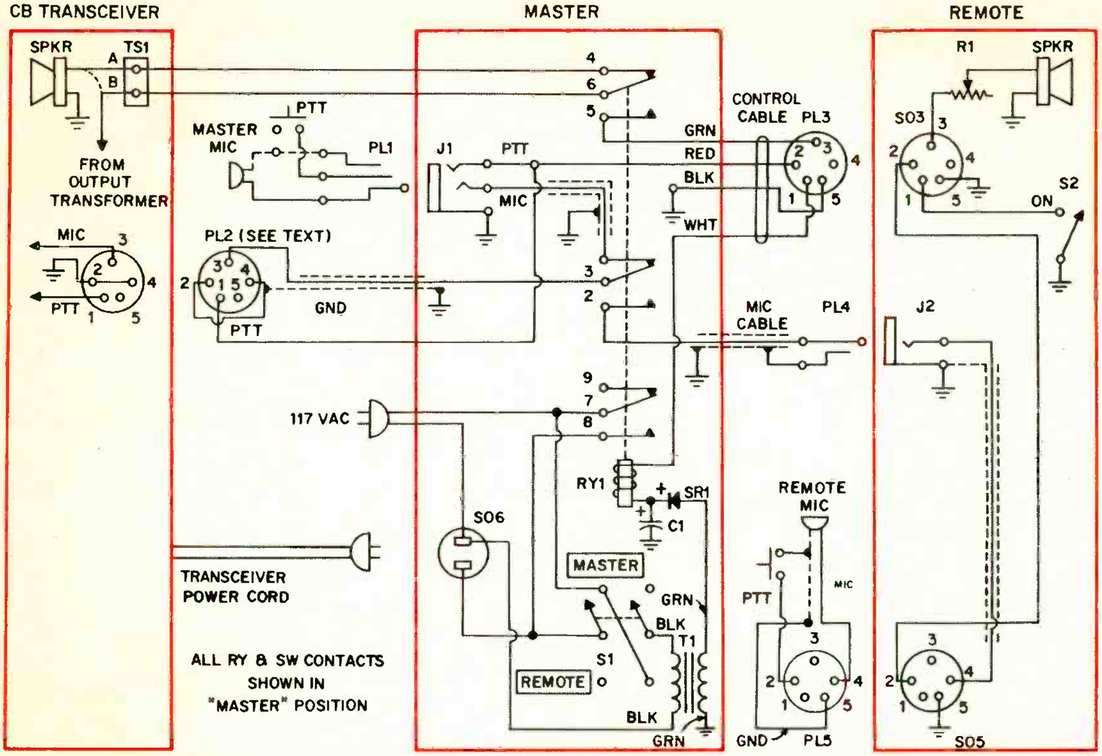
The other connections are made through the transceiver's mike jack and by plugging the transceiver's line cord into an AC socket (SO6) on the Master.

The heart of the system is relay RY1 in the Master. When S1 is set to *Remote*, the speaker and mike connections are transferred to the Remote unit and AC is supplied to the transceiver. Using a relay makes it unnecessary to run 117-volt AC in the cable between the Master



Inside view of the master control unit. Parts arrangement is not critical and may be changed. Lead from pin 1 of PL2 is PTT, lead from pin 3 is mic, and lead from pins 2 and 4 is ground.





PARTS LIST

R1—50-ohm, 5-watt wirewound potentiometer
C1—250 mf, 15 V electrolytic capacitor
RY1—3-pole, double-throw relay (Potter and Brumfield KA14DY; 6 V DC coil)
SR1—Silicon rectifier, 200 ma, 50 PIV
T1—Filament transformer. Secondary, 6.3 V @ .6 A (Allied Radio 61 G 416 or equiv.)
S1—DPDT toggle switch
S2—SPST toggle switch
TS1—2-terminal barrier strip
SPKR—4-inch PM speaker. 3.2-ohm voice coil
J1—2-circuit phone jack (see text)
J2—Phone jack
PL1—Plug on transceiver mike
PL2,PL3—5-prong plug (Amphenol 91-MPM5L or equiv. See text)
PL4—Phone plug
PL5—Plug on new mike (see text)
SO3,SO5—5-contact socket (Amphenol 78-PG5, 78-PCG5 or equiv. See text)
SO6—AC socket
Misc.—5x4x3-inch Minibox (Master); 6x5x4-inch Minibox (Remote); 5-lug terminal strip; Belden No. 8444 4-conductor cable; shielded microphone cable; crystal or ceramic mike with PTT switch

Schematic of the complete system. PL2 must mate with the microphone connector on your transceiver.

and Remote. Only 6 volts for the relay is carried by the cable.

Construction. The first thing to do is identify the three wires in your mike's plug. If the connections you find don't agree with the information to follow, you have one of the few transceivers this system cannot be used with.

First of all, your mike must have a PTT (push-to-talk) button and the transceiver must use a transmit/receive relay. Exceptions are those transceivers which have a PTT switch on the panel, more or less than three wires in the mike cord, or electronic (relayless) switching.

To identify the three wires, remove the shell of the mike plug and examine the leads. There should be a ground which is either a shielded braid or a single bare wire. An ohmmeter will tell you quickly. The resistance from the wire to the transceiver chassis should be zero ohms when the mike is plugged in. Next lead to find is the PTT. (Turn off the AC power before making this check.) Plug in the mike and connect the ohmmeter probes between one of the other leads and the chassis. You have found the lead when depressing the PTT button causes the resistance indication to fall to zero ohms.

Finally, there is the mike lead to verify. This lead always is covered with a braid or metal-foil shield. Set the ohmmeter to its high-resistance range and touch the probes to the mike lead and ground. When you depress the PTT button, the meter should barely fall from a high-resistance reading. It does not matter when the PTT button is released whether the meter indicates high or low resistance. If your mike connections met these tests, you can proceed.

All construction and wiring details appear in the pictorials and photos. However, there are several things to watch out for. Plug PL1 is on your present mike and may not be the same as the type shown in our schematic and pictorial. Since it is to be plugged into J1 on the Master, J1 must mate with it. It is necessary, therefore, to purchase a jack or socket for J1 that is identical to the one on the front panel of your transceiver and not necessarily the type that is specified in the parts list or shown in the pictorial and schematic.

The three connections you've now identified in your mike plug—ground, PTT and mike—are labeled in the diagrams and should be wired to J1. The same applies to PL2, which is on the cable connecting the Master to the transceiver's mike jack. It must match the mike socket on your transceiver.

The rest of the construction is straightforward. Be sure the connections between SO5 and your new mike are correct. Quite often a microphone will have four leads emerging from its cord. The three necessary ones can be identified as we described. The fourth lead usually shows up as a direct short to ground when the PTT button is *not*

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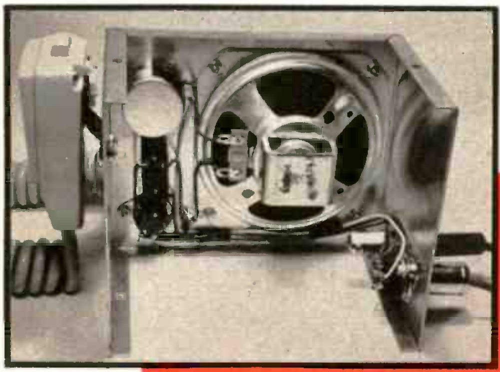

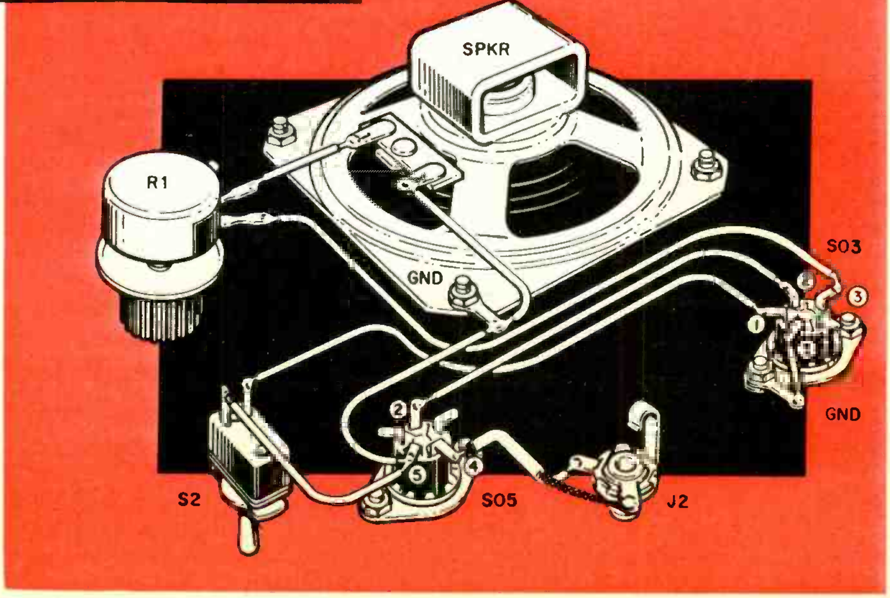

Inside views of remote unit. Check the connector on the new microphone you buy, then select SO5 to mate with it. Lead to pin 2 on SO5 is PTT and the lead to pin 4 is mic. Pin 5 is gnd.

THE LISTENER

SWL-DX NOTES

BY C. M STANBURY II

CONTROVERSY . . . is the key ingredient for sound broadcasting in the 1960's. Whatever a station's purpose—propaganda or just plain profit—the controversial is a must. Let's take a look at some examples and see how it works out.

"Independent communist" is the claim (or boast) of at least two world leaders, Yugoslavia's President Tito and British Guiana's Premier Cheddi Jagan. The latter asserts that while he is a Marxist, he is not a Communist—which, if true, certainly would be the neatest trick of the decade. This fine distinction between Marxist and Communist no doubt would be lost on most radio listeners. But Premier Jagan seems to think that it's one thing to advocate the kind of state Marx envisioned, quite another to be labeled a Communist.

Yugoslavia's chief short-wave outlet is Radio Beograd (see photos). Since Tito is dictator there, it follows that R. Beograd is state-owned and nothing more than a government mouthpiece. For some reason, there is no North American service. Maybe U.S. financial aid has something to do with this. Poland also dropped its transmissions to the U.S. after receiving American dollars. Nevertheless, Beograd's 1700 EST English news is received widely on 9505, 7200 or 6100 kc, depending on conditions. Here's your chance to discover how independent communism works out, propaganda-wise.

Meanwhile, Premier Jagan's plans have run into several roadblocks, including the British government in London (the nation hasn't been granted full independence). Jagan's lack of success is reflected in Guiana's SWBC representative, ZFY at Georgetown, a private station. In this respect, ZFY will act as a barometer of the nation's freedom movement. How long it will be before the government takes over ZFY is anybody's guess—if it's able to do so at all.

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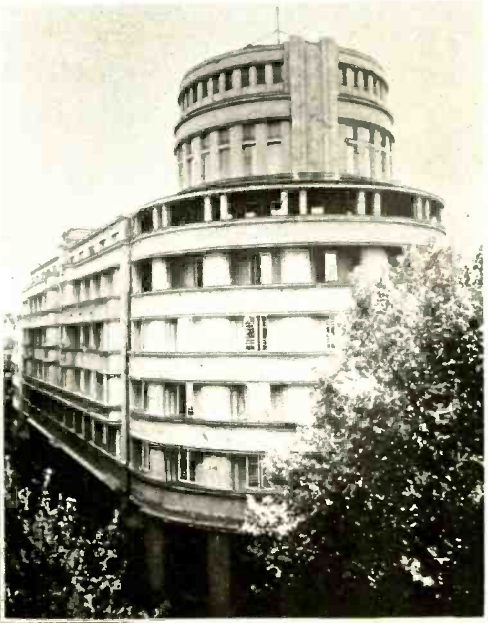
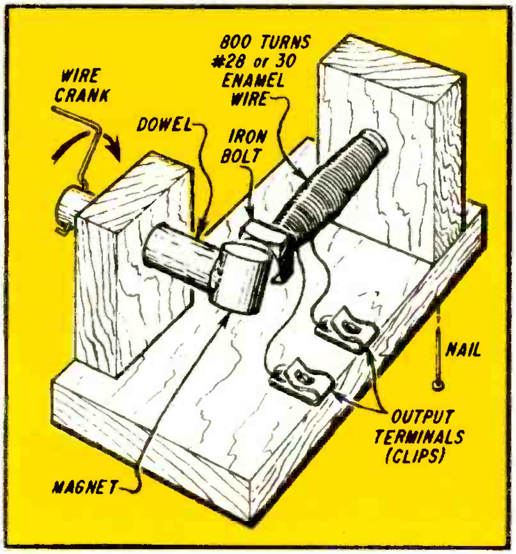


Radio Beograd actually is part of a huge broadcasting complex known as Radio-Television Beograd. Most programs emanate from the Main Building (above), but many are direct reports. Photo at left shows coverage of the Belgrade Conference.

BEGINNERS PAGE

build your own AC GENERATOR

AC power is widely used and taken for granted. Although we know why we need it, we never give much thought to how we get it. Our project, an AC generator, demonstrates the process of converting mechanical energy into electrical power. The generator consists of a rotating magnet and a coil of wire wound on a large iron bolt. As you turn the magnet past the head of the bolt, a current is induced in the coil which we will observe on a meter.



First, wind 800 turns of No. 28 or No. 30 enameled wire on a 2- or 3-inch long iron bolt. Leave about one-quarter inch of threads clear for mounting the bolt in the wood block. Scrape the enamel insulation off both ends of the wires and connect them to the terminal clips.

The next step is the mounting of the magnet and the construction of its support. We glued a small magnet from an old damaged PM speaker to the end of a wood dowel. Push the dowel through a hole in the support block and force a crank, made with a piece of coat-hanger wire, in a hole in the other end of the dowel.

Get hold of a 0-1 ma DC meter and adjust the zero-set screws so the needle comes to rest about mid-scale, allowing it to swing left and right. Connect the meter to the output clips. As you turn the crank, the needle will move to the left and right of its resting point, indicating the generator output is an alternating current.

The electricity we generated started with a source of energy—the force exerted by your hand. As the moving magnetic field passes the head of the bolt, it produces a fairly high output current because of the combination of a large coil of wire and large bolt. In addition to being a form for the coil, the iron bolt provides a good magnetic path between the magnet and the coil.

The meter needle, moving from left to right, shows that the direction of the magnetic field determines which way the current flows. Rotate the magnet very slowly and watch the needle. As one end of the magnet approaches the bolt, the needle moves in one direction. As the same end of the magnet moves away from the bolt head, the current reverses direction.

The speed at which the magnetic field moves past the bolt affects the magnitude of the current. The faster you turn the crank, the greater the current. This illustrates an important principle: The more magnetic lines that cross the wire *per second*, the higher the current.

Our rotating magnet and coil correspond, respectively, to the armature and field coil in a car's generator. Our generator only produces a few thousandths of a watt of power. The car generator gives over 300 watts.—*H. B. Morris*

EI Reports on 4 TRANSISTOR AMPLIFIER KITS

Integrated transistor stereo amplifiers are here! Half the physical size of their vacuum-tube counterparts, they deliver comparable power and a sound all their own. EI built and tested the Heathkit AA-21, Lafayette KT-900 and Realistic 208. The Knight-Kit KG-800, not available for checking at press time, is previewed.

Heathkit AA-21

A CLOSE look at the Heathkit AA-21 ($139.95 kit, $167.95 assembled) and you realize that its designers remembered to include every important operating and design feature usually found in the most elaborate tube amplifiers. The circuit includes 12 transistors per channel, four transistors in the regulated power supply and ten diodes.

There are 21 controls, five inputs and outputs for 4, 8 or 16-ohm speakers and a tape recorder. All input and output jacks are on the rear panel.

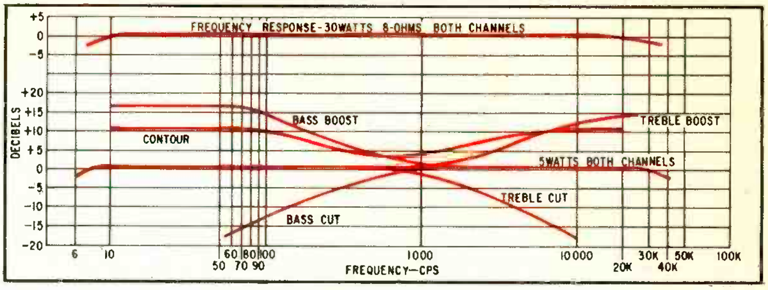
Although all of the controls are on the front panel, only five are visible. The others are behind a hinged door at the bottom of the panel. The five visible controls are concentric volume, bass and treble; an input selector switch (to select any one of five inputs on both channels); and the stereo/mono mode-selector switch. The concealed controls are input level (for all inputs except tape head and tape monitor) and switches to control loudness compensation, the tape monitor input and speaker-phase reversal.

The sound from the AA-21 is quite startling. Compared to tube amplifiers, the most noticeable difference is the clarity and crispness of reproduction of transients. This is most apparent when listening to castanets, jingling keys or snapping fingers.

An outstanding feature of the AA-21 is its output-transistor and speaker-protection circuitry. Possibly the greatest problem with many direct-coupled transistor output stages is that an accidental short of the speaker terminals will instantly destroy the transistors. Or, if one of the output transistors fails, the speaker may be damaged. Heath solved this problem by using miniature circuit breakers.

One is in the output stage to protect the speaker and output transistors. Two others are in the power supply to protect the output stage against being overdriven. The circuit breakers operate fast and reset themselves automatically a few seconds after the trouble has been corrected.

In terms of measured specs, the AA-21 performs as well, and in most cases better than claimed by Heath.



Curves show power and frequency response at both low and high power levels, and effect of tone controls. Loudness compensation approximates true loudness contour by providing both bass and treble boost. Tone controls give 15db boost, 24db cut. There are no rumble, scratch filters.

THE AA-21 AT A GLANCE			
Power Output: 8-ohm loads	20 cps	1 kc	20 kc
Watts	31	45	40
Maximum power per channel for 1 per cent total harmonic distortion: 48 watts			
Size: 15¼ inches wide, 5 inches high, 14 inches deep			
Weight: 25 pounds			
Construction Time: about 20 hours			

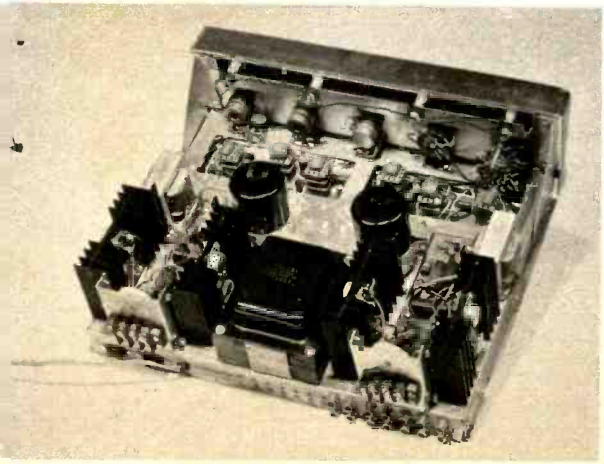
Driving both channels simultaneously into 8-ohm loads, the maximum sine-wave power available at mid frequencies (measured at 1,000 cps) when clipping occurred was 45 watts. At 20,000 cps, the maximum power was 40 watts and at 20 cps the maximum power was 31 watts.

The maximum power output is lower with 4 and 16-ohm loads. With a 4-ohm load the maximum at 1,000 cps was 22 watts. With a 16-ohm load, the maximum at 1,000 cps was 30 watts.

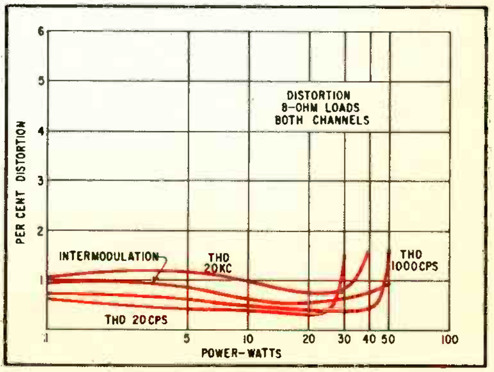
Distortion measurements showed that the THD (total harmonic distortion) at 1,000 cps and 20,000 cps and the IM (intermodulation) distortion was considerably lower than claimed by Heath. However, the THD at 20 cps is 1 per cent at about 28 watts—a bit higher than the claimed specs.

The hum and noise figures, though meeting Heath's specs, would be considered a bit high for a tube amplifier. We measured —65db on the high-level inputs and —55db on the low-level inputs.

Heath has made some minor modifications in the AA-21's power supply and tone control circuits which might change our figures slightly. Earlier models had four transistors in the power supply. Current models have two transistors in the power supply.



Six encapsulated modules and five circuit boards keep construction time down to about 20 hours. Output transistors are on heat sinks at the rear.



The AA-21's harmonic distortion curves for both channels fed into 8-ohm loads. Test frequencies for IM distortion were 60 and 7,000 cps, 4:1.

KIT
EI
REPORT

Lafayette KT-900

THE Lafayette KT-900 ($134.50, kit only) is well styled, easy to build (about 12 hours) and an outstanding performer. All its controls are on the front panel. There are concentric volume, bass and treble controls and the following switches: mode, input selector, loudness, scratch, rumble and power. There are no input-level controls and all input and output (including tape) connectors are at the rear. There are ten transistors per channel, two transistors in the regulated power supply and ten diodes.

The output-power capabilities of the KT-900 were impressive and substantially exceeded Lafayette's ratings. Both channels could deliver 45 watts of 1,000-cps sine-wave power simultaneously into 8-ohm loads before clipping occurred. At 20 cps and 20 kc, 35 watts and 32 watts, respectively, could be delivered before clipping. The maximum 1,000-cps sine-wave power into 4-ohm loads was 22 watts and about 31 watts into 16-ohm loads.

The 1 per cent harmonic distortion point was at 46 watts at 1,000 cps, 35 watts at 20 cps and 28 watts at 20 kc. We found the IM distortion rather high at *low* power levels. A 1 watt, the IM distortion was 5½ per cent. The IM distortion dropped to 1.7 per cent at 44 watts. Despite this, the quality of the sound did not seem to be degraded seriously. We did not attempt to troubleshoot the cause of the distortion. Hum and noise, referred to 35 watts, was slightly below manufacturer's specs, being —70db for the high-level inputs and —60db for the low-level inputs.

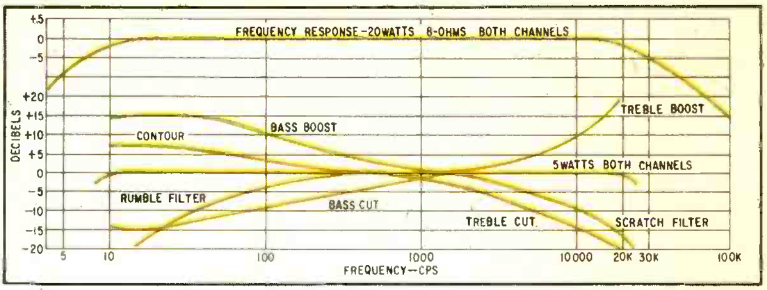
The frequency response of the KT-900 proved to be much better than claimed by Lafayette. At both the 5- and 30-watt power levels, the response was flat down to 5 cps (limit of measuring equipment) and down 3db at 33 kc.

Record and tape equalization met RIAA and NARTB standards. Bass and treble boost were maximum (15db) at 63 cps and 4.9 kc, respectively. Bass and treble cut were maximum (15db) at 154 cps and 4,670 cps, respectively. The scratch filter, because of its position in the circuit, cannot be used with any of the high-level inputs because it loads them severely. Although the filter normally would be used when playing records, it is sometimes desirable to use it when listening to scratchy recordings from an FM station.

The most serious shortcoming of the KT-900 is its lack of protection for its speakers and output transistors. There are no circuit breakers. It is, therefore, important to take care not to short the output terminals when the amplifier is on. This won't be a problem since at normal listening levels, the output-stage power will not reach a level high enough to cause transistor failure. Lack of circuit breaker protection also means that when a transistor in the output stage fails, a heavy DC output current will be applied to the speaker and may damage its voice coil.

Care should be taken with regard to matching speaker impedance to amplifier output impedance. The KT-900 has only one pair of output connections for

Curves show frequency and power response at 5- and 30-watt power levels. Bass and treble boost and cut are rather fast. 3db-down point of rumble filter is between 150 cps and 200 cps, depending on position of volume control. 15db of bass cut between 35 and 46 cps depends also on volume control.



THE KT-900 AT A GLANCE

Power Output: 8-ohm loads	20 cps	1 kc	20 kc
Watts	35	45	32
Maximum power per channel for 1 per cent total harmonic distortion: 46 watts			
Size: 13⅜ inches wide, 4 inches high, 12⅜ inches deep			
Weight: 25 pounds			
Construction time: About 12 hours			

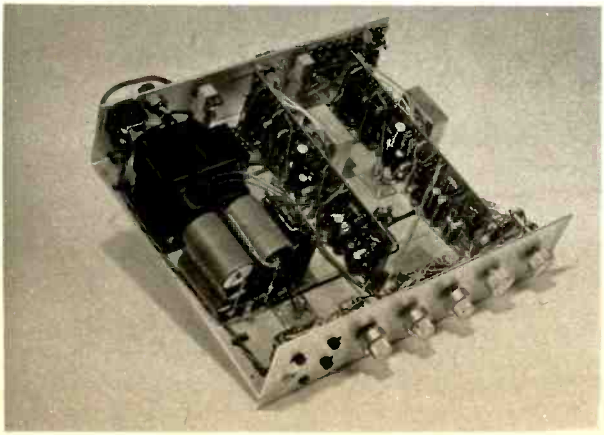
each channel. If you are going to use a 4-ohm speaker with the KT-900, you must *remove* a jumper wire across an internal current-limiting resistor. When using 8- or 16-ohm speakers, the jumper must be installed across the resistor.

All of the output and driver transistors are mounted on the bottom plate of the amplifier, which acts as a heat sink. The cases of the transistors are isolated from chassis ground so a voltage potential exists between them and the chassis. Be sure, therefore, that there are no metal objects between the amplifier's underside and the surface on which it is placed. Three-quarter-inch-high feet minimize the problem.

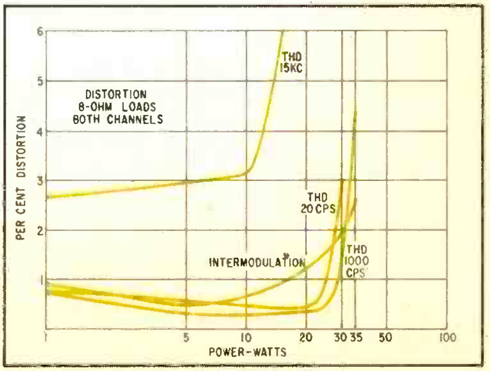
And don't put your hands under the KT-900 to lift it when the power is on. If your fingers touch any of the transistors and the base, you may lose your grip because of a slight shock.

One small shortcoming is that the mode-selector switch does not have a mono position. This means you cannot combine the left and right inputs to play a stereo record monophonically.

Construction was a pleasure because of the use of printed-circuit boards and uncomplicated wiring of the controls. All controls are mounted on the front panel, then wired. The circuit boards are wired and installed next. The last step is the connections between the controls, circuit boards and the base-mounted power transistors. All things considered, the KT-900 is a good buy.



Two printed-circuit boards simplified construction. Power transformer is at upper left. Driver transformers are to the right of the circuit boards.



The distortion curves for both channels driving 8-ohm loads. Note that IM distortion is high at low power levels but drops as power increases.

Realistic 208

THE Realistic Model 208 ($89.95 as a kit, $119 assembled) has output stages that eliminate the problem of speaker impedance matching or accidental damage to the ouput transistors or speakers. Unlike the four-transistor (per channel) output stages in other transistor amplifiers, the 208 has only two output transistors per channel. And, unlike the usual output transistors, these are tetrodes. This means the amplifier can drive a load of as low as 2 ohms (for example, four 8-ohm speakers per channel in parallel).

On the front panel there are concentric bass and treble controls, a single volume control for both channels, a concentric balance/blend control, an input-selector switch and a mode switch. In addition, there are switches for stereo-mono operation, rumble filter, scratch filter, loudness and AC power. A speaker phase-reverse switch is on the rear panel.

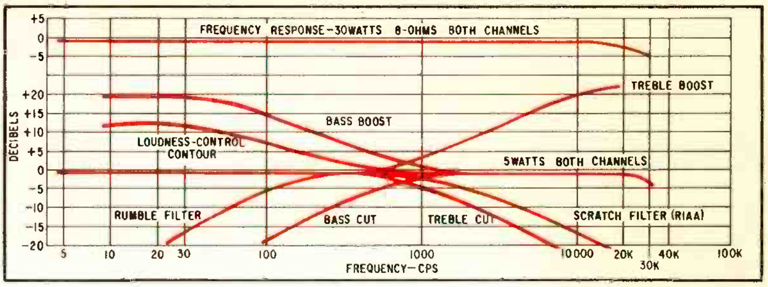
There are no input level controls. But the model 208 has input jacks for every conceivable type of program source. There are left- and right-channel tape output jacks on the front *and* rear panels and a headphone jack on the front panel. Each channel includes nine transistors. There are four diodes in the unregulated power supply.

An interesting feature about the 208 is a blend control which enables you to mix both channels to any degree up to 100 per cent. On some other amplifiers, balance of the channels is achieved by adjusting the individual concentric clutch-type volume controls. On the 208, however, a single *balance* control accomplishes the same thing more easily. A single volume control changes the level of both channels simultaneously.

The sound produced by the 208 is not quite as crisp or brilliant as you might expect it to be from a transistor amplifier. In general, the 208 more or less meets the specs claimed by Radio Shack. With 8-ohm loads connected to left and right channels, the 208 could deliver 30 watts of sine-wave power at 1,000 cps before clipping occurred. At 20 cps and 15 kc, it delivered 24.5 and 20 watts, respectively. (The high-frequency power measurement was made at 15 kc because distortion at 20 kc was too great for accurate measurements.) The maximum output power was 37 watts into 4-ohm loads and 16 watts into 16-ohm loads, both at 1,000 cycles.

The frequency response at the 5-watt level was down 3db at 8 cps and 25 kc. At the 20-watt level, the response was down 3db at 9 cps and 22 kc. Total harmonic distortion at rated output (25 watts) was below .5 per cent at both 1,000 and 20 cps. However, the distortion at 15 kc was high at all power levels, ranging from 2.6 per cent at 1 watt to 6.2 per cent at 20 watts. The distortion at high frequencies appeared to be a type of crossover distortion that may originate in the large driver transformers.

The IM distortion was good at low-power levels but slightly exceeded the manufacturer's claim (1.5 per cent) at 25 watts.



Curves show power and frequency response at 20-watt and 5-watt power levels. Bass and treble controls are losser-type. Rumble and scratch filters are R-C type. Loudness control provides bass boost only (maximum of 15db). Frequency response at 20 watts is down 5db at approximately 33 kc.

THE 208 AT A GLANCE

Power Output: 8-ohm loads	20 cps	1 kc	15 kc
Watts	24.5	30	20

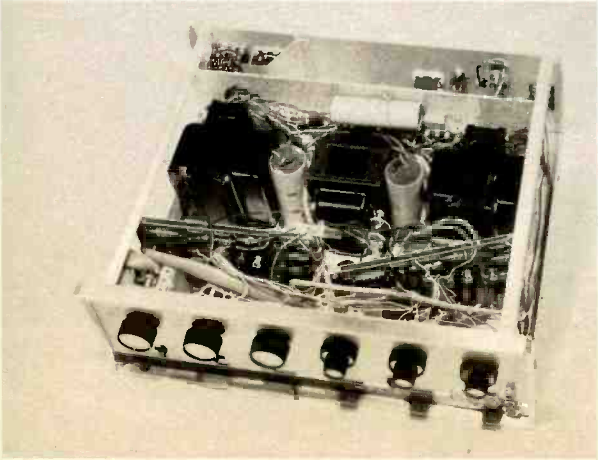
Maximum power per channel for 1 per cent total harmonic distortion: 29 watts

Size: 4¾ inches high, 15½ inches wide, 12⅞ inches deep

Weight: 28 pounds

Construction time: About 16 hours.

Hum and noise was —60db for the high-level inputs and —50db for the low-level inputs. The rumble and scratch filters produced a 15db cut at 21 cps and 17.7 kc, respectively. Bass boost is a maximum of 12db at 56 cps. Bass cut is 15db down at 18 cps. Treble boost is maximum (12.8db) at 17.8 kc and treble cut is down 15db at 10.8 kc. Record and tape equalization conform to RIAA and NARTB standards.



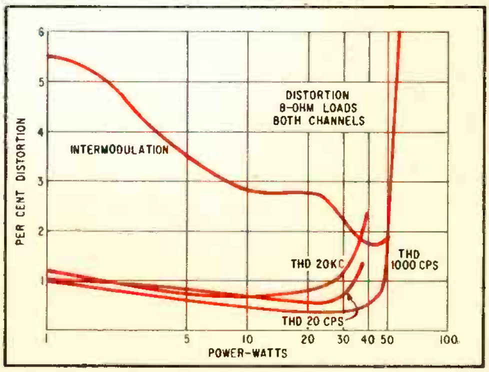
Inside of model 208. Printed-circuit boards are behind controls. Driver transformers are at the left and right. Power transformer is in center.

Tetrode output transistors, which have two bases, give the 208 its extremely low output impedance. This accounts for the amplifier's ability to drive extremely-low-impedance loads.

There is only one pair of output connectors per channel and it is not necessary to modify the output stage to match the speaker impedance. Just connect any load and away you go.

Since the output stage is a constant-voltage source, the lower the speaker impedance, the greater the power capacity. The high-power rating of the tetrode transistors (70 watts per channel into a 4-ohm load) pretty much eliminates the possibility of output-stage failure due to overdrive.

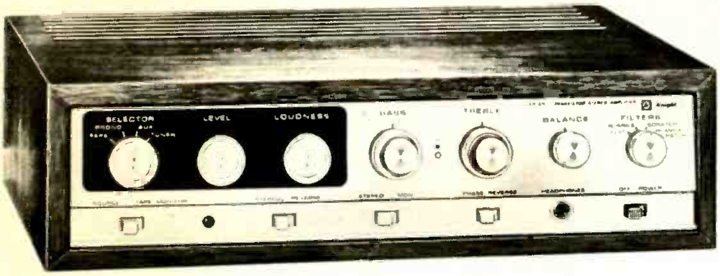
Because of the mechanical design of the amplifier and the wiring of the controls, construction leads to some problems. All preamp parts are mounted on PC boards. Wiring between the controls and boards was a small headache, but we built the kit in 16 hours.



Distortion of both channels. THD is quite high at all power levels, ranging from 2.6 per cent at one watt to 6.2 per cent at the 20-watt level.

KIT
EI
PREVIEW

Knight-Kit KG-870



THE Knight-Kit KG-870 amplifier ($99.95, kit) was not available for testing before press time. Our preview report is based on the specifications and a schematic provided by Allied Radio Corp.

The KG-870 is rated at 35 watts (IHF music power) per channel, both channels operating simultaneously. The front-panel controls are input selector, level, loudness, concentric clutch-type bass and treble, balance and scratch/rumble filter selector. There are five slide switches and a headphone jack on the front panel. Each channel has 11 transistors and there are four diodes in the power supply.

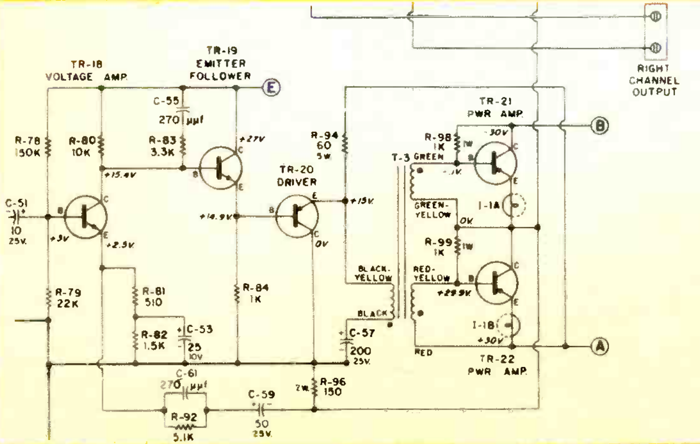
The frequency response is flat within ±½db from 20 cps to 30 kc and flat within ±3db from 12 cps to 60 kc at full-rated output. The harmonic distortion is 0.5 per cent at full-rated output and the IM distortion is less than one per cent at full-rated power (40 cps and 12 kc; 4:1). The hum and noise for full-rated output power is —60db for tape head, —68db for magnetic cartridge, —85db for tuner and —85db for aux. inputs.

The input impedances are: tape head and magnetic cartridge, 200,000 ohms; tuner, 23,000 ohms; aux No. 1, 100,000 ohms; aux No. 2, 450,000 ohms; tape monitor, 100,000 ohms.

The bass boost and cut is 15db at 50 cps. Treble boost and cut is 13db at 15 kc.

The input sensitivity for rated output for tape head is 2 mv, for magnetic cartridge; 3 mv; for tuner, 0.5 V; for aux No. 1, .25 V; for aux No. 2, 1 V.

The KG-870 has only one pair of output connectors per channel. It is not necessary to take any special care in matching speaker impedances to the output. Either four, eight or 16-ohm speakers may be connected to the amplifier. There are no individual level controls for each of the inputs.



Output and driver stage of KG-870. Power transistors TR-21 and TR-22 (Tung-Sol 2N1541) operate in single-ended push-pull circuit. Lamps, I-1A and I-1B, protect transistors from being destroyed by limiting current if output is shorted. Rest of circuit is similar to earlier model amplifiers. Capacitor C-57 prevents DC from flowing in primary winding of T-3.

Handyman's CABLE & PIPE FINDER

By Bert Mann

WE all know about the proverbial needle in a haystack, but it's only when you try to locate something like a water pipe or a BX cable in a wall that the saying has real meaning. Sometimes you get down to such destructive probing as is done with a hefty drill or a crowbar before you find what you're after.

A much more palatable type of probing can be done with the Handyman's Cable & Pipe Finder. In seconds it will lead you unerringly to those elusive pipes, electrical junctions and cables, structure beams, wire lath and the like.

The finder will run you about $12 and is sensitive enough to indicate the center of a pipe within a quarter inch. The unit is designed specifically for scanning walls, floors and other such structural members, having a range of 3 to 4 inches. We do not recommend that you try souping it up or start using it to look for Civil War relics. Instead, use one of the special instruments designed to look for buried treasure and reserve EI's palm-size snooper for the tasks it was designed for.

Construction. Our Finder is built in a 2¼x2¼x4-inch Minibox. To keep the size small we made a printed-circuit board with standard copper-clad perforated stock. All major components except tuning capacitor C2, switch S1, battery B1 and jack J1 are mounted on the board. Follow the diagrams as we run through the steps in preparing the board.

Cut a piece of perforated board 15 holes wide and 10 holes high. On the copper-clad side, letter the ten rows A through J and mark the 15 columns one through 15, as shown in Fig. 1. Place a resist dot over the holes indicated (B1, G7, etc.) and join the dots with resist tape (the heavy lines in Fig. 1). Place the board in a glass or plastic tray and pour in etchant solution to cover it. Agitate at least once every minute.

After about 15 minutes, examine the board. (Do not touch it with your bare fingers; etchant solution is caustic and will burn your skin.) If the *uncovered* copper has been removed, rinse the board under running water, peel off the dots and tape and clean the remaining copper foil with scouring cleanser. Rinse again.

Figure 2 is a diagram of the reverse side of the board. Notice that here the letters are on the right side and the numbers now increase in order from right to left. Install all components and the jumper (shown in color in Fig. 2), bend the leads slightly, then apply a drop of solder to each lead at the foil. When soldering the transistors, hold the leads with a pair of pliers to prevent heat damage. Then clip all leads short.

Connect C4 to lugs 1 and 2 on T1. Solder one-inch leads to T1's lugs (including lugs 1 and 2) before mounting it on the board. The lead from lug 4 (near the green dot) goes into hole G7. All of T1's other leads should fall into place as indicated on the board. Follow Fig. 4 when installing the board in the cabinet, keeping the parts side up (they aren't shown in place in Fig. 4). Connect leads from SO1, C2, S1, B1 and J1 to the points indicated in Fig. 2. Use a small angle bracket to mount the board in the cabinet between holes D15 and G15.

To wind coil L1, drive four nails into a wood block so they form a 2¼x2¼-inch square. Wind 50 turns of No. 30 enameled wire around the nails. At the 50th turn, bring the wire out in a three-inch loop and wind five more turns. Saturate L1 with General Cement Q-dope. After the Q-dope sets, remove the nails and let the form dry overnight. Now, cement L1 to a 6x½x⅛-inch-thick strip of plastic or Masonite as shown in Fig. 3, and mount the coil assembly on the Minibox cover.

Scrape the enamel insulation from the coil leads and solder hookup wire to each one. Tape the hookup wire to the support strip. The first turn of L1 goes to pin No. 1, the tap goes to pin No. 2 and the last turn goes to pin No. 3 of PL1.

Adjustment. Before L1 is plugged in, turn on the Finder and place it near a radio tuned to a vacant spot on the dial around 750 kc. Adjust T1's slug with a plastic alignment tool until the radio is silenced. Plug a pair of high-impedance phones and L1 into the Finder and adjust C2 until you hear two loud whistles in the phones. These whistles should occur when C2's plates are a quarter to half meshed. Readjust C2 for the *louder of the two* whistles and put a mark on the dial and

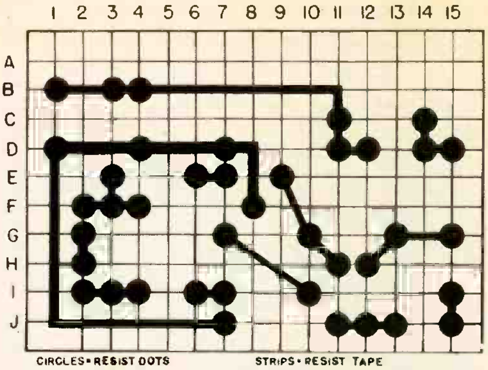
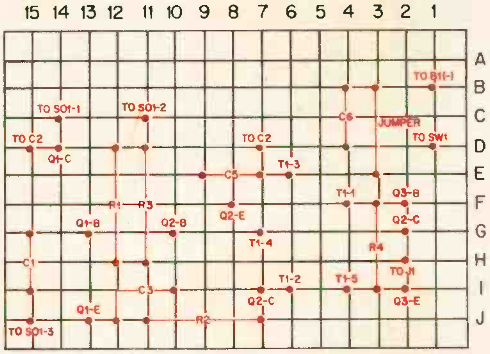


Fig. 1 (above)—Copper-clad side of circuit board shows you where to apply resist dots and tape. Fig. 2 (below)—Parts location on reverse side is shown. Q1-B, for example, is for base lead of Q1.



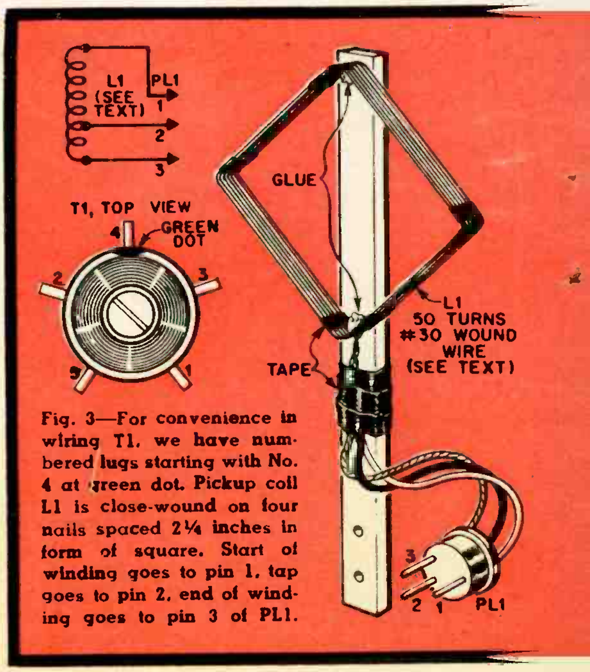


Fig. 3—For convenience in wiring T1, we have numbered lugs starting with No. 4 at green dot. Pickup coil L1 is close-wound on four nails spaced 2¼ inches in form of square. Start of winding goes to pin 1, tap goes to pin 2, end of winding goes to pin 3 of PL1.

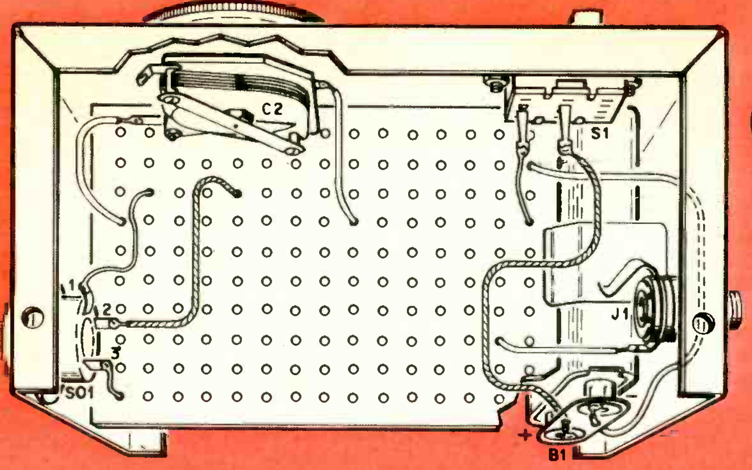
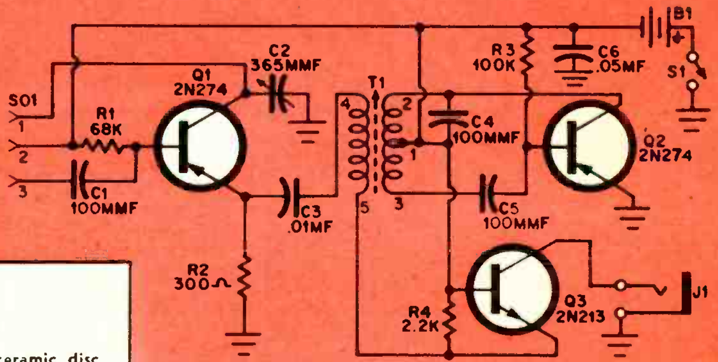


Fig. 4—After circuit board is installed, connect leads to components mounted in cabinet, using the diagram in Fig. 2 as a guide. If you'd rather not attempt to make a printed-circuit board, use regular perforated board and flea clips.



Oscillator Q2 operates at a frequency that is determined by the setting of T1's slug. Frequency of oscillator Q1 is set close to Q2 by C2. L1's inductance is changed when it is brought near a pipe. This shifts frequency of Q1 and tone in phones.

PARTS LIST

Resistors: ½ watt, 10%
R1—68,000 ohms
R2—300 ohms
R3—100,000 ohms
R4—2,200 ohms
C1,C4,C5—100 mmf, 50 V or higher ceramic disc capacitors
C2—10-365 mmf variable capacitor (Lafayette MS-445 or equiv.)
C3—.01 mf ceramic disc capacitor
C6—.05 mf, 50 V or higher ceramic disc capacitor
L1—Pickup coil (see text)
T1—Oscillator coil (Lafayette MS-265)
J1—Phone jack
PL1—3-prong plug (Amphenol 78-S3S)
SO1—3-prong socket (Amphenol 71-3S)
Q1,Q2—2N274 transistor
Q3—2N213 transistor
S1—SPST slide switch
B1—9-volt battery
Misc.—2¼x2¼x4-inch Minibox, copper-clad perforated board (Lafayette MS-847), resist dots (Lafayette MS-737), ⅛-inch tape-resist (Lafayette MS-736), etchant (Lafayette MS-729), No. 30 enameled wire.

panel. This will be your operating setting for C2.

Operation. Adjust C2 so the dot on its dial is opposite the dot on the panel. The *exact* setting isn't terribly important so long as you hear a tone of about 2,000 cps in the phones. At this setting even a slight change in the tone's frequency will be apparent when you hold L1 near metal. Try it out on a piece of pipe. Hold the Finder so L1's support rod is parallel to the pipe and move L1 back and forth across it. As you approach the pipe the tone will either rise or fall in frequency; depending on the setting of C2.

If you get a rise in pitch but prefer a fall, move the Finder away from the pipe and readjust C2. Now when L1 is directly over the pipe the tone should be at minimum or not heard at all. This will depend on how close L1 is to the pipe. When working over decorative tile, adjust C2 with L1 against the tile. Wire lath in walls produces a fluttering tone or no tone.

How It Works. Oscillator Q2 operates at a fixed frequency. The frequency of oscillator Q1 is close to that of oscillator Q2 and can be adjusted with C2. Their outputs beat together and produce sum and difference frequencies. (We are interested only in the difference frequency.) For example, if oscillator Q2 operates at 800 kc and

[*Continued on page* 117]

SPOTLIGHT

HOW TO DX the 16-meter band can be summed up in one sentence: do it when you can! There's a reason why 16 meters poses a real challenge to adventurous DXers. During periods when 16 meters is open signals often are surprisingly clear and strong. But when fate shows its other hand the band is doornail-dead, without a trace of a signal. And, in view of the present downward trend in the sunspot count, the band is going to be dormant more and more frequently.

Unlike the lower short-wave bands, the 17700- to 17900-kc spot has but one major factor governing reception or the lack of it—skip. The question: will signals be reflected by the ionosphere and skip back to earth? Or will they pass right through and be lost somewhere out in space?

Let's see what's responsible for this thing called skip. Under normal conditions, only the F2 layer—the one at the top of the ionosphere and some 200 miles above the earth—is capable of reflecting 16-meter signals. Whether the F2 layer will toss back a 16-meter transmission depends on the layer's ion density, or degree of ionization.

In turn, F2's degree of ionization is subject to many variables. It's affected by the sunspot count—the more sunspots, the greater the ionization. The season of the year—it's highest in winter, lowest in summer, which is precisely the reverse of other layers. Geographic location—there's less ionization at the poles. And time of day—ionization can be considered to be at its peak at about 1400 local time.

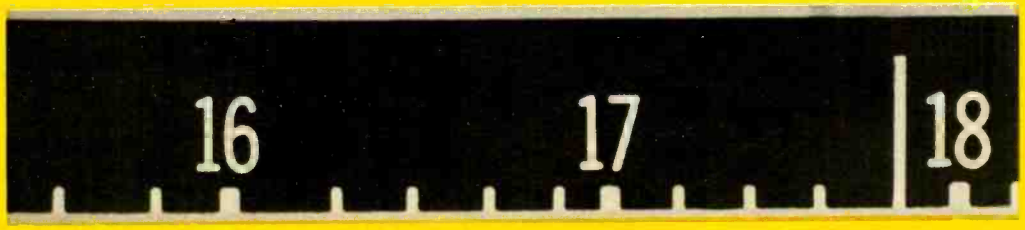
Naturally, it's the ion density at the point where the signals strike the F2 layer that counts, not the ion density above the receiving or transmitting location. If your listening post is within 2,500 miles of a station (2,500 miles is the maximum skip distance with the F2 layer), then the point at which the signal contacts the F2 layer would be midway between the transmitter and your receiver.

In the case of multi-hop reception, there must be sufficient ionization at each point the signal hits the F2 layer in order for you to pick up distant stations.

Nature has its compensations, though, and the intriguing sporadic-E layer is one of them. Sporadic E occurs below the F2 at about the same height (70 miles up) as the normal E layer. However, the sporadic-E layer is capable of reflecting much higher frequencies than normal E—even TV signals.

Although it often coincides with ionospheric disturbances, sporadic E appears frequently during apparently normal conditions. In fact, because of the currently decreasing sunspot count and the F2 layer's dependence on sunspots for its ionization, much of the reception on 16 meters today is of the sporadic-E variety.

Sixteen meters has at least one problem in common with all the other bands—noise. However, it's noise of a different kind. With the exception of interference from local thunderstorms, atmospheric static—which shows up on



ON 16 METERS

By C. M. Stanbury II

most other wavelengths—is practically nil on 16. Surprisingly, the real problem on 17700-17900 stems from automobile ignition systems.

If yours is a communications receiver, it probably is equipped with a noise limiter. Such limiters frequently are ineffective in coping with atmospherics, but they come through with at least a 50 per cent reduction in ignition noise. On the other hand, if you're using a receiver that doesn't have a limiter, you'll either have to add one or try your luck at DXing over and between the noise bursts.

Both the intensity and duration of such bursts will depend to some extent on the proximity of the traffic and just how heavy that traffic is. After a few weeks of listening, you should know the extent of the problem in your locality. If it turns out that you're in a heavy-traffic area, you might try a dipole antenna directed away from the flow of cars.

Actually, a good antenna is of utmost importance on 16, just as it is on any band. But it needn't be elaborate, and it doesn't even have to be directional. A single wire that's both long and high will provide good general reception in most areas. However, a directional antenna or an array does have the advantage of boosting signal strengths enough so that stations can be received via scatter-wave even after skipping.

For example, in cases where the minimum skip zone is 2,000 miles, a listener 1,900 miles away still should be able to pick up a minute signal with a nondirectional antenna. But, if he has a high-gain directional array, that signal is far more likely to be readable.

The simplest directional antenna you can use is the half-wave dipole. Each arm of the dipole should be approximately 13 feet long, with the lead-in attached to the center as with any dipole. Since a dipole exhibits a broadside pickup pattern, an antenna running north and south will receive best from an easterly or westerly direction.

A combination of dipoles properly spaced (an array) will boost directivity and gain still more. For complete technical details on such antennas, you might consult a basic text such as The ARRL Antenna Book.

Because of pronounced skip and low QRM, 16 meters provides broadcasters with an opportunity for really distant transmissions. And, by and large, they take advantage of it. For example, a station in Japan might use 16 meters to beam signals to Eastern North America during periods when the lower frequencies are laden with QRM.

The 16-meter band has an additional advantage of being open when reception on other bands is impaired by absorption—the tendency of signals to be swallowed up when passing through the lower layers of the ionosphere. Since 16 meters isn't particularly subject to this type of signal-swallowing, it's often open when many other bands are not.

The chart at left lists some of the rarer DX stations to be found on 16 meters. With a better understanding of what 16-meter DXing is all about, you may be lucky enough to bag one of these catches! Good luck!

DX GUIDE TO 16 METERS

Frequency	Location	Time (EST)
17720	Red Lion, Pa.	1300-1600
17750	Colombo, Ceylon	1200-1400
17835	Cairo, Egypt	About 1200
17855	Delhi, India	2330-2340
17860	Damascus, Syria	Early Eve.
17890	Karachi, Pakistan	0835-0850
17910	Accra, Ghana	About 1200
17920	Cairo, Egypt	About 1200

TELEPHONE BELL EXTENSION

By Al Toler

SEVERAL million of Mr. Bell's customers have telephone extensions of one type or another—upstairs, downstairs, in the shop, outdoors or in the barn. An extension assuredly is handy but it is difficult to move one around or adapt it to a momentary situation. Besides, a certain amount of money is involved in having an extension, and often you merely want to know your phone is ringing; you don't particularly want a full-service telephone at hand.

EI's telephone bell extension is an alerting device. Energized by the ringing signal in your phone, it rings a bell or lights a bulb or turns on some other signaling device at any remote location you choose. Hook it to a large outside bell and it could summon you from half a mile away. It's more likely, however, that you'd want to locate the extension bell in your upstairs bedroom if your phone is downstairs and you think its ring might not awaken you at night.

The extension is not connected directly to your phone (the phone company frowns on direct connections), and the all-transistor rig costs less than $10 to build.

It works this way: When a call comes through, the extension's relay connects the 6.3-VAC secondary of T1 to the output terminals to energize an external bell. But you can use the output circuit in several other ways which we'll mention later.

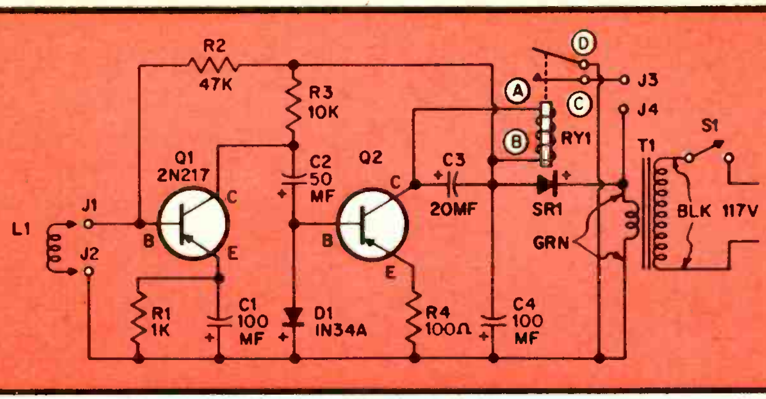
The extension also can be used as a remote power sensor. For example, set it up near a washing machine in the basement and it will turn on a signal light upstairs to tell you when the wash/dry cycle is completed. Or if you're checking your boiler's operation and don't feel like spending a day in the basement watching the cycling, you can set up the extension so you get a visual or aural indication of the boiler's operation in your living room. The extension's applications for monitoring electrically-operated devices are practically unlimited.

Construction. The extension's relay amplifier is built on a perforated-board subassembly. Flea clips are used for tie points. The wiring is straightforward and no particular care has to be taken in assembly. Just remember that relay RY1's frame is the common switch terminal and it should not touch any other components or the metal box.

C2 may give you some trouble; it is a high-capacity electrolytic and its leakage current may cause the amplifier to operate improperly. Do not mount C2, therefore, in an inaccessible place since you may have to change it after testing the unit.

The transistor and diode leads are short so be certain to use a heat sink, such as an alligator clip, on the leads to prevent overheating when soldering.

T1 can be any low-cost, low-current, 6.3-volt filament transformer. Notice that the power supply's output is negative with respect to ground. Take particular care that the polarity of SR1 and C4 is correct. Under both standby and

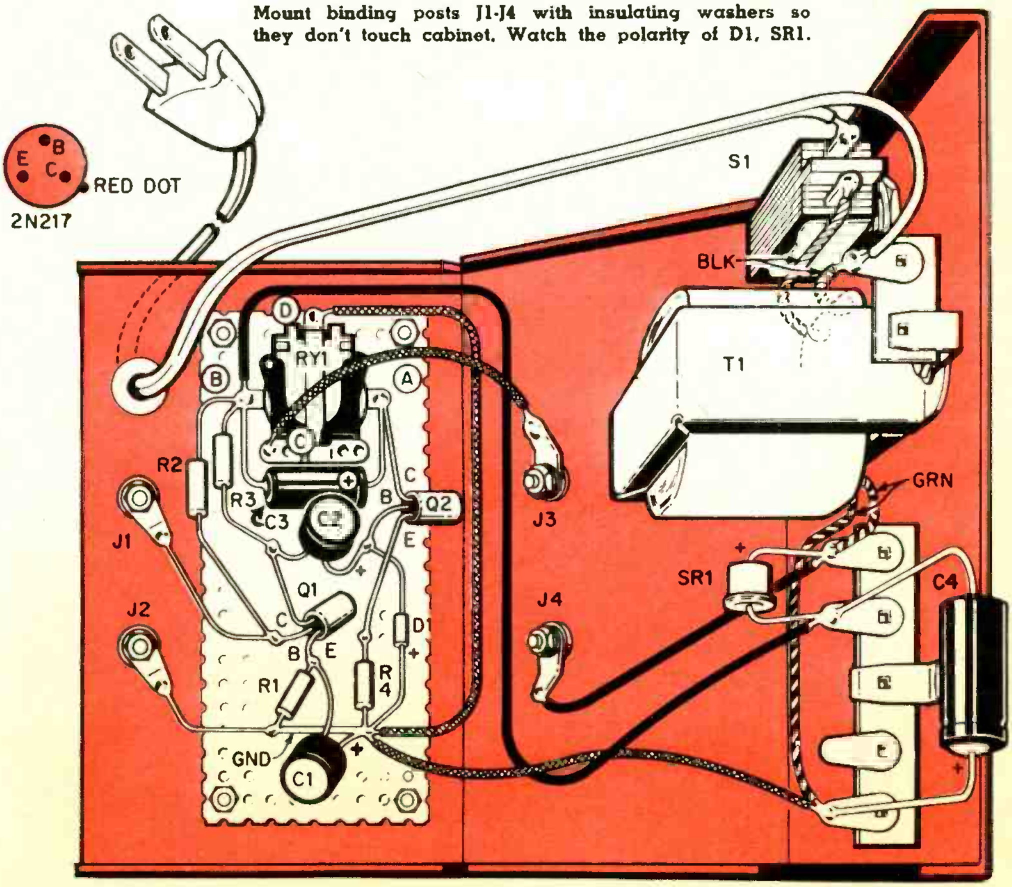


RY1's coil is 335 ohms and its contacts are rated at 2 amps. If you plan to use the extension to operate a signaling device that draws greater current, get a relay with heavier contacts or use RY1 to energize the coil of a remotely located relay.

PARTS LIST

Resistors: ½ watt, 10%.
R1—1,000 ohms R2—47,000 ohms
R3—10,000 ohms
R4—100 ohms
C1—100 mf electrolytic, 6 VDC or higher
C2—50 mf electrolytic, 10 VDC or higher
C3—20 mf electrolytic, 10 VDC or higher (see text)
C4—100 mf electrolytic, 15 VDC or higher
L1—Telephone pickup coil (Lafayette MS-16)
T1—6.3 V filament transformer
RY1—SPDT relay, 6 V coil (Potter and Brumfield RS5D)
Q1,Q2—2N217 transistor
D1—1N34A diode
SR1—Silicon rectifier, 50 ma, 50 PIV or higher
S1—SPST toggle switch
J1-J4—Insulated binding posts
Misc.—Cabinet, terminal strip

Mount binding posts J1-J4 with insulating washers so they don't touch cabinet. Watch the polarity of D1, SR1.



operating conditions, the power supply delivers about 9 volts DC.

C3 may be required to prevent RY1 from chattering. Depending on your local phone system, RY1 may close and stay closed when the phone rings or it may open and close (chatter) in time with the ring signal. If it chatters, simply connect C3 as shown.

The amplifier subassembly board is mounted on one end of a 3x4x5-inch Minibox. The power supply components are mounted on the other end of the box. To avoid shorting the flea clips, which extend through the perforated board, place a rubber grommet between the board and the cabinet over each of the corner mounting screws. To be doubly safe, put a heavy piece of paper between the cabinet and perforated board.

L1 is a standard telephone pickup coil; however, do not substitute some other type for the one we have specified. The DC resistance of the coil is part of Q1's base-bias circuit and if a coil with a different DC resistance is used, the circuit may not operate.

Checkout. Connect the shield of L1's cable to J2 and connect the inner conductor to J1. Connect a 0-20 milliammeter between the power supply and the amplifier. In the pictorial, disconnect the lead coming from the amplifier to the lug on the terminal strip to which C4 and SR1 are connected. Connect one side of the meter to the lug and the other side to the lead from the amplifier.

When power is applied, RY1 will close momentarily and the meter will indicate about 20 ma. When RY1 opens the current should fall to about .5 to 2 ma. If the idling current exceeds 2 ma, C2 has excessive leakage and should be replaced with another unit that keeps the idling current below 2 ma.

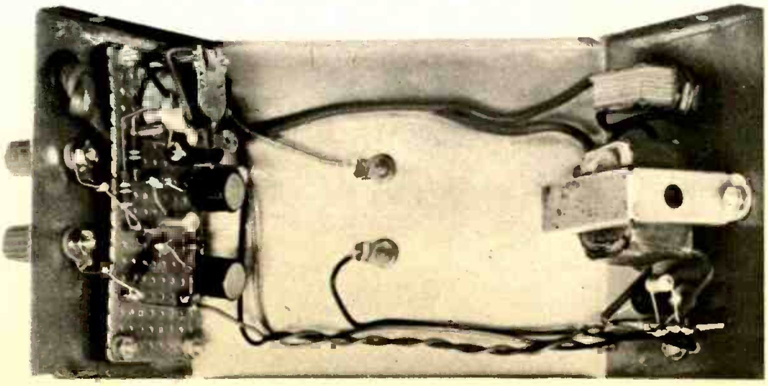
Next, check L1 by placing it near a soldering gun that is turned on, or near T1. RY1 should close for about 3 to 5 seconds. If RY1 fails to close, check for a wiring error.

Installation. Place L1 under the phone cradle. When the phone rings RY1 should close. If RY1 does not close, move L1 to a different position—perhaps under the phone. Usually the extension will work the first time if L1 is strapped to the *side* of the phone.

If the extension is to be used to indicate that a motor has started, L1 should be able to pick up the field within a foot of the motor.

You can use the extension to close an external circuit rather than supply power to a separate bell. To do so, connect J4 directly to terminal D on RY1. Make sure D and J4 are not both connected to the secondary of T1.

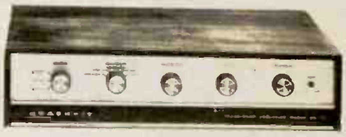
How it Works. L1 picks up the AC field set up by the ringer coil in your phone when a call comes through. The voltage across L1's terminals is amplified by Q1 and fed to Q2 causing Q2 to conduct. Q2's collector current, which flows through RY1's coil, increases and causes RY1 to close. When contacts C and D of RY1 close, the other side of 6.3-VAC secondary of T1 is connected to J3. ◆



If you want to mount bell in Minibox there is plenty of room for it in center. If bell is to be located externally, a smaller box can be used.

FOR HAM RADIO—Heathkit 80 Meter SSB Transceiver, Kit HW-12, $119.95.

FOR SPORTS—Heathkit 1-Watt Walkie Talkie, Kit GW-52, $74.95.



FOR STEREO/HI-FI—Heathkit 40-Watt All-Transistor Stereo Amplifier, Kit AA-22, $99.95.

Here are a few Heathkit values... there are 245 more where these came from!

FOR YOUR BOAT—Heathkit 25-Watt Radiotelephone, Kit MWW-13, $164.95.

FOR YOUR CAR—Heathkit Ignition Analyzer, Kit IO-20, $89.95.

FOR TEST EQUIPMENT—Heathkit "Service Bench," VTVM, Kit IM-13, $32.95.

FOR YOUR HOME—Heathkit Electronic Organ, Kit GD-232, $349.95.

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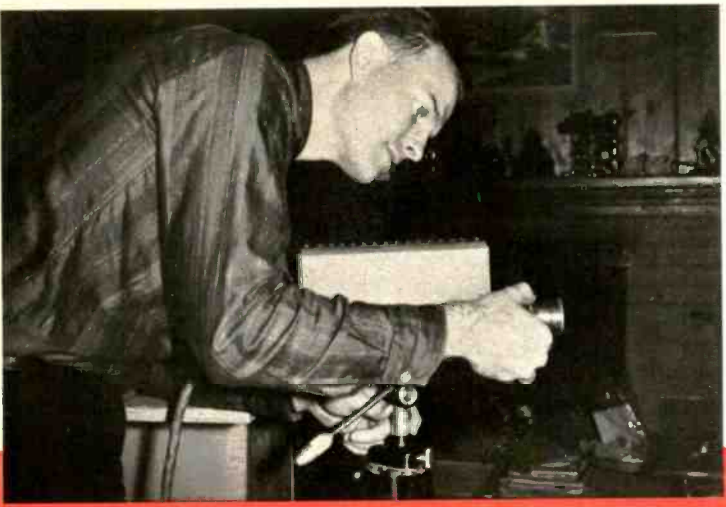


Experimenters and hobbyists looking for a last frontier go for ham-TV in a big way. A TV camera is all it takes to transmit video, other than a ham ticket and a transmitter, and who ever heard of QRM on the 420-450-mc UHF band? The gentleman shown focusing the lens at left is Laird Campbell, W1CUT, who already has conducted a good many TV transmission tests while mobile.

HAMS ON TV

There's fresh excitement on hamdom's New Frontier: now they have pictures to go with the sound!

By Len Buckwalter, K1ODH

ONE OF the most intriguing and least-known pursuits of the radio amateur is coming of age. It's ham-TV, where you *see,* as well as hear, the other end of a contact. Once restricted to sophisticated tinkerers, ham-TV is claiming dozens of new converts daily. The reason is simple: the incredibly high-priced equipment and oddball parts no longer present serious obstacles.

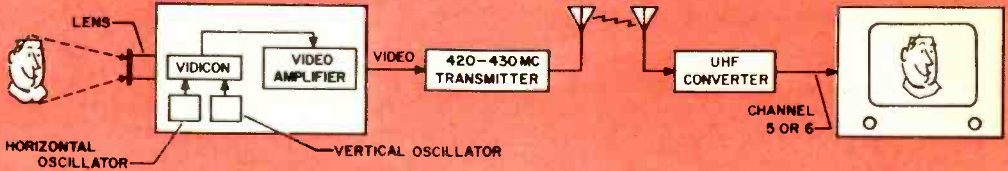
Johnny Carson and Captain Kangaroo notwithstanding, ham-TV can duplicate anything you see on your home screen. Even the feeble illumination from a candle will drive the sensitive equipment in today's ham-TV systems. Under normal room light, a whole shack can be televised at the sweep of a camera.

But the big attraction of ham-TV isn't due entirely to its visual delights. For ham-TV offers the intermediate and advanced experimenter an area of activity that is virtually untouched. As a veteran operator puts it, "Ham-TV is one of the last remaining fields where you're on your own—so little has been written on the subject."

The number of ham-TV stations now on the air is estimated at less than 1,000. But the figure is deceptive. There are several thousand additional installations operating in closed-circuit systems; the camera feeds a receiver directly in the same home. Many of these closed-circuit boys would get on the air in a matter of days if they had someone to contact. Most only need build a conventional RF transmitter.

A big impetus to the hobby came several months ago when the FCC raised maximum transmitter power from 50 watts to a full kilowatt. But the most potent factor for the growth of ham TV is just coming into existence. It's the kit—a package that contains all hard-to-get components, right down to the C-mount (a ridiculously simple adaptor ring for lens mounting that's almost never available from parts houses). It's now possible to secure all the elusive components from at least two suppliers

Most ham-TVers use a set-up similar to the one in the block diagram below. A camera, containing a Vidicon, a couple of oscillators, a lens and an amplifier, feeds a video signal to a UHF transmitter. At the receiving end, a UHF converter changes the signal to TV channel 5 or 6 and feeds it into an ordinary TV set. Photo at right shows actual ham-TV transmission on home TV screen.



who specialize in the ham TV field.

If any one person earns the title of Mr. Ham TV, it well may be Al Denson. From a mountain top in northern Connecticut, he operates W1BYX-TV and Denson Electronics, one of the major sources of ham-TV components. A look at his operation gives a clue to what's happening in the field.

Al began running small ads in electronics magazines some seven years ago. The response at that time wasn't dramatic; much of the equipment offered was in the surplus field and its appeal strictly limited. It took several months to stimulate enough interest to mail out 200 flyers. Today, Denson's mailing list stands at 45,000 and is handled by a busy three-girl office staff. It's no hit-or-miss list—this is the number of respondents hungry for such catalog gems as a tube-neck clamp or interlace sync generator.

To get an idea of how much it costs to get on TV, let's consider one of Denson's three basic component kits—the Electromagnetic Deflection TV Camera. Since a camera forms the heart of any system, the Denson kit includes only the rare camera components: deflection yoke, lens and mounting, special power transformer, focus coil and some ten other items. The package includes a punched chassis and cabinet; cost so far is $99.50 for the basic kit.

The only other special component needed to complete the camera is a Vidicon tube. This is sold separately, since a local TV station might be a source of sub-standard, but still usable, tubes.

If purchased from Denson, one of three Vidicon tubes may be selected—all the same type and number. The difference is in the grading.

Grade A Vidicons are the most costly. With a few slight imperfections outside the viewing area, they are tagged at $100 apiece. Grade B, at $60, may have some imperfections that'll show up when the picture is viewed—a few speckles or dots on the screen, say. Grade C has more imperfections but is priced at $34.50. In any case, performance and life of these tubes are equivalent to those of brand-new Vidicons that net for several hundred dollars.

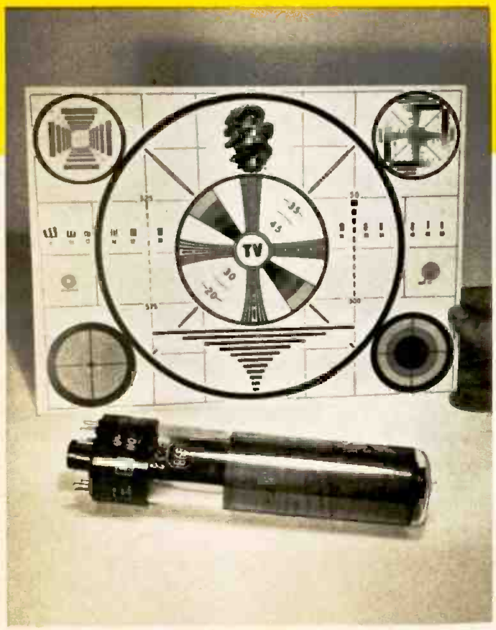
Tally the cost to this point and you come up with about $135. The parts needed to complete the camera are standard stock at any electronics distributor. They add up to about $25 and consist of resistors, receiving-type tubes, capacitors and the like. Thus, for a total of approximately $160 you can construct an operational camera that will be usable in a closed-circuit system.

Getting a signal on the air calls for the addition of a transmitter and antenna. But you can build a rig rated at a few watts RF input (adequate for most work) for about $50—less, if your junkbox holds such basic items as power-supply components. An antenna array (with elements some 13 inches long) will put your mug on the air over a circle about 20 miles in diameter, depending on antenna height and surrounding terrain.

Adding voice to the picture is another problem. In commercial TV broadcasting, separate transmitters handle audio (FM) and video (AM). To avoid complexity, the common practice in ham-TV is to use an existing AM rig on 6 or 2 meters for audio. Circuits are being developed to multiplex the sound onto the video signal for the desirable result where the TV receiver alone reproduces both sound and picture.

This happens to be Al Denson's approach, although it's only one of several now available to the interested ham. If you want more information, drop Al a card at Denson Electronics, Box 85, Rockville, Conn.

Another kit package for ham-TV is by the Craftsmen Instrument Lab, 60-30



Vidicon tube and test pattern serve much the same purpose as a phono cartridge and a test record in a stereo setup. Like the cartridge, the Vidicon is a transducer, in this case converting the image into electrical signals. Test pattern aids adjustment.

Complete TV camera kit is now marketed by Craftsmen. Packages in background contain kit parts.

34th Ave., Woodside 77, N. Y. An early operational model (see photo) was introduced at the Communications Fair held in New York City several months ago.

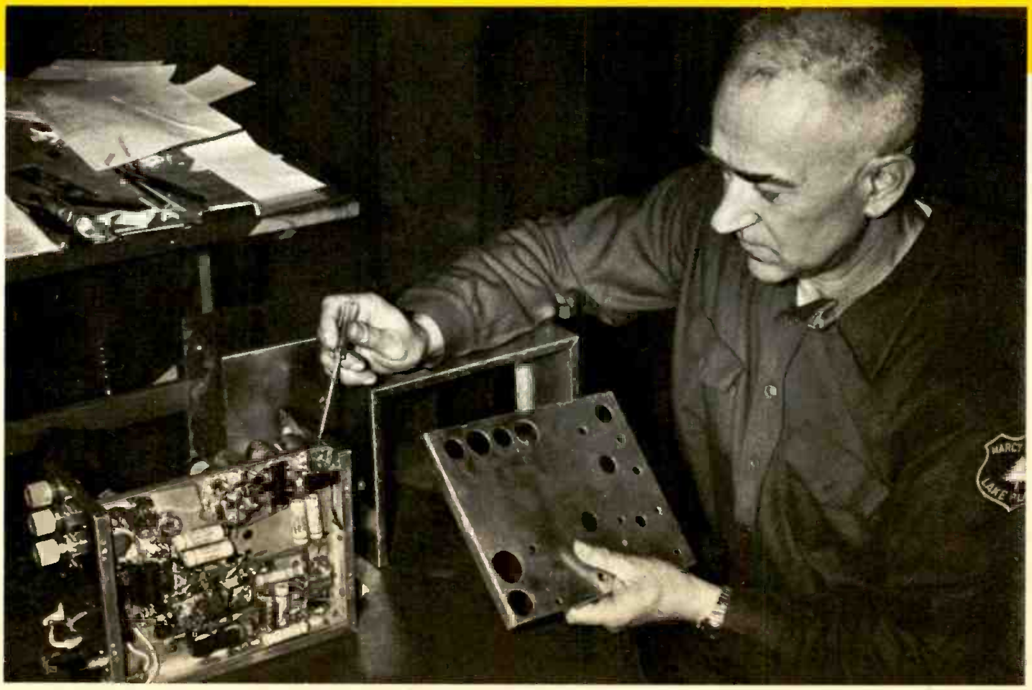
Key difference between the Craftsmen kit and the one already described is in the packaging. All components, including resistors and capacitors, are included, and construction information is provided in greater detail. Understandably, the price is necessarily higher. The kit sells for $225, less Vidicon and lens, while a fully wired version is available for $490.

And now for the jackpot question: "Who is capable of building a successful ham-TV station?" There's agreement on this point: don't attempt it if you're a beginner in electronics. One criterion is that you should be able to construct a circuit from a schematic alone. This doesn't mean you need to know TV theory, but you must have the knack of assembling electronic equipment without the help of drawings that give point-to-point wiring steps.

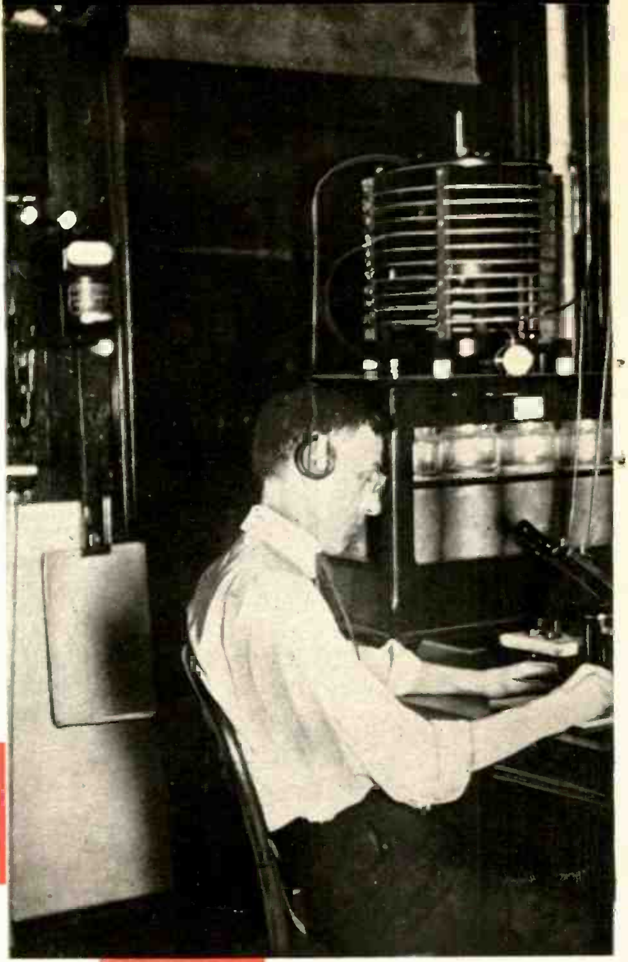
Contrary to what you might think, the most difficult section isn't the camera. Frequencies in this circuit don't exceed 5 mc and wiring isn't especially critical. It's the transmitter that can cause headaches. At the lowest legal frequency for ham-TV (420 mc), it takes a lot of trial and error to resonate tuning circuits and avoid signal losses due to poor layout and wiring.

For the jaded ham who already has cut his teeth on low-band equipment, ham-TV might be just the thing. The beginner, however, will have to wait for more experience or further simplification of construction techniques. But these seem inevitable. After all, it was only a few years ago when the idea of an audiophile building an FM tuner kit would evoke laughter from those in the know. Who's to say that ham-TV won't follow the same path in the years ahead?

A second TV camera in kit form—this one by Denson Electronics—contains only special, hard-to-get components. Al Denson, firm president, holds punched chassis, one of the basic parts in his camera-kit package.

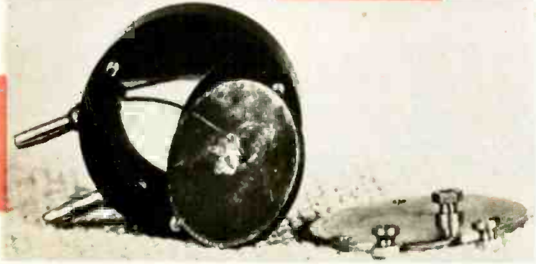


WHEN PAW WAS A BOY

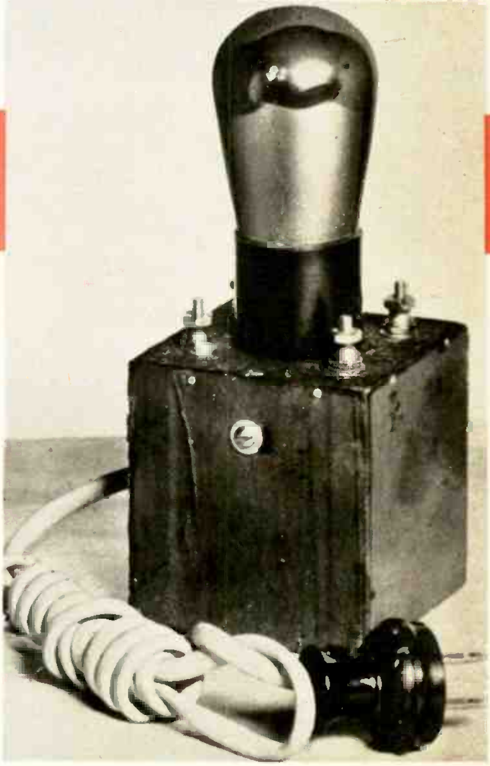


TICKLISH TICKLER . . . Movies still couldn't talk in 1926, but the Washington Navy Yard did produce a battery-operated black box of note. A "high-frequency receiver," the set boasted a "tuning condenser" and a "regeneration control" that were both log-calibrated. It even had a "filament rheostat" as part of a bonus that probably went unnoted: adjustable electric candlelight for the gastrophiles in the crowd.

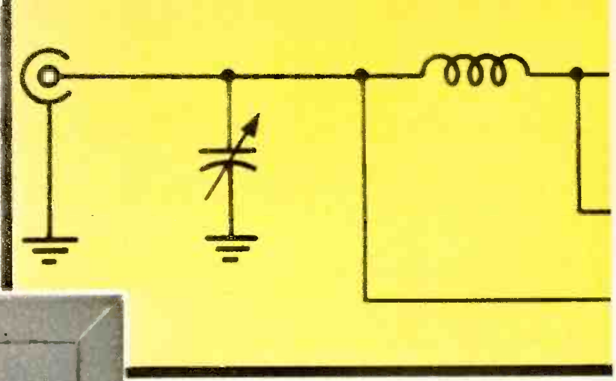
GAPS AND JARS . . . Students at the Philadelphia School of Wireless Telegraphy benefited from some modern teaching techniques way back in 1911. To learn by doing, the men (and boys) handled bona-fide commercial wireless messages with ships at sea. Their transmitter, a 1-kw spark station, came equipped with all the latest frills of the day. There was a shaft and knob for adjusting the electrode spacing of the spark gap, itself enclosed in a heavy cardboard tube to muffle its deafening crash. The right kind of relay was far in the future but a 100-amp, marble-base DPDT knife switch took care of switching the antenna from transmit to receive. Filtering was no problem either, though the capacitors, visible in the center of the photo, looked exactly like what they were: two-quart Leyden jars. Matter of fact, capacitors in those days often were rated in quarts, since today's term of microfarads was still just a trifle impractical—and technical!



HOME-MADE HOLDER . . . Life was a little less hectic in days gone by, though paw couldn't take much for granted as a ham—not even a crystal in a respectable holder. But this didn't stop him from rolling his own—cigarette, coil, ham rig or holder! In the crystal holder shown above, the case is made of a circular ring, which was cut from a piece of Bakelite tubing. A highly polished metal plate, permanently secured to the case, forms the bottom contact for the crystal, while a circular, polished brass plate comprised the upper contact. The crystal simply is sandwiched between the two, and a nickel-plated screw-on cover completes the assembly. Description makes it sound simple as E = IR, but then even grandpaw knew talk was cheap.



MERCURY KEYER . . . A vacuum-tube keyer is as much a part of the CW scene as a tank coil these days, but this wasn't the case in paw's day. As you can well imagine, he had to devise his own, and he wasn't half-bad at it, either. The device above dates from the 1930's and uses—of all things—a mercury-vapor rectifier tube (UV-280-M) as the keyer! Self-contained in a wooden case (could it have been maw's breadboard?), the keyer followed keying as fast as you could let 'er have it. Since paw isn't around, we'll tip you off on his circuit. Actually, the line cord and plug he's left out there pretty much give it away—a filament transformer and a couple of capacitors tucked away inside the case, with four screw terminals smack on top.



SWL

This matcher peps up your receiver to give you up to two more S-units.

By RUSS COGAN

IF YOU own a fancy communications receiver equipped with an antenna-trimmer control, you've got it made. But if yours is a budget or surplus receiver hooked to a random-length antenna (and your rig doesn't have that trimmer control) we'd wager you're not satisfied with your set's sensitivity and could use EI's Antenna Tuner.

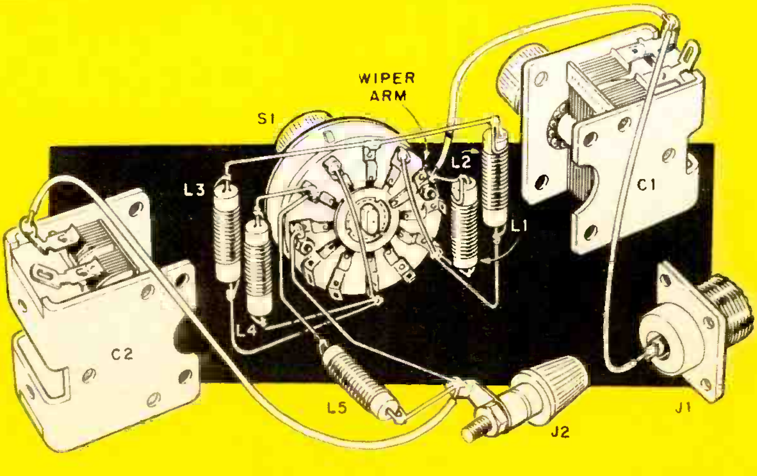
The tuner can match any antenna impedance to your receiver's input, giving you up to a 10db increase in signal (nearly two S-units) within the range of 1 to 30 mc.

Construction

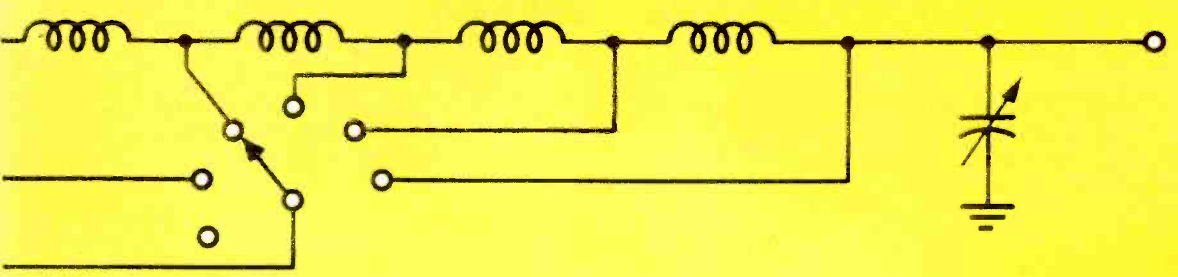
The tuner is built in a compact 5¼x3x2⅛-inch Minibox. Since space is limited, follow the layout in the pictorial carefully when mounting C1, C2 and S1. To simplify construction, we used standard RF chokes instead of tapped or hand-wound coils.

Since S1 is detented for SPDT operation, it must first be modified. Holding S1 sideways so the detent faces you, remove one tab on the left side of the detent stop and three tabs from the right side. The unused switch lugs (at the bottom in the pictorial) are used as tie point for the chokes. Don't attempt to wire the chokes directly to the terminals on the top of S1, which could cause shorting.

C1 and C2 have small copper trimmer straps. Remove the trimmer screws and cut off the straps before mounting. Wire to the sections of C1 and C2 that have the greater number of plates. This will produce good results from 10 to 30 mc. Actually C1 and C2 have little effect at low frequencies. If you're primarily interested in frequencies below 10 mc, connect the two sections of each capacitor in parallel. Install jumper wires between the two lugs on the top of C1 and C2 before mounting them in the cabinet.



Tuner is built in U-section of Minibox. Make sure C1, C2 and S1 don't block cover screw holes. Coaxial jack can be used for J1 if receiver has 50-ohm input. If receiver has high impedance input, use binding posts. Mount chokes and wires on S1 before installing in the cabinet.



Antenna Tuner

Connect your receiver to J1 and your antenna to J2. Set S1, C1 and C2 full clockwise. The tuner is now out of the antenna line. Tune in a station and rotate S1 to the position that produces the strongest signal, then peak the signal with C1 and C2. C1 normally has little effect, but under certain conditions it may produce an extra S-unit of signal. Once the signal is peaked, try the next higher or lower position of S1 and then readjust C1 and C2.

It may be possible to find another setting of C1, C2 and S1 that will produce an even stronger signal. Try the tuner on all bands and list the peak settings of all controls.

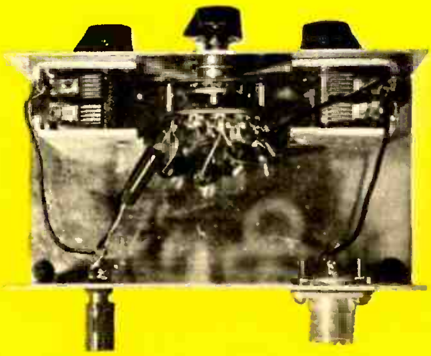
Connection of the tuner to your receiver can affect sensitivity so try all possible connections to the receiver's antenna terminals. It is possible that the tuner will not improve performance above 15 mc with your particular receiver and antenna. If this is the case, change L5 to a 1.5 microhenry choke (Stancor RTC-8516 or equiv.).

The tuner also can be used to reduce the signal from a strong local station which may be blocking your receiver. Adjust C1, C2 and S1 for *minimum* signal strength and you're in business. ◆

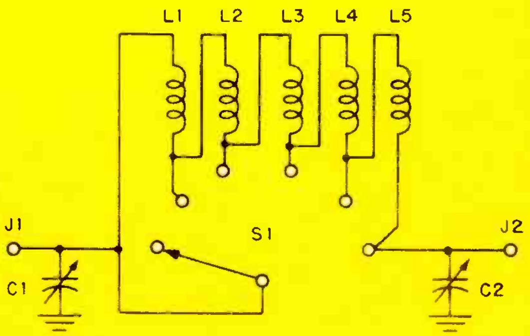
PARTS LIST

C1, C2—Miniature two-gang superhet variable capacitor, 123 and 78 mmf sections. (Lafayette MS-261 or equiv.)
J1—SO-239 coaxial connectors (see text)
J2—Five-way binding post
RF Chokes: All Stancor Nos.
L1—55 microhenries, RTC 8668
L2—15 microhenries, RTC 8524
L3—24 microhenries, RTC 8525
L4—10 microhenries, RTC 8523
L5—6.2 microhenries, RTC 8520
S1—6-position, non-shorting rotary switch (Centralab PA-1001)

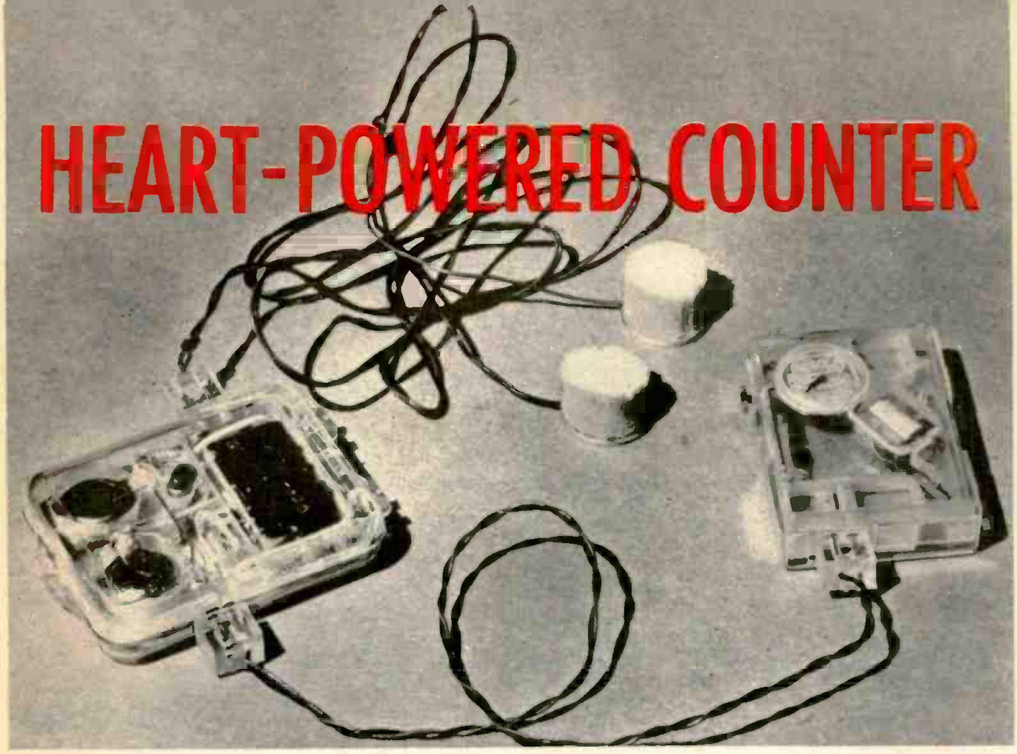
Inside view of the tuner. J1 is at the right and C1 is directly behind it. C2 and J2 are at the left.



Combinations of C1, C2 and L1-L5 in this pi-network circuit match the antenna impedance to the receiver.



HEART-POWERED COUNTER

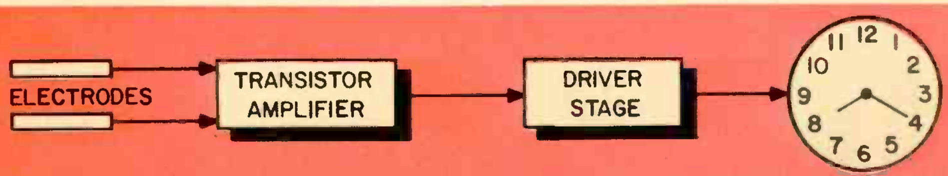


THERE'S not much of a trick to taking a patient's pulse—it's a kind of two-finger exercise that even a Cub Scout can master. But what happens when there's need to record the number of heartbeats over a long interval—24 hours, say? Obviously, it would take someone with superhuman concentration and a mind bent on math to keep track of that many heartbeats for so long a time. Why not let electronics take over?

Working at the request of Dr. G. V. LeRoy of the University of Chicago Medical School, engineers at the Illinois Bell Telephone Co. have developed an electronic pulse counter for this job. Here's how it works. Two electrodes, taped to the chest some 5 or 6 inches apart, pick up the minute currents which flow in the chest during each heartbeat. A sensitive transistor amplifier, biased almost to cutoff, delivers a sharply defined signal each time the heart beats. These signals magnetically actuate the escapement mechanism of a small wrist watch. And a calibrated dial allows direct reading of the cumulative number of heartbeats.

Since the cardiotachometer can record continuously for 36 hours, doctors at the U. of C. are finding the device extremely valuable in studying the effects of various drugs and in calculating proper dosages. The heart-powered counter also may show whether a progressive increase in the average number of heartbeats indicates that coronary arteriosclerosis is in the offing.

—*Alexander Dorozynski*



Essentially an electronic switch, counter picks up minute electrical pulses to heart muscles. Amplified pulses trigger escapement mechanism in a wrist watch.

all-purpose WIRELESS CONTROLLER

By John Potter Shields

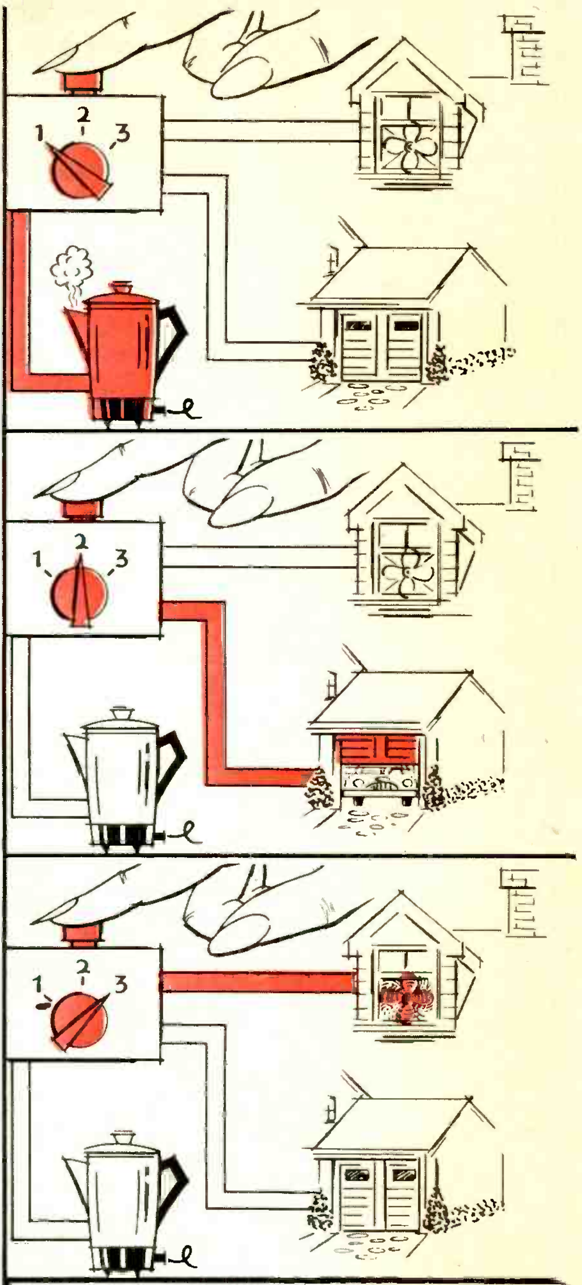
WHAT could be more luxurious than chair-side control of just about any device in your house?

Set a rotary switch, push a button and you can start the attic fan. Set the switch to another position, push the button and the coffee starts perking when you wake up. It will now be ready when you get down for breakfast. Set the switch to yet another position, push the button and the garage doors open as your wife's car approaches the driveway. And all this with no wiring!

As a matter of fact, you can control individually up to as many as ten devices—anything from your hi-fi system to the washing machine, to a signaling device in a neighbor's home which calls the kids in for supper.

The Controller uses your 117-volt power lines to link the transmitter to the receiver. The cost of both units is low and construction is a snap. There are no special parts or complicated, hand-wound coils.

The Controller's range depends on several factors. If the transmitter and receiver are used in semi-rural areas, the range may be several miles. On the other hand, in a metropolitan area the range will be limited to the same building. In general, the range is greatest when both transmitter and receiver are



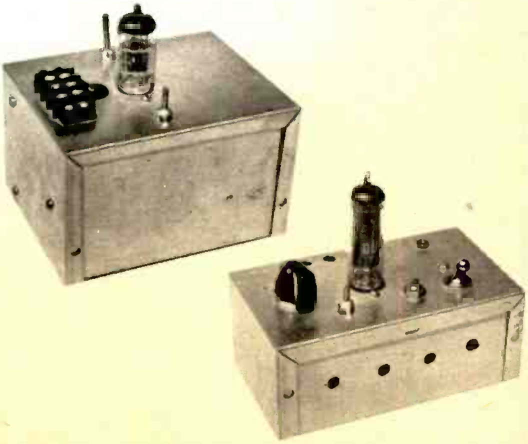


Fig. 1—Receiver (left) and transmitter (right) can be housed easily in small aluminum cabinets.

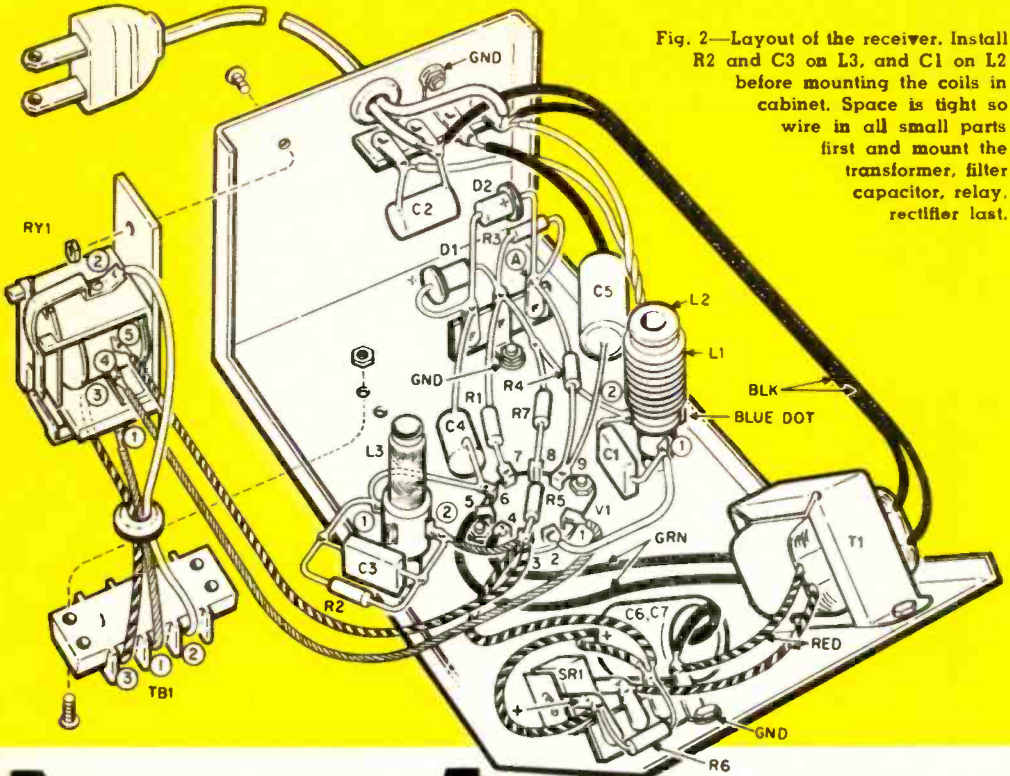
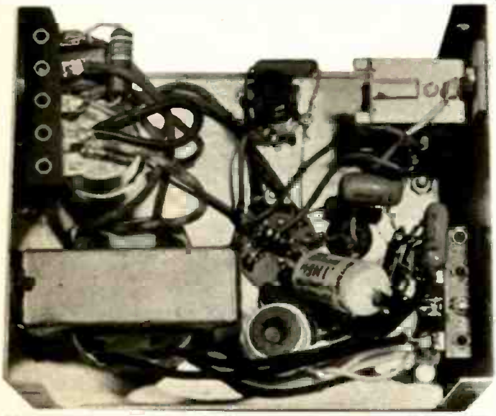


Fig. 2—Layout of the receiver. Install R2 and C3 on L3, and C1 on L2 before mounting the coils in cabinet. Space is tight so wire in all small parts first and mount the transformer, filter capacitor, relay, rectifier last.



RECEIVER PARTS LIST

Resistors: ½ watt, 10% unless otherwise indicated
R1—330 ohms
R2—22,000 ohms
R3,R4—2.2 megohms
R5—47,000 ohms
R6—1,000 ohms
R8—15,000 ohms
R7—470 ohm, 1 watt
C1,C3—400 mmf, 500 V silver-mica capacitor
C2,C4—.05 mf, 500 V disc capacitor
C5—.1 mf, 600 V tubular capacitor
C6,C7—20 mf, 150 V electrolytic capacitor
L1—Same as L2 in transmitter
L2,L3—Same as L1 in transmitter
T1—Power transformer. Primary: 117 V. Secondary: 125 V @ 15 ma, 6.3 V @ .6 A. (Allied Radio 61-G-411 or equiv.)
RY1—SPDT relay, 5,000-ohm coil (Potter and Brumfield LB5-5000 or equiv.)
RY2—Same as RY1 but DPDT contacts
SR1—65 ma, 500 PIV silicon rectifier
D1,D2—1N34 diode
S1—SPST push-button switch
V1—6U8 tube

on the *same side* of a power distribution transformer.

The operating principle is simple. The transmitter generates one of several selectable RF signals between 50 and 200 kc. The signal is fed through a capacitor back into the AC power line. A remotely located receiver's input is capacity-coupled to the power line and tuned to one of the transmitter's operating frequencies. When you depress a button on the transmitter, the signal fed into the power line energizes a relay at the receiver's output. The relay can be connected to apply or remove power from almost any device.

A rotary switch on the transmitter gives you a choice of several operating frequencies. Thus, several receivers, each of which can be tuned to a different transmitter frequency, may be installed throughout the house.

Receiver Construction. The receiver was built in a 5x4x3-inch Minibox. Make coil L1 by winding 11 turns of No. 20 stranded hookup wire over L2. The value of C1 and C3 must be the same as *either* C1, C2 or C3 in the transmitter.

For example, if the transmitter uses 500 mmf, 700 mmf and 900 mmf capacitors, then C1 and C3 must be either 500 mmf, 700 mmf, or 900 mmf capacitors.

Since L2 and L3 are unshielded, it is important to mount them at least 3 inches apart or coupling between them will cause the receiver to oscillate. If only one receiver is to be used and it is in the same building as the transmitter, substitute an 82,000-ohm, ½-watt resistor for C3 and L3. Although this will reduce the receiver's sensitivity and selectivity somewhat, operation will remain satisfactory.

Transmitter Construction. The transmitter is built in a 3x2⅛x5¼-inch Minibox. Since filament-voltage dropping resistor R2 gets quite hot, drill ventilation holes directly above it and on both sides of the box. Parts layout is not critical, but use short leads between oscillator coil L1, V1 and frequency-selector switch S1. Coil L2 is made by winding 11 turns of No. 20 stranded hookup wire evenly over L1.

The values of frequency-determining capacitors C1, C2 and C3 were chosen arbitrarily by the author. Since receiver selectivity is quite sharp, much closer values, such as 500 mmf, 700 mmf and 900 mmf, may be used without the possibility of more than one receiver responding to the same signal. Use silver-mica capacitors for C1, C2 and C3 for good frequency stability.

Alignment. Turn on both units and screw the slug of the transmitter's oscillator coil L1 in about halfway. The slugs of both L2 and L3 in the receiver should be screwed all the way out—maximum counterclockwise. Connect a VOM with at least 10,000 ohms-per-volt sensitivity or a VTVM between point A on the receiver (see schematic in Fig. 3) and the chassis. Set the meter to 50 VDC or higher.

After both units have warmed up,

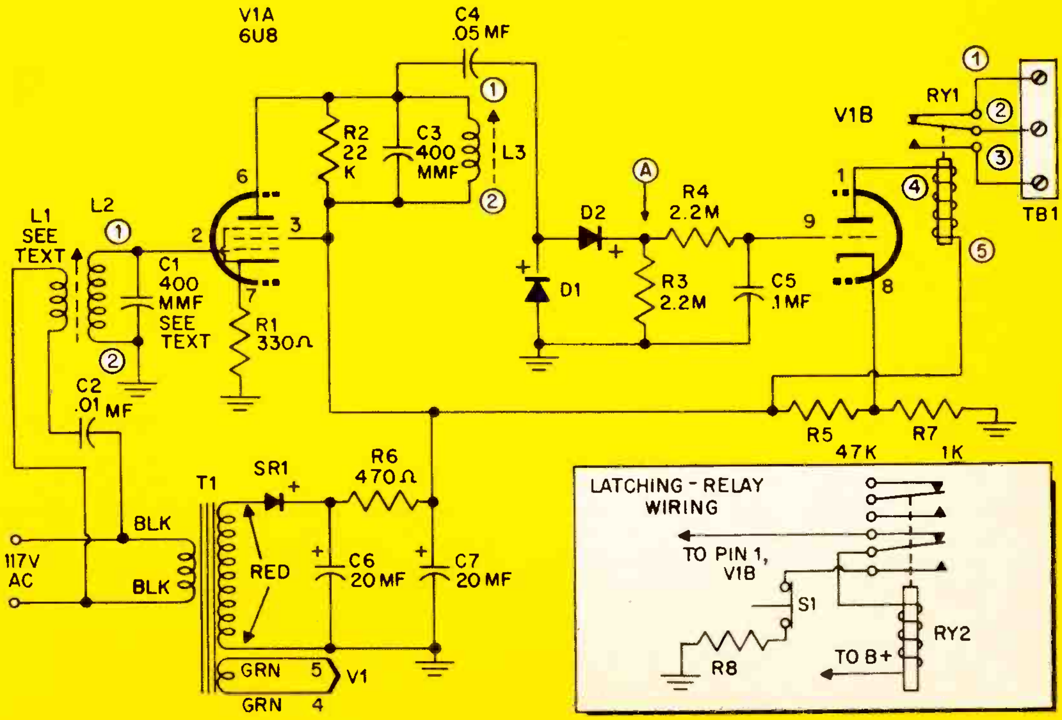


Fig. 3—Receiver. When S3 on transmitter is released, RY1 opens. By using latching relay circuit, RY2 stays closed until S1 is depressed. R8 should be about 15,000 ohms (1 watt) for a 5,000-ohm coil relay.

BATTERY

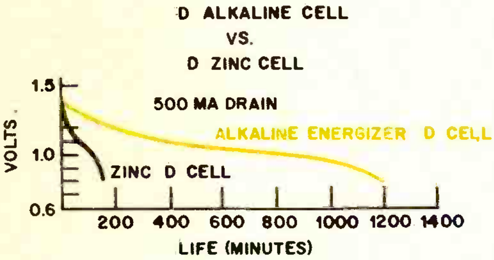


Fig. 1—Output voltage vs time of size D alkaline energizer and zinc cells at 500 ma drain.

TABLE 1—1.5-VOLT BATTERY CURRENT RANGES AND CLASS OF SERVICE

BURGESS	EVEREADY	RCA	VOLTS	CURRENT RANGE (ma)*	SERVICE	SIZE
N	904	VS073	1.5	0-20	General	N
7	912	VS074	1.5	0-20	General	AAA
920	815	VS734	1.5	0-25	Photoflash	AA
Z	915	VS034A	1.5	0-25	General	AA
930	1015	VS334	1.5	0-25	Transistor	AA
120	835	VS735	1.5	0-80	Photoflash	C
I	935	VS035A	1.5	0-80	General	C
220	850	VS736	1.5	0-150	Photoflash	D
2R	950	VS036	1.5	0-150	General	D
230	A100	VS336	1.5	0-150	Transistor	D
AL-N	E90	VS1073	1.5	0-85	Alkaline	N
AL-9	E91	VS1334	1.5	0-150	Alkaline	AA
AL-I	E93	VS1335	1.5	0-300	Alkaline	C
——	E94	——	1.5	0-300	Alkaline	½D
AL-2	E95	VS1336	1.5	0-650	Alkaline	D
——	E97S	——	1.5	0-1300	Alkaline	G

* May vary, depending on manufacturer.

life if the maximum current drain doesn't exceed 150 ma in either short, intermittent or continuous service. You could use either of these batteries in flashlights, which may take half an amp, or in walkie-talkies, which may pull over 1 amp during transmit.

One of two factors that would govern which of these batteries is best for the job is the *"service for which intended"* specification. If you could use the aforementioned batteries until the output fell to 0.8 volt, the general-service type could deliver 300 ma to a flashlight for 11 hours at the rate of two hours a day. On the other hand, the electronic-applications battery would be hard-pressed to give even nine hours of service—and it costs a nickel more.

Now consider the same batteries for transistor radios that require only 60 ma and see what happens. If the radio is played four hours a day, the general-service battery will give 100 hours of service, while the electronic-applications battery gives 150 hours of service. For 5 cents extra you get 50 per cent more life—a darned good buy!

The second specification to remember is the *"recommended current range,"* which all batteries have. The general-service D cell usually has a range of 0-150 ma and maximum battery life is obtained if you stay within this range. However, a battery can give up to three times the service if it is used at *half* its maximum rate. For example, a Burgess No. 2 general-service D cell will deliver 27 hours of service at 150 ma or 70 hours at 75 ma. Generally, you get the most service per dollar at the *recommended current range* rating. If you need 150 ma to operate a project, use two 150 ma batteries in parallel. While you pay for two batteries, you get the useful-life equivalent of about *three*.

But there is a limit to paralleling. Two D cells delivering a total of 150 ma

Fig. 2—Popular 1.5-volt cells. Size designation is followed by manufacturer's number. Left to right: N (904), AAA (VS074), AA (Z), C (VS1335), D(2R), ½D alkaline energizer (E94), G alkaline energizer (E97S).

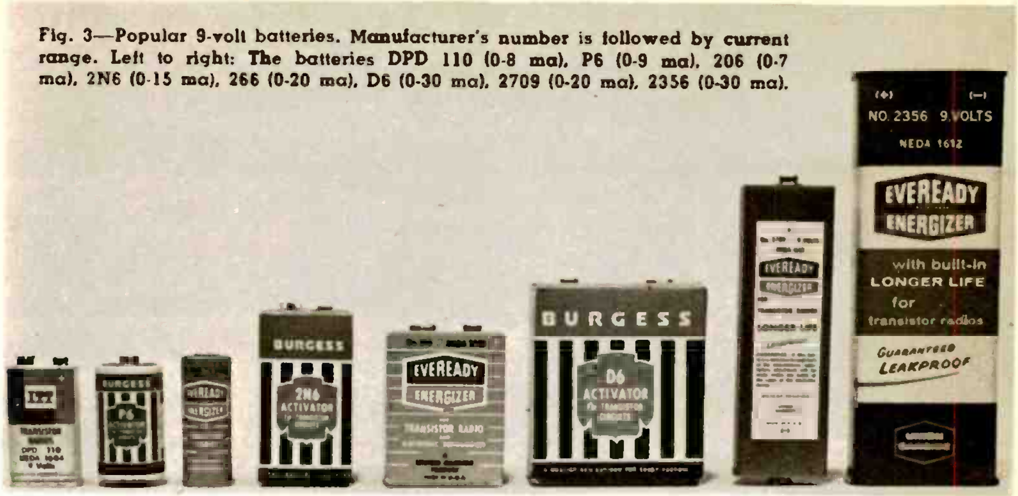


Fig. 3—Popular 9-volt batteries. Manufacturer's number is followed by current range. Left to right: The batteries DPD 110 (0-8 ma), P6 (0-9 ma), 206 (0-7 ma), 2N6 (0-15 ma), 266 (0-20 ma), D6 (0-30 ma), 2709 (0-20 ma), 2356 (0-30 ma).

will split the load in half. If you connect additional cells in parallel to reduce the drain per battery even further, the shelf life of the batteries may be exhausted before you can utilize them fully.

And don't use a battery which has excess capacity. If you need only 5 ma for a crystal calibrator which you might use one minute a day, don't use a D cell when a smaller AA cell can do the job. Chances are, both types will die a natural death before you can use them up.

To simplify your selection, refer to Table 1, which shows the recommended current range and class of service for commonly-used 1.5-volt batteries.

Shelf Life. The moment a battery comes off the assembly line its output starts to fall. So far as manufacturers are concerned, shelf life is the time it takes for a battery to lose about 10 per cent of its capacity. However, it's still a good battery, and many times you may buy a battery that has been on the shelf long enough to lose that 10 per cent. When the term *shelf life* is mentioned in a construction project, the author generally means that current drain is so low that the battery will die a natural death before the current drain kills it.

Actually, it's rare for a battery to be stone-cold dead when it fails to operate equipment. The battery that can't do more than cause a flashlight to glow can be put to months of service in a low-current transistor oscillator. A dead set of walkie-talkie batteries still can run a transistor radio or a one-transistor oscillator. Here's where you save your petty cash.

Battery packs (Table 3), such as the 6-volt Burgess Z4 are made up of standard cells wired in series or parallel, or both. The Z4 consists of four AA pen-

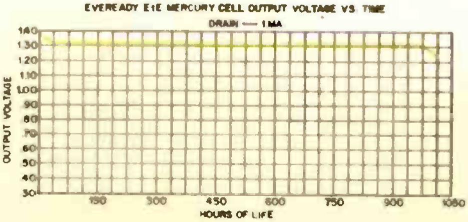


Fig. 4—Output voltage vs time of Eveready E1E mercury cell. Note the abrupt drop at 975 hours.

TABLE 2—TRANSISTOR-RADIO BATTERIES

BURGESS	EVEREADY	RCA	VOLTS	CURRENT RANGE (ma)*
L6	206	VS337	9.0	0-7
2U6	216	VS323	9.0	0-8
P6M	226	VS300	9.0	0-9
2N6	246	VS305	9.0	0-15
M6	266	VS322	9.0	0-20
——	2709	VS326	9.0	0-20
D6	276	VS306	9.0	0-30
C6X	2356	——	9.0	0-30
XX9	239	VS304	13.5	0-10
K15	420	——	22.5	0-6

* Value may vary, depending on manufacturer.

light cells connected in series. In Table 1 you see that the Burgess 930 has a current range of 0-25 ma. Since the cells are in *series*, the Z4 still has a range of 0-25 ma.

Now that you know how to save some of your loose change, you can afford to look into the special types of batteries you've been shying away from.

Mercury Batteries. The most important feature of Mercury batteries (zinc-mercuric oxide composition) is constant output voltage (see Fig. 4). In contrast to the output voltage of a zinc-carbon battery, which falls gradually with use, the mercury's voltage remains uniform over its useful lifetime, then dies suddenly. The mercury battery commands a stiff price, but it's worth the cost to maintain the constant speed of a movie camera's motor, low distortion from a voltage-sensitive oscillator or consistent accuracy from an exposure meter.

Alkaline Energizer Batteries. The newest addition to the battery family, the alkaline energizer (alkaline-manganese dioxide, zinc) is able to deliver a tremendous surge of energy and then bounce back to deliver it again. Let's compare two Eveready batteries: the D-size flashlight cell, No. 950, and the alkaline ½D, E-94 (which is exactly half the 950's physical size). The 950 has a 0-150 ma current range and the E-94 has a 0-300 ma range. But there is a string to these ratings. The E-94's capability is for short current surges. You can pull up to 2.5 amperes out of it and then do it again and again. Try this with the 950 and it will lay down and die. On the other hand, pull only 30 ma and the 950 will be chugging away after the E-94 has quit.

If we compare the D-size alkaline (0-650 ma current range) with the general-purpose battery the difference is even greater. You can pull more than 4 amperes from the alkaline for 30 minutes at a time, and do it several times. You can't come close to this with general-purpose batteries. Even in low-current applications the alkaline is unbeatable. At a continuous 30-ma drain, the E95 will deliver about 380 hours of continuous service before the voltage falls to 0.8 volt. The general-purpose battery will give only about 200 hours.

While the alkaline looks impressive, its nearly 300 per cent premium price

[*Continued on page* 114]

TABLE 3—BATTERY PACKS

BURGESS	EVEREADY	RCA	VOLTS	CURRENT RANGE (ma)*	NO. AND TYPE CELLS
Z4	724	VS305	6.0	0-25	4, AA
F4BP	510S	VS040S	6.0	0-250	4, F
TW1	731	VS317	6.0	0-500	16, F
4F4H	706	VS103	6.0	0-1000	16, F
4F6H	716	VS140	9.0	0-1000	24, F
TW2	—	—	12.0	0-250	8, F
—	2780	—	12.0	0-500	8,260—6
XX9	239	VS304	9,13.5	0-10	9,135
K10	417	—	15.0	0-6	10,132
4156	763	VS102	22.5	0-40	15,163

* May vary, depending on manufacturer.

Fig. 5—Miscellany. Left to right: Hg-9. 1.4-volt mercury; E134. 5-volt mercury; VS149. 4.2-volt mercury; H146. 8.4-volt mercury; 239. 13. 5 volts; Z4. 6 volts; 763. 22.5 volts; and F4BP. 6 volt general purpose.

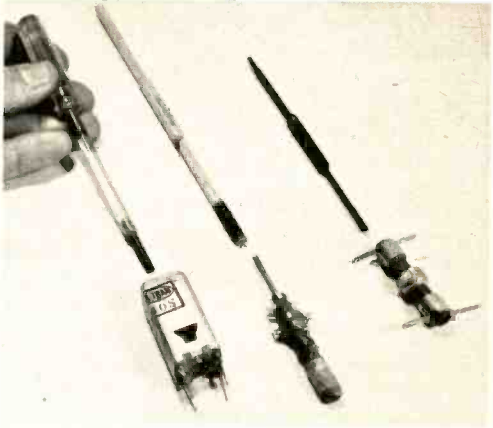
FOOTING THE BILL

CB CORNER

BY LEN BUCKWALTER
KBA4480

FACTS & FEES . . . Just have your money ready when you file for a CB license or renewal. Beginning January 1, the FCC's much cussed and discussed schedule of fees goes into effect. The tab is $8 for a new ticket or renewal, except for Class A. That'll cost you a ten-spot.

The FCC's authority for charging fees comes from a law Congress passed back in 1952. It gives federal agencies the right to prescribe reasonable charges for providing special benefits. Philosophy of the legislation is three-fold: to lift the tax burden from the general public, place it on the privileged individual himself (who, in this case, is the CBer and thus make the agency self-supporting.



Contrary to what some CBers believe, the new FCC rule wasn't levied against Class D operators as a punitive measure. It's one of some three dozen fees tacked onto most users of the radio spectrum—from TV stations ($100) to applicants for radio-telephone permits ($2). However, there is a significant postscript to the action. It reaffirms the lack of unification among the near-half-million licensed CB operators.

Consider this quote from the FCC: "Probably the most vigorous opposition from any one group to the fee proposal came from licensees of the Amateur Radio Service." The result? The fee for a Novice ticket was dropped entirely and the modification fee fell from $4 to $2. In other words, the well-organized hams were successful in persuading the FCC to alter a few of *their* fees.

Where the CBer suffers most is in the "modification" area. There is just no such thing in the CB schedule. The U.S. census tells us that one in every five Americans moves each year. So in any 12 months 20 per cent of all CBers are going to be shelling out $8 for a change of address. The lack of an under-$8 modification fee, as in the case of amateur radio, presents a puzzling picture.

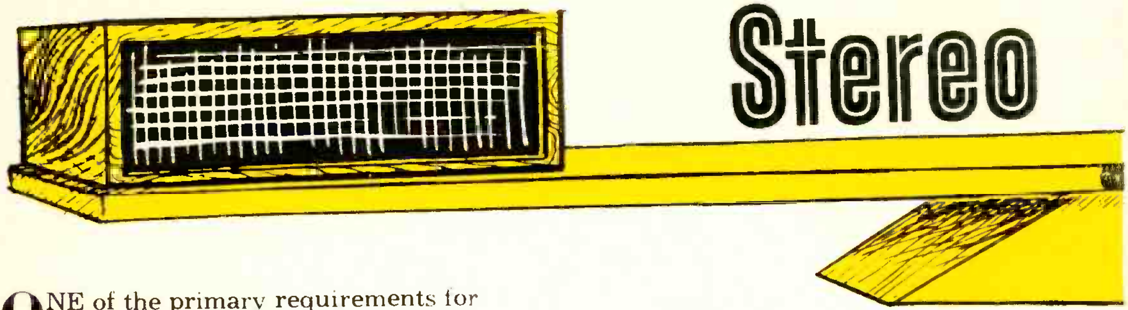
Tune-Up Tip... Driven by need and temptation, many CBers like to repair and maintain their own rigs—but without the proper tune-up tools, such as those shown in our photo. This kind of work is legal, so long as the transmitter's oscillator circuit is left untouched. Trouble is, many fix-it jobs create more problems than they're supposed to cure.

The victims often are tuning cores and slugs inside coils and transformers. In virtually no instance are these intended to be adjusted with a regular screwdriver. Without the proper alignment tool, brass slots break off, cores crumble into powder or threads are ruined on coil forms. Even the metal shaft of the screwdriver is inappropriate; it can lead to tuning error.

Shown in our photo are three tools that will handle just about any CB tuning job you're apt to encounter. Their total cost can run lower than the price of a ruined transformer. Although ap-

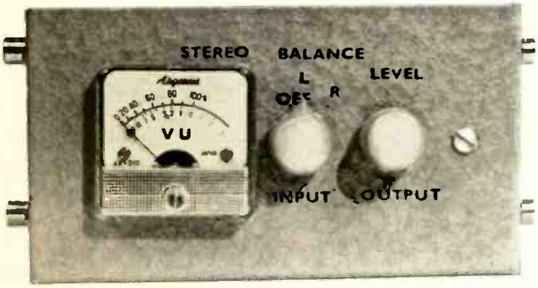
[*Continued on page* 114]

Stereo



ONE of the primary requirements for full stereo enjoyment is balance. The sound you hear from the left speaker must be at the same intensity as the sound you hear from the right speaker. Variations should occur only in the program you're listening to—not the system. Often you may juggle and re-juggle the amplifier's gain controls to achieve balance—only to find you have to go through the process again when you change your listening position.

EI's Stereo Balancer will aid in quickly setting your amplifier's volume controls for optimum sound balance, no matter where you sit in the room.



Input switch connects left or right speaker to meter. Output control sets level to amplifier.

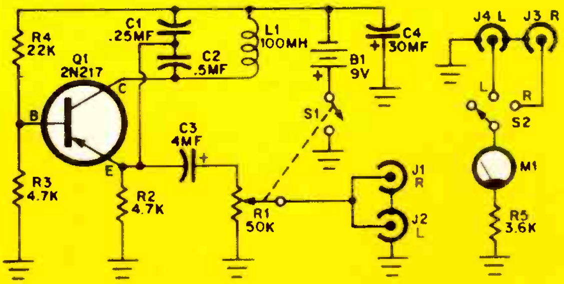
The Balancer consists of an oscillator and a VU meter that can be connected to either the right or left speaker. The oscillator provides a *steady* signal, making balancing a snap. No longer do you have to adjust the amplifier's gain controls with a program whose level changes constantly. The Balancer's oscillator output level is set so even if your amplifier's gain control is turned up to normal, the neighbors won't be jarred off their chairs when you apply the signal.

The VU meter allows the level of each channel to be set for perfect balance. Or the VU meter can be used to produce exact *listening* balance when the channel levels must be different, such as when your speakers are of different efficiency or when your listening position is closer to one speaker than the other.

The oscillator is independent of the meter's speaker selector switch (S2). Its output is adjustable from zero to about 0.1 volt and it also can be used as a low-distortion signal source for

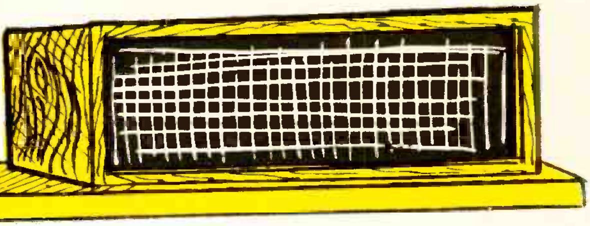
PARTS LIST

R1—50,000-ohm potentiometer
R2,R3—4,700-ohm, ½-watt, 10% resistor
R4—22,000-ohm, ½-watt, 10% resistor
R5—3,600-ohm resistor (see text)
C1—.25 mf, 75 V capacitor (see text)
C2—.5 mf, 75 V capacitor (see text)
C3—4 mf, 12 V electrolytic capacitor
C4—30 mf, 12 V electrolytic capacitor
L1—100 millihenry RF choke
M1—VU meter (Lafayette TM-10 or equiv.)
B1—9-volt battery
J1-J4—phono jacks
S1—SPST switch (on R1)
S2—Two-pole, five-position rotary switch
  (Lafayette SW-78, see text)
Misc.—Cabinet, terminal strip



Colpitts oscillator operates at about 1,000 cps. Increasing the value of C1, C2 lowers frequency.

Balancer



By Lawrence Glenn

troubleshooting your amplifier.

Construction. We built the Balancer on the main section of a 5¼x3x2⅛-inch Minibox. Special care when wiring is not required, other than to protect transistor Q1 and the low-power resistors from excessive heat when soldering.

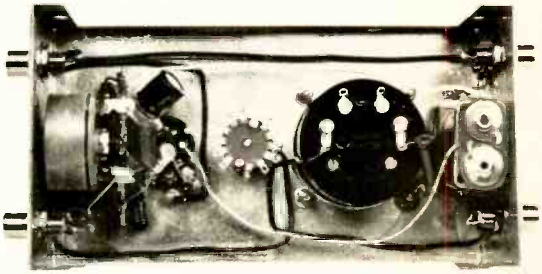
Miniature components are used throughout to prevent a parts jam at the terminal strip. The specified C1 and C2 will produce a test frequency of about 1,000 cycles. C2 consists of two .25 mf capacitors connected in parallel. We did it this way because miniature .5 mf capacitors are hard to come by. If you prefer a test tone lower than 1,000 cycles, change C2 to 1 mf and C1 to .5 mf.

Q1 can be a 2N217 or a 2N109 transistor. By using R5, which is supplied with the meter, nearly full-scale readings will be obtained at low volume levels.

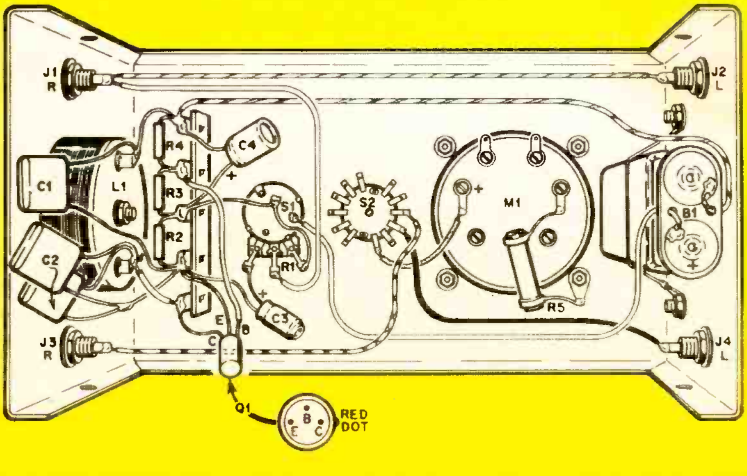
The VU meter is connected to either speaker by S2. S2, a two-circuit, five-position switch, was chosen only because of its small size and low cost. A single-pole, three-position or single-pole, center-off switch may be substituted if desired.

Battery B1 is held on the side flange of the Minibox with a piece of hookup wire passed through a solder lug positioned on both sides. To prevent B1's terminals from shorting, put a piece of tape in the Minibox's cover opposite the battery connector.

Operation. Connect the Balancer to your amplifier as shown in the block diagram. Connect J1 and J2 to the right and left utility inputs, respectively (or you may use any other input). Connect J3 to the right-speaker output terminals and J4 to the left-speaker terminals. Set the amplifier's volume controls approxi-



Connect components to terminal strip at left before mounting choke. Tape battery connector.



To save space, C2 is made up of two capacitors in parallel. Terminal-strip mounting lug, to which R2 and R3 are connected, is ground point. Unused lugs at top of meter are for built-in pilot lamps.

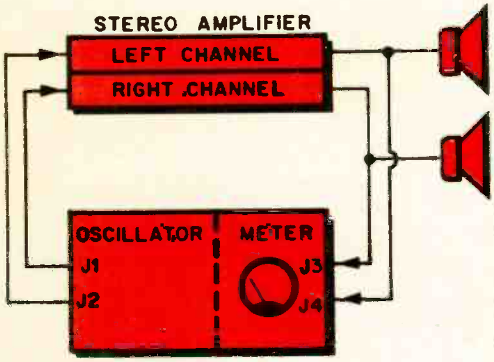
Stereo Balancer

mately to normal position and turn on the Balancer.

Set S2 to the *left* channel position and advance R1 until the meter indicates zero VU (100%). Then set S2 to the *right*-channel position and adjust the amplifier's right-channel volume control for zero VU indication. Your stereo system is now balanced (assuming your listening position is midway between the speakers).

If your normal listening position is not centered, you can program the Balancer for balanced sound where you sit.

If you sit closer to the right speaker, start with the right channel. Adjust the amplifier's right-channel volume control for a convenient meter reading—say 50%. Then set S2 to the left-channel position and have someone adjust the left-channel volume control until the sound seems (at the listening position) equal to the sound from the right speaker. The system is now balanced for off-center listening.



Block diagram shows the connections of the Balancer to inputs and outputs of stereo amplifier.

Note the meter reading of the left channel. It will be higher than 50%. From now on, whenever you want to balance the system for this listening position, just set the amplifier's controls to produce the same meter readings. This test can be programmed for any listening position in your room.

The Old Frontier

If there is a single word to describe the scene in the postwar electronics field it would have to be *progress*. Good, but less comprehensive words like *faster* and *better* and *farther* and *higher* might be runners-up.

Those of us who work in or chronicle or merely watch the goings-on have to check the superlatives bin now and again to see whether there's anything left. We talk about faster and smarter computers, fantastically stable radio circuits, amplifiers with incredible frequency response and so on. Sometimes you wonder whether you're not going to get run down by this progress business, and left for a trampled antique at the roadside. Or you're tempted to sit down and just watch it pass by.

Kindred spirits in the upcurrent, let's-rest-a-while boat should take heart from a recent experience we had on a trip to California. The Ford Motor Co. took a group west for a preview of its 1964 cars, flying us in a chartered plane out of Detroit. The big bird was a DC-6B, a slightly antiquated but still dependable airline job. While it was lumbering over the Rockies we slipped up to the flight deck, a failing we indulge in if the cabin door doesn't happen to be locked.

The three-man crew was only moderately busy and the flight engineer pointed out a few things while we glanced over the equipment.

"Nice layout," we remarked, thinking of all that automatic stuff stowed out of sight.

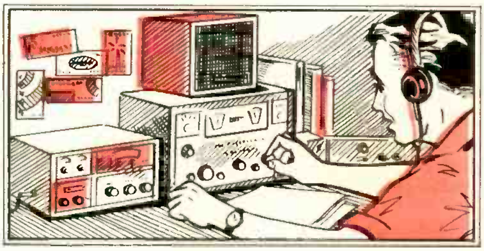
"It's handy," the flight engineer said.

[*Continued on page* 119]

notes from EI's DX CLUB

IN its more than two years of existence, EI's DX Club has been taking on new members at a fast clip. At the end of our last Award Period there were 591 short-wave listeners and DXers scattered around the world who had one of the club's certificates to display.

As those who follow EI's activities in the SWL-DX field know, the club is unique in many ways. It has no officers, no bylaws and no meetings. Its office consists of a filing cabinet full of certificate blanks, filled-out logs, 3x5 cards listing award winners and a few rubber stamps and stamp pads. Nearby are several dozen short-wave schedules, some frequency charts, reference books, official countries lists and the like. The club's financial statement would horrify a level-headed tycoon type. Since it makes no charge for awards, the club has never taken in a penny. The only finances that are familiar around the filing cabinet are printing bills and postage charges.



But whatever its monetary picture may be, we consider EI's DX Club a satisfying success. SWL and DX fans have been enthusiastic about the club, which was set up wholly for the purpose of making awards. The fact that the awards carry a special distinction of having been *earned* (even the ten-country certificates require an appreciable amount of effort) has its own appeal to knob-twirling hobbyists, it is evident. The absence of a "service charge" gives the awards a singular foundation—merit. No DXer can feel he's "buying" a certificate for the wall.

The club has become truly international in character, having members on all six continents. Included in the addresses on our 3x5 cards are Australia, the Philippines, South Korea, Sweden, England, Chile, South Africa . . . and Wolf Island.

In addition to members, we have almost-members here and there. Though we don't keep a count of those who didn't quite make it, and their names don't appear in our files with black marks beside them, the total, we'd estimate, is well over 100. A goodly number of them probably will qualify during our next Award Period—those who inadvertently showed duplications in the countries in their logs, didn't follow the rules, couldn't find their QSL cards when verification time came around or got fouled up in some other minor way. The few DXers who bluffed and got called on it may require a little more time to qualify.

During our last Award Period, the reasons most often cited for rejecting applications were: 1) failure to list complete information in the log, and, 2) duplication of countries. The first can be taken care of easily by a DXer merely by filling in all blanks in the club log. As for the second, it should be remembered that awards are made on the basis of the *number of countries* DXed—not on the number of stations.

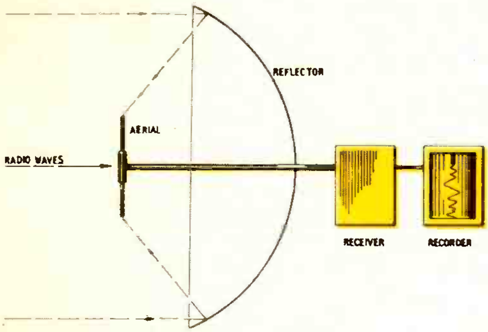
Our last Award Period opened at this time of year, being announced in the November '62 EI, but we have decided to postpone the next period a few weeks so it will coincide more closely with the peak-DX season of the year. It will be announced in the near future in EI. Meanwhile, happy listening—and keep adding those countries to your list!

GOOD READING

By Tim Cartwright

RADIO ASTRONOMY FOR AMATEURS. By Frank W. Hyde. W. W. Norton & Co., New York. 236 pages. $5

Translating the data from a radio telescope is a good step beyond deciphering Morse code, but this book should go a long way toward pulling more hobbyists into a fascinating field. The author covers basic astronomy *and* basic electronics in the one slim volume. In addition to summing up complex theory in an easy-to-read style, Mr. Hyde outlines the kinds of equipment (including build-it-yourself circuitry) that will bring worthwhile returns for a fairly small investment. Our illustration, taken from the book, shows how a radio telescope works.



YOUR CAREER IN ELECTRONICS. By Harry Edward Neal. Julian Messner, Inc., New York. 191 pages. $3.95

The latest in a series of career books by Mr. Neal, this edition is more than a cool appraisal of electronics' many branches; it's a sprightly, well-written come-on for a career *somewhere* in electronics. The author outlines the way of life (including salary) you can expect as anything from a telephone lineman to a computer programmer. If you have a kid brother whose sole ambition seems to be the acquisition of a rock-'n'-roll library, give him this book—and pray that he reads it.

HOW TO REPAIR MAJOR APPLIANCES. By Ernest Tricomi. Howard W. Sams & Bobbs-Merrill, New York & Indianapolis. 223 pages. $3.95

My local newspaper carries an ad regularly about a man who "will take on any job that no one else can handle" —which suggests that the day of the jack-of-all-trades hasn't passed. But I don't think the professional handyman will profit much from this book. Instead, I recommend it to the frustrated householder who knows what's wrong with an appliance but hasn't a notion as to how to get it working again. Although the book covers everything from air conditioners to garbage disposers, it naturally can't guarantee that you will conquer every odd job about the house. But at least it will help you carry on an intelligent discussion with your local repairman.

TUBE AND TRANSISTOR HANDBOOK. Published by De Muiderkring N.V., Bussum, The Netherlands. Distributed by Continental Dynamics, Beaumont, Tex. 504 pages. $3.75

From what I can decipher from a Dutch advertisement, De Muiderkring is a home-study institute in The Netherlands. If this handbook is a typical example of its instruction material, the school should be a fine one by any standards. The manual is printed in one multi-lingual edition, but its material is so well organized that there never is any confusion. Like other books of this kind, it concentrates on one or two standard applications per category for each tube or transistor. But unlike its contemporaries, it covers some specialized foreign types that I haven't seen listed anywhere else.

And make note of . . .

AM-FM BROADCAST OPERATIONS (Volume Two, Broadcast Engineering Notebooks). By Harold E. Ennes. Sams. 238 pages. $5.95 —◆—

Continued from page 32

release, Ravel's *Bolero,* has the worst end-of-side distortion I've heard in years (so bad that I checked several copies with top-flight pickups to make sure). And there are other faults I won't try to describe—except to say I think they're unnecessary and the result of trying for a louder disc.

I have two reasons for launching this little tirade. First, I think the Dyna*groove* itself is a big step forward and ought to be used properly. Second, I'm certain that *you* can have a big say in what Victor eventually decides to do with the new process. By all means sample a Dynagroove release for yourself. And if your ears give the same verdict as mine, let Victor know.

As things stand, Dynagroove seems to be aimed at the man with the $29.95 portable phonograph.

Meanwhile, back at the not-so-ranchy headquarters of the Record Industry Association of America, they've been doing more than argue about Dynagroove. They've been making an unpublicized decision on a big subject.

You may remember the problems we had at the beginning of the hi-fi era, when every record manufacturer turned out discs with his own pet amounts of bass cut and treble boost (if any). You had to have one or two extra knobs on a preamp to compensate for the different curves, and you even had to consult a chart to find out *which* manufacturer used *what* equalization. Then came the RIAA curve—an industry-wide equalization standard that's been applied to all records since 1955. The problem promptly disappeared, and so did those extra knobs on most preamps.

Now we seem to be on the verge of another important standard from the RIAA that you might call the RIAA Slope. For quite a while, the RIAA people have been suggesting that all stereo disc-cutters should cut grooves at a uniform vertical angle—15 degrees front-to-back (see drawing on page 32). The suggestion has just been reaffirmed.

Why? Mainly because no pickup has been able to play *all* kinds of stereo discs—cut at all sorts of vertical angles—equally well. No one has told you and me much about this angle problem, but it's been audible all along. It might well be the reason why all Oompah Records, which sound fine on your neighbor's inferior rig, have sounded terrible on yours. (He has a stylus with the right vertical rake for Oompah grooves; you don't.)

When and if the RIAA settles on a uniform cutting angle for all records, you may have to invest in a new stylus to get the right angle. But that'll be cheaper—and a lot easier on your nerves—than winding up with even a few records that don't sound right on your stereo system.

Transistors finally have begun to prove themselves in hi-fi circuitry, and it looks like there's no stopping them. One of the biggest manufacturers, Harman-Kardon, has no more vacuum-tube amplifiers on its drawing boards; it's all transistors for H-K from here on in. And now there are rumors of the first totally new idea in cartridges for a long, long time—a transistor pickup.

You may remember EI's report on Raytheon's transistor microphone, a pinhead-size gadget in which changes of pressure on a junction transistor vary a bias voltage, producing a signal flat from 1 to 200,000 cps. Well, the principle can be adapted to a phono pickup, and at least one manufacturer is hard at work.

If it reaches the market, the new pickup will be second cousin to ceramic cartridges, which also operate on the stress principle. Difference is that a semiconductor element needs a lot less pushing-around by a stylus to produce a good signal.

Who's to say that the right kind of transistor won't prove the most sensitive and accurate signal-producer ever put in a pickup? Sure, there are problems. Ironing out the kinks in a stereo version is a big one—so big that this could be another one of those "dream" products that never quite make it. But I'm not willing to bet against it right now. Are you?

Scatter

Continued from page 45

son is that the receiving antennas are directed to pick up only signals emanating from one point on the earth's surface.

Of course, this directivity also causes some problems, due to the constantly changing conditions in the troposphere and the ionosphere. If the average reflecting height changes slightly, the transmitted signal will miss the receiving antenna, causing a break in communications.

Whether scatter will replace the microwave relay completely is doubtful, since scatter requires so much more power than line-of-sight systems. But when line-of-sight stations can't be erected, or when secrecy is the order of the day, you can bet your scalp that scatter will be the answer.

In fact, scatter, rather than an orbiting satellite, someday may bring television programs direct from Europe to your living room. Imagine what Pocahontas would have said!

CB Corner

Continued from page 107

pearance may vary from one manufacturer to the next (General Cement, Walsco, etc.) here are the functions, pictured from left to right:

IF (or K-Tran) Alignment Tool. This one has a non-metallic screwdriver tip with a thick blade that exactly fits the cup cores of most IF transformers. Unlike an ordinary screwdriver, it won't destroy the delicate adjustment slot.

Recessed Blade Tool. This is needed mostly for tuning the threaded brass shafts of RF coils in both transmit and receive sections of the rig. It won't shear off the soft metal slot.

Hex Aligner. This tool engages slugs with a six-sided hole (hidden inside some IF transformers and RF coils). It also allows you to align top and bottom cores of IF's from the top of the chassis.

In other areas of a CB set other special tools are needed, but those listed here are a good start.

Choose the Right Battery

Continued from page 106

may not justify its purchase. For high-current applications, as in a model airplane's engine ignition, electric motors or such a project as the PANIC BUTTON (Nov. '61 EI), the price is compensated for by great performance.

A few words about 9-volt transistor-radio batteries. These cells have two drawbacks. First, some have low current ranges which often are exceeded in homebrew projects. Some have ranges as low as 0-8 ma. If you select a 9-volt battery for a project, make sure it can handle the required current. To help you make the best selection, we have listed the current ranges for popular 9-volt batteries in Table 2.

The second problem is the poor quality of some 9-volt batteries. Name brands like Eveready, Mallory, Burgess and RCA are dependable, as are the imported brands handled by reputable parts distributors. But there are many poorly manufactured imported batteries around for as little as 9 cents each. At this price, be suspicous and don't stock up.

Nickel-Cadmium Batteries. The Nickel-Cadmium (NC) rechargeable battery is relatively expensive but it is being used more often these days.

The NC's biggest advantages are that it can deliver high surge current at relatively constant voltage, and that it can be recharged hundreds, even thousands, of times. Where equipment gets continuously heavy use, such as in a speedlight or a walkie-talkie, the high initial price of the NC is offset by a lower energy/dollar cost. As an example, a walkie-talkie can burn up a $1.60 set of penlights every day under heavy use. Use a $25 NC, which you can *recharge* overnight, and six months later you'll still be going strong on the same set.

To sum up, remember these three rules of good battery economics: 1) Use a battery designed for the intended service. 2) Stay within the recommended current range. 3) If a battery is to be used infrequently, pick the one with the lowest price.

Continued from page 68

During the next few months ZFY's programming and political line may fluctuate drastically, depending on what pressures are put on the station at any given time. But frequencies should remain the same. This means 3255 kc in early evening (until about 2115 EST) and 5980 kc in the early mornings from approximately 0415. Ambitious DXers also might be able to log the BCB outlet on 760 kc early Monday morning. There'll be heavy Cuban QRM, but Detroit's WJR is silent at that time.

Trend Teller . . . While the subject of broadcast-band DX certainly isn't rare, one important aspect of it often is overlooked. BCB stations reflect trends in American life much more clearly than other broadcasters—TV, FM or short wave. In order to view the trends on a national level, one must, of course, receive stations from all parts of the country—DX, in other words.

Over the past few years AM radio has been swept by several trends or formulas. There was (and still is) rock 'n' roll, ranging in quality from bawling adolescences on up to legitimate folk music. But a new and possibly more representative formula has arrived. It's slightly more complex (the industry term is *adult*) than R&R but generally it follows these rules: 1) Play nothing but soft, soothing, inoffensive background music. Then listeners won't object to almost any commercial between selections, whether it be a patent medicine or real estate in Florida's Great Dismal Swamp. 2) Run regular editorials which stop just short of slander. These will provide the most publicity for the least money. If located near the border, think about breaking diplomatic relations. 3) Throw in a few public-service features, like the "Klu Klux Klan Hour." This prevents the FCC from cancelling your license (freedom of speech, you know).

You think we're kidding? Well, maybe your local broadcaster is agin progress. In which case, we only can urge you to go and DX for yourself.

CB To The Rescue

A FEW months ago, the frame houses on a quiet street in San Pedro, Calif., were slumbering out the night. Suddenly, two walls of one house fell away under the thunderous blow of a gas explosion. Almost before a crowd could gather, four young CBers had the situation under control.

Tony Cardenas, KEJ0066; Dave McTaggart, 11Q2652; Phil Stevens, KEJ2890; and Gordon West, KEJ5173, were on patrol for the new local chapter of REACT—Radio Emergency Associated Citizens Team. Each had his mobile CB rig tuned to channel 6, the emergency monitoring channel.

Within minutes of the explosion Cardenas and McTaggart were at the scene. Cardenas gave first aid to a man who was limping along the street. McTaggart, meanwhile, sent out a 10-33 which Stevens and West picked up.

Stevens was assigned the task of calling ambulances, firemen and police. West, whose car boasts four transmitters and ten receivers (see photo), stood by in case of further complications.

The incident, by no means unique, typifies the helpful contribution which Citizens Banders can make to their communities.—*David Gray*

The Beam That Does Anything

Continued from page 62

microscopes were being built with resolving powers approaching the wavelength of light. Since you can't see an object much smaller than the light ray that illuminates it, improved lenses—or greater magnification—wouldn't help.

The solution was the electron microscope. In this remarkable instrument, a beam of electrons shoots through a thin sample to be viewed. Different parts of the target absorb varying numbers of electrons. As a result, a light-and-dark pattern of electrons develops, in much the same manner that light rays form a distinctive pattern when passing through an object of varying translucence. Since the electrons aren't limited by the wavelength of light, they can see details thousands of times smaller than those seen by microscopes.

The electron beam then goes through a series of electrical lenses—magnetic or electrostatic fields—which spread the beam, just as optical lenses magnify light rays. With the electron microscope, scientists now routinely see viruses, the crystalline structure of metals and other incredibly small objects far beyond the power of standard microscopes.

There seems to be no end to the jobs that can be done by the beam. Physicists long have known, for example, that if you stir up atoms—bombard them with some kind of energy—they get excited and radiate energy of their own. Each different element generates energy at its own characteristic wavelength: iron at one wavelength, copper at another, chromium at a third and so on.

The microbeam probe makes use of this principle. It slams a beam of electrons into a sample to be analyzed, then measures the radiation given off. By studying the results, an operator can tell how much of each element is in the sample.

Art museums have found the microbeam probe especially handy for checking the authenticity of paintings. They can use a sample piece so small that you couldn't see where it came from without a magnifying glass.

A short time ago, an expert in the Boston Museum of Fine Arts suspected that a painting alleged to be 400 years old was, in fact, a phony. He chipped off a tiny sample of its paint, put it under the microbeam probe and read the results. The paint contained ingredients not in use until about 50 years ago. The painting obviously was a fraud.

One of the most ingenious electron-beam devices to come along is the thermoplastic recorder, developed a few years ago by a young General Electric scientist named Bill Glenn. As a clear thermoplastic tape slides beneath a recording head, Glenn "writes" on it with a modulated electron beam.

IBM scientists recently discovered a new way to make insulators by using the electron beam. They had noticed that the anode of an electron microscope became contaminated where the electron beam hit—probably because the beam was causing random molecules of impurities floating in the evacuated chamber to stick to the anode.

They put a metal plate under an electron beam, then introduced a controlled amount of the organic gas butadiene into the chamber. Where the beam struck the plate, it plastered on an extremely thin, uniform layer of solid butadiene. It's the thinnest, most reliable layer anybody's been able to come up with yet. Capacitors made with this insulator between their plates could have tremendously high values of capacitance in a tiny volume.

The electron beam, which is valuable enough on earth, ultimately may render one of its most unique services as a construction tool in space. When men are ready to start buliding orbiting, man-carrying space stations, they'll probably fire the station skyward in pieces, then assemble it in orbit.

For the assembly job, the electron beam will be a natural. Workers won't have to take along gas for fuel. The electron beam needs only a source of electric power. Its high-temperature operation will make the beam ideal for welding and cutting tough metals. And, best of all, there'll be no vacuum problems. Vacuum in unlimited quantity is free for the asking in space! ◆

Ultra-Sensitive Exposure Meter

Continued from page 49

wide open, full-scale deflection corresponds to an illumination level of 0.25 foot-candles).

When the window is partially open (for high-illumination levels), multiply the shutter speed by four. That is, if the dial tells you to shoot at 1/25 second, set the shutter speed on your camera to 1/100 second.

Using the meter.

- Set dial C's arrow to the ASA rating of your film.
- Point the meter at your subject at close range and note the reading on the microammeter.
- Set dial B's arrow to the number on dial A corresponding to the meter reading.
- Read the shutter speeds on dial C against the f stops on dial B. Use these shutter speeds if the meter is being used at its 0.25 foot-candle sensitivity (fully-open window). Multiply the shutter speed by four if the meter is being used at its 1-foot-candle sensitivity.

The calculator dial is calibrated for meter readings as low as 1 microampere. Since this is only half a scale division, light values in this low range must be interpreted with common sense.

Cable And Pipe Finder

Continued from page 81

C2 maintains oscillator Q1 at 798 kc, the difference frequency is 2 kc. This 2-kc signal is amplified by Q3 and fed to the phones.

When L1 is brought near metal its inductance changes, causing a change in the frequency of oscillator Q1. This lowers or raises the pitch of the tone in the phones.

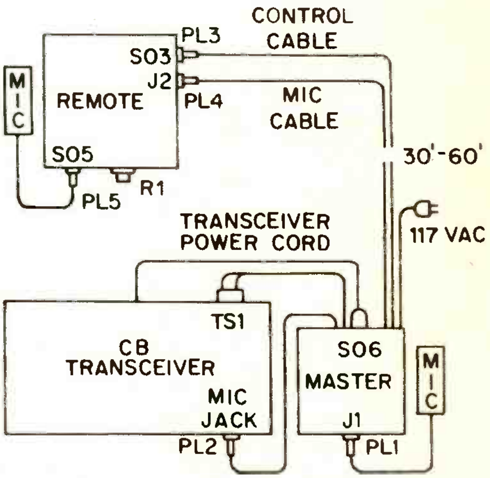
The important thing to listen for as you move L1 over the wall is a *change* in pitch—from high frequency to a lower frequency or a null. When you get this reaction, you've found your needle in a haystack.

Multi-Function Extension

Continued from page 67

depressed. It may be clipped short and forgotten.

After the units are completed, make the connection to the transceiver's speaker leads. Find the hot, or ungrounded speaker lead and connect it to B on TS1. Add a wire from A on TS1 to the free speaker lug. It's important that both terminals of TS1 be insulated from ground. If you don't want to cut the cabinet, use a spacer under the mounting screws to keep TS1 away from the cabinet.



Use this as a guide when connecting the transceiver, master control unit and remote unit. If system is removed, short TS1's terminals.

Although the system works up to 50 feet between the Master and Remote, greater distances are possible. The limitation on distance is hum that may be picked up by long mike leads. Speaker volume also drops slightly and RY1 may not pull in quickly.

You'll notice that the Remote's volume control may not kill the sound. It was intended this way so that when it is turned all the way down you'll still be warned that the Remote (and the transceiver) is still on. To further reduce volume, the resistance of R1 should be two or three times the value specified.

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El At Large

Continued from page 110

"I guess you're on automatic pilot," we guessed.

"No. *He's* flying it," the engineer said, poking a thumb at the captain.

"Oh. Will you be going back to automatic?" we dogged on, with visions of all that wonderful new electronic equipment they put in planes nowadays.

"He's our automatic pilot," our guide said.

"Huh?"

"We don't have the kind with knobs in this type of plane. Besides, *he* talks."

"Mmmm," said the captain.

We slipped quietly back to our seat.

The Latest

NOT to be outdone by less progressive industries, electronics has hatched its own versions of those Tom Swifties, which may be better than shaggy-dog stories, but not much. Our best: "You've got the wrong kind of solder," Tom said acidly.

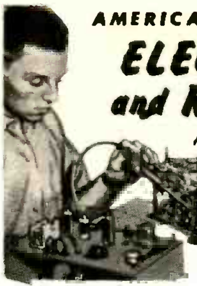
Alphabet Zoup

IF you put an IRE and an AIEE in a bottle and shake them up, what do you get? The answer, in case you ever wondered, is an IEEE.

The IRE, of course, is the Institute of Radio Engineers and AIEE is—or was—the American Institute of Electrical Engineers. There has been talk for years of merging the two societies, though few ever thought it could be done. But it happened, and now we have one king-size outfit called the Institute of Electrical and Electronics Engineers, Inc.

You could make like a badman falling off a cliff and call the new organization Ieeeee! But I-triple-E seems to be more widely accepted.

The under-fire baptism of IEEE came last spring with the big trade show here in New York—once called the IRE Show but now the IEEE Show. The affair seemed to go off smoothly and the merger's working. Surprise!—*R.G.B.*



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Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	0Z4	.79		6AU8	.87		6K6	.63		12CU5	.58
	1AX2	.62		6AV6	.41		6S4	.52		12CU6	1 06
	1B3	.79		6AW8	.90		6SA7GT	.99		12CX6	.54
	1DN5	.55		6AX4	.66		6SH7	1.02		12D4	.69
	1G3	.79		6AX5	.74		6SJ7	.88		12DE8	.83
	1J3	.79		6BA6	.50		6SK7GT	.95		12DL8	.88
	1K3	.79		6BC5	.61		6SL7GT	.84		12DQ6	1.04
	1R5	.77		6BC8	1.04		6SN7	.65		12D57	.84
	1S5	.75		6BE6	.55		6SQ7GT	.94		12DT5	.76
	1T4	.72		6BF5	.90		6T4	.99		12DT7	.79
	1U5	.65		6BF6	.44		6T8	.85		12DT8	.78
	1X2B	.82		6BG6	1.70		6U8	.83		12DW8	.89
	2AF4	.96		6BH8	.98		6V6GT	.54		12DZ6	.62
	3AL5	.46		6BJ6	.65		6W4	.61		12ED5	.62
	3AU6	.54		6BJ7	.79		6W6	.71		12EG6	.62
	3AV6	.42		6BK7	.85		6X4	.41		12EK6	.62
	3BC5	.63		6BL7	1.09		6X8	.80		12EL6	.50
	3BN6	.75		6BN6	.74		7A8	.68		12EZ6	.57
	3BU8	.78		6BQ6	1.12		7AU7	.65		12F8	.66
	3BY6	.58		6BQ7	1.00		7EY6	.75		12FA6	.79
	3BZ6	.56		6BU8	.70		7Y4	.69		12FM6	.50
	3CB6	.56		6BX7	1.11		8AU8	.90		12FR8	.97
	3CS6	.58		6BZ6	.55		8AW8	.93		12FX8	.90
	3DG4	.85		6BZ7	1.03		8BQ5	.60		12GC6	1.06
	3DK6	.60		6C4	.45		8CG7	.63		12J8	.84
	3DT6	.54		6CB6	.55		8CM7	.70		12K5	.75
	3GK5	.99		6CD6	1.51		8CN7	.97		12L6	.73
	3Q4	.63		6CG7	.61		8CS7	.74		12SF7	.69
	3S4	.75		6CG8	.80		8EB8	.94		12SK7GT	.95
	3V4	.63		6CL8	.79		8FQ7	.56		125L7	.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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Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	5AQ5	.54		6CU5	.58		12AE6	.50		17AX4	.67
	5AT8	.83		6CU6	1.08		12AE7	.94		17DQ6	1.06
	5BK7	.86		6CY5	.70		12AF3	.73		18FW6	.49
	5BQ7	1.01		6CY7	.71		12AF6	.67		18FX6	.53
	5BR8	.83		6DA4	.68		12AJ6	.62		18FY6	.50
	5CG8	.81		6DE6	.61		12AL5	.47		19AU4	.87
	5CL8	.76		6DG6	.62		12AL8	.95		19BG6	1.39
	5CQ8	.84		6DJ8	1.21		12AQ5	.60		19EA8	.79
	5EA8	.80		6DK6	.59		12AT6	.50		19T8	.85
	5EU8	.80		6DN6	1.55		12AT7	.76		21EX6	1.49
	5J6	.72		6DQ6	1.10		12AU6	.51		25AX4	.70
	5T8	.86		6DT5	.81		12AU7	.61		25C5	.53
	5U4	.60		6DT6	.53		12AV6	.41		25CA5	.59
	5U8	.84		6DT8	.94		12AV7	.82		25CD6	1.52
	5V6	.56		6EA8	.79		12AX4	.67		25CU6	1.11
	5X8	.82		6EB5	.73		12AX7	.63		25DN6	1.42
	5Y3	.46		6EB8	.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
	6AG5	.70		6EV5	.75		12BE6	.53		35C5	.51
	6AH4	.81		6EW6	.57		12BF6	.60		35L6	.60
	6AH6	1.10		6EY6	.75		12BH7	.77		35W4	.42
	6AK5	.95		6FG7	.69		12BK5	1.00		35Z5	.60
	6AL5	.47		6FV8	.79		12BL6	.56		36AM3	.36
	6AM8	.78		6GH8	.80		12BQ6	1.16		50B5	.69
	6AQ5	.53		6GK5	.61		12BR7	.74		50C5	.53
	6AS5	.60		6GK6	.79		12BV7	.76		50EH5	.55
	6AT6	.49		6GN8	.94		12BY7	.77		50L6	.61
	6AT8	.86		6H6	.58		12BZ7	.86		70L7	.97
	6AU4	.85		6J5GT	.51		12CN5	.56		117Z3	.85
	6AU6	.52		6J6	.71		12CR6	.67		807	.75

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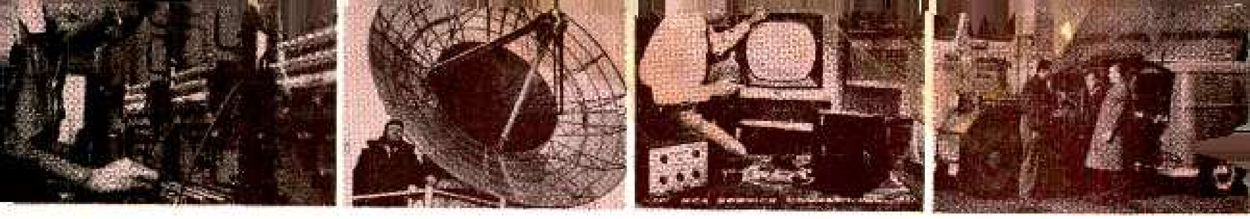

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