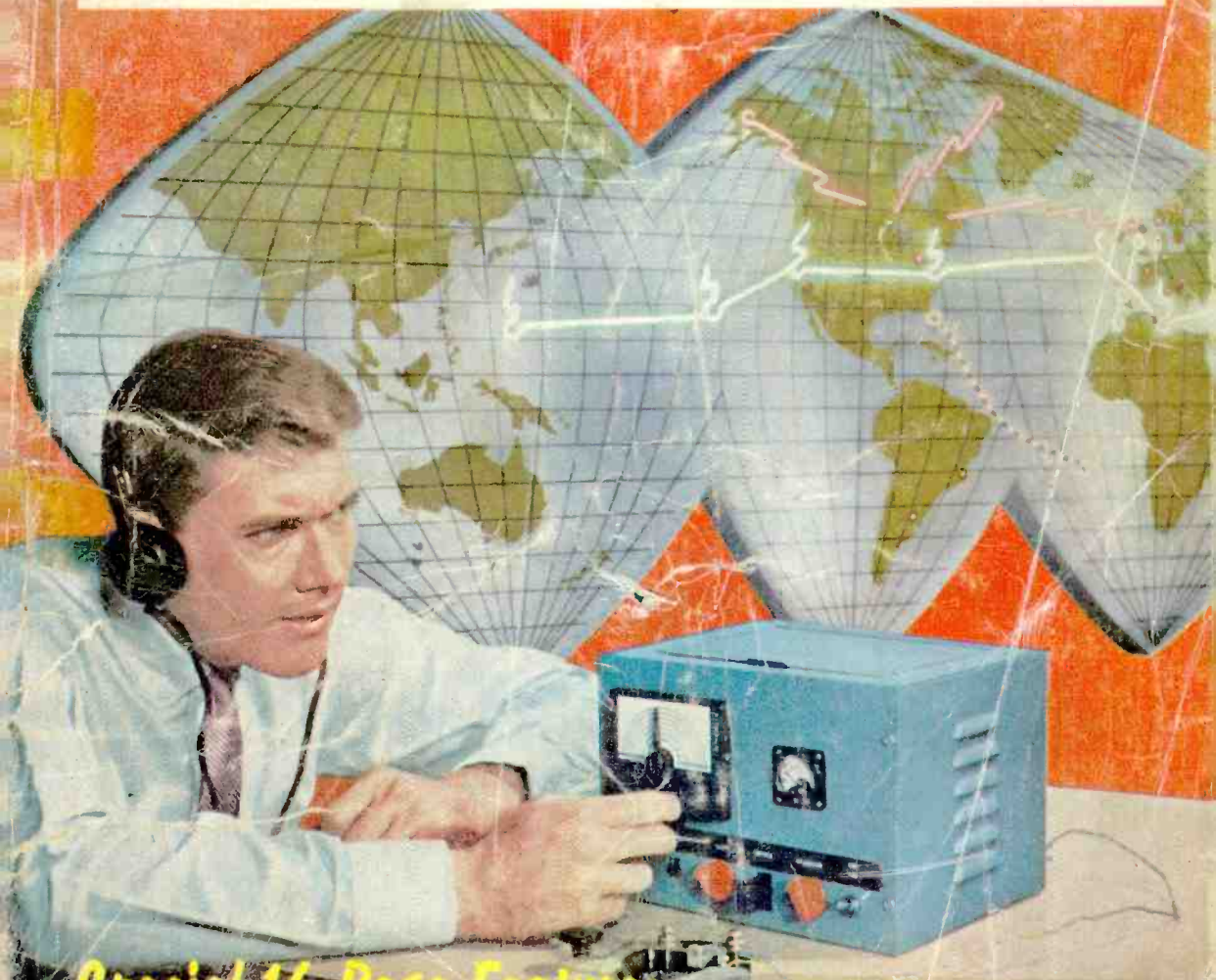
ALL ABOUT ELECTRONIC FRAUDS

SEPTEMBER • 35 CENTS

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

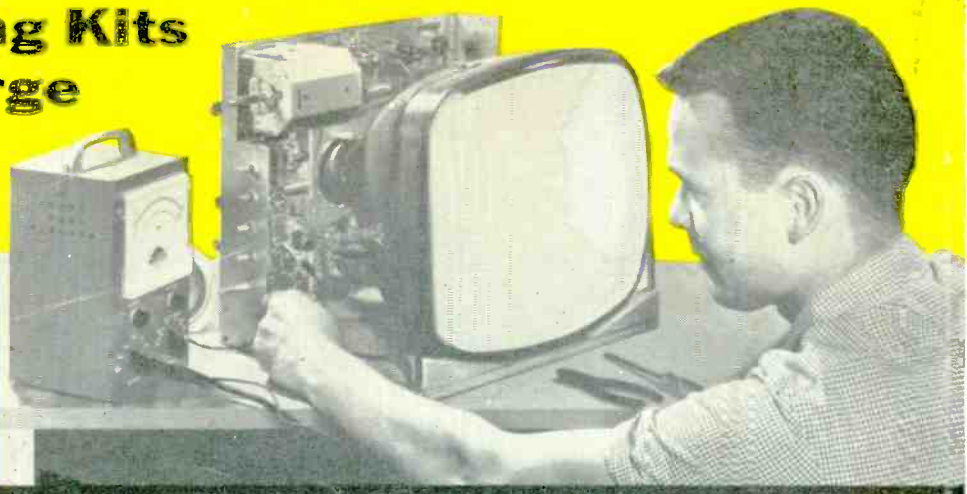


Special 16 Page Feature:

How to Build This Complete Ham Station

Training Kits
ra Charge

nd depend on the
r ever before. New
are increasing the
Radio-Television-
ns. Right in your
pare time, you can
lop skills needed to
vast industry. You
get NRI kits de-
give actual practice
part of your NRI
all parts including
the 17" Television
vacuum tube Volt-
ght. You use this
adio-TV-Electronic
, experiments. All
keep.



START AND A BRIGHT FUTURE
ONICS Radio Television
SPARE TIME

You Can Start Soon Earning Extra Money in Spare Time

any NRI students find it easy and profitable to fix
ts for friends and neighbors starting a few months
ter enrolling. Use the Tester built with parts NRI
rnishes to locate and correct Radio-TV receiver
oubles. Picking up $10, $15 and more a week gives
bstantial extra spending money. Many who start
spare time soon build full time Radio-Television
les and service businesses, enjoy prestige, respect
d satisfaction in this fast growing industry.

Benefit by NRI Experience—Oldest, Largest Home Study Electronic Radio TV School

RI's more than 40 years experience training men
r success—the outstanding record and reputation
this school—benefits you in many ways. NRI
ethods are tested, proven. Successful graduates are
erywhere, in small towns and big cities. Here is
investment that pays big profits soon. Each week,
vest only a few hours spare time in yourself—
reparing to be a Radio-TV-Electronics Technician.
vest in training to get ahead. NRI can provide the
aining you need.

NRI Offers the Tested Way to Better Pay

echnical know-how brings better pay, fast advance-
ent. Radio-TV-Electronic opportunities are great,
d are increasing. NRI has devoted over 40 years
developing simplified, practical training methods.
ailing the card at left can be one of the most
important acts of your life. Do it now.
Reasonable tuition. Low monthly pay-
ments available. Let us send you 64-page
Catalog—FREE. Address: NATIONAL
RADIO INSTITUTE, Dept. OJK, Wash-
ington 16, D. C.

. E. Smith
Founder

Broadcasting offers satisfying careers. Hundreds of Radio and Television stations on the air offer interesting jobs for Operators and Technicians. Police, Aviation, Two-Way Communications are expanding. Men with Radio-TV training are in demand.

A solid, proven field of opportunity for good pay is servicing the millions of Radio and TV sets now in use. Government, military, guided missile manufacturers industry . . . all need Technicians. Color TV, Hi-Fi are increasing the opportunities.

National Radio Institute
Washington 16, D. C. Est. 1914

men 17-55

JOB OPPORTUNITIES! EXCITEMENT! MONEY!

All this can be Yours as a trained

Electronics TECHNICIAN

OVER 6,000 FIRMS HAVE EMPLOYED DeVRY TECH GRADUATES!

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

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

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

HOW DeVRY TECH CAN "BLUEPRINT" YOUR CAREER!

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

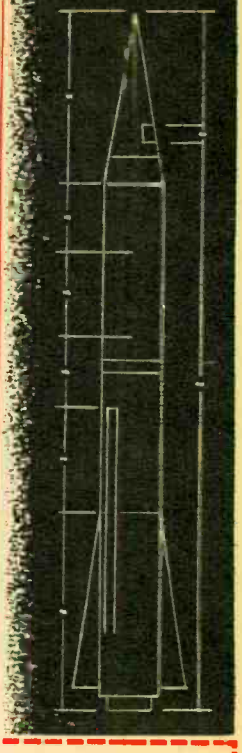
NO ADVANCED EDUCATION NEEDED!

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

EFFECTIVE EMPLOYMENT SERVICE

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

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



2 FREE BOOKLETS Send Coupon TODAY!

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

Accredited Member of National Home Study Council

DeVRY TECHNICAL INSTITUTE
CHICAGO • TORONTO

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill., Dept. EI-7-Q

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

Name_____ Age_____
PLEASE PRINT
Street_____ Apt._____
City_____ Zone_____ State_____
☐ Check here if you face military service.

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

◀ See Page 22 for the BEST BUYS in CITIZENS TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS.

don't be taken by

Electronic FRAUD

You can't keep a good con man down. Electronics offers sterling opportunities for the rising crook.

By E. M. Delman

ALTHOUGH the greatest "electronic" frauds of all—rigged TV quiz shows—are common knowledge, there are at least a dozen forms of true electronic frauds that are rarely brought to the attention of the general public and hardly talked about by the more knowledgeable, such as the readers of *Electronics Illustrated*. Over the years, millions of people have lost millions of dollars. And in the case of fake medical electronic equipment, many thousands of Americans may have lost their health, years of life, or life itself!

Despite the efforts of many governmental and private organizations, reputable electronic companies, the elec-

Experimental Transformerless Transistor Audio Amplifier

By Donald L. Stoner, W6TNS

TEXTBOOKS tell us that transistors are low impedance devices. The wide-awake reader might wonder to himself "Why not use a transistor to drive a loudspeaker directly?" Wouldn't this eliminate the output transformer, and its poor frequency response?" The logic is good, but this "thinking man" has overlooked one point. The operation of a loudspeaker depends on the current passing through it. In other words, when the current passes in one direction the cone moves in, and when the current reverses the cone moves out. If we were to connect the speaker directly to the transistor, the collector current would hold the cone in some position other than the correct one. This is the main reason transformers are used between a transistor and loudspeaker.

But our "thinking man" won't give up the idea. He reasons, "Why not connect two transistors to the speaker? One would draw current

build this

Test Bench Control Panel

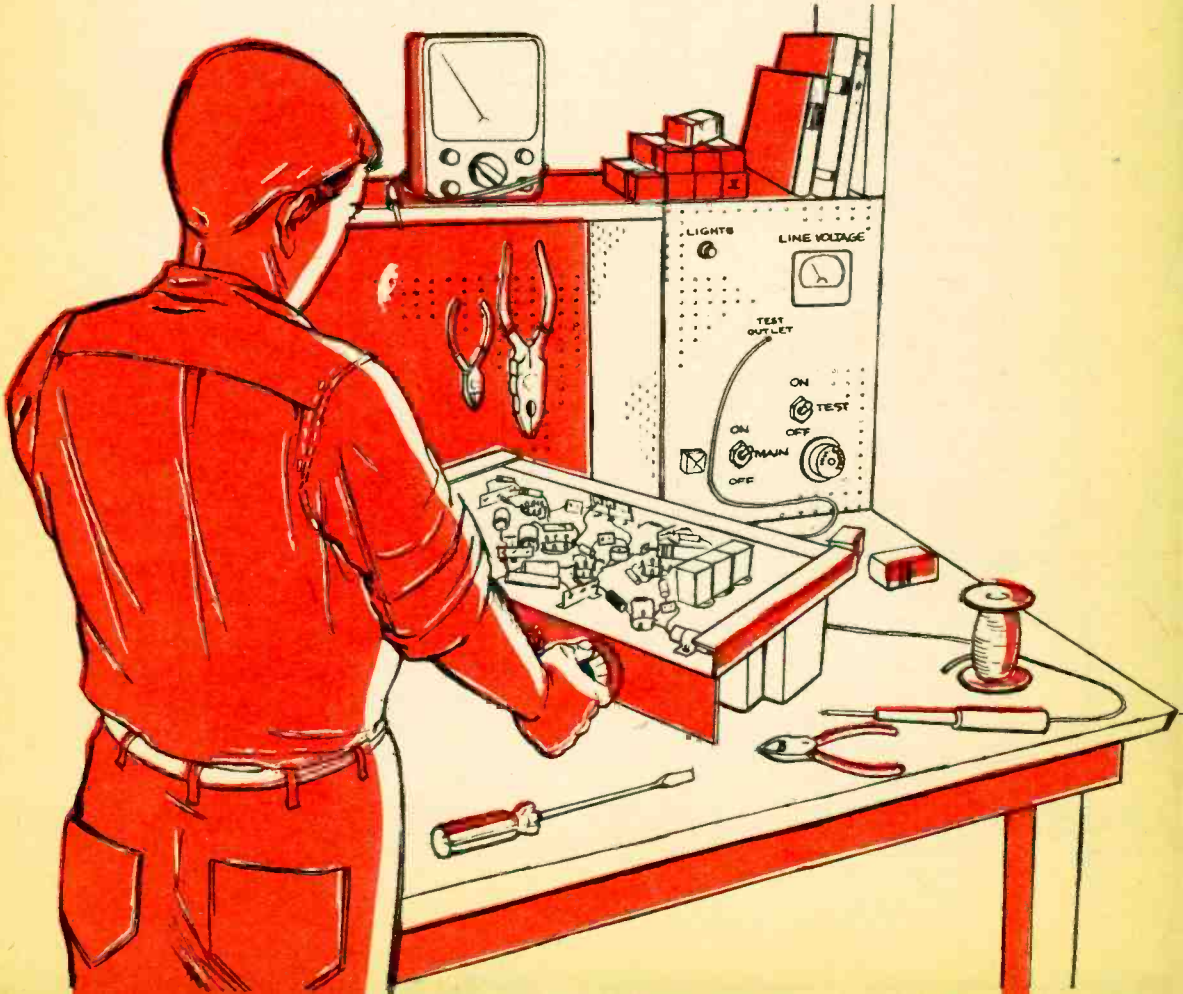
to speed up your testing and troubleshooting.

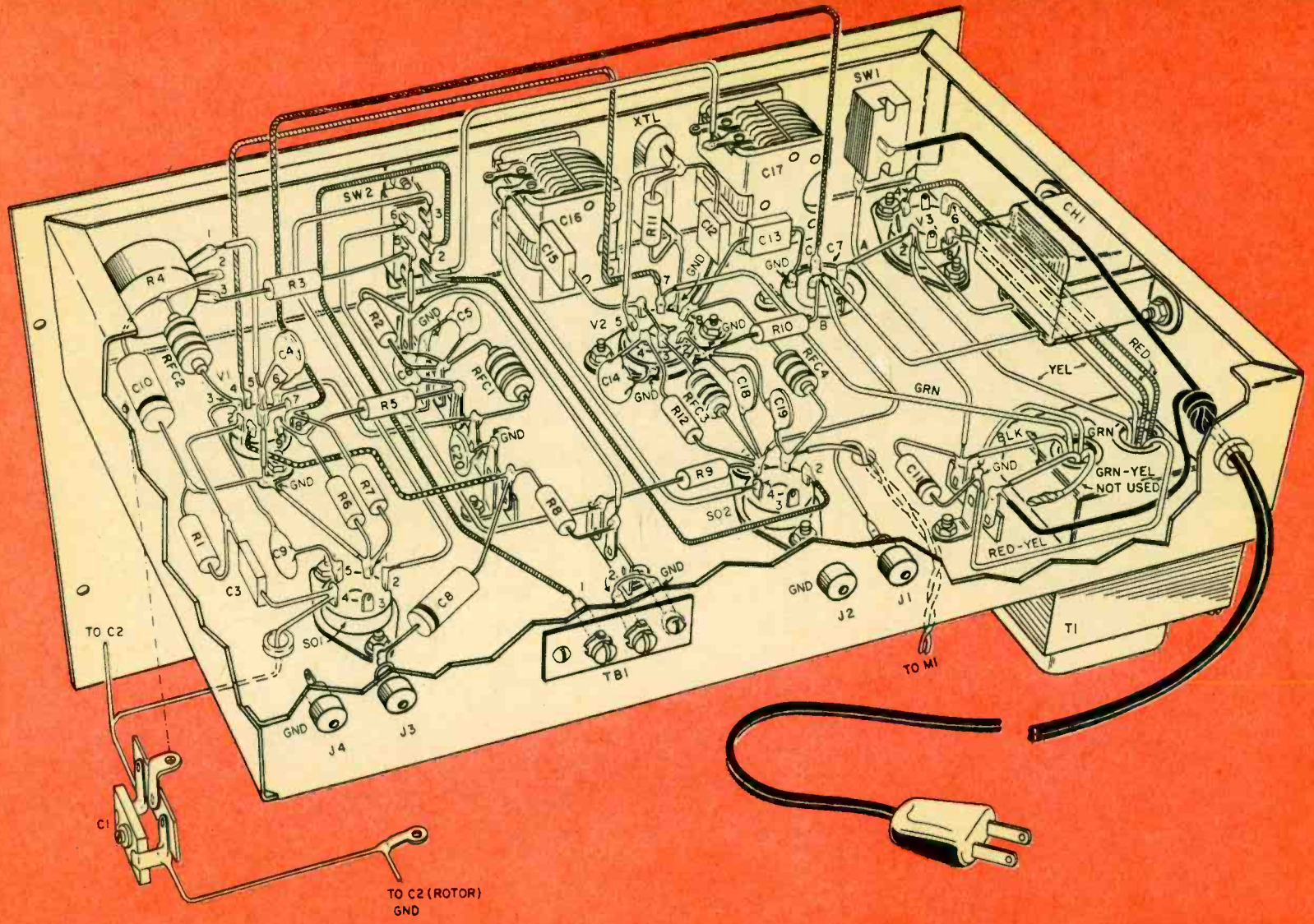
By Matt Johnson

A CLOSE friend has dropped in with a PA amplifier he wants repaired in time for a big dance Saturday night. The complaint is that it blows its fuse about 5 seconds after it's turned on—but doesn't show a short to an ohmmeter. In other words, it tests okay when off, but turn it on and it blows a fuse before you can get your test leads into it.

Or you've just completed wiring an amplifier chassis. After all the usual "cold" checks, you plug it in, flip the switch and . . . S-s-s-st-pow! A B-plus short practically melted your rectifier tube and then blew the fuse.

What's the answer to these problems? Why not build yourself a test panel which will not only automatically tell you whether or not you have a short, but even help you troubleshoot




SW1
XTL
SW2
CH1
C17
C16
C15
C13
C7
R11
C12
R4
R3
R2
C5
C4
RFC2
C10
V1
R5
RFC1
C20
R6
R7
R1
C3
C9
SO1
C8
R8
V2
C14
RFC3
R12
R10
RFC4
C18
C19
R9
SO2
V3
GRN
YEL
RED
BLK
GRN
GRN-YEL
NOT USED
RED-YEL
C11
GND
TB1
J1
J2
J3
J4
T1
TO C2
TO M1
C1
TO C2 (ROTOR)
GND

men 17-55

JOB OPPORTUNITIES! EXCITEMENT! MONEY!

All this can be Yours as a trained

Electronics TECHNICIAN

OVER 6,000 FIRMS HAVE EMPLOYED DeVRY TECH GRADUATES!

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

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

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

HOW DeVRY TECH CAN "BLUEPRINT" YOUR CAREER!

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

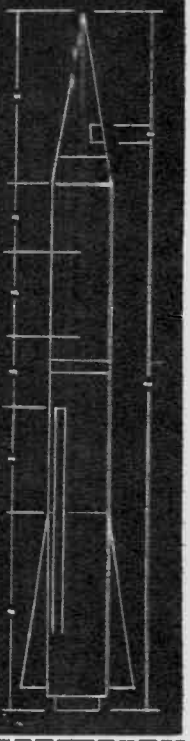
NO ADVANCED EDUCATION NEEDED!

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

EFFECTIVE EMPLOYMENT SERVICE

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

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



2 FREE BOOKLETS Send Coupon TODAY!

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

Accredited Member of National Home Study Council

DeVRY TECHNICAL INSTITUTE

CHICAGO • TORONTO

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill., Dept. EI-7-Q

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

Name_____ Age_____
PLEASE PRINT

Street_____ Apt._____

City_____ Zone_____ State_____

☐ Check here if you face military service.

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

Science Fair Winners

El's DIGITAL COMPUTER was the project of two regional science fair winners and finalists at the last National Science Fair. They are Lynn P. Kovarik, 16 (top photo) of Bishop Karaga Central High School, Marquette, Minnesota, and James Seay Brown, Jr., of Cookeville Central High School, Cookeville, Tennessee. Notice the different layout and wiring approaches used by the two boys in their breadboard versions. The circuitry is the same in both units. (The original by Ronald Benrey, in our January, 1960 issue, was built in a metal cabinet.) We applaud Lynn and Jim for taking on the challenge of this computer and for the individuality and skill they have shown. We hope they will go far in science or engineering if they choose careers in these fields. May their example inspire others.

NOW! at a price you can afford!

MAKE MORE MONEY in TELEVISION RADIO-ELECTRONICS

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

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

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

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

These two FREE books will show you how!

You get all information by mail . . . You make your own decision . . . at home! NO SALESMAN WILL CALL

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

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

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

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

EARN AS YOU LEARN. We'll show you how to earn extra money right from the start. Many of our students pay for their course—and more—while studying. So can you!

LESSONS AND INSTRUCTION MATERIAL ARE UP-TO-DATE, PRACTICAL, INTERESTING. Every National Schools Shop-Method lesson is made easy to understand by numerous illustrations and diagrams. All instruction material has been developed and tested in our own Resident School Shops, Laboratories and Studios.

SEND FOR INFORMATION TODAY . . . it can mean the difference between SUCCESS and failure for you! Send for your FREE BOOK "Your Future in Television-Radio-Electronics" and FREE Sample Lesson. Do it TODAY, while you are thinking about your future. It doesn't cost you anything to investigate!

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shop, Labs and Radio-TV Studios. Here you work with latest Electronic equipment . . professionally installed . . finest, most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school . . and part time job while you learn. Check box in coupon for full information.

GET THE BENEFITS OF OUR OVER 50 YEARS EXPERIENCE

Approved for GI Training

MEMBER

NATIONAL TECHNICAL SCHOOLS
Los Angeles 37, Calif.

YOU GET...

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

SHOP-METHOD HOME TRAINING COVERS ALL PHASES OF INDUSTRY

1. Television, including Color TV
2. Radio AM & FM
3. Electronics for Guided Missiles
4. Sound Recording and Hi-Fidelity
5. FCC License
6. Automation and Computers
7. Radar & Micro-Waves
8. Broadcasting and Communications

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

MAIL NOW TO

NATIONAL TECHNICAL SCHOOLS, Dept. R4Y-80
4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ AGE _____

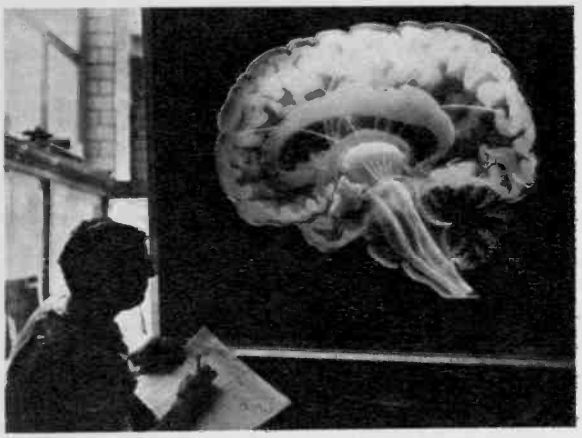
ADDRESS _____

CITY _____ ZONE _____ STATE _____

☐ Check if interested ONLY in Resident School training at Los Angeles.

VETERANS: Give date of Discharge _____

. . . electronics in the news



A GIANT BRAIN MODEL, made of 20 layers of transparent plastic, was developed by Dr. Harold E. Himwich for a recent medical exhibition. It demonstrates the lesser-known effects of tranquilizers and barbiturates on the brain..... A separate "electronic brain" keys hidden lights which illuminate and color parts of model while a recorded narrative describes the effects of each drug under consideration. The electronic unit was designed by Dr. Herbert M. Teager of MIT. A grant from Wallace Laboratories, a pharmaceutical firm, made the whole project possible. More than 90 changes in the plastic display are cued by control tones on the narrative recording.....

• • • • •

A ROOM IN SPACE is what we might call this anechoic chamber at Republic Aviation's electronics laboratory on Long Island. Aircraft and space vehicle antenna patterns can be tested here without reflections or "echoes" from ground or nearby objects to falsify the results. Walls of room are lined with radio-wave absorbing materials, and calculated bulges also minimize any reflections. No signal can enter from the outside. Antennas or models are rotated in a radio beam, while automatic instruments outside the room measure and record the pickup and radiation patterns.

• • • • •

WILL YOU PICK UP THE FIRST COSMIC CQ? Dr. Ronald N. Bracewell of Stanford University says radio amateurs and others should listen for possible messages from intelligent beings of planets outside our own solar system, elsewhere in the Milky Way Galaxy. Shown here with radiotelescopes he designed, Bracewell cites opinion of many astronomers that there could be intelligent communities on planets circling other stars in our galaxy. They may be probing the universe with radio signals, as our scientists will do in project OZMA. Some say an alien radio satellite may already be circling our Sun.....

BUILD 20 RADIO CIRCUITS AT HOME

with the New

PROGRESSIVE RADIO "EDU-KIT" ®

Reg. U.S. Pat. Off.

only **$26.95**

A Practical Home Radio Course

Now Includes

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ School Inquiries Invited
- ★ Sold in 79 Countries

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

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

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

SERVICING LESSONS

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

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

FROM OUR MAIL BAG

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95

☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.

☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 528AE, Hewlett, N. Y.

. . . News

Women have been recognized as a special and important problem for the high fidelity components industry. An "electronic curtain" seems to keep women from buying high fidelity sets in component form, and of course the American wife must be considered for any big family investment. Women, the industry realizes, see components as strictly a gadgeteer's approach, in a class with hot rods or the basement workshop. They prefer to buy a one-piece unit that they recognize as *furniture* which holds no technical terrors. H. T. Harwood, advertising director of Shure Brothers, Inc., urges component-makers to emulate the automobile industry, stress beauty (of sound and components), prestige, enhanced pleasure and convenience.

—o—

American Electronics Co. announces a new crystal-controlled 2-Meter Converter kit, in addition to its 6-Meter Converter kit already on the market. Using three miniature tubes on a 2" x 2½" x 5" chassis, the unit can be installed inside a receiver. The low power requirements can be taken from the receiver or from a companion power supply kit, Model PS-1, available separately. The converter's two RF amplifiers include a high gain, low-noise input stage. Crystal is supplied with unit to deliver IF output at 7-11 mc or 14-18 mc, to match any short wave receiver. Price: kit, $23.95; wired, $33.95; from American Electronics Co., 178 Herricks Rd., Mineola, N. Y. Write to manufacturer for more detailed specs.

—o—

A new, low-priced, high-impedance dynamic microphone, expressly designed for mobile and industrial use, has been introduced by Lafayette Radio. The PA-77 is designed for application in CB and amateur mobile gear. Small sized (3" x 1¾" x 1"), it has a send-receive switch. Price: $5.95, from Lafayette, 165-08 Liberty Ave., Jamaica 33, N. Y.

F.C.C. COMMERCIAL OPERATOR LICENSE

Training... *for* **Jobs** *in* **Electronics**

F.C.C. LICENSE—THE KEY TO BETTER JOBS

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

WHICH LICENSE FOR WHICH JOB?

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

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

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

GRANTHAM TRAINING PREPARES YOU

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

CORRESPONDENCE OR RESIDENCE CLASSES

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

HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Richard M. Wilhoit, 2104 Santa Paula, Las Vegas, Nev.	1st	12
Larry R. Perrine, 7 Normandy Place, Champaign, Ill.	1st	15
Marion Woolsey, 3246 Warwick, Kansas City, Mo.	1st	12
Harold W. Johnson, 5070 Hermosa Ave., Los Angeles, Calif.	1st	15
Ralph Frederick Beisner, 2126 Grand, Joplin, Mo.	1st	12
N. B. Mills, II, 110 So. Race St., Statesville, N.C.	1st	12
Dean A. Darling, 403 S. Chase Ave., Columbus 4, Ohio	1st	12
Gerald L. Chopp, 518 Audubon Road, Kohler, Wisc.	1st	12

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

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

Grantham School OF ELECTRONICS

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

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

MAIL COUPON NOW

To: **GRANTHAM SCHOOL OF ELECTRONICS**

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

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

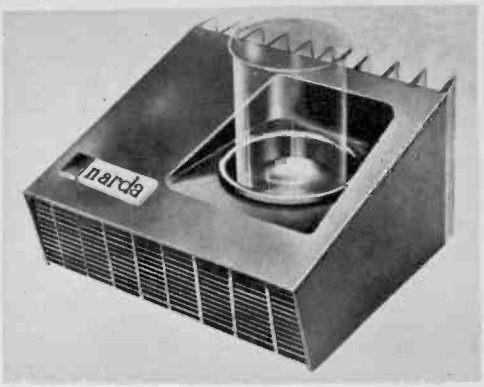
Name_____ Age_____

Address_____

City_____ State_____

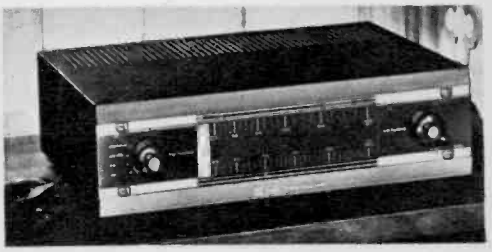
I am interested in: ☐ Home Study, ☐ Resident Classes 08-P

. . . News



A new transistorized, compact ultrasonic cleaner, made to sell for under $100 has been released by Narda. The UniBlast, unveiled at the IRE show in New York is for the consumer market. It cleans by transmitting sound waves at 40,000 cps which creates and collapses myriads of tiny vacuum bubbles in a cleaning solution and these literally blast all foreign matter from the item being cleaned. However, this action does not harm the most fragile of articles. Complete information about this ultrasonic cleaner is available from Narda Ultrasonics Corporation, 625 Main Street, Westbury, Long Island.

—o—



A new Knight-Kit FM-AM tuner has been put on the hi-fi market. It features completely independent FM and AM sections, in fact, may be purchased as an FM-only kit adding the AM section separately. Space is provided for a multiplex adapter unit. Price of the FM tuner kit (Stock No. 83 YX 732) is $68.50 and the AM section purchased separately is $21.50. Complete specs available from Allied, 100 N. Western Avenue, Chicago 80, Illinois.

. . . News

A portable Citizens Band test set, combining many functions in one unit, was announced by Seco Electronics, Inc. The Model 500 checks fundamental and third-overtone crystals, provides tone-modulated or blank RF carrier for receiver adjustment, acts as a transmitter field strength meter and modulation monitor. Price: $29.95 from Seco, 5015 Penn Ave., Minneapolis, Minn.

—o—

Snap-on speaker grilles in different furniture styles to accommodate the decorating taste of the purchaser are featured with the "Medallion XII" speaker systems by University. Available in Modern, French Provincial, Early American, Italian Provincial and Swedish Modern, prices for the "Select-A-Style" frames range from $9.95 to $14.95 depending on style, finish, and wood. The "Medallion XII" itself, less grille, is $139.95, and uses a 12" woofer, 8" mid-range speaker, and University's "Spheri-con" tweeter. Technical details are available from University Loudspeaker Corp., 80 S. Kensico Ave., White Plains, N. Y.

—o—

The greatest users of two-way land radio, next to police departments, are the nation's electric and gas utilities. More than 125,000 transmitters are now in use in this field.

Here's The Offer No Other Radio-TV School DARES MAKE!

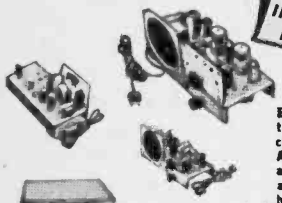
LEARN AT HOME in Spare Time!

YOU DO MANY PRACTICAL JOBS with the kits we send you. That's right, you PRACTICE what we TEACH! You build a Signal Generator, AC-DC Power Pack, and AC-DC Superheterodyne Radio Receiver and top quality 21 Inch TV Set. EARN AS YOU LEARN with the famous RTS 30 Day Income Plan. Full instructions provided. NO HIGH SCHOOL DIPLOMA NECESSARY. This is a COMPLETE course which starts with basic subjects and gradually advances to Radio-TV. . . . ALL FOR A PRICE YOU CAN AFFORD!

*THE ONLY VERTICAL MULTI-CHASSIS 21" TV KIT OFFERED BY ANY RADIO-TV SCHOOL

YOU BUILD THESE AND OTHER UNITS!

COMPLETE COLOR TV INSTRUCTION INCLUDED!

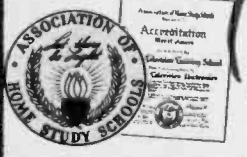


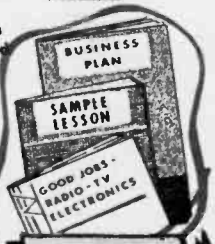
MULTITESTER KIT INCLUDED!

*Tubes Excluded

Each student is entitled to unlimited consultation service. All questions are answered promptly and completely by highly specialized instructors.

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





RADIO-TELEVISION TRAINING SCHOOL
815 EAST ROSECRANS AVENUE
LOS ANGELES 59 CALIFORNIA
L 101D Est. 1922

Rush Coupon for FREE FACTS!

RTS Will Train You at a Price You Can Afford and When You Are a Qualified Graduate Will Help You Open a Service Shop of Your Own and Supply You With Every Bit of Equipment You Need to Get Started - Plus an Inventory of Parts and Necessary Supplies.

ALL FINANCED WITHOUT INTEREST OR CARRYING CHARGES!!

You Also Receive . . . Advertising Help and Material, Shop Plans, Business Systems, Letterheads, Calling Cards and Much More!

Here's What Two of Many Business Plan Shop Owners Have to Say!

This business takes in between $1500 and $2000 a month. I've had to hire help to keep up with it.
CULLEN W. IRBY
Corpus Christi, Texas

The school lives up to its promises 100%. RTS does not lose interest in its students once they graduate.
HAROLD R. STANLAKE
Perry, Michigan

DON'T LOSE OUT — *FIND OUT!*

RADIO TELEVISION TRAINING SCHOOL, Dept. E1-960
815 EAST ROSECRANS AVE · LOS ANGELES 59 CALIF.
Rush me full information by return mail. (Please Print)

NAME _____ AGE _____

STREET _____

CITY _____ ZONE _____ STATE _____

NO SALESMAN WILL CALL ON YOU!

. . .News

New Parts and Gadgets

Nothing is safe from electronics. Fish that are wise to dry-fly and lure now have to contend with the "**Beetle Bomb,**" a transistor fish caller said to imitate the chirping of insects, arouse the "inborn curiosity" of fresh- and salt-water fish. $14.95 from Turner Sales Co., 1729 S. Henderson St., Fort Worth, Texas. . . . New subminiature **selenium diodes,** designed for a wide range of application from computers to hearing aids and electrical games, have been developed by Radio Receptor Co. (Selenium Division). Besides low cost, the eight new types feature working voltages up to 400. None of the diodes is larger than an aspirin tablet. Address inquiries to Dept. ED, Radio Receptor Co. (Selenium Division), 240 Wythe Ave., Brooklyn, N. Y. . . . A "do-it-yourself kit" for electronics manufacturers was announced by RCA. Called a **Micromodule Laboratory Kit,** it would enable engineers to design and build micromodules and electronic circuits with several hundred thousand parts per cubic foot, for space probes and satellites, small digital computers, missile guidance systems, miniaturized communications equipment, etc. The "Kit" is available for less than $8000. Essentially, a micromodule is a series of razor-thin ceramic wafers, a third of an inch on a side, with tiny capacitors, resistors, diodes and even transistors applied on them. These are assembled in a "riser wire" cage and encapsulated in plastic. The "Kit" enables the engineer to modify the tiny parts to suit his design needs.

—o—

Eight new TV antennas which combine the major elements of two of its best-known designs are being marketed by JFD Electronics. The eight are the company's "Hi-Fi Fireball" series, containing 9 to 24 working elements for ranges of from 50 to 125 miles. Price range: from $15 to $45. JFD, 6101 16th Ave., Brooklyn, New York.

IMPORTANT: For the man who wants to make big money in Radio-Television!

ONLY SPRAYBERRY TRAINING IN RADIO and TELEVISION

OFFERS YOU ALL OF THESE VITAL NEW ADVANTAGES TO HELP YOU EARN MORE MONEY FROM THE START!

NEW BUSINESS BUILDERS

...through these practical proven plans and ideas we help you make plenty of extra money in spare time while training.

NEW TRAINING EQUIPMENT

...the famous Sprayberry Training kits have been newly engineered by our staff to offer you the latest in Radio-TV Service Techniques!

NEW TRANSISTOR COURSE

...literally millions of new transistor radios are being used. We show you how to make money fixing them!

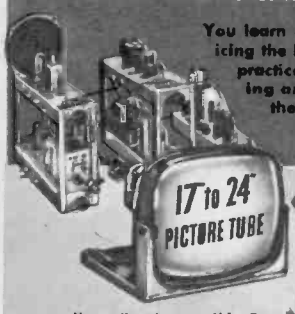
NEW HIGH FIDELITY

...there's big money to be made installing and servicing Hi-Fi units. Your Sprayberry training now offers you this valuable and profitable preparation!

TRAIN AT HOME—SPARE TIME

WITH THESE **25 BIG COMPLETE KITS of PARTS & EQUIPMENT**

You learn Radio-TV Servicing the best way...the practical way...testing and assembling these modern kits of equipment.



The new Sprayberry Training Television Receiver, built and tested in 5 sections.

Now offered . . . this fine modern oscilloscope.

You build this powerful two-band superheterodyne radio receiver.

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

FREE These two big new books are yours free! Find out what Radio-Television offers you . . . and let us show you how easily you can learn, even without previous experience of any kind. Rush COUPON today!

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
Dept. 120-P, 1512 West Jarvis Ave., Chicago 26, Ill.

The field of Radio-Television Servicing is such a fast moving industry that the best jobs and biggest incomes always go first to the man with the most modern, complete and up-to-date training. Thanks to constant revision and improvement . . . Sprayberry Training helps you earn more from the start . . . and keeps you earning more in the months and years ahead!

Make no mistake! All radio-television training is *not* alike. The basic purpose behind Sprayberry Training is to prepare you as rapidly and as surely as possible . . . to make top money servicing Radio and Television sets and equipment. This is where the big money has been for years . . . and will continue to be in the years ahead.

It's important for you to know that for over 30 years . . . Sprayberry Training has been preparing ambitious men for success in this interesting and profitable kind of work. Our school has helped hundreds to qualify for the best jobs . . . or to get started in profitable businesses of their own. Today our student rolls are the largest in our school's history . . . because the need and demand for Radio-Television Service Technicians has never been more urgent.

Just $6.00 Starts You

To encourage more men to enter Radio-Television at once . . . to help fill the great need for trained men . . . we're making it easier than ever before to start training. Just $6.00 enrolls you. This liberal offer is naturally limited. Get the facts now and consider enrollment while these favorable terms are available to you.

KEEP YOUR JOB ... *while learning*

Under the Sprayberry Plan you train entirely at home in spare time. You combine the most modern lesson training with fascinating and invaluable practical work with 25 big kits of parts and equipment that we supply. You get the equivalent of years of shop practice . . . and you can train as fast or as slowly as you wish. We help you make excellent spare time money while learning . . . and everything you receive—lessons, books, manuals, equipment—all yours to keep!

This is the Radio-Television industry's most modern and up-to-the-minute training. Sprayberry is the *one* school that gives you personalized attention and takes a real interest in your progress. Remember . . . just $6 starts you! Mail the coupon today. Let the facts speak for themselves. Let us send you our new catalog and sample lesson . . . and *prove* the kind of opportunity that Sprayberry training can open up for you.

MAIL COUPON - No Salesman Will Call

SPRAYBERRY ACADEMY OF RADIO-TELEVISION

. . .News

Hams-to-be will be interested in **EICO**'s transistor code-oscillator kit with built-in 3″ speaker. A headphone jack is provided for "private" practice, as well as a "temporary" key on the front panel. Tone is continuously variable between 500 and 2000 cycles. Front panel has terminals for external key. Price: $8.95 for the kit; $12.95 wired. 33-00 Northern Blvd., Long Island City, N. Y.

—o—

Hi-fi and stereo addicts have a new concept and gadget to enthuse about: the "reverb." Used originally in Hammond Organs, it is now included in console hi-fi and stereo sets made by Zenith and Philco, to give "concert-hall reverberation" to musical material, whether stereo or mono. Essentially, the reverb is a spring, with an extra amplifier at one end. The set's main amplifier feeds the spring some of its sound output. There is a time delay before the sound can reach the extra amplifier at the other end. (Of course, stereo requires two springs, two extra amplifiers, to cover both channels.) The output of main and extra amplifiers is combined in the speaker system (s) to give sound-with-an-echo, as is found naturally in concert halls. This adds to the expense of equipment, but not prohibitively.

want to double your pay?

Move Ahead in ELECTRONICS

Get All 3 Free!

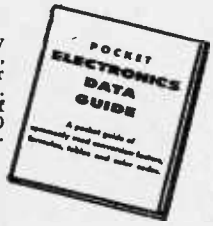
FIND OUT how we guarantee your FCC license

The Master Course in Electronics will provide you with the mental tools of the electronics technician and prepare you for a First Class FCC license (Commercial) with a radar endorsement. When you successfully complete the Master Course, if you fail to pass the FCC examination, you will receive a full refund of all tuition payments.

GET THIS HANDY POCKET ELECTRONICS DATA GUIDE

Free...

Puts all the commonly used conversion factors, formulas, tables, and color codes at your fingertips. Yours absolutely free if you mail the coupon in 30 days. No further obligation!



TO GET THIS FREE GIFT, MAIL COUPON Within 30 Days!

FIND OUT how the FCC license helps you get a better job or increase your pay on your present job

MAIL COUPON TODAY

Cleveland Institute Announces an EXCLUSIVE Technician Training Program in Computers, Servo Mechanisms Magnetic Amplifiers, and others

Other advanced fields covered include Basic Math, A. C. Circuit Analysis, Pulse Circuitry, Color TV, Radar, Advanced Measuring Techniques, Industrial Electronics, Instrumentation, Automation, Radio Telemetry. Send for information today.

Accredited by the National Home Study Council

Cleveland Institute of Electronics

Cleveland Institute of Electronics
Desk EI-24, 4900 Euclid Avenue, Cleveland 3, Ohio

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

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

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

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

Address .....

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

EI-24

. . . News

New Books and Booklets

"Electronics for the Beginner" by Jay Stanley teaches electronics by having the neophyte tackle construction projects that get progressively more complex. After a few simple ones are built and working, Stanley takes the reader back to them to study schematics. No tubes are used in any project: the reader practically cuts his teeth on transistors. $3.95 from Howard Sams, 2201 East 46th Street, Indianapolis, Ind. . . . Gernsback's **"Fundamentals of Semiconductors"** discusses theory, development, functions and potentialities of diodes, transistors, rectifiers, thermistors, masers, etc. $2.95 from 154 E. 14th St., N. Y. 11, N. Y. . . . **Supreme Publications** offers a free booklet describing its "1960 Television Servicing Manual." Also, Supreme's 1960 master index to its radio and TV manuals is available at 25¢. 1760 Balsam Road, Highland Park, Illinois. . . . **RCA's** booklet on photosensitive devices and cathode ray tubes can be had from RCA Electron Tube Division, Harrison, New Jersey. . . . Heard-in-the-locker-room jokes and cartoons are in **Precision Equipment Co.'s** new Laugh Book, 4401 N. Ravenswood Ave., Chicago, Ill. . . . **Hi-Fi Equipment catalogs are** available from EICO, 33-00 Northern Blvd., L. I. City, N. Y.; Harman-Kardon, Inc., 520 Main Street, Westbury, N. Y.; and Kierulff Sound, 1127 Wilshire Blvd., Los Angeles, Calif. . . . Amperex Electric Corp., 230 Duffy Ave., Hicksville, N. Y., is offering a new **semiconductor** catalog . . . **Test equipment** and panel meters are listed in Precision Apparatus Co.'s Reference Catalog. 70-31 84th St., Glendale, N. Y. . . . **Tung-Sol Tips** covers all phases of theory and practice encountered in servicing non-entertainment electronic equipment. Free subscription, 1 Summer Ave., Newark 4, N. J.

—o—

The Voice of America may be heard more loudly and clearly throughout the world because of six new 250,000 watt transmitters being built by G. E.

get a real head start in work you like!

choose
qualify
know
...before
enlistment

It's up to you! The Army's new "Choose-it-Yourself" System lets you choose your vocational training before you enlist! Here's how it works:

1. CHOOSE... before enlistment! Choose your training from fields like Metal Working, Electronics, Motor Maintenance, Guided Missiles, Radar & TV Repair—and many more.

2. QUALIFY... before enlistment! Next you take aptitude and physical examinations to qualify for the training you've chosen.

3. KNOW... before enlistment! If you qualify, you know you'll get the training you like. Your choice is written into your future Army record—guaranteed before you enlist.

AND THERE'S NO OBLIGATION! Choose, qualify and know—without the slightest obligation to enlist. You get the Army training you like—guaranteed in writing—or you don't enlist! This week, see your Army recruiter and choose from his complete list of available fields.

CHOOSE IT YOURSELF VOCATIONAL TRAINING SYSTEM

US ARMY

◀ See Page 22 for the BEST BUYS in CITIZENS TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS.

don't be taken by

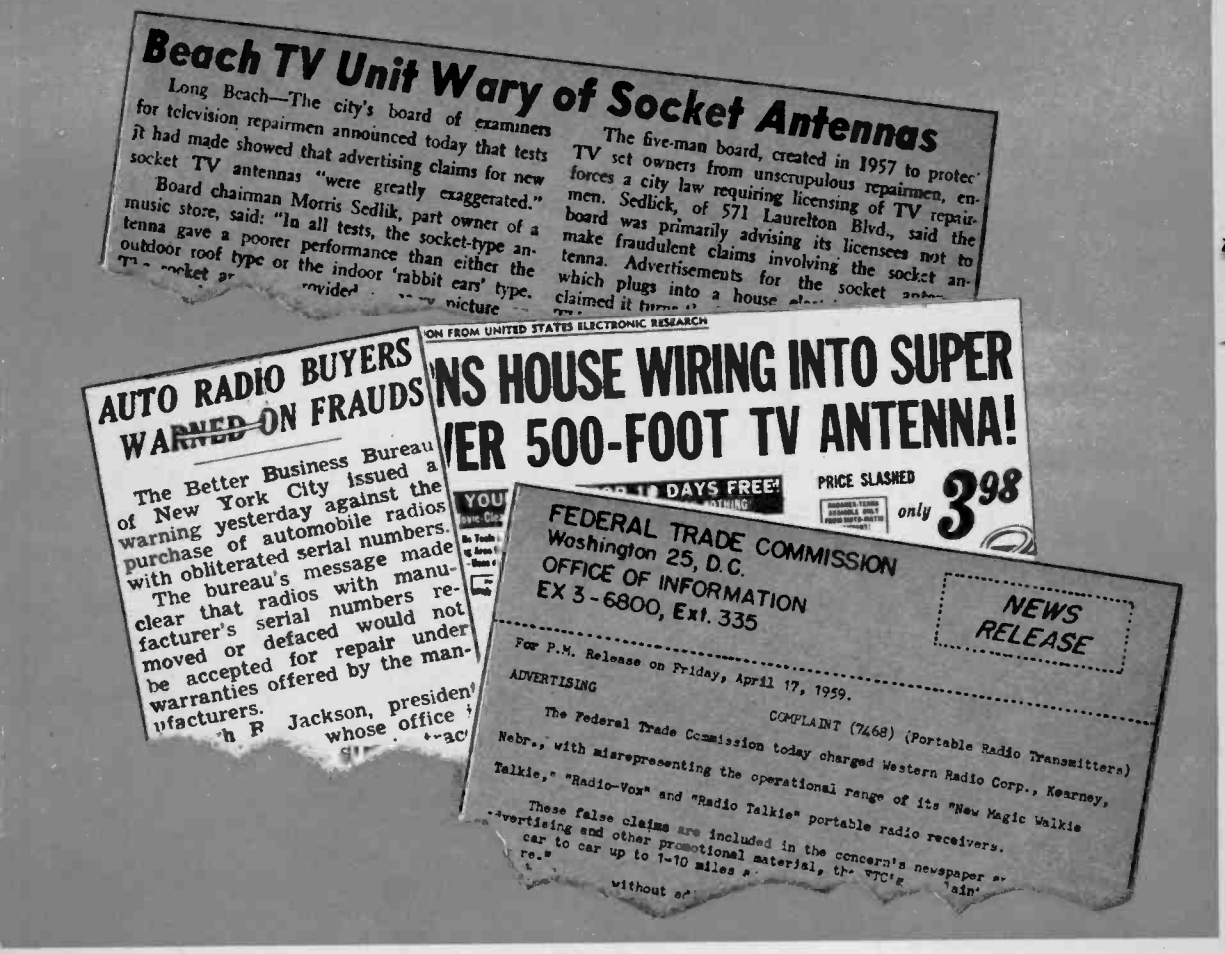
Electronic FRAUD

You can't keep a good con man down. Electronics offers sterling opportunities for the rising crook.

By E. M. Delman

ALTHOUGH the greatest "electronic" frauds of all—rigged TV quiz shows—are common knowledge, there are at least a dozen forms of true electronic frauds that are rarely brought to the attention of the general public and hardly talked about by the more knowledgeable, such as the readers of *Electronics Illustrated.* Over the years, millions of people have lost millions of dollars. And in the case of fake medical electronic equipment, many thousands of Americans may have lost their health, years of life, or life itself!

Despite the efforts of many governmental and private organizations, reputable electronic companies, the elec-



The battle never ends. The same old swindles keep cropping up in spite of publicity and law.

tronics press, and the police, the billions spent on electronics and the general lack of knowledge of electronics by customers act as magnets attracting new crooks and inspiring con men to concoct new frauds.

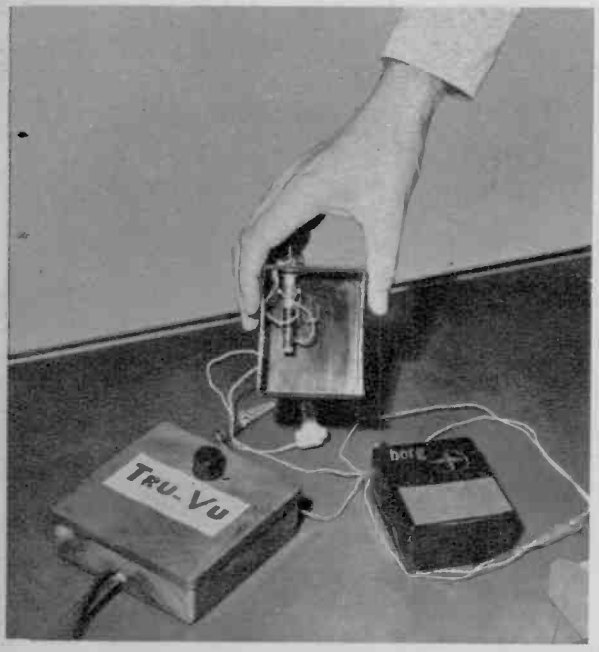
To gain the knowledge to protect yourself, your family, and your friends against the phonies and deceivers, you must first become familiar with the current frauds. Someone with a flexible set of morals is sure to try them or a variation again:

- Radios and even transmitters featuring "sensational" performance for "amazingly" low prices such as $1.98, $3.98, or $7.98. Although some of these sets may actually contain one or two transistors, which is enough to give minimal performance in strong signal areas, most are just plain old crystal sets. They are usually sold only by mail, because you would never buy one following a salesman's demonstration, assuming that he could ever get one to work!
- Color TV "converters" for about five dollars. Anyone with the faintest knowledge of electronics would know that you can't convert a black-and-white TV set to color for five dollars. Nevertheless, thousands of suckers shelled out up to five dollars apiece for a couple of pennies worth of plastic film daubed with paint. If you hold these flimsy sheets in front of an ordinary incandescent bulb, they turn the bulb into a "color TV set" too.
- Tube-tester "routes." Taking advantage of an unfortunate loss of con-

SEVEN POINT BUYING GUIDE FOR CONSUMERS
(As compiled by the Attorney General of the State of New York)

1. Don't be misled by the dealer who lures you to his establishment with an advertisement of a standard brand item and then tries to talk you into a higher priced off-brand article. Be wary of the story that he is all out of the advertised item, or that there will be a long wait for delivery, or that what he is now trying to sell you is better than the advertised item.
2. Don't be blinded by "bargains" offered at prices which are hard to believe. Check prices of the same quality merchandise or service offered by other dealers and make sure that the advertised article is what it is claimed to be. Such phrases as "reduced from," "made to sell for" and the like should act as a warning signal to you to check further.
3. Don't be rushed into buying anything by talk of a "golden opportunity" or "last chance to get in on a good thing." Take your time, investigate, and make up your own mind.
4. Don't allow a door-to-door salesman to leave merchandise with you on an "approval receipt" until he returns. He may not come back and you will find yourself with a bill for an article which you do not want. Always ask for the door-to-door salesman's credentials. If he hasn't any, don't let him in the door.
5. Don't accept an oral guarantee. Get it in writing. Make sure that you understand what it says and that it protects you fully. Be sure that installations of appliances and TV sets are guaranteed by the dealer, because a manufacturer may claim that a product's warranty has been voided if it has not been installed properly.
6. Don't sign a contract without reading it carefully . . . especially the fine print. Insist that all details of the sale be in writing. NEVER SIGN A BLANK CONTRACT OR A CONTRACT WITH BLANK SPACES IN IT. Demand and get a copy of the contract. Check with a lawyer if you don't understand it.
7. Don't hesitate to investigate before buying. If you have any doubt about a dealer or a mail-order ad, check with the local district attorney, Better Business Bureau, Chamber of Commerce, or other community organization which works to protect the consumer and the legitimate business man.

Hand holds "pocket radio," a crystal set with simple circuit. TV "socket antenna" on table is potential shock hazard, practically useless.



Our pretty girl can smile, but sick people who put faith and money into fakes like this "blood iron magnetizer" had nothing to smile about.

Detectives seizing fraudulent diagnosis-and-treatment machine. Treatment "rays" turn out to be colored light, or do not exist at all.

fidence in the nation's TV servicemen and of dissatisfaction with the high cost of TV repairs, many companies are now manufacturing do-it-yourself tube-testing machines. They are usually installed in drugstores and supermarkets. The great majority of companies distributing these machines are perfectly honest. However, some phonies have been charged by the Federal Trade Commission with making exaggerated claims as to the earning power of these machines: that servicing a string of them will make profits of "$10,000 a year and more for only a few hours work a week." If the business were that good, distributors wouldn't cut strangers in on the deal.

● Phony TV antennas. One of the country's outstanding mail order operators, Charles Torelli, bilked the public for $117,000 worth of these worthless gadgets. Doing business as Moto-Matic Company of New York, he palmed off thousands of the "Radarex-Tenna" at $3.98, with a special "Duotronic Plus" model going for a dollar more.

Consisting of nothing more than a length of lead wire, two electric plugs and a "capacitator" (Torelli's spelling), the contraption allegedly converted all the electric wiring in your home into an "antenna longer than the antenna atop the Empire State Building."

As you know, TV is transmitted at fairly short wavelengths, and this *rules out* long antennas, even if this gadget could convert your household wiring into a "500-foot super power television antenna."

On the basis of a court judgment, Attorney General Louis J. Lefkowitz of New York State is holding $10,000 of Torelli's funds to insure that he refunds the purchase price to anyone who sends a Radarex-Tenna back to the Moto-Matic Company at 350 Fifth Ave., New York 1, N. Y.

In March, 1959, the Post Office issued fraud complaints against Thoresen, Ltd., another Torelli enterprise, for selling a pocket-portable radio which was supposed to work "indefinitely." As a result of the complaint, sale of this miraculous device has stopped.

Two of the slipperiest operators in this and other frauds are David L. Ratke and Monroe Caine. Their arrest in New York about a year ago for making untrue and misleading advertising statements about their Borg-Johnson "germanium diode" pocket radio didn't scare them off at all. A few months later they were selling a phony spark intensifier for cars called the "Turbo-Jet Converter." But the authorities dragged the two and their partners before a Federal Court in Detroit and secured indictment on eleven counts of mail fraud.

● Medical [*Continued on page* 112]

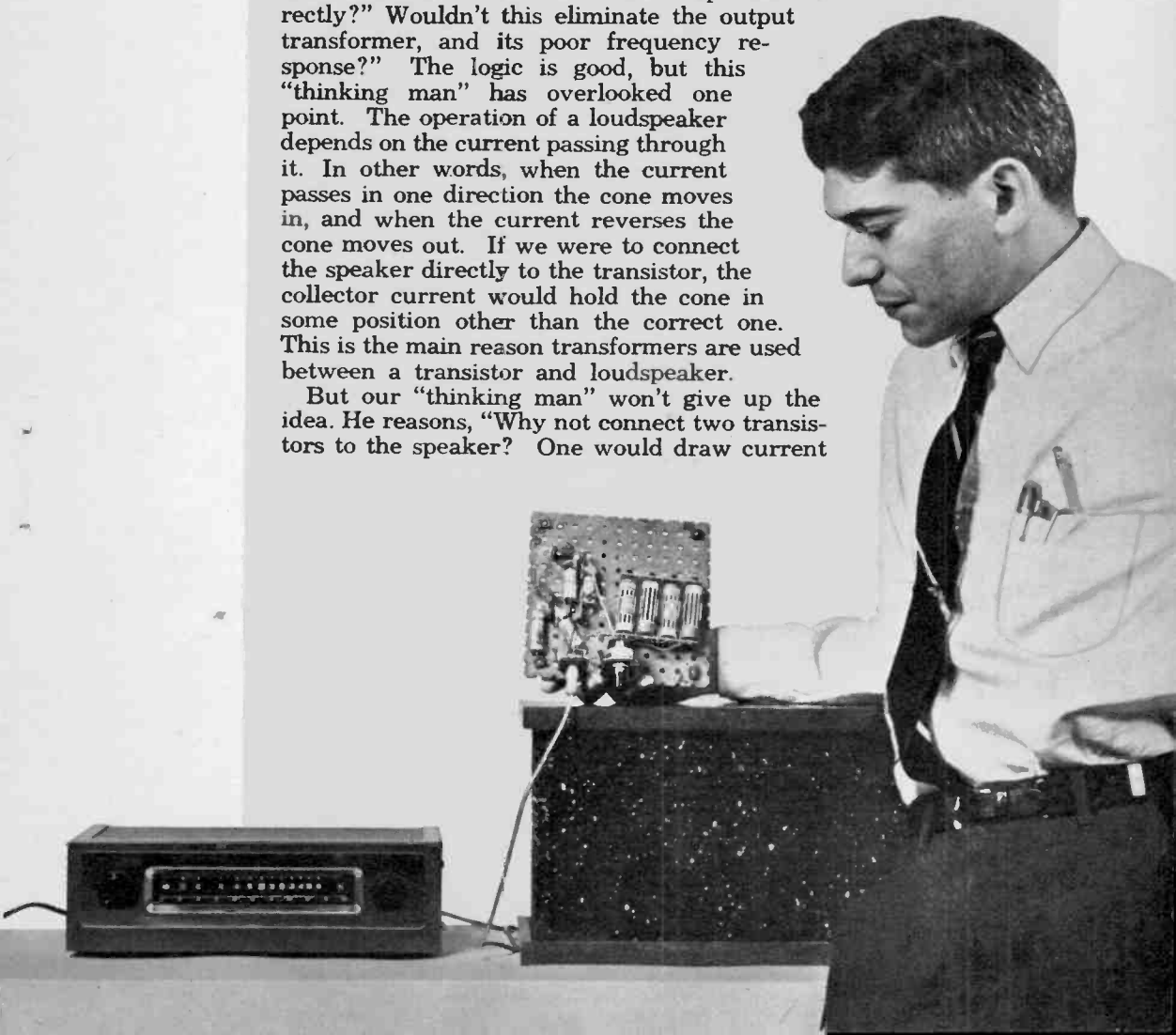
Girl lying on "health board" tries several "cures" at once. Machines don't really do anything so she is perfectly safe, though bored.

Experimental Transformerless Transistor Audio Amplifier

By Donald L. Stoner, W6TNS

TEXTBOOKS tell us that transistors are low impedance devices. The wide-awake reader might wonder to himself "Why not use a transistor to drive a loudspeaker directly?" Wouldn't this eliminate the output transformer, and its poor frequency response?" The logic is good, but this "thinking man" has overlooked one point. The operation of a loudspeaker depends on the current passing through it. In other words, when the current passes in one direction the cone moves in, and when the current reverses the cone moves out. If we were to connect the speaker directly to the transistor, the collector current would hold the cone in some position other than the correct one. This is the main reason transformers are used between a transistor and loudspeaker.

But our "thinking man" won't give up the idea. He reasons, "Why not connect two transistors to the speaker? One would draw current



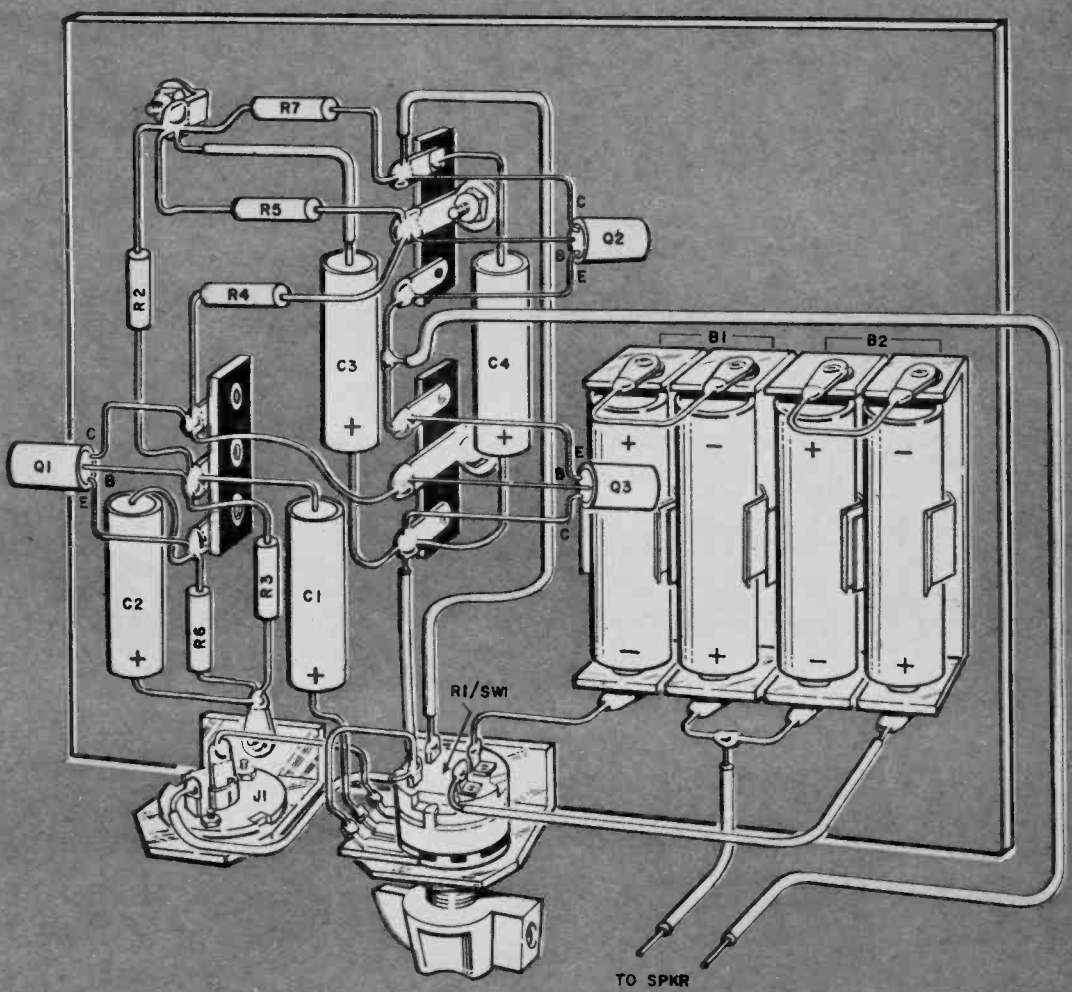
through the speaker coil in one direction, while the other would oppose it. If the two transistors were balanced, the net current through the speaker would be zero."

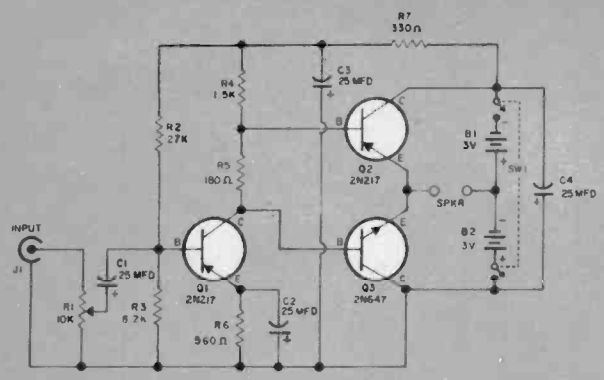
The above thoughts may have gone through the mind of the person who invented the *complementary symmetry* amplifier circuit. This ten-dollar name simply means that two transistors in identical circuits (symmetrical) work together (complement) to drive a loudspeaker. Such a circuit is shown in the schematic. In the output stage an NPN (Q3, 2N647) and a PNP (Q2, 2N217) transistor are connected directly to the speaker.

If we could follow the current around in the PNP stage we would find it flows *away* from the emitter, through the speaker and B1, and back to the collector of the 2N217. In the NPN stage the current passes from collector to B2, through the speaker, and flows *toward* the transistor emitter. Thus the currents oppose each other in the speaker coil, and the cone rests in its normal position until audio is applied to the amplifier.

This clever circuit also eliminates the need for an interstage transformer.

Any layout desired can be used. Unit may be constructed on flat board as shown or small cabinet.





PARTS LIST

Resistors—½ watt, 10%
R1—10K potentiometer (audio taper) with DPST switch SW1
R2—27,000 ohms
R3—8200 ohms
R4—1500 ohms
R5—180 ohms
R6—560 ohms
R7—330 ohms

Capacitors
C1,C2,C3,C4—25 mfd, 25 volt miniature electrolytics

Transistors
Q1,Q2—2N217 (RCA)
Q3—2N647 (RCA)

B1,B2—1.5 volt "AA" cells (4)
SW1—DPST switch mounted on rear of R1

Three transistors are used in a special amplifier circuit that has no vacuum tube equivalent. Two sets of batteries are connected in series to provide power.

When a tuner or phonograph is connected to the input (J1), the electrical impulses are amplified by transistor Q1. The amplified audio looks like a series of cycles when it appears across the load resistors R4 and R5. The negative half cycles make the PNP transistor draw more current and the NPN draw less. The positive half cycles make the NPN increase current while the PNP decreases. During either half cycle the balanced current in the speaker coil is upset and the cone moves back and forth and you hear the reproduced sound.

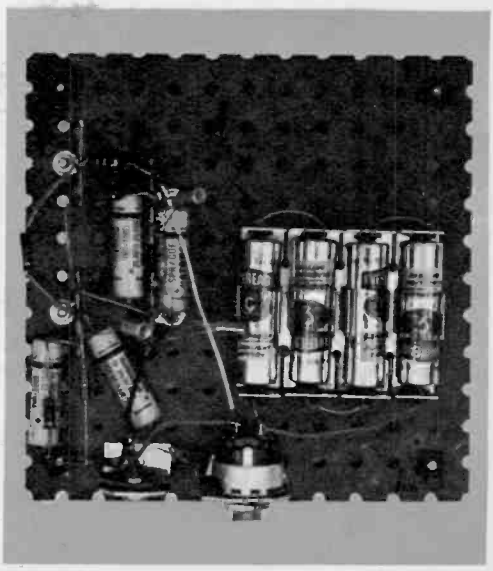
When you stop to think about it, this amplifier is really amazing! There is no such thing as an NPN or PNP vacuum tube, thus the complementary symmetry amplifier can *only* be constructed with transistors.

Now that your gray cells have been stretched to the breaking point, relax and construct the amplifier. You can build it up in an hour or so on a piece of "peg board" about 6" square.

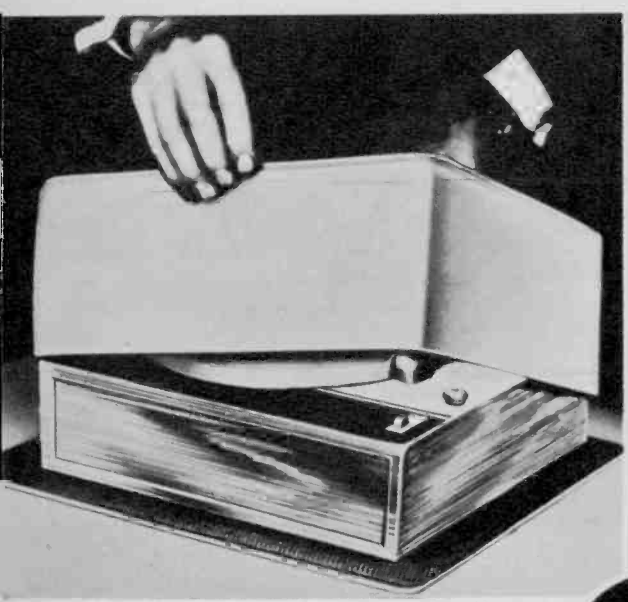
Before turning on the switch, check to make sure that the batteries are in correctly. The negative end should connect to the collector of Q2 through SW1.

Connect an audio source (phonograph, tuner, audio oscillator, etc.) to input jack J1 and hook up the speaker. Turn up the volume control and listen to the transformerless amplifier perform. Don't expect the volume to shatter your ear drums or even drive you out of the room. This little "peanut whistle" only puts out 100 milliwatts (0.1 watts) and therefore doesn't sound off as loudly as a vacuum tube amplifier. However, even with 0.1 watts, you will find the volume is more than adequate for most applications.

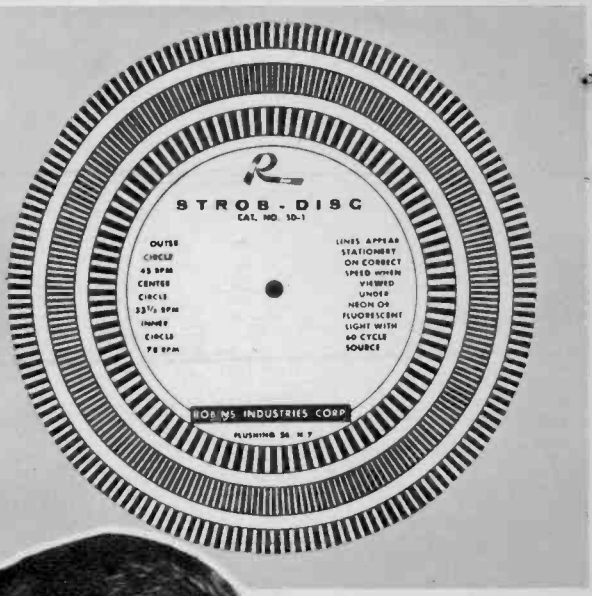
All the necessary components are easily mounted on a six-inch square pegboard with bolts. The switch-potentiometer R1/SW1 and jack J1 are mounted on L-brackets.



A turntable cover, like this Audiotex product, protects both record and player from dust. This increases record life, keeps sound good.



Stroboscope disc for checking turntable speed. Used with 60-cycle light source (like fluorescent lamp) disc permits adjustment.



Author uses hand microscope on stylus. Inspection should be frequent as worn stylus can ruin records before ear detects damage.

get the most out of hi-fi with

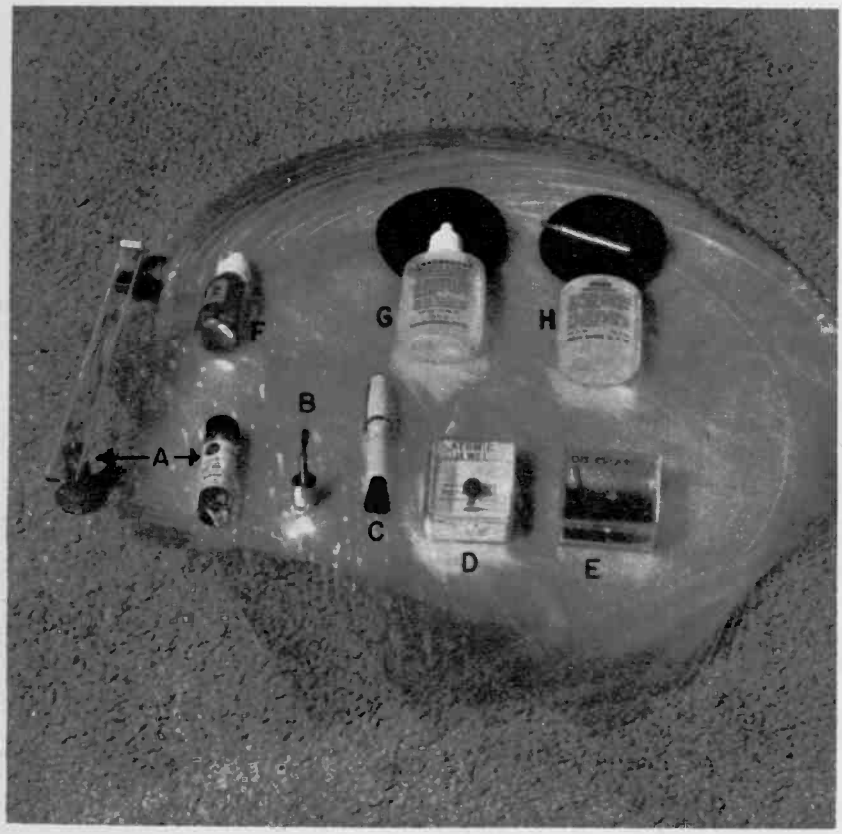
Phono Accessories

Improve your hi-fi set's performance and increase the life of your precious records with these aids

By Norman Eisenberg

CURRENTLY, some of the hottest items on the high fidelity dealers' shelves are the cleaners, gauges, switches and what-not known generally as "hi-fi accessories." Most of these are in the do-it-yourself maintenance class, with emphasis on protection rather than correction. In surveying this growing field, *EI* discovered that these accessories serve a real need. The hi-fi or stereo owner would do well to consider their relative merits. The reason? Playing microgroove records has always demanded special attention for best results over a long time. Stereo simply has made the old rules apply more forcibly, and added a few new ones.

Possibly the most important rule is that clean sound starts with a clean record. And indeed the largest single class of accessories is the cleaning devices. Actually, the best way to clean a record is to bathe it in a solution of lukewarm water and detergent (as described in *Electronics Illustrated*, Nov. 1959). This method, however, may not always be convenient. What's more, after a record has been cleaned, it ought to be kept that way. The first



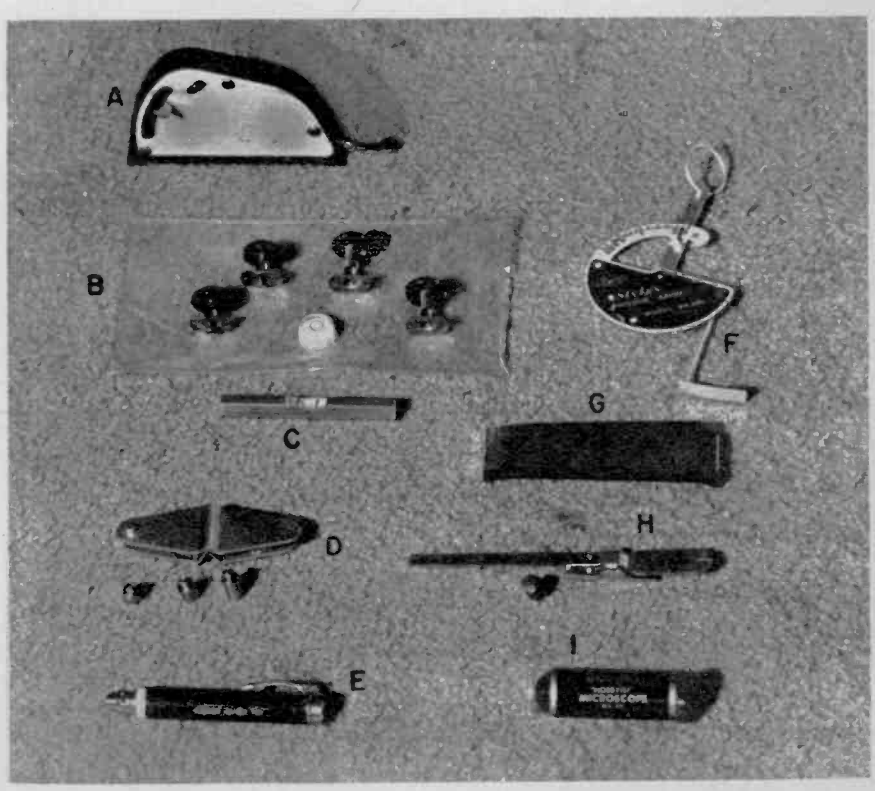
Record Accessories: A, ESL "Dust Bug" and fluid; B, Prosound-Gramercy needle brush; C, Bower brush; D, Robins "Atomic Jewel"; E, Mercury "Dis-Charger"; F, Prosound-Gramercy "Sound-Oil"; G, Dexter "Lekrostat" kit; H, Delvan cleaning kit; Plastic disc covers underlie all.

problem is one of getting dust and dirt out of the grooves; the second, of foiling the disc's inevitable attraction for new dust. The commercial cleaning kits offer a means of doing both.

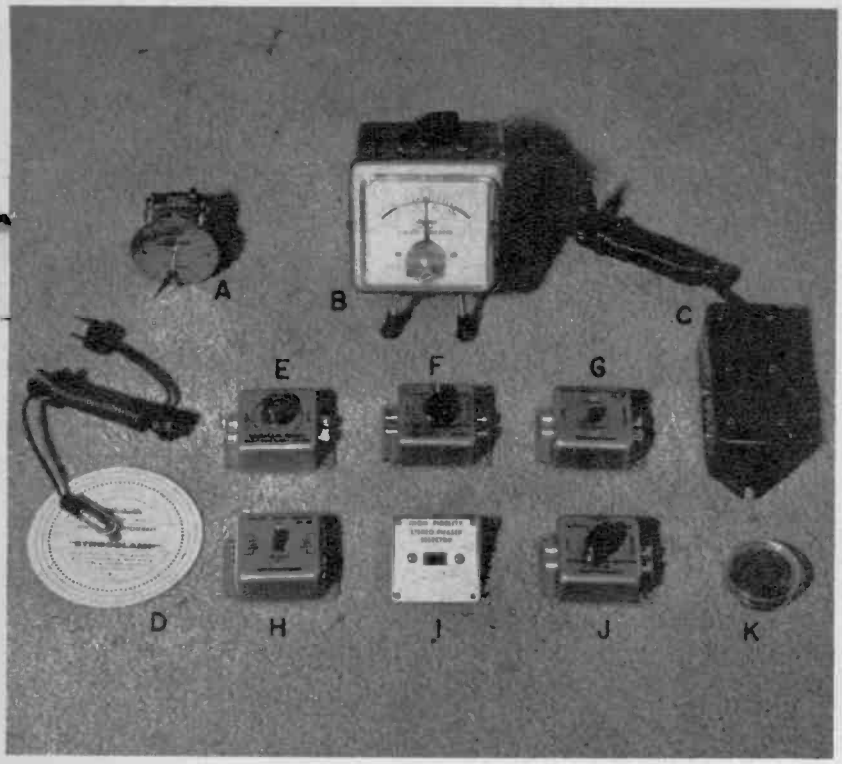
These kits come in a variety of forms (sprays, liquids, impregnated cloths) but the basic idea is to apply some of the cleaning solution (generally a silicone and detergent mixture) to the record, and then to wipe it off before it has a chance to clog the grooves. The wiping removes a good deal of dirt but does not destroy the effect of the original application, which is to neutralize the static charge on the record. The static charge (caused by stylus friction in the record groove, or even the slipping of the record in and out of its liner) is what attracts dust in the first place.

Cleaning liquids generally are packaged with an applicator. The velvet pad type is quite effective. Some kits, such as the Walco and Duotone, supply two pads—one for applying the liquid, the other for wiping it off. Other kits, such as the Lektrostat and the apparently similar but lower priced Delvan, provide a pad for the record and a small brush for cleaning the stylus tip. A stylus brush, incidentally, is a highly recommended substitute for the finger in whisking away little globs of gunk at the end of the stylus. The finger actually can add more dirt (in the form of grease and skin oils) besides upsetting the delicate suspension of the stylus assembly.

As an alternative to getting a stylus brush with the record cleaning kit, you can get a separate brush, such as Prosound Corporation's "Gramercy" or Robins Industries' "Klee-Needle." This type may be used held in the hand, or mounted permanently on the record player base so that the stylus automatically whisks across it when cueing a record. A fountain-pen type brush useful for stylus cleaning as well as superficial record dusting is the Bower and some others.



Stylus Accessories. Stylus pressure gauges: A, Garrard; D, Audax; F, Argonne; G, Robins; H, Lafayette. B, Wellcor levelling set; C, Robins spirit level. Stylus microscopes: E, Argonne; and I, Robins.



Stereo and special accessories: A, Lafayette Stylochron (see text); B, Argonne stereo balance meter; C, Argonne AC cutoff; D, Switchcraft strobe-and-light; E, Switchcraft stereo level control. Stereo-mono-reverse controls: F, Argonne; G, J, Switchcraft. Speaker phasing switches: H, Switchcraft; I, Vidaire; K, Robins 45-rpm adapters.

Robins and Walco also produce a small brush that clips onto the tone-arm and sweeps the record ahead of the stylus. These brushes do some dusting, but do not impart any anti-static effect. One that does is the fairly expensive ($14.95) Static-Master by Nuclear Products Co. This wide brush is fitted to an ionizing unit that contains alpha-emitting polonium. The rays (harmless to humans) neutralize the disc's static charge; the brush grabs up the dust. On a more modest scale are such items as the Robins "Atomic Jewel" and Mercury's "Dis-Charger." This is a tiny plastic bulb that houses a minuscule amount of polonium. Clipped at the head of the tone-arm, it too reduces the static charge on the record.

For records that are not terribly dirty, as well as to keep the average record clean and static-free as it is played, there are the very handy "dust bugs" put out by Electro-Sonic Laboratories and by Audiotex, a divison of General Cement. Both [*Continued on page* 108]

A well-equipped player, with running-time meter, pressure gauge, cueing lever, stylus brush, anti-static devices, microscope, level.

Sun-Powered Transistor Receiver

Special features of this simple circuit include a light-operated charger for its built-in battery.

By George Gordon

WHEN this two-transistor receiver was first assembled, it was planned as a sun-powered job that would perform satisfactorily for private earphone outdoor listening at the beach or on a picnic. Of course, this also included playing it in the winter on a sunny window sill. Imagine our surprise when we found that this unit also operated under a reading lamp! After a check with a milliammeter, it turned out that the transistors drew less than 1 milliamp. Since the solar battery delivers about 4 milliamps at about 3 volts in ordinary sunlight, using the light of a strong reading lamp will provide enough power for some background music while you're reading a copy of *EI*.

The rechargeable dry cell was included to take advantage of the generous amounts of free power supplied by the sun during those periods when you'd rather throw a beach ball around than listen to Sinatra or a newscast. Keeping the dry cell charged from the power supplied by the solar battery will enable you to play the receiver when you're indoors or under a shady tree.

To simplify changing the power source from solar battery to dry cell (or to place the dry cell in a charging condition), a three-way switch (SW1) is employed. Thus, on position No. 1, the solar battery supplies power; on position No. 2, the dry cell supplies power, and on position No. 3, the dry cell is connected across the solar battery for charging.

You'll notice in the pictorial that the large round cells used were cut in half and wired in series to obtain double their normal voltage output. Since this model was built, new smaller low cost cells have become available which require no cutting. See Parts List.

It's advisable to use as long an antenna as is practical. We found that a six-foot wire provided about twice the signal strength of a three-foot wire. This doesn't necessarily mean that you can double the signal strength again with a 12-foot wire, but use as long an antenna as you can.

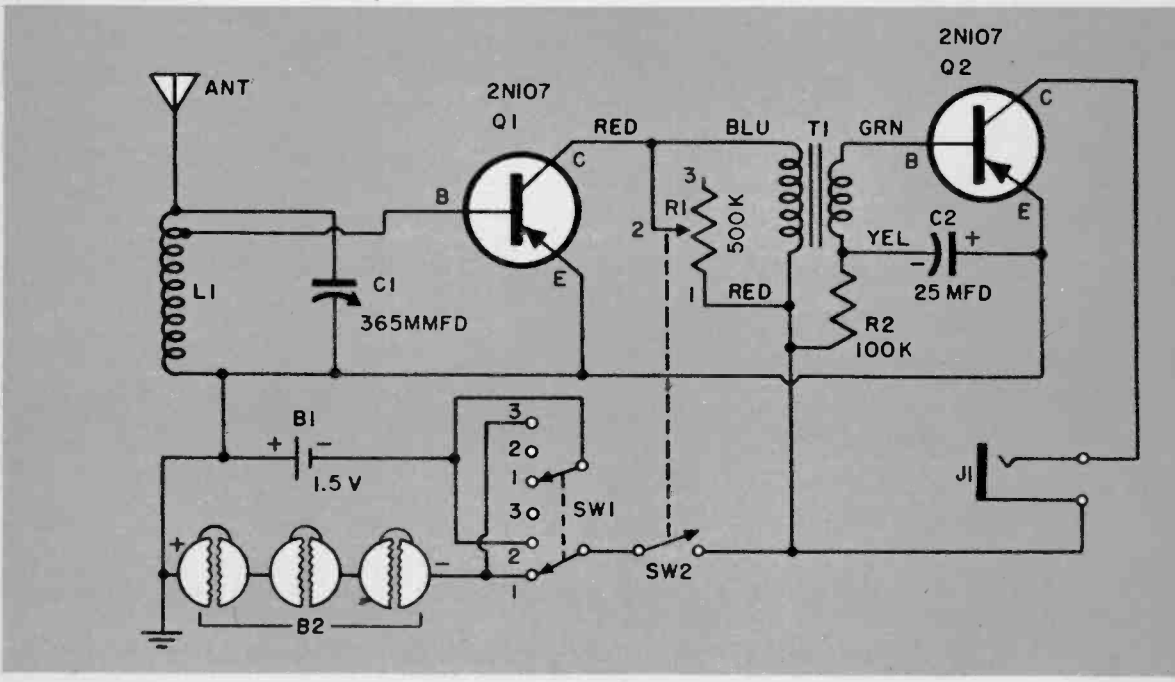
The plastic case used in the model was chosen arbitrarily. Any similar case, in plastic or wood, will be adequate. Plexiglas does have an advantage in that the solar cells can be mounted beneath the surface of the case and still receive direct sunlight.

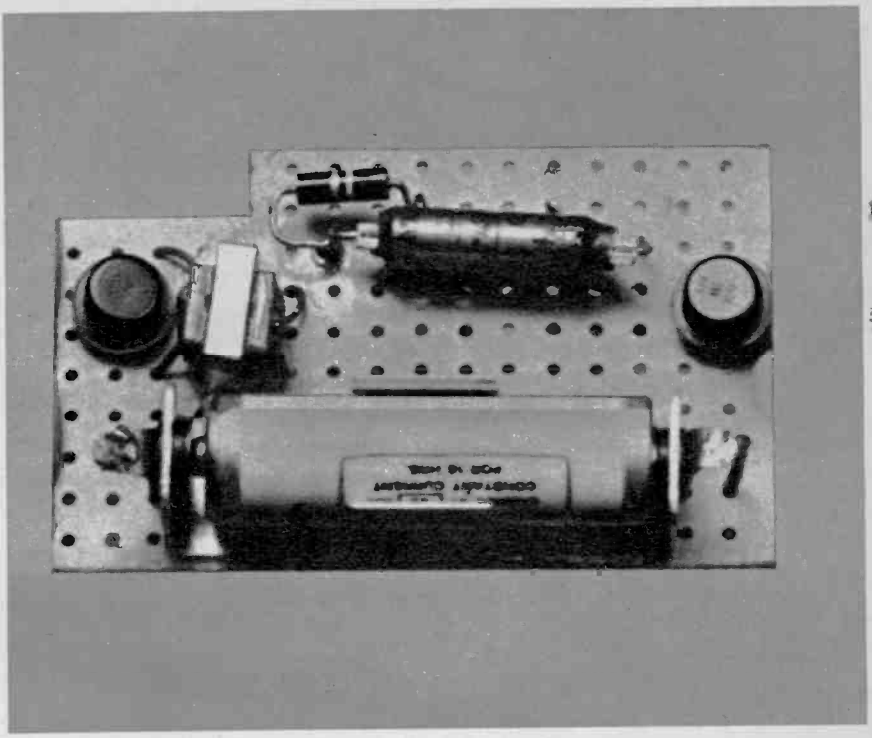
Note that the silvered back of the cell is the *positive* side, the silver ring on the other side is *negative*. Connect a small-gauge insulated stranded wire from the positive side of one cell to the negative side of another, as shown. If the negative ring is covered with a protective coating, carefully scrape away

PARTS LIST

R1—500,000 ohm miniature potentiometer with SPST switch SW2
R2—100,000 ohm, ½ watt resistor
C1—365 mmfd variable capacitor (Lafayette MS-185 with tuning dial)
C2—25 mfd, 6-volt electrolytic capacitor
Q1,Q2—2N107 transistors
J1—miniature phone jack to fit earphone plug
L1—tapped ferrite antenna coil (Superex VLT-240)
T1—audio transformer, primary 100,000 ohms, secondary 1000 ohms
SW1—4-pole, three-position rotary switch (2 poles not used)
B1—1.25 volt rechargeable cell (Sonotone S101)
B2—6 solar cells (Lafayette MS-771)
Earphone, 2000 or 3000 ohms impedance with phone plug

Three-position switch SW1 selects on 1, solar battery; 2, dry cell; and 3, dry cell charging.





Close-up of perforated board. Miniature components mount easily without crowding. Dry cell at bottom is new rechargeable variety.

a portion of the surface over the ring to provide a good soldering area. When the six cells are soldered together, you should have one positive and one negative lead extending from the two ends.

Construction Tips

Another good technique for making the mounting holes in case is to melt a small hole with the thin tip of a soldering pencil, and then carefully ream it to size.

The solar cells can be secured to the case by placing wood strips across the backs, and wedging the strips between the sides of the case as shown in the pictorial. The newer cells can be mounted on a piece of perforated board. The earphone specifications given in the parts list describe many inexpensive and fairly good signal-handling units; however, the better the earphone the higher the sound level and fidelity.

If you use the recommended antenna coil, set the tuning capacitor to a station about 1000 kc and adjust the loopstick core for maximum earphone volume. Then try the stations at the low and high end of the band. This adjustment may require resetting.

Theory of Operation

The RF carrier signals are picked up by the antenna and the station selected is determined by the resonant point established by the tuned circuit, L1-C1. The antenna coil, L1, is tapped to provide a low impedance match to the base-emitter input of transistor Q1. Q1 is a combination diode-detector-audio amplifier. The RF signal is detected and the audio is amplified and appears across potentiometer R1. The potentiometer regulates the amount of signal fed to the primary of transformer T1, and therefore serves as a volume control. The signal is current amplified through T1 by step-down action and fed to transistor Q2 where it is further amplified. The signal current from the collector of Q2 is then fed through the earphone and returned to the negative side of the battery source.

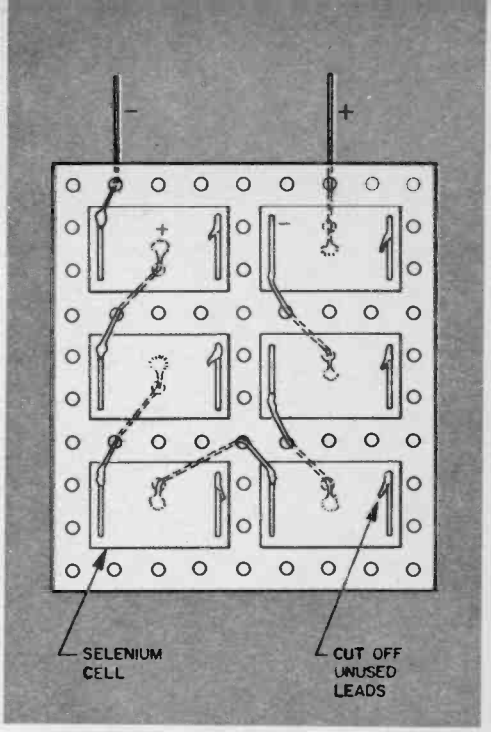
Caution

1—When two batteries of dissimilar

voltages are connected in parallel, the battery having the higher voltage will charge the one with the lower voltage. For this reason it is important that the solar battery is exposed to the sun when SW1 is in "charge" (position 3). If the sun does not strike the solar battery, and its voltage should drop below 1.25, the dry cell will tend to discharge through the solar cells.

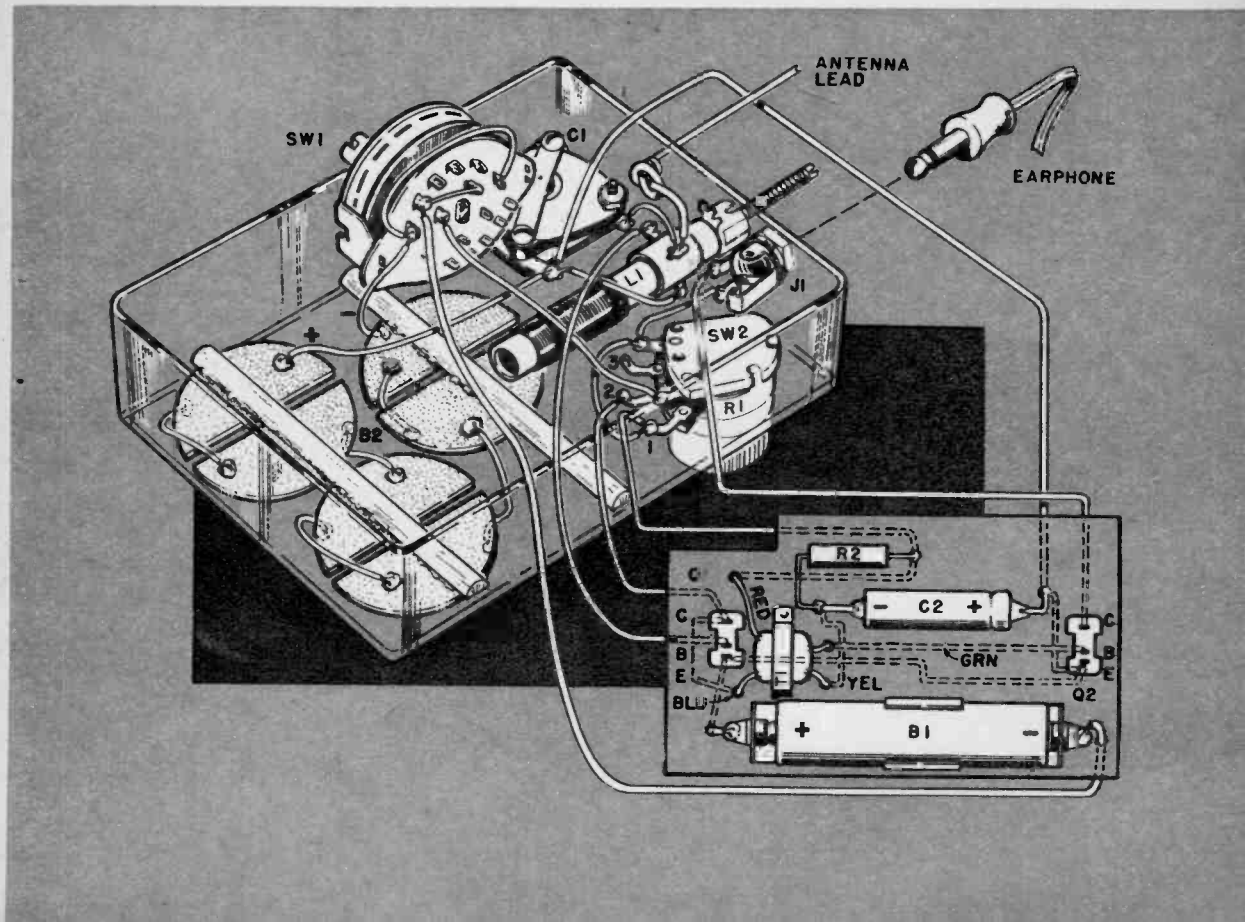
2—In "charge" position, turn off SW2 to cut off all power to the receiver circuit otherwise charging will be slower, since the receiver circuit will be draining current.

The rechargeable cell used in this unit has many features: every single discharge cycle is equal to the life of an ordinary dry cell; charging rate is about 16 hours and these cells can be charged from a completely dead condition without harming cell.



Original solar cells B2 are shown properly connected. Carefully observe switch terminals.

New solar cells above may replace round ones. Correct polar connection is a must.



"Privateer," flying from land or water, has 9½ foot wingspan, can carry any control gear.

keeping up to date with

Model Radio Control

Fun is increased, easy to come by with today's versatile radio control gear and model selection.

By Paul E. Del Gatto

EVERYTHING gets easier these days, and so it is with radio-control models and equipment. New technical developments, and new frequency allocations by the Federal Communications Commission, not only make things easier but much more fun.

Now modelers have six radio channels at their disposal in the new Citizens Band which extends from 26.965 to 27.255 megacycles: the "27 mc" band. When radio control equipment first appeared on the commercial market, it was "single channel" in design. Only one radio frequency could be used, and only one audio "beep" or tone, if any, was provided. Now there is inexpensive equipment which will use any of the six radio channels, and up to ten different audio tones can be carried on the signal. (Modelers also use the "old" Citizens Band at 460 mc, but channels there were assigned on an individual basis, and no new assignments are now made. Present permits for 460-mc operation

will not be renewed after 1963. This allows time for changeover.

In buying equipment, or planning a model's control system, you may run into some confusion because of jargon, especially if you are new to radio control. Modelers speak of "channels" and so do radiomen. To the radiomen (and the FCC) a "channel" is a tight group of radio frequencies used by a transmitter: it is "the spot on the dial" where a station appears.

To a modeler, a channel is *also* a tone or "beep" that rides on or "modulates" his transmitter signal, and some model-control equipment handles up to *ten* tones or "channels."

The confusion of meanings here is unfortunate, but it won't take you long to get the hang of it. Keeping the two kinds of "channels" straight really isn't hard. Equipment that can use more than one radio-frequency channel is called "multi-channel" gear, while units that handle two or more control-beep tones are called "simultaneous" equipment.

You don't need any tones at all, as you can use single-channel "carrier" type equipment (the simplest and cheapest) and control a model simply through the "commands" you send by turning the carrier on and off, or "keying" it. However, even one tone keeps your model safe from being taken over by nearby radio-controlled

A sampling of radio control receivers, from tiny single-channel unit (note matchbook for size comparison) to complex selective "simultaneous" sets.

Lafayette "KT-127" kit

Citizen-Ship "CTX"

F&M Electronics "Hercules"

Arlsto-Craft "Rangemaster"

Transmitters. At top, single-channel carrier kit. Others use 1 to 8 "channels" on carrier.

garage doors, etc. which are usually controlled by "blank" carriers. More tones give you flexibility of control.

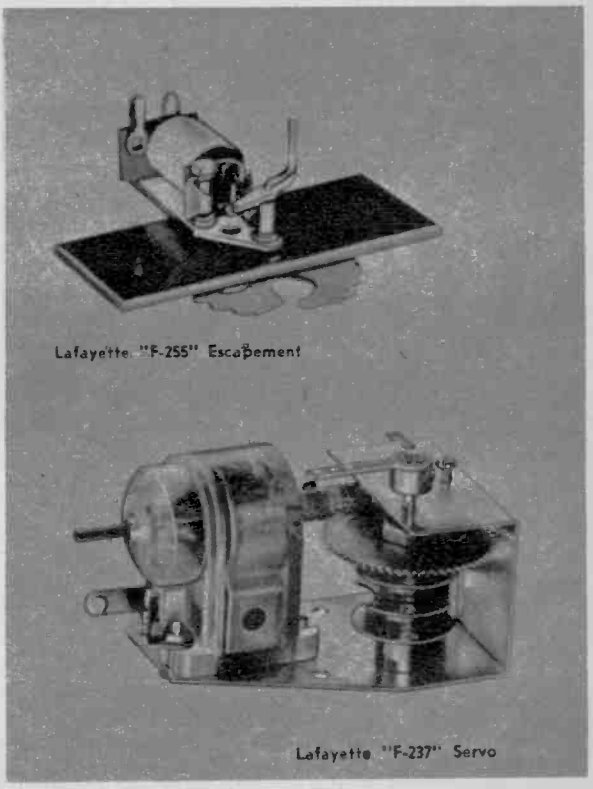
Though single-channel equipment is still popular, multi-channel designs are gaining ground despite their higher cost.

Receivers

Typical single-channel receivers are *Citizen-Ship's* model UR, *Aristo-Craft's* TRR (Tone) and *Eck-Babcock's* Magic Carpet, along with *Lafayette's* F-208 and *F&M Electronics'* Pioneer (Tone). The tiny UR weighs only 1¾ ounces; its 9-volt battery weighs 1⅓ ounce more. The TRR weighs in at about two ounces, without battery. The Pioneer weighs 1⅛ ounces, and is one of the least expensive. The F-208 is possibly the least expensive but there is a lot in the "package."

In the last three years tremendous strides have been made with "simulta-

Escapements and servos link receiver aboard model with rudder and other control surfaces.

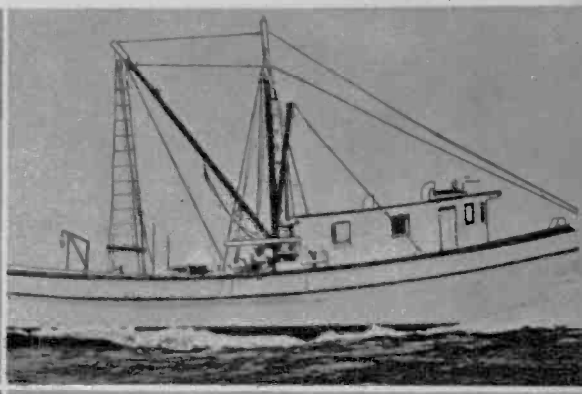


Lafayette "F-255" Escapement

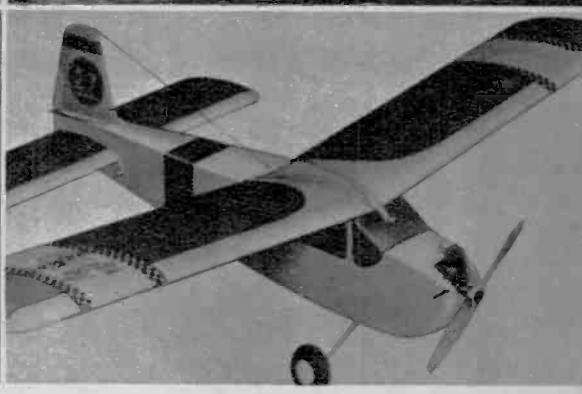
Lafayette "F-237" Servo

Babcock "Tri-Pacer"

Ideal "Shrimp Boat"



Sterling "Corvette"



Sterling "Mambo" R/C Trainer

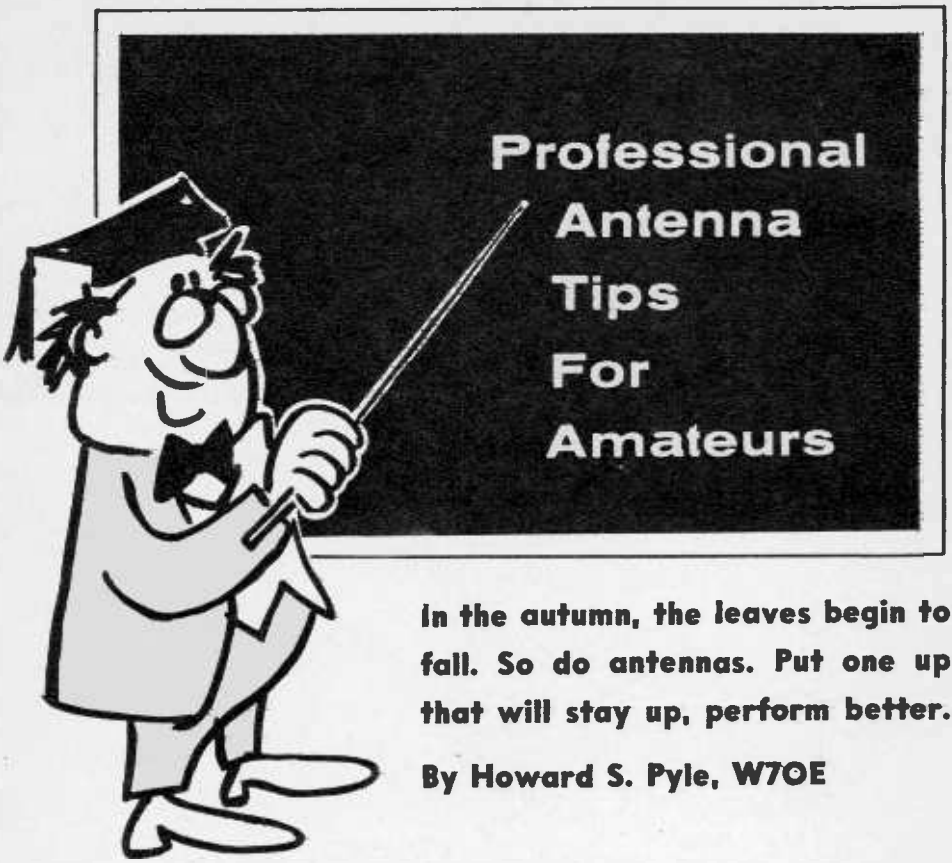
Models also vary in size, complexity, and expense. Some look like real thing; others, like "trainer" at lower right, are made for simple economical control.

neous" equipment. *Bramco's* Competition Ten is a good example. Ten-channel receivers are relatively new, but eight-channel designs are fairly well established. *F&M Electronics*, manufacturers of the CG line, are in this field with their popular Atlas. Designed to respond to all tones between 200 and 475 cps, it is perhaps one of the most advanced and reliable receivers available and has been accepted by modelers everywhere. *Citizen-Ship's* SS-MSR-8 is another recent development. It retains all the features of this firm's proven MSR-8 eight-channel reed receiver, with the addition of a selective superheterodyne "front end." This permits flying on any one of six radio channels with no interference from traffic signals, communications equipment, or modelers on any of the other five frequencies. (*Selective* means, essentially, "sharp tuning," or "narrow frequency passband.")

Transmitters

Transmitters, like receivers, are available in varying degrees of complexity and expense, to suit a particular need or pocketbook.

For all the new 27-mc assignments, *Citizen-Ship* has a "custom" tone or carrier-wave single channel transmitter, CTX. *Lafayette* puts out a build-it-yourself kit, KT-127, as well as assembled rigs. *F&M Electronics* offers Hercules, an eight-channel simultaneous transmitter. This is an *MOPA* type, fully meeting all FCC frequency-stability requirements. (*MOPA* means "master oscillator, power amplifier." Two tubes or a dual tube are used, one circuit only to generate the signal, the other to put the carrier and its tones "on the air.") *Aristo-Craft's* Rangemaster IAP transmitter is quite popular because of its low [*Continued on page* 110]



In the autumn, the leaves begin to fall. So do antennas. Put one up that will stay up, perform better.

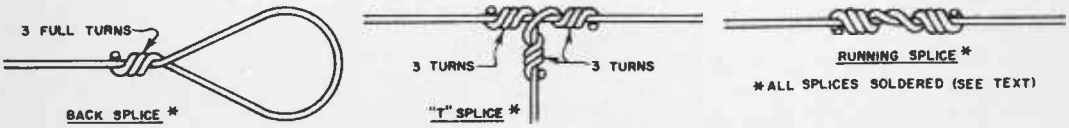
By Howard S. Pyle, W7OE

ABOUT this time of the year, the serious ham is found gazing thoughtfully at his antenna, its supports and general condition. Will it last through another winter season? Probably not, and he will be faced with emergency repairs in the dead of winter, hampered by snow, ice, sub-zero temperatures and too many clothes to permit doing a really good job.

With your own antenna in mind, we'll wager that you will find much room for improvement right in your own back yard. After viewing thousands of amateur stations in the last fifty years, it is the writer's observation that amateur antennas, all too often, sorely lack *craftsmanship*. Handbooks on antennas and their supporting structures are in plentiful supply, but even they lack detailed information on the little refinements which make for a *good* antenna, electrically and mechanically.

Haywire antennas, if cut correctly, radiate well, at least for a while. They do tend to be eyesores, however, and they do tend

Fig. 1



Solid-wire splices are simple. Steel-cored wire is highly recommended.

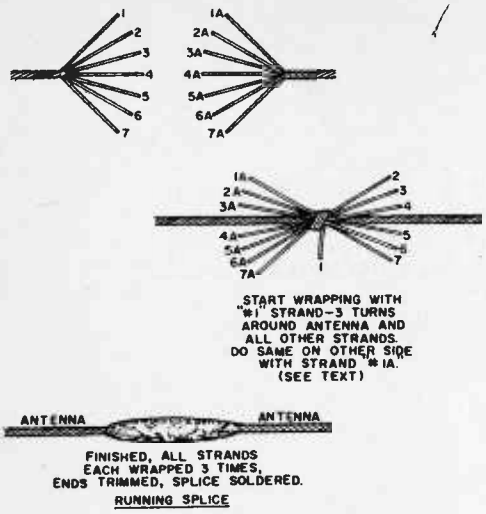


Fig. 2

Trim off excess strands before soldering. Use rosin-core solder. Overheating weakens wire.

to fall at inconvenient times, and their electrical performance can and often does fall off. It was discovered long ago, by the way, that poor antennas are a source of television interference. Corroded joints tend to act as diodes, taking some of the RF power, converting it to a family of harmonics, and radiating TVI even though the transmitter is clean.

Let's take the bull by the horns and quit merely *thinking* about putting up a better dipole or long wire. Let's get out there and just do it. First, we'll consider our choices of wire.

Solid wire: if you are going to use solid copper wire, make sure it is at least #12 in size, and "hard-drawn" to eliminate the chance of its stretching. Your best choice is not copper wire, but *copper-clad steel* wire. It won't stretch or sag, it is unlikely to snap in bad weather, and it will not be weakened by soldering. Yes, you are going to do some soldering.

What about the conductivity: isn't copper better? At radio frequencies, you are only interested in the *surface* conductivity, and the copper coating takes care of that. The steel core is merely the strengthening agent. This wire is available at most electronic parts distributors or mail order houses.

The first illustration shows the splices most often used in solid wire. They are certainly easy to make. The running splice is shown in case you measured wrong somewhere. The "T" splice takes an extra little piece of wire, which is wrapped around the feeder and then around the antenna, on the other side of the joint from where the feeder was wrapped.

All joints are soldered to prevent corrosion. Avoid overheating the wire, especially if it is solid copper, as you

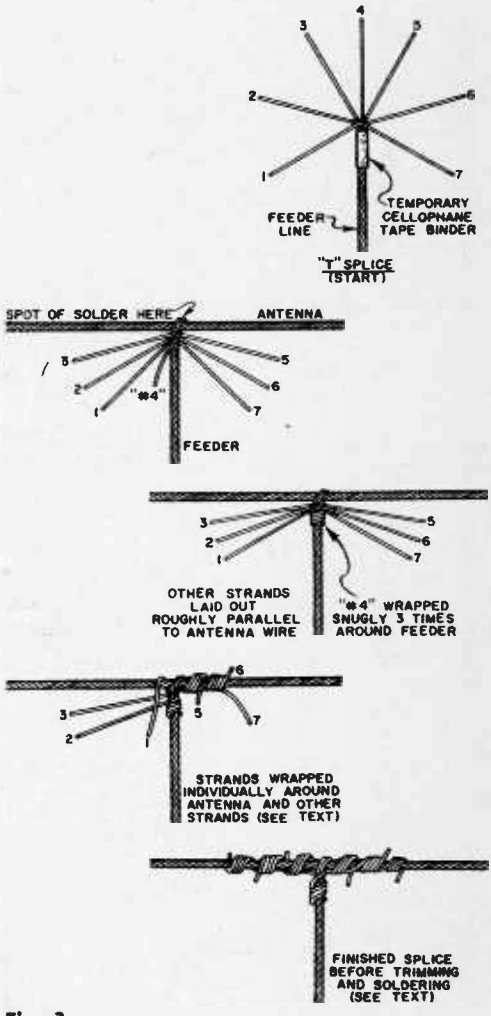


Fig. 3

"Windings" of strands are actually closer than shown here. They are spread apart for clarity.

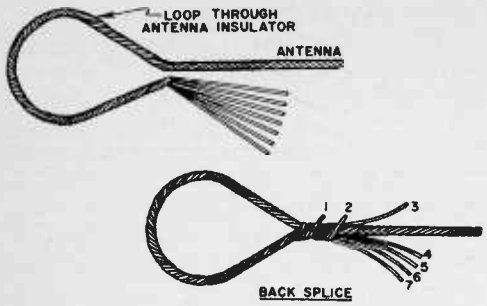


Fig. 4

Back splice for insulators. Wire is run through insulator hole (!), spliced, trimmed, soldered.

may weaken it. Use rosin-core solder even here: the job isn't big enough to require acid solder flux, which is avoided in radio applications.

And for heaven's sake, remember to put the wire through the hole in the insulator *before* making that back splice!

If you use stranded wire, an entirely different treatment is called for. For practice, you may want to make a simple running splice.

As shown in Figure 2, the strands of each wire are spread out for 1½" or so. Then they are interlaced by pushing the two wires as close together as possible without distorting them. "Strand 1" goes between strands 1a and 2a, etc. until strand 7 is between 1a and 7a. Now, bend the strands down against the main wires, in the direction toward which they point. Pick out strand No. 1 (any strand, really) and start wrapping. Wrap the strand neatly and tightly around the main wire *and all other strands* on that side. Then take the next strand, wrap around the main wire and all other strands, etc. You may want to alternate sides of the splice you work on: wrapping 1, then 1a, 2, then 2a, etc. The final strands, 7 and 7a, each go three times around the main wire alone.

This gives you a *tapered* splice. Snip off the excess strand ends—trim them with a file, too. Flow solder over the whole works.

Now you have a joint that won't work loose, won't create receiver noise, won't generate any TVI. It's nice-looking, too. A thing of beauty and a joy forever—or at least until you change antennas.

By the way, you ought to make those "wrappings" closer than in the illustrations. They should be adjacent, in fact. They were spread a little in the pictures for clarity.

Never make a running splice by twisting the main wires together.

The T-splice is used for attaching feeders to the antenna, or anywhere where a right-angle joint must be made. Notice that a piece of cellophane tape (or equivalent) is wrapped around the wire before the strands are separated. You may want to do this for all splices —it makes the whole business easier as it keeps the wire from separating any farther than you intended. Wrap the middle strand ("No. 4," see Fig. 3) three times around the antenna first. Leave it pointing downward or back along its own main wire, and put a spot of solder on that wrapping. Then lay the other strands parallel to the antenna, three in each direction. Wrap "No. 4" three times around the feeder, remove tape, and then treat the other strands the same as for a running splice. Solder.

The back-splice, or "eye," is essential. This is the one that goes through the insulators, and if it lets go, much of your work is undone. Once again, the first strand goes around the main wire and all others; the next around the main wire and [*Continued on page* 116]

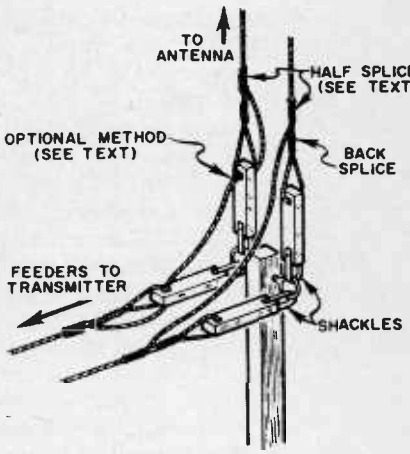
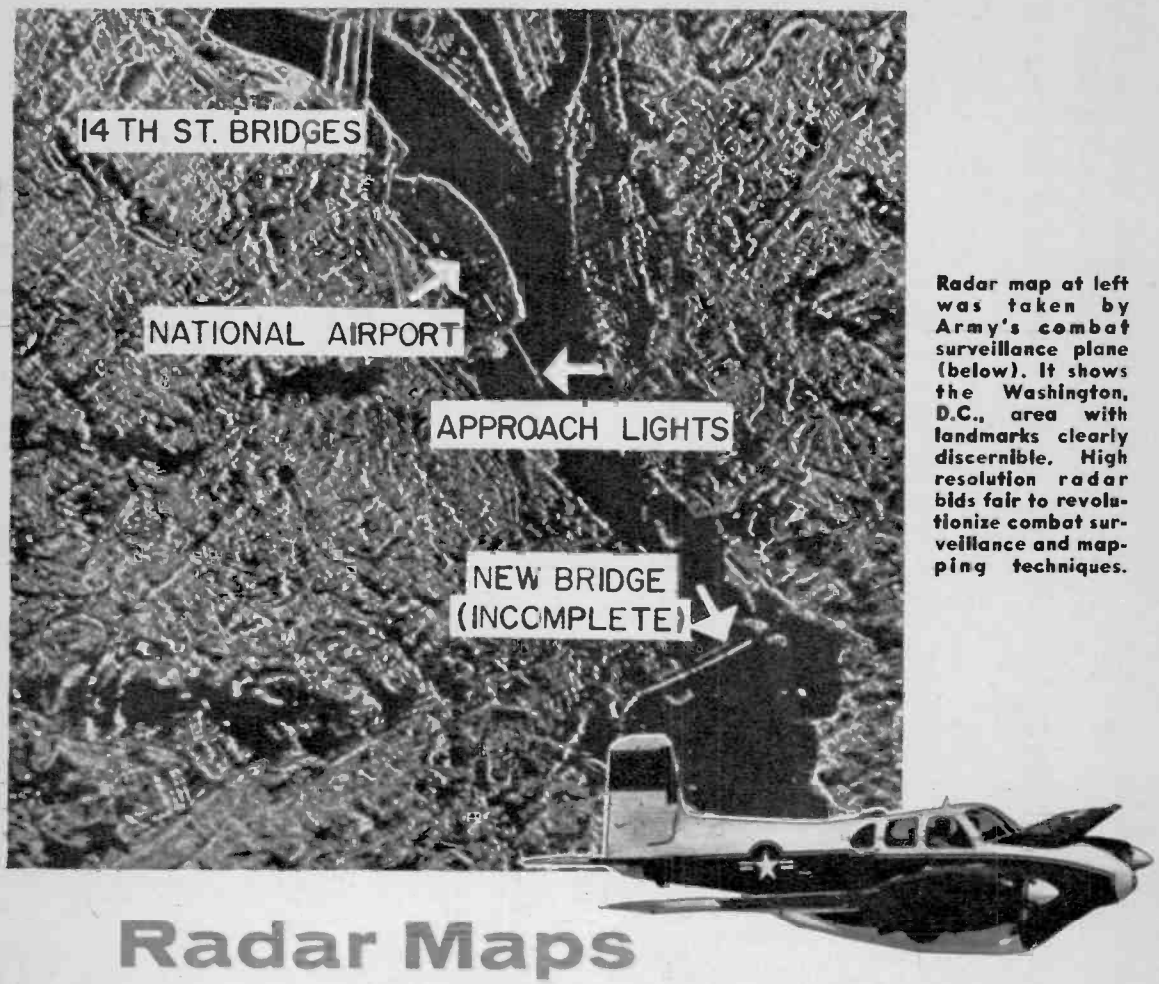


Fig. 5

Structurally and electrically, this method is superior to casual treatment of feeder bends.



Radar map at left was taken by Army's combat surveillance plane (below). It shows the Washington, D.C., area with landmarks clearly discernible. High resolution radar bids fair to revolutionize combat surveillance and mapping techniques.

Radar Maps

THE U. S. Army now has a radically new radar system that produces a clear, distortion-free strip map in which the terrain being mapped appears to be directly below although, in fact, the aircraft carrying the radar is flying many miles to one side—"looking" at enemy territory from friendly airspace. Developed by the Signal Corps, Univ. of Michigan and Texas Instruments, the airborne radar provides instantaneous detailed information in any kind of weather, day or night.

The aircraft, an L-23D, has two side-looking antennas, equipment to store the data gathered by the radar, and a new doppler-inertial navigation system which keeps the plane flying a steady straight-line path and corrects the data for any deviation from that straight-line path.

The airborne radar can survey an area ten times as great as that actually visible from the plane on a clear day, and all of it will appear as if it had been taken from directly overhead.

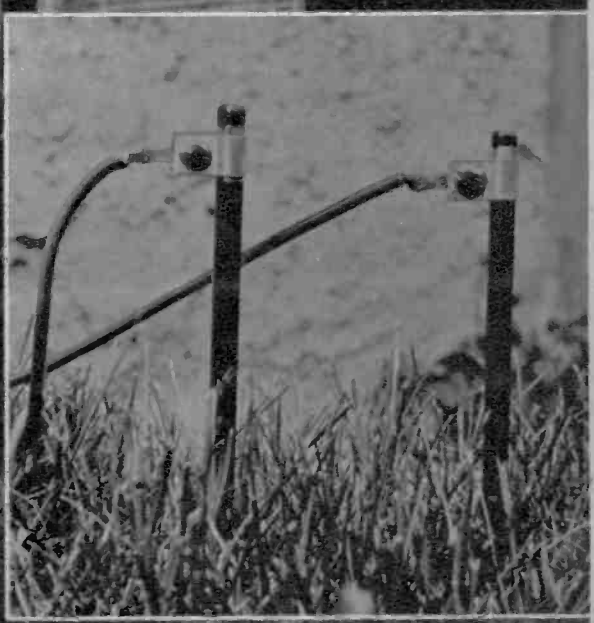
The radar reflections returned to the plane are stored on film which is later developed in a mobile van. Heights of various structures on the strip map can be determined through photo-interpretation of the radar "shadow" of the object.

the best of EI

The EI Automatic Lawn Sprinkler

By Byron G. Wels

Your soil "tells" this sprinkler when it needs water, sprinkler turns off when soil has enough.



Photos by John Schneider

WITH this unit attached to your lawn sprinkler, you can leave home during vacation or on long trips and never need worry about whether your lawn is being properly watered. As a matter of fact, this can be used all through the summer and fall to relegate lawn sprinkling to the realm of automation.

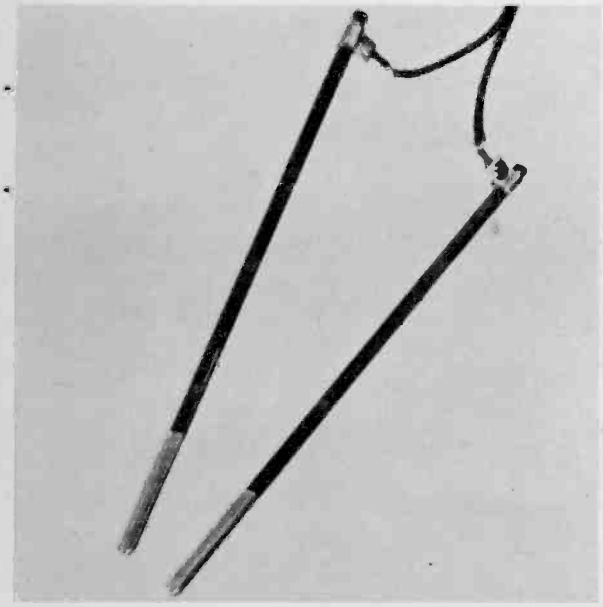
There are three basic requirements in the building of this automatic sprinkling device. These are the solenoid water valve, the rain detector probes and the defeat circuits.

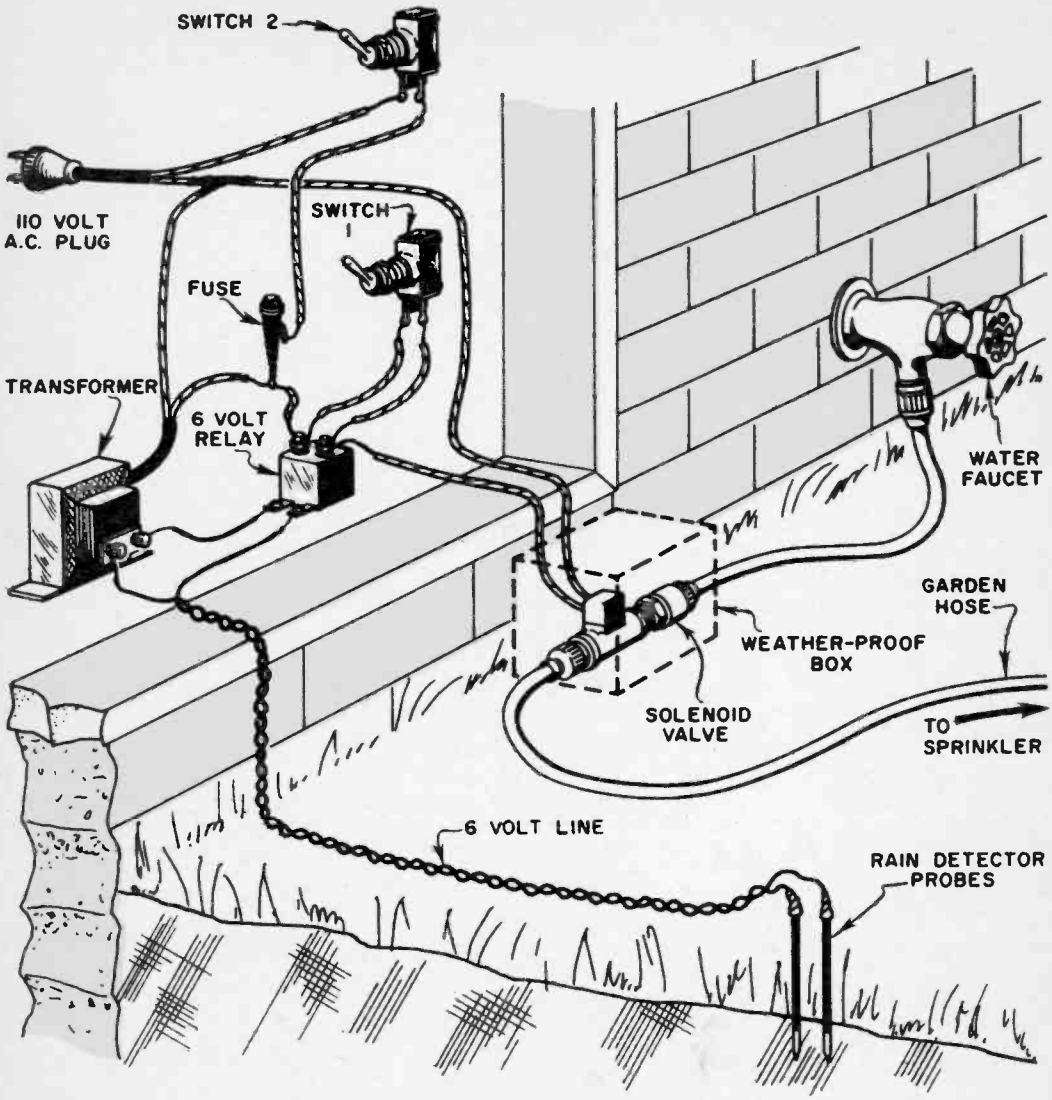
In shopping for a suitable solenoid water valve, the author found many inexpensive units available on the surplus market. Some of these surplus units require minor modifications. For a little more, a unit requiring no modification may be obtained at your local washing machine repair store. These will have garden hose connecting fittings.

As to the second requirement, we need some way for the earth to "tell" the solenoid when it needs water. The pair of "rain detecting probes" described here will do this trick nicely.

The probes are made from ten-inch lengths of aluminum rod, which was chosen for its ability to stand up well under severe conditions of weather and soil action. Use masking tape to mask off two inches of the bottom end of each probe and an area of about ½ inch near the top. Then dip the entire probe into a can of good outside house paint, shake the surplus paint off the probe and allow it to dry. After the tape is removed you will have bare aluminum in two places on each probe. At the top of each probe, fasten a small electronic cable clamp, using a bolt, nut and lockwasher. Also include a solder lug which serves as the

The soil moisture-detecting probes consist of two ten-inch lengths of aluminum rod, painted to within two inches from the bottom, with an unpainted section near the top for connections. Their separation in the soil depends upon the mineral content and porosity of the soil. The solenoid valve, shown unenclosed below right, is connected between the faucet and sprinkler hose.





Wiring guide showing all necessary connections. For safety, solenoid should be in separate box.

terminal for the wire to the rain probe.

The defeat circuit is needed to allow the user to obtain water from the hose for washing his car, for example, or other purposes. This circuit consists of a pair of switches. Flip one switch on, and regardless of the outside condition of the soil, no matter what the probes say about dampness, the water will flow through the valve.

The other switch is included for people who live in areas where the summers are very dry. In such areas, restrictions are often enforced regarding alternate day sprinkling, or restricted hour sprinkling. To avoid violation of any such laws, this switch enables the user to prevent the water from going on regardless of outside conditions.

The probes are inserted into the top soil to a depth at which the top soil ends. However, make certain that the cable clamps on the tops of the probes are at least one inch *above* the surface. As only the lower ends of the probes are not insulated by paint, these are the

only current sensitive areas, and they are able to sample the soil moisture at a practical depth.

As the soil becomes wet due to the sprinkling, its resistance drops, causing an increase in current flow between the probes. A six-volt bell transformer supplies the energy to actuate this circuit. This avoids the possibility of shock hazard to small children and animals.

In series with the probes and the transformer, is a small relay of the current-sensitive type (Sigma 41FZ-10) as used for model control. This relay "pulls in" or closes when increased current flows between the probes, opening the powering circuit for the solenoid and thereby shutting the water.

Switch 1, which is used to override the probes, is connected in parallel with the relay contacts. The other switch is used in the primary voltage circuit which supplies the entire system, and is effectively an ON-OFF switch for the system.

The entire solenoid assembly should be mounted in a sealed aluminum box, such as a chassis cabinet. The sealing can be accomplished by the liberal use of rubber caulking and plastic spray. Remember, there is 110 volts AC at the terminals of the solenoid.

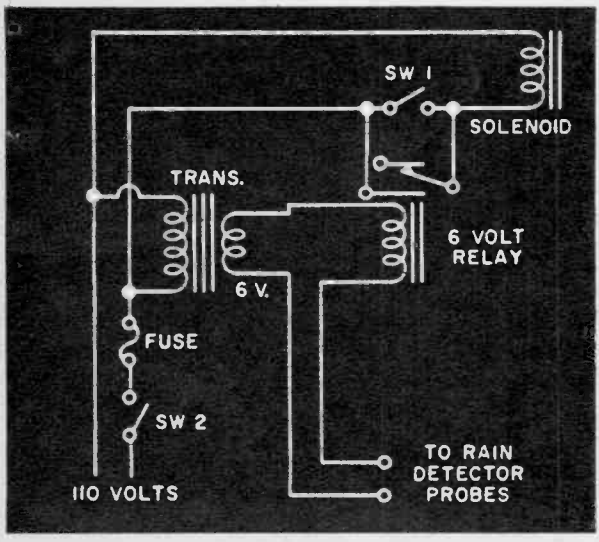
After making the electrical connections to the probe, use a brush and completely coat the exposed contact area.

Since the mineral content of soil throughout the country varies, you will have to determine how far from each other to place the probes in the ground. If you put the probes into the soil and the water does not turn off when the ground appears to be soaked to a reasonable depth, move the probes closer together. If the water will not go on at all, try moving the probes further apart. In either case, if the probes do not seem to have any effect at all, check your wiring for mistakes.

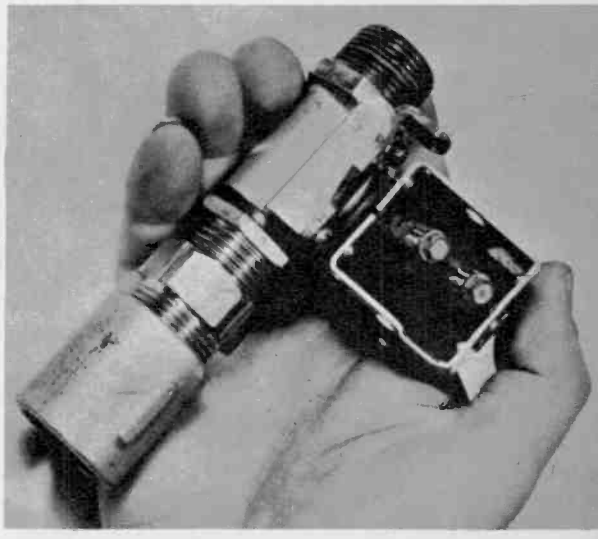
It will prove helpful when making initial tests of your equipment, not to insert the probes to their full depth, but rather, just insert the bare tips into the earth.

A more difficult problem faces those whose soil has low porosity. If your soil is "hard pan" or similar, your property might be flooded before the probes could turn the sprinkler off. In such cases, it may be advisable to dig a small hole somewhere in the sprinkled area and fill this hole with a more porous soil. Seed same as rest of lawn and insert the probes into this section. Calibrate the probes as before.

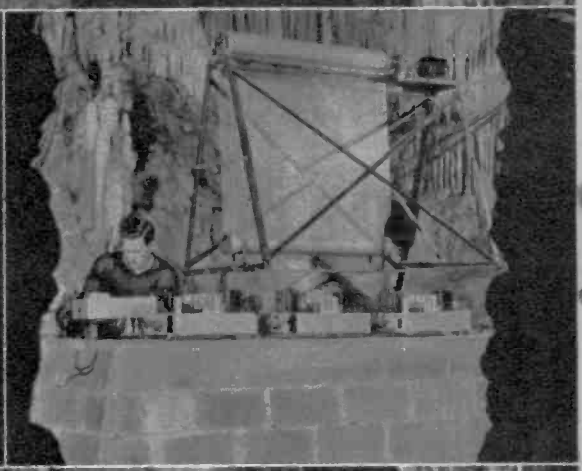
The 6-volt relay shown in schematic below is a Sigma 41FZ-10 model or an equivalent make.



Typical 110-volt solenoid valve available in washing machine supply or in surplus stores.

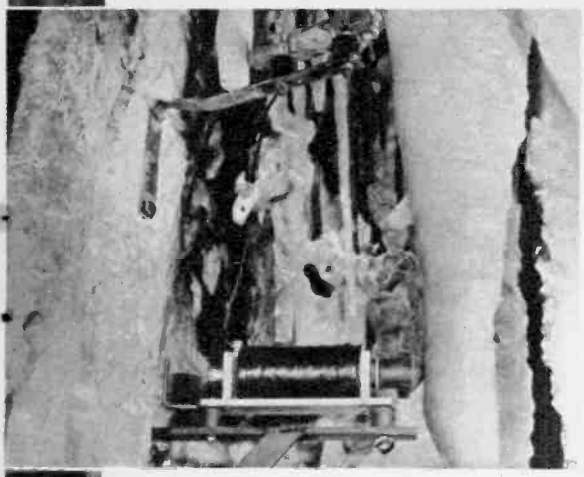


At right are some of the electronic amplifiers and controls and the "piano roll" plastic that permits automatic operation of the huge instrument.



Far beneath earth's surface in an intriguing fairyland of Nature, electronic scientist Leland Sprinkle performs on the unique Stalacpipe Organ.

Photos by Rudy Arnold



Rubber-tipped plungers deliver a quick blow to the tuned stalactites and spring back to cocked position. Lower plunger and coil are bigger than unit at top because lower stalactite is larger. Size is critical in achieving tone. Right: A stalactite gets tuning with drill-sander and tuning fork.

music from stone . . . the

Great Stalactite Organ

THREE hundred feet below the earth's surface in the eerie and breathtakingly beautiful "Ball Room" of Virginia's famed Luray Caverns, Mother Nature and modern electronics have joined forces to create a unique musical instrument that gives the listener complete stereophonic sound—360°.

The Great Stalacpipe Organ, as it is called, is probably the biggest organ in the world and is the brainchild of Pentagon electronic scientist Leland Sprinkle, Sr., who discovered that the cavern's stalactites gave off a musical tone when thumped. Why not use them as "pipes" in a mammoth organ? Built up at the rate of one cubic inch every 120 years due to lime-water drippings, these icicle-like rocks, once tuned, could hold their tune for a thousand years!

Sprinkle set to work with various electric grinding tools and tuning forks. Much to his initial dismay, he found only two stalactites that were naturally in tune. On the larger ones, precise tuning was accomplished with a system of precision oscillators amplified so they could be heard above the grinding, which continued until all wavy effects and undesirable harmonics disappeared.

Each octave has its own power supply and plunger firing apparatus. As the keys and pedals are depressed at the four-keyboard console, electrical contact is established and a current is passed through a tube to a relay coil. The relay discharges a capacitor through a long wire leading to a magnetic coil which surrounds a rubber-tipped brass plunger mounted so it strikes the stalactite. The smaller the stalactite, the smaller the plunger, and vice versa. At the moment of capacitor discharge, [*Continued on page* 115]

EI builds a

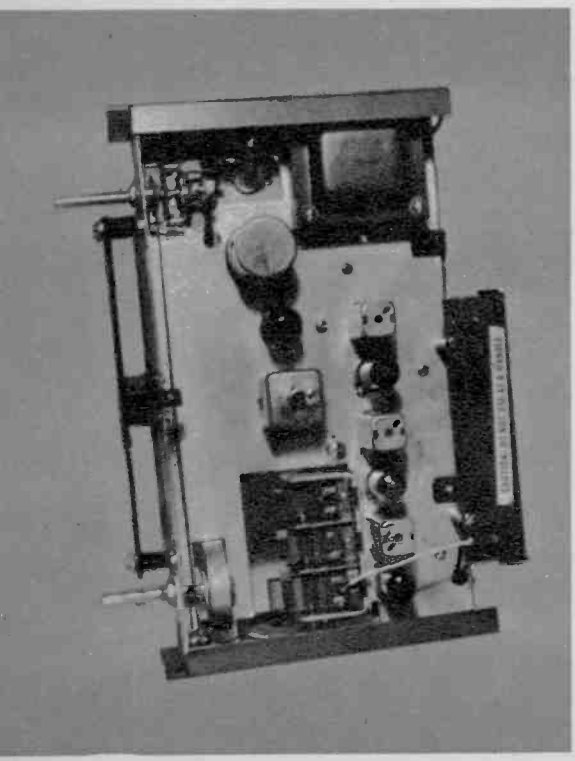
Hi-Fi AM Tuner

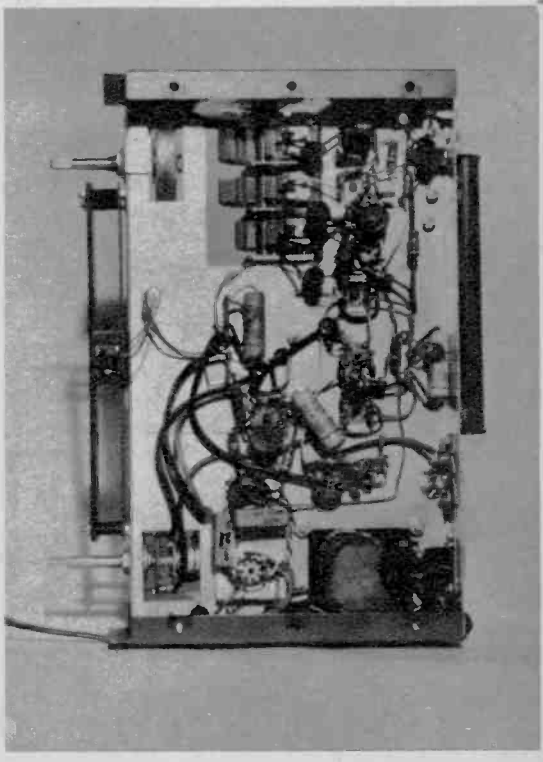
IMPROVED programming, live broadcasts, and most important, AM-FM stereophonic broadcasts, have all done their part to focus new attention on the AM tuner as a good music source. Although commercial AM tuners have been available for many years, their high price was not always matched by their quality.

A new AM tuner designed by EICO is intended for use with your present high fidelity system and provides the listener with a choice of wide or narrow bandpass. In the wide bandpass position, the tuner's response extends to 9 kc—which will provide close to FM quality audio from wideband broadcast stations.

The normal narrow bandpass position is used for the distant stations (when switched to narrow bandpass the circuit has higher gain) as well as those that don't transmit more than a 4 or 5 kc audio bandwidth. If you are in the narrow bandpass position on a station with poor audio and switch to the wide bandpass position, you will only succeed in raising the noise level. With a good station, however, the increase in fidelity is startling. Additional features include the 10kc filter to prevent interstation

Top and bottom views of completed tuner. Open type construction insures ease of wiring. Note the antenna stick at left with its warning label.





Front view of unit with its optional perforated cover. Provision is made for panel mounting.

whistles, traveling tuning eye indicator that contracts into an "exclamation point" at the center of each broadcast channel, and dual low impedance outputs.

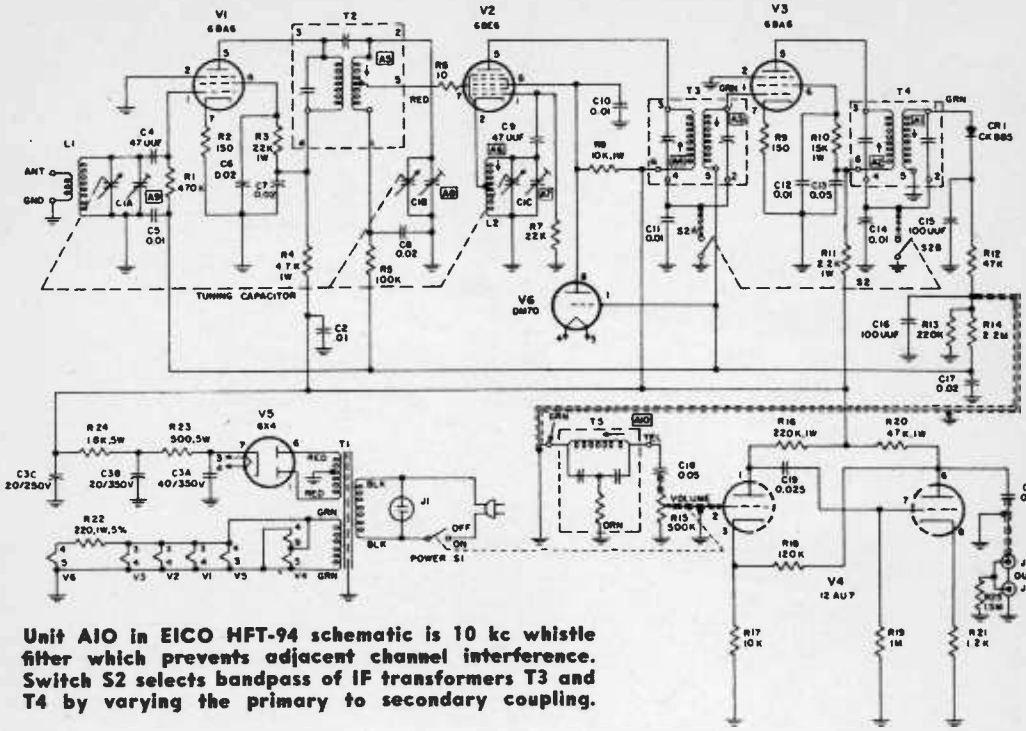
The kit book is adequate and construction shouldn't present any special problems for the novice. If you run into an occasional ambiguous construction note, you can clear it up by referring to one of the many pictorial diagrams.

Seven and nine-pin miniature tube sockets are used throughout, and it's a good idea to double-check their mounting to make sure that each "key" (wide spaced area between the pins) is facing in the direction shown in the pictorial diagram. Before soldering any connections to the tube socket terminals, carefully spread them apart to avoid shorting one against the other.

On page 5C, step 15, the novice may find the directions for mounting the IF cans a little confusing since those supplied in kit had four color dots and the directions referred to one color dot for orientation. Note that only the correct color dot is visible when the cans are mounted. On page 13C, step 2, the lead going to XV2-7 should be insulated with spaghetti to avoid shorting against the ground lug. Also on page 13C, in step 22 the braid wire should be 1¾" long rather than 1½" as indicated.

When the completed tuner was plugged in for the first time, it worked perfectly. The factory aligned coils resulted in "on the nose" reception. No further alignment was necessary; however, complete instructions for touching up the unit are included in the kit book.

In New York City, when the HFT-94 was tuned to a good station and the bandpass selector switch in the *wide* position, there was only a slight limiting of the frequency response when compared A-B against a high quality FM tuner. [*Please turn page*]



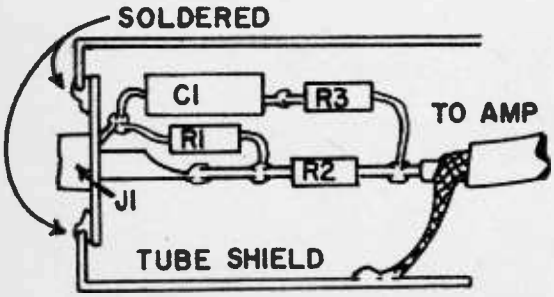
Unit A10 in EICO HFT-94 schematic is 10 kc whistle filter which prevents adjacent channel interference. Switch S2 selects bandpass of IF transformers T3 and T4 by varying the primary to secondary coupling.

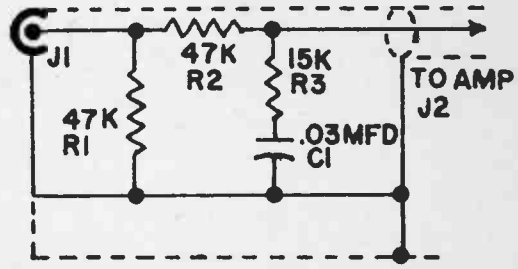
Magnetic Phono Input for PA

HERE'S a circuit for adding a magnetic phono pickup input to your PA amplifier, by means of a simple adaptor consisting of three resistors, one capacitor and a shield.

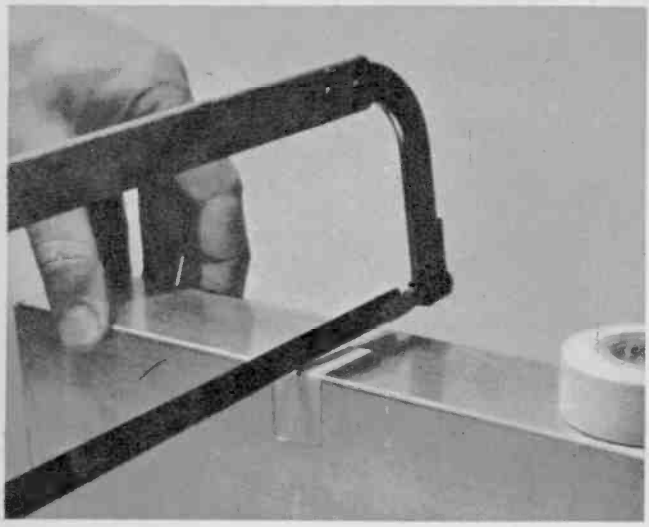
It is the job of these new components to provide the equalization and the proper load required by the new cartridge. If R1 is made larger, the treble response of most cartridges will be boosted. If made smaller, treble will be cut. A larger value of C1 will boost the bass response. The circuit as shown works well with the GE monophonic VR-11 cartridge, but will also serve most magnetic cartridges wired up for mono use.

The components can be assembled in a tube shield with the phono input jack (J1) soldered directly to the top of the shield as shown. Wire the components to J1 before installing the assembly in the shield. A jack to fit the input on the PA amplifier should be attached to the shielded wire output. Use as short an output lead as possible.



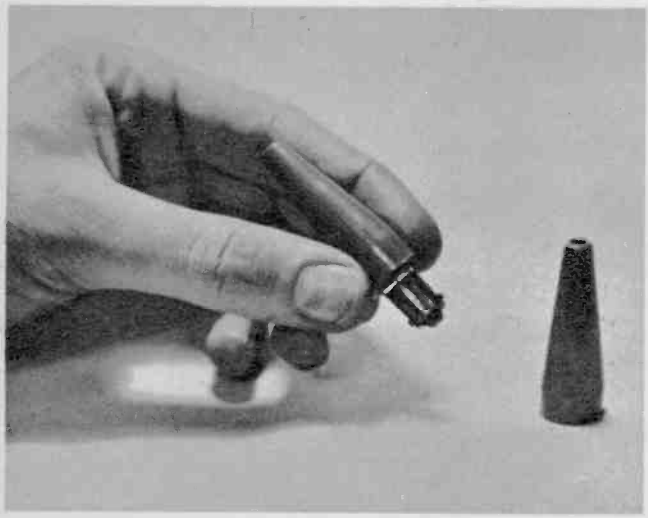


Try These



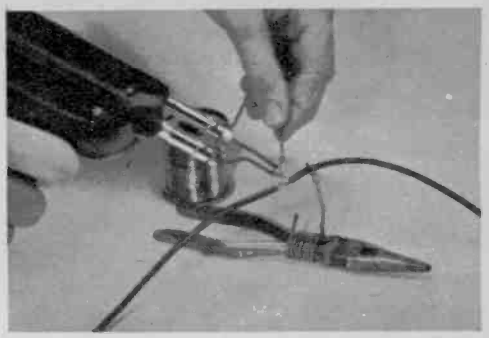
When hacksawing a metal chassis, you can start the cut easily and accurately if a strip of masking tape is placed right at the point you want to cut.

Poking around in compact circuits with your test prods may cause shorts. To avoid this, partially insulate the metal prod tips with plastic electrical tape.

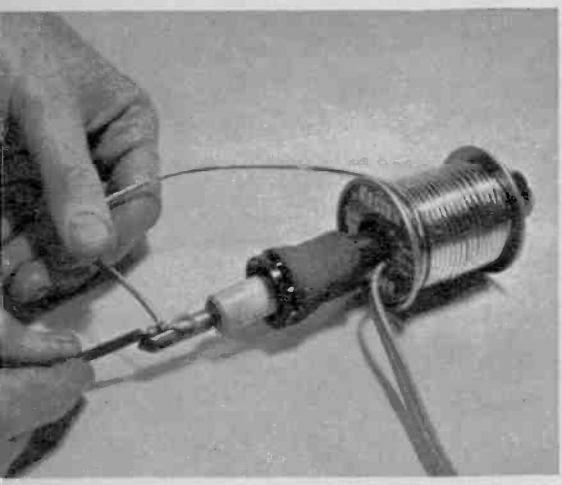


The removal of a pilot lamp can be one of the toughest jobs in radio work. An ideal pilot lamp puller is the Mueller number 87 crocodile clip insulator.

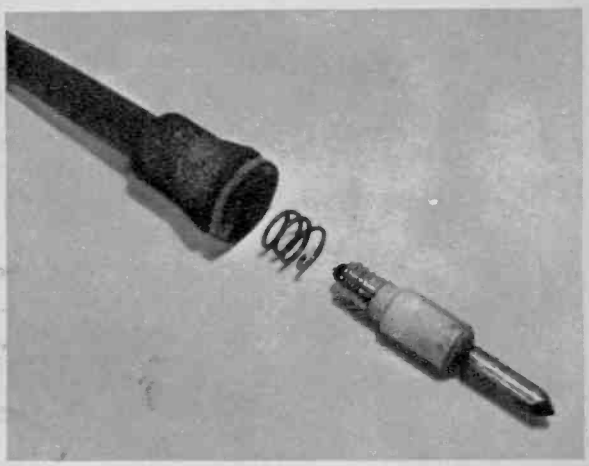
El's Hot Tips



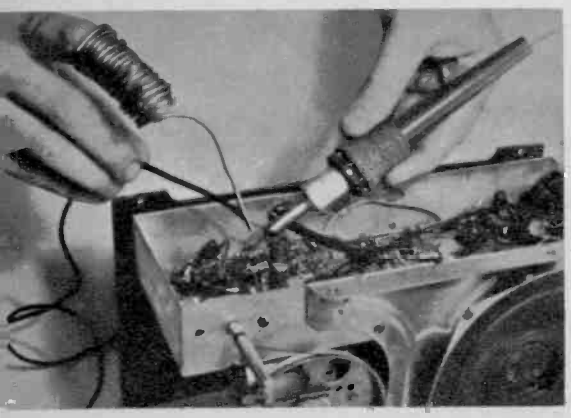
A handy holder for leads to be soldered can be made from a short length of solder wrapped around the handle of a heavy enough flat tool.



Use that heavy spool of solder to hold your pencil as shown, when you face a tough three-handed soldering job. To prevent the spool from rolling, bend the edge of both flanges.



To prevent the screw-in elements of a pencil iron loosening, slip a short coil spring over the heating element before screwing it into the pencil's handle socket as shown at right.



Your index finger can also lend a hand in soldering jobs where you need a third arm. Wrap the solder around your finger as shown, but be careful not to cut off the circulation.

build this

Test Bench Control Panel

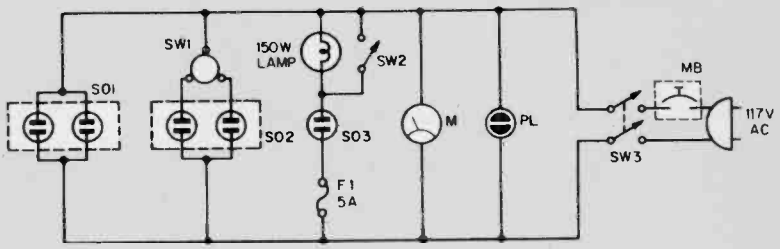
to speed up your testing and troubleshooting.

By Matt Johnson

A CLOSE friend has dropped in with a PA amplifier he wants repaired in time for a big dance Saturday night. The complaint is that it blows its fuse about 5 seconds after it's turned on—but doesn't show a short to an ohmmeter. In other words, it tests okay when off, but turn it on and it blows a fuse before you can get your test leads into it.

Or you've just completed wiring an amplifier chassis. After all the usual "cold" checks, you plug it in, flip the switch and . . . S-s-s-st-pow! A B-plus short practically melted your rectifier tube and then blew the fuse.

What's the answer to these problems? Why not build yourself a test panel which will not only automatically tell you whether or not you have a short, but even help you troubleshoot



Simple schematic of test panel suggests a variety of applications. Main test circuit is 150 watt lamp in series with AC outlet SO3. SW2 shorts out lamp while fuse F1 protects circuit.

PARTS LIST

SO1,SO2—surface mounting duplex AC receptacle
SO3—single AC receptacle
SW1—three-wire canopy switch
SW2—SPST toggle switch
SW3—DPST toggle switch
F1—5 amp. fuse and assembly
M—150 volt AC meter
PL—neon pilot light assembly
MB—10 amp Mini-Breaker
Misc.—Porcelain socket, 150 watt lamp, perforated Masonite board

it. If you wish, you can, as the author did, add a few items to the panel which will make life easier for you while you build your projects.

The most important part of the panel is the test circuit. This consists of an AC outlet (SO3) in series with a 150 watt lamp and parallel switch (SW2) which shorts out the lamp when not needed.

The author found a 150-watt lamp just about right when checking out a 25 watt (audio) hi-fi amplifier. For appliances that draw heavy loads you will probably need a higher wattage lamp. It would be best for you to experiment to find the best values for your own needs.

Let's say you are checking out a newly completed amplifier kit. You plug it in the test outlet (SO3) and turn on its switch. The test lamp glows at partial brightness as the amplifier's filter capacitors charge, and then the lamp dims to a faint glow. We now know that there is no short and you can go on with your testing and measuring.

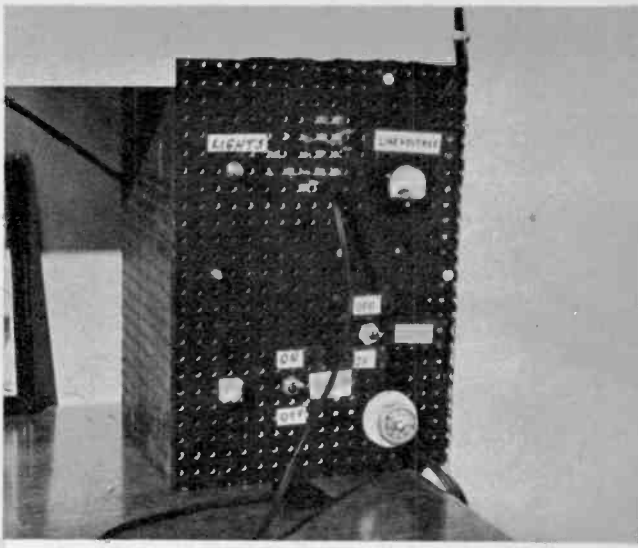
Let's take the other case. You plug the amplifier in, flip the switch and the bulb comes to full brightness—and stays that way. You know immediately you have a short and that troubleshooting is in order. The technique is simple. All you have to do is pull the rectifier tube from its socket. (Careful, it's hot!) If the lamp immediately dims, this indicates the shorted condition is somewhere in the area fed by the B-plus line. Of course if you are working on an AC-DC receiver, removing the rectifier tube from its socket will break the filament series string and the entire receiver will go dead. In this case, unsolder the resistor and capacitor (if present) from the cathode of the rectifier, usually, a 35Z5 or 35W4 or from the positive terminal of the selenium rectifier.

It is now a simple matter to disconnect the various sections where the short may be occuring until the lamp dims. When this happens all you have to do is localize the specific wiring error, bad component or short to ground and the job is done.

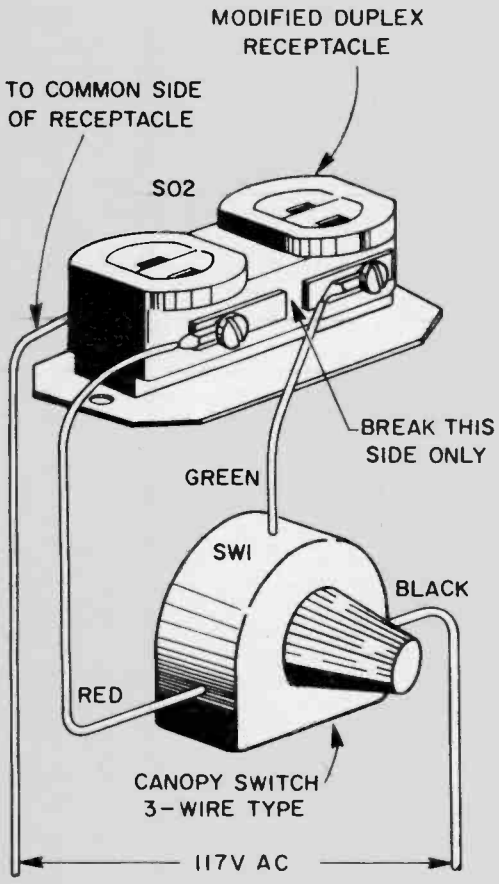
Let's see how the test circuit operates:

We can think of the lamp and the

View of perforated panel board indicates layout of surface mounted parts.



Wiring guide of 3-wire canopy type switch SW1 which controls 2 bulbs individually in duplex receptacle SO2.



amplifier as two resistances in series. If the amplifier is shorted, it becomes in effect a very low resistance. The full voltage drop (or most of it) is across the lamp and it will glow at its brightest. However, the large voltage drop across the lamp effectively prevents excessive current from flowing through the amplifier transformer and the inevitable fuse blowout.

If there is no amplifier short, the high resistance of the transformer compared to the very low resistance of the lamp filament will, according to Ohm's Law, cause most of the voltage to drop across the transformer and very little to drop across the lamp. Hence, the lamp will glow dimly.

When you have determined there is no short in the unit, flip switch (SW2) which shunts out the bulb and allows you to make further tests with full line voltage applied to the circuit under test. That, incidentally, is the reason for the 150 VAC meter in the circuit—a rather inexpensive way to allow you to monitor the line voltage during testing of critical circuits.

The test outlet socket (SO3) was not mounted on the panel, but on the end of a short length of line cord, which allows components and appliances with short line cords to be plugged in and

[*Continued on page* 115]

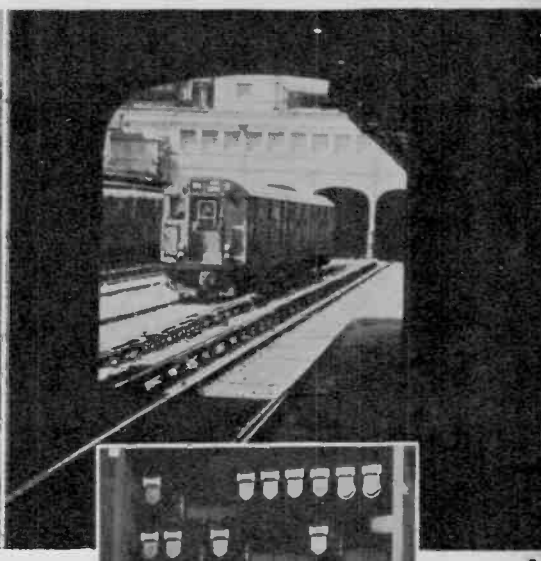
On a French railroad line, this fully automatic control board replaces several mechanical posts, controls train movements for entire station.

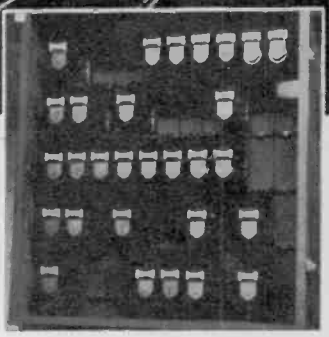
Brains for Trains

Here and in Europe, "ghost trains" become real as electronics takes on once-human control functions.

By Victor E. Howard

IN a bustling French marshaling yard south of Paris, a powerful engine moves smoothly over switches and sidings to couple to a string of freight cars. No one is at the controls. In New York City, a speeding subway train rounds a curve and hurtles into a station, brakes screeching, and comes to a halt. Doors open and passengers scurry off and on before the train starts for the next station. No human hand is involved as the train halts unerringly at the proper spot on the platform and the doors open. In the Far West, a dispatcher punches a series of buttons to divert a long, slow freight train to a siding while a fast express speeds by on the main line. The dispatcher in his control tower is many miles away from the converging trains as they pass each other with complete safety.

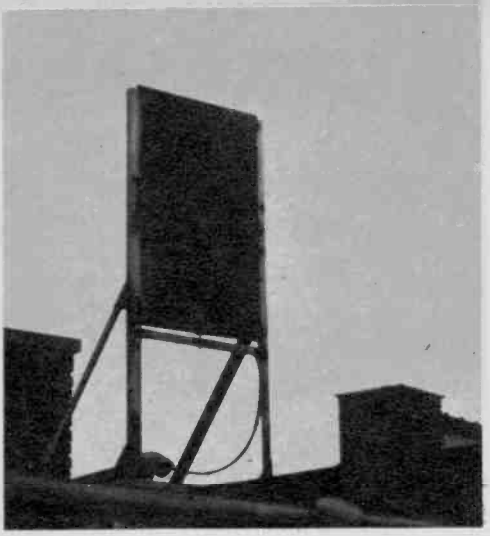




In New York, experimental "Times Square Shuttle" train is put through paces in Brooklyn test area. Left, posts mark limits of "station." Technicians check precision of train's automatic stop. Right, automated train heads for "destination" on simulated shuttle run. Inset: banks of relays, underground, help driverless train to "think."

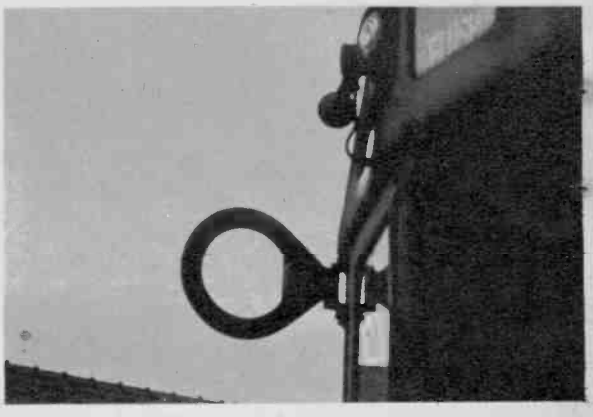
Paris would be a model railroader's paradise. French control setup shunts engines, couples and decouples trains, runs entire yard from single control tower. Standard type engines have nobody aboard.

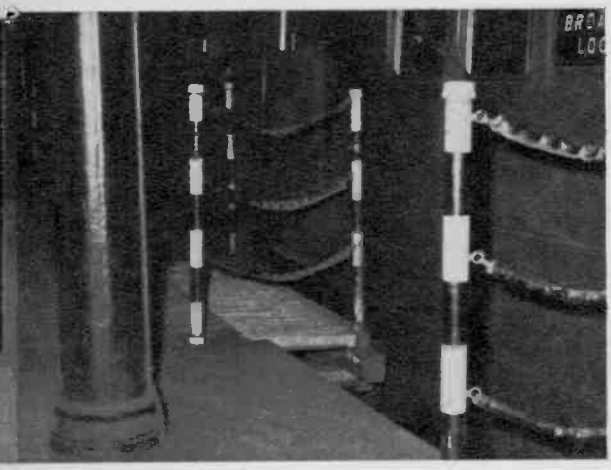
Courtesy French National Railroad



Sensing grid on New York subway line detects and identifies trains (local, express, etc.), activates track switches and safety signals.

"Doughnut" on front of subway train generates field to energize grids. Its variable impedance coil has four settings for train types.





Automatic moving platform extension fills gap between train door and platform at station on curved tracks, pulls back when train departs.

Technician on moving shop car inspects tracks with ultrasonic flaw detector. Method is more reliable as well as faster than visual check.

All over the world, railroad operations are undergoing revolutionary changes brought about by new developments in electronic control of train movements—computer-type banks of circuits which eliminate the possibility of error that contributed to the disastrous wrecks of past years.

Recently, a railroad dispatcher stood on a long platform with a stop-watch, timing an approaching train as it careened into the station and stopped. Rapidly calculating the elapsed time, he hurried to the head of the train to reprimand the engineer for speeding. When he got there, he found the cab empty, the train being controlled by new devices under test. Technicians aboard showed him the actual speed recorded on a continuous tape, and he turned away, shaking his head slowly as he walked back to the office. His stopwatch had been wrong for years!

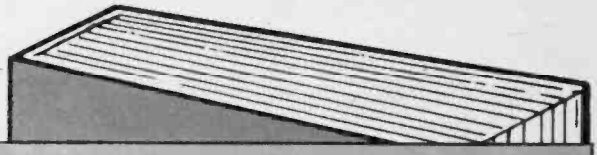
Perhaps the most spectacular advances in electronic railroading are being tested in [*Continued on page* 104]

FREE

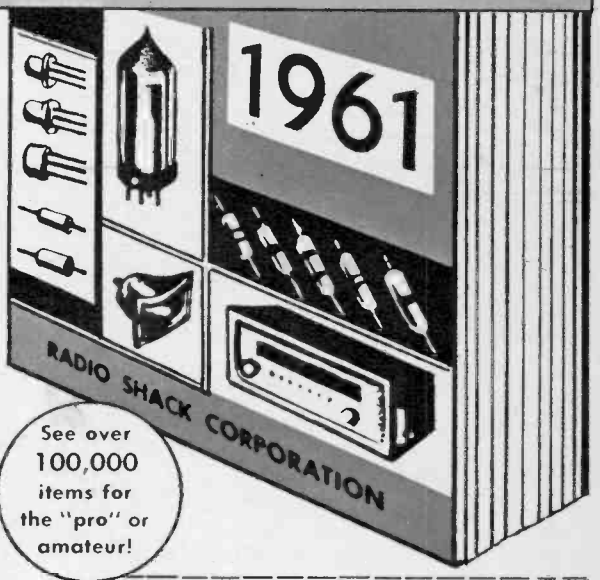
Full Year's Subscription to RADIO SHACK'S Electronics Catalogs

See the world's most complete line of electronic equipment

- **Stereo**
- **Hi-Fi**
- **Ham Radio**
- **Transistors**
- **Test Equipment**
- **Kits and Parts**



DETACH AND MAIL BOUND-IN POST CARD
or Clip Coupon Below Immediately



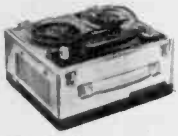
Send for your free catalogs today. Receive the latest 1960-61 Radio Shack Buying Guide plus every issue—hot off the press for one full year! Free and postpaid!

Radio Shack is one of the oldest and most famous corporations in Radio and Electronics. The name came from the term used for the communication center of ships at sea since earliest wireless days. Today as always, Radio Shack is dedicated to bringing the newest and best in electronics to millions—both individual electronic devotees and industry all over America.

Shop Radio Shack catalogs for quality electronic equipment and scores of other items—all priced at truly remarkable savings. Buy on credit, open a charge account. 15-day no-risk home trial on any item. Money back guarantee of satisfaction! Get what you want, when you want it from RADIO SHACK. Mail tear-off card or clip coupon today for your FREE catalogs.

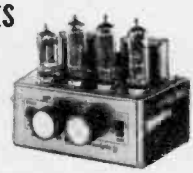
See over 100,000 items for the "pro" or amateur!

Three Typical RADIO SHACK VALUES



Realistic 2-speed Tape Recorder
Compare at ~~$99.85~~
$49.50

Complete Code Practice Set
key and buzzer included
$1.79



Realistic Stereo Fully Wired Amplifier
A complete stereo unit
$9.95

RADIO SHACK CORPORATION
730 Commonwealth Ave., Boston 17, Massachusetts

RADIO SHACK CORPORATION **Dept. 60J8A**

730 Commonwealth Ave., Boston 17, Mass.

Without obligation, please send me FREE and POSTPAID, your latest Electronics Catalog plus every new issue for one full year.

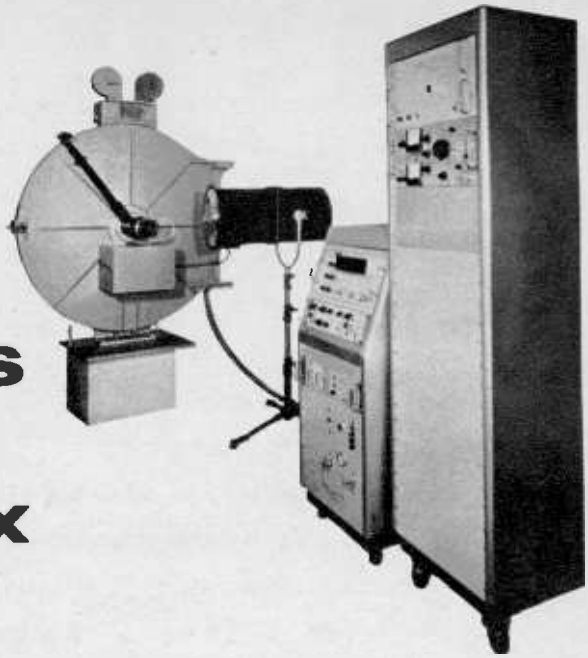
Name_____

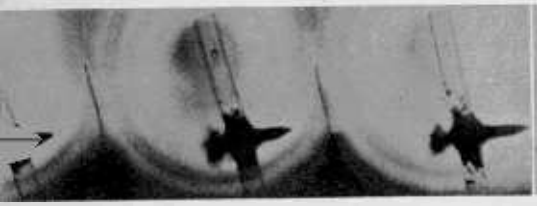
Address_____

Post Office or City_____ Zone____ State_____

ultra-speed camera

Magnifies Time 100,000x





Top: Film lies along inside rim of circular box. Power supply, controls and light are at right.

Left: A .30 caliber bullet at 6500'/sec hits solid plastic. Impact causes a fluid flow.

HERE'S a movie camera that can stretch the events of one second into 28 hours by taking up to 1,600,000 pictures per second on standard 35mm film. When run through a standard projector at 16 frames per second, ultra-fast is slowed down 100,000 times. A valuable research tool, it can stop motion in cams, relays, springs and breaker points with ease, and has proved successful in high speed impact studies. Such impacts may occur, for example, when meteor particles hit the skin of space vehicles. The resulting stress waves (traveling at 11,000 mph) can now be seen.

Since no mechanical shutter can approach this speed, an electro-optical shutter is used which controls passage of light by means of ultra rapid electronic pulses. The shutter assembly consists of two polaroid filters and a cell filled with a special substance in an electric field. When the field is off, no light passes through the assembly. When a high energy electric pulse is applied, the light is polarized in such a manner that it passes freely through the filters. One or two optical lenses focus the image onto a rotating mirror in the film box.

The film remains stationary while the mirror revolves at 100,000 rpm on the shaft of a high speed, [*Continued on page* 115]

a complete

Novice Ham Station

Contents

Barely a week goes by when amateur radio doesn't hit the news in one way or another. In recent months hams handled life and death message traffic in a midwest tornado area and communicated between the East Coast and England by bouncing signals off an earth satellite. We are going to show you how you can obtain the two essentials—a license and a station—which will enable you to join this fascinating fraternity of amateur radio enthusiasts.

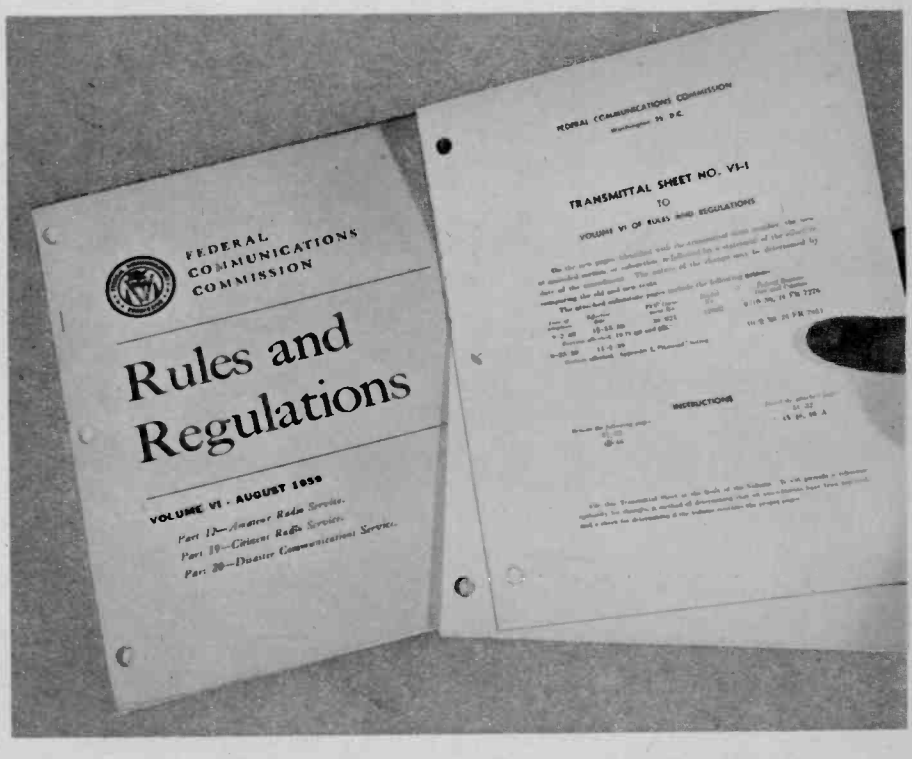
by Len Buckwalter

The Novice License

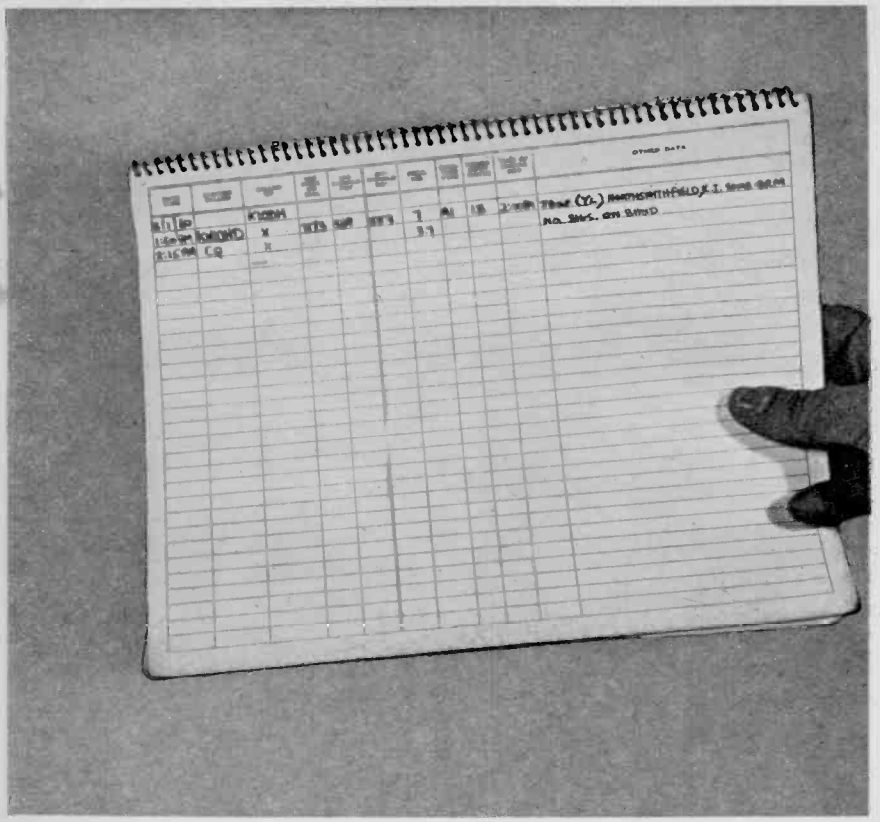
BACK in September, 1949, the Federal Communications Commission considered an entirely new kind of ham license—the Novice Class. The idea was to strip away much of the complex theory and code speed requirements of the higher grades. A reality by 1951, it offered the beginner, especially youth, a chance to get on the air with an easily-acquired license.

The Novice is really a ham-in-training. He has a 1-year (non-renewable) term to raise his code speed and build up a background in basic electronics, prerequisite to a renewable type of ticket with full privileges. The Novice license has limitations; transmitter power can be no greater than 75 watts and the frequency bands are restricted. However, it does provide a splendid opportunity to "learn by doing"—a far more fascinating process than working with textbooks and code machines alone.

Your first step toward the Novice license is to acquire a copy of Part 12 of the FCC's rules and regulations covering the amateur service. Due to a recent change in format, it appears in a 3-section volume which also contains rules for the Citizens Radio and the Disaster Communication Service. The cost of the volume is $1.25 and entitles the purchaser to all the new rules and amendments as they appear. Part 12 is an invaluable "handbook" of information for the prospective ham. Though written in legal language, it nevertheless is an understandable guide to the ham's obligations under the law. It is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Ask for FCC Rules and Regulations, Volume VI.



Rules and Regulations are available from Government Printing Office. "Transmittal Sheets" contain new rules, amendments, etc.



Log book, required by law, is a written record of transmission.

Ham radio is one of the few hobbies which require a license from the federal government. In fact, two are necessary; an operator and station license. Actually, a single white card contains both authorizations. The license covers transmitting equipment only—no need for regulations on the receiver—and must be in your possession while operating.

Once you have mastered the test questions (on pages 83 to 85) the application and exam papers are requested in writing from the FCC Engineer-In-Charge of your district. Field office addresses are given in Part 12 of the rules and regulations. Ask for an operator and station license form for the Novice Class license and the mail examination papers. The material is free and will probably reach you in about 10 days.

Carefully follow the instructions accompanying the sealed examination. The person you choose to administer the code portion must hold a General, Advanced or Extra Class license—or be a commercial telegraph operator. He may also act as witness, if over 21 years old, to the written part of the test. If necessary you can request assistance from the FCC Engineer-In-Charge of your district.

Achieving the code speed requirement of the test (5 words per minute) can be easy if you use one of the systems available to the prospective Novice: phonograph records, magnetic tape recordings and automatic keyers. Unless you have the services of an experienced ham, these systems are recommended.

How to Build a Novice Station

Enclosed in one metal cabinet, the *Electronics Illustrated* Novice station includes the receiver, transmitter and power supply. The only additional item required—the license itself. Since the waiting period for a call-letter assignment runs about six weeks; that time can profitably be used for construction.

The design of the rig resulted from an effort to see just how much a rig could be stripped away and still match the performance of a Novice station costing much more. It's portable too.

Receiver

The receiver is the first of the rig's three basic sections (the other two are transmitter and power supply). It consists of the single tube V1. The first section, V1A, is a regenerative detector; the second half serves as an audio amplifier to boost the signal to comfortable earphone level. See schematic diagram on page 77.

When compared to a big superhet, the performance of a regenerative receiver is amazing. The regen's sensitivity is high and it can't be beat for low cost and simplicity. Any drawbacks? Yes—very strong signals at close range will tend to occupy a large space on the dial blocking out the weaker ones.

The receiver plug-in coil L1 has three separate windings; A, B and C. Signals enter winding L1A from the antenna and couple into L1B. C1 ("Calibrate" on side) and C2 (tuning capacitor on

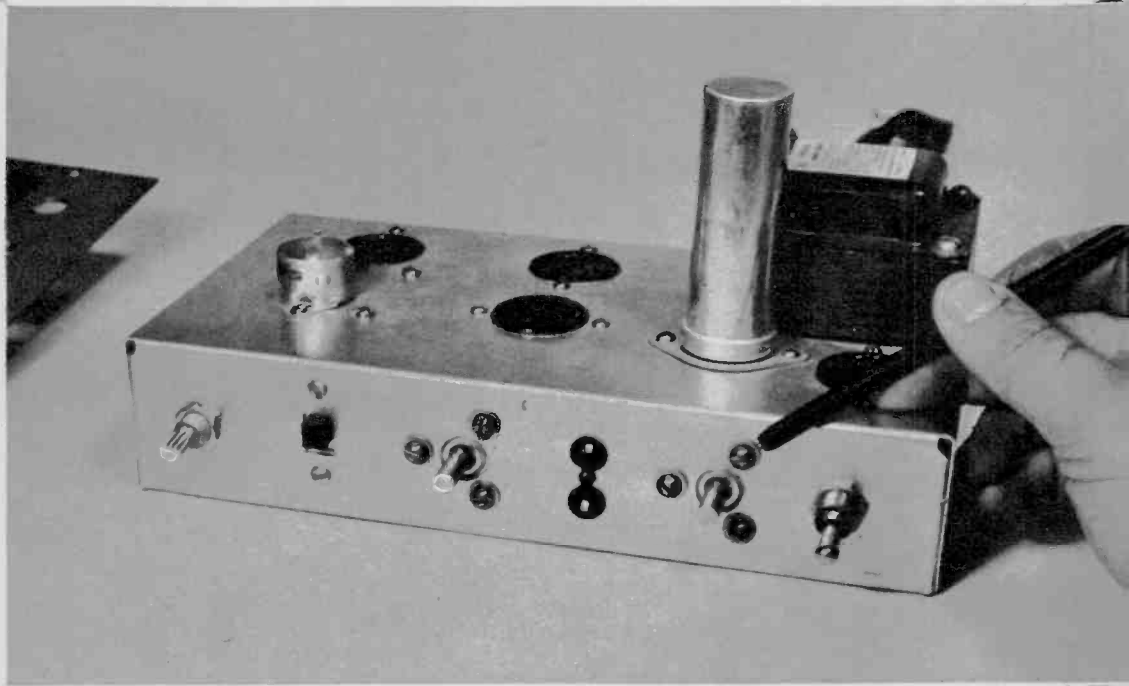
front panel) form a tuned circuit with L1B for selection of the desired station. The last winding is L1C, the "tickler." It feeds energy from the screen (pin 3) of tube V1A back to the grid through coupling with L1B. The result is a sustained oscillation. Both antenna and oscillation frequencies mix and an audio tone results. The tone appears in V1A's plate circuit and proceeds to the second half of the tube (V1B) for straight audio amplification. A network of RFC1, C4, and C5 filters out radio frequencies which may appear in the plate circuit.

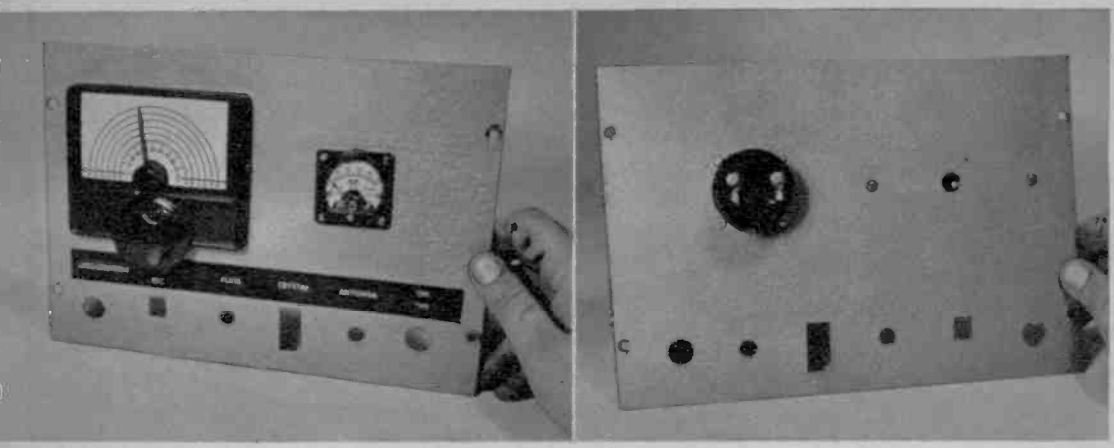
The keying circuit opens and closes the current path from ground to the cathode of V2. This can pose a slight shock problem with high-powered rigs, but nary a tickle is felt when the fingers are placed across the bare metal of the key. The meter (M1) is in series with the key and monitors cathode current, useful during tune-up. Although M1 specified in the Parts List had no polarity indications, its negative terminal goes to J1. If the meter reads in the wrong direction, reverse the connections to the meter.

There is nothing critical in the rest of the transmitter circuit. Don't attempt to use this stage as a frequency doubler (that is, using an 80 meter crystal and a 40 meter coil) as its stability will be adversely affected.

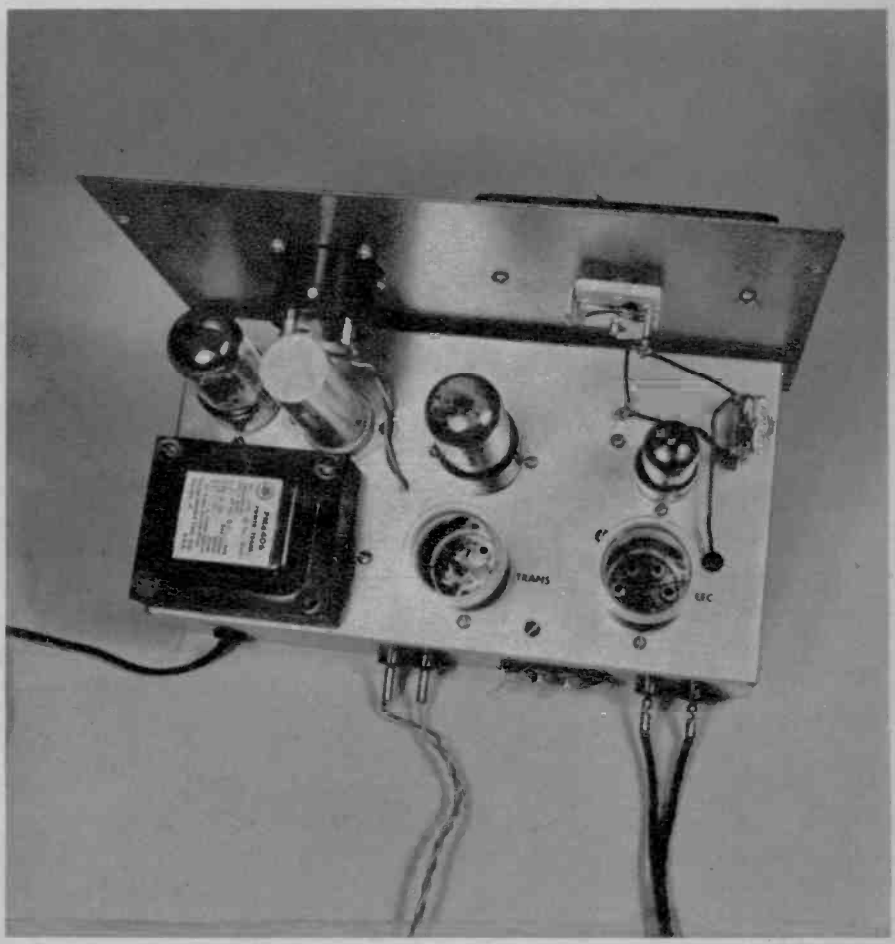
The *Send-Receive* switch SW2 connects the outside antenna to L2 when in the *Send* position. The tube's high voltage is not switched (as in the receiver) since the key itself accomplishes this. This will be important during the calibration procedure

Front view of chassis after major parts have been mounted. Use washers under screwheads which hold tuning capacitors, to prevent hitting plates.

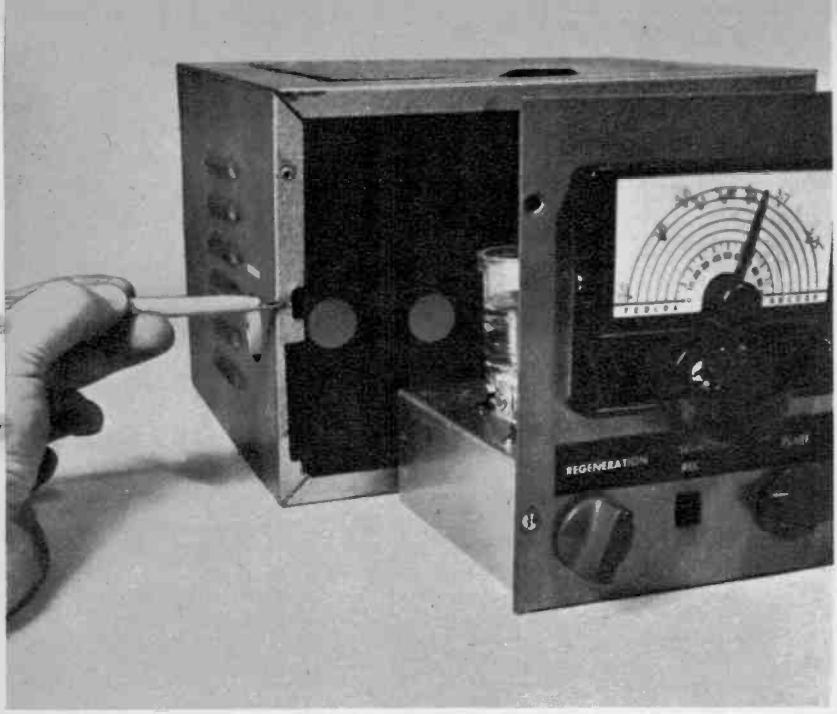




Holes have been cut along bottom edge of front panel to allow controls to pass through. Rear of front panel shows meter at left, dial mechanism bushing, right. Panel is held to chassis by Regeneration, On-Off controls.



Top view shows location of major components. Note heavy enamel wires (upper right) which run from tuning capacitor to calibration capacitor on right side chassis.



Cabinet flange must be filed away to permit chassis to slide in. Pencil points to notch to fit calibrating capacitor.

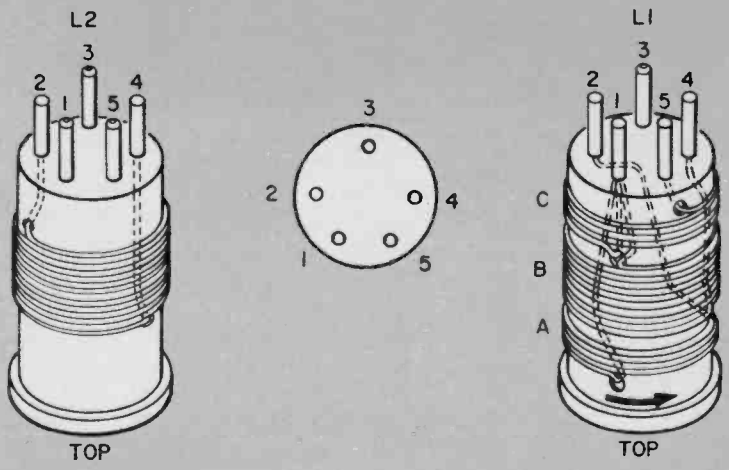
where the receiver and transmitter must be on at the same time.

Typical operating voltage of the transmitter is +300 volts, measured at the ungrounded side of bleeder resistor R10. This is with the key down and the meter indicating about 40 milliamperes (input power: 12 watts).

The regeneration control R4 varies the screen voltage of V1A. As R4 is advanced, the screen voltage rises and imparts enough gain to the tube for it to break into oscillation. Perhaps the only critical aspect of the receiver is to ensure feedback from screen to grid. If coils B and C are not wound in the correct direction, the tube won't oscillate. No difficulty should be encountered if the coil winding chart is carefully followed. However, there is an easy way of remedying an incorrect winding. After the rig is complete, advance the regeneration control and listen for the characteristic "pop" in the earphones as the circuit begins to oscillate. If you don't hear it, and no other error exists, try reversing the two wires of L1C which go to pins 1 and 5 of SO1.

The *Send-Receive* switch (SW2) connects the outside antenna to L1 (terminals 2 and 3) when in the *Receive* position. Terminals 5 and 6 of this switch connect the receiver section to the high voltage B+.

The only other consideration in constructing the receiver is the wiring between tuning capacitors C1, C2, and the tube socket. This is done with heavy enamel or Formvar insulated wire, #14 or larger. These stiff wires aid in receiver stability. Note that the ground lead runs from the rotor tab of C2 to a ground lug on the top of the chassis, and continues on to one lug of C1. The other wire runs from a stator lug (post) on C2 to a lug on C1 and through a rubber grommet on the chassis to the coil socket SO1. When choosing the lug for the ground wire on C1, check with an ohmmeter to be certain it's the one which connects to the tuning screw of this trimmer capacitor. If the tuning screw is at ground potential, the calibration procedure is far less tricky. The final



NUMBER OF COIL TURNS	
80 METER	29 TURNS
40 METER	14 TURNS
USE NO. 20 ENAMEL WIRE	

NUMBER OF COIL TURNS			
80 METER	5T(A)	24T(B)	5T(C)
40 METER	3T(A)	11T(B)	3T(C)
USE NO. 24 ENAMEL WIRE			

To wind transmit coil: Drill small hole in coil form 1½" from tip of pin 2. Scrape ends of wire, insert into drill hole and solder to pin 2. Wind proper number of turns, drill hole over pin 4, insert wire through it and solder.

To wind receiver coil: Drill small holes over pins, 5, 4 and 1. Insert wire and solder to pin 5. Wind C in direction of arrow. After correct number of turns, insert in hole and through pin 1. Wind coils B and A in same way.

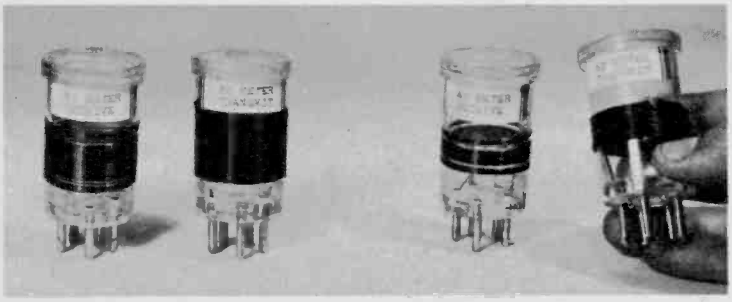
step in the receiver section is to dope the coil with polystyrene cement or other suitable liquid.

The Transmitter

The one-tube transmitter uses a 6V6 tube V2 as an oscillator operating at a power input level of about 13 watts. This definitely is above the "flea-power" class and, with a reasonably good antenna, will give a good account of itself many hundreds of miles away.

Oscillation frequency is controlled by the crystal (Xtal), and is sustained by the feedback path from the cathode to the grid of V2 through a capacitor divider—C12 and C13. Energy in V2's plate circuit is tuned by plug-in coil L2 and plate tuning capacitor C16. Capacitor C17 is the antenna loading control. This output circuit is a pi-network and will match into

One pair of coils is used for 80 or 40 meter operation. Receiver coil wires are spaced about 1/16" apart. All coils plug into top of chassis.



PARTS LIST

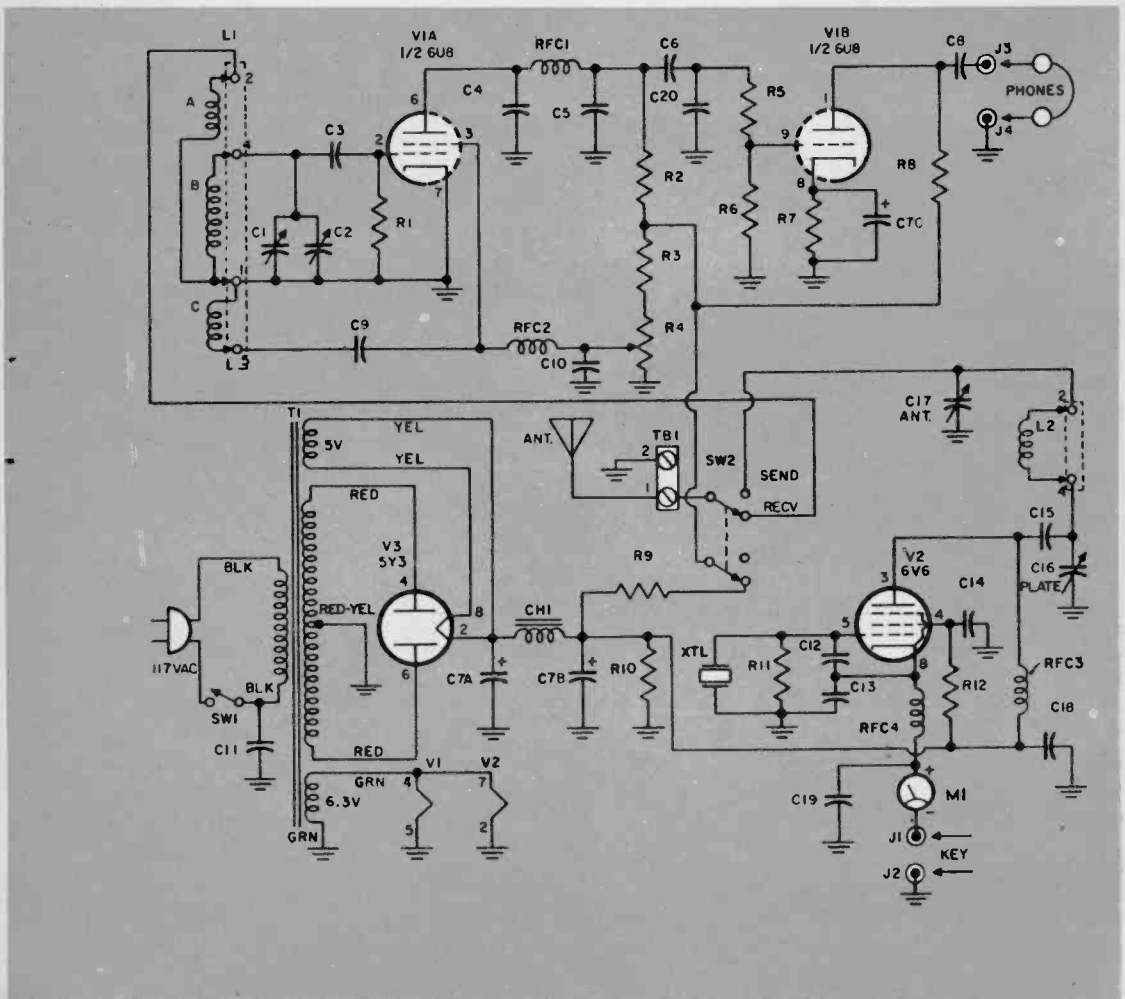
Resistors (½ watt unless otherwise noted)
R1—1 megohm
R2—22,000 ohm
R3—47,000 ohm 2 watt
R4—50,000 ohm potentiometer 2 watt, linear taper
R5,R11—100,000 ohm
R6—470,000 ohm
R7—470 ohm
R8—1800 ohm 1 watt
R9—3900 ohm 2 watt
R10—100,000 ohm 2 watt
R12—15,000 ohm 2 watt

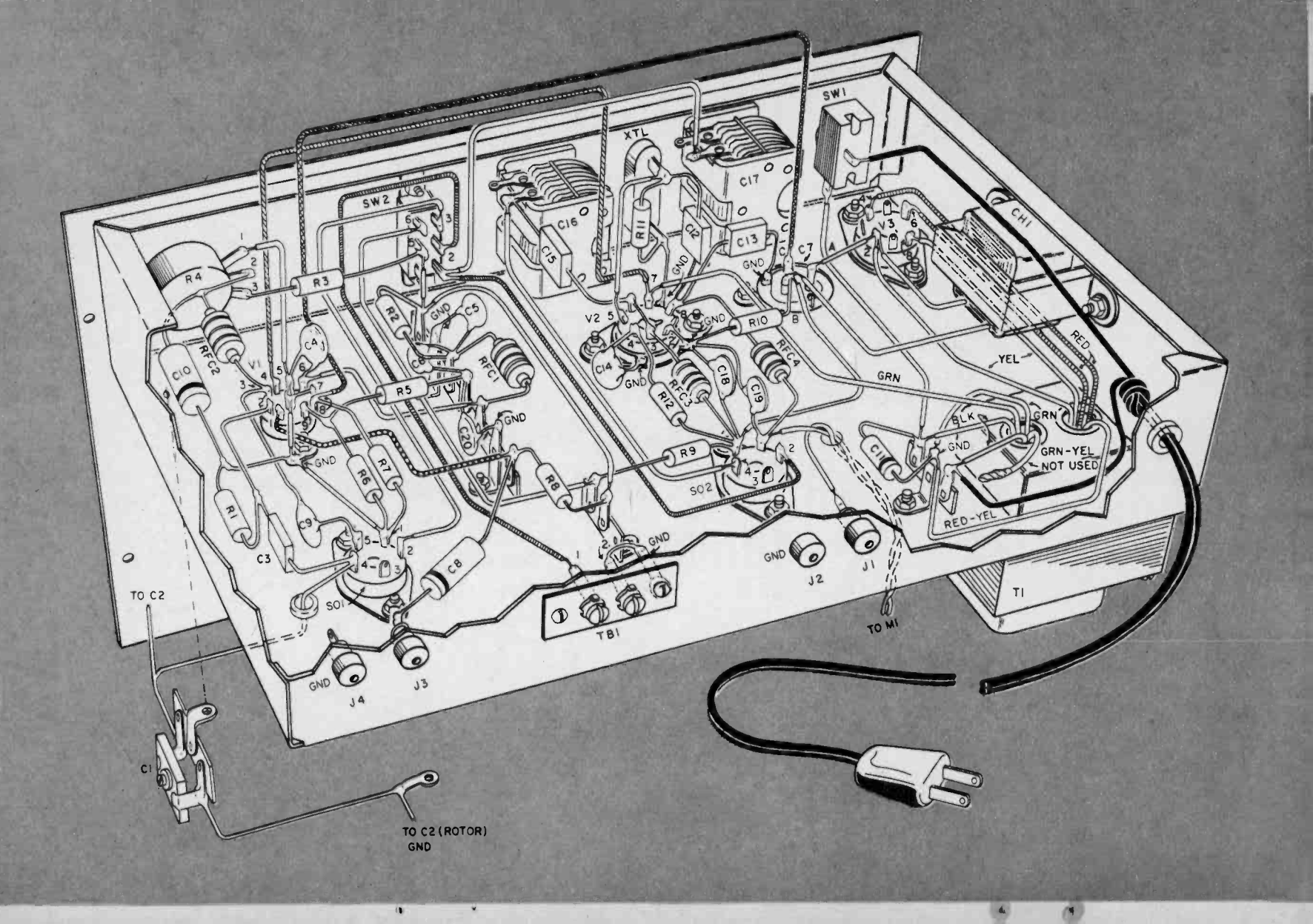
Capacitors
C1—180 mmfd mica trimmer
C2—15 mmfd variable air (Hammarlund HF-15)
C3—100 mmfd mica, 500 volt
C4,C5,C9,C14,C15,C18,C19—.001 mfd disc ceramic, 1000v
C6—.0047 mfd disc ceramic, 1000 volt
C7A,C7B,C7C—Triple-section electrolytic: 20 mfd @ 450 volts; 15 mfd @ 450 volts; 20 mfd @ 25 volts
C8—.02 mfd paper, 600 volt
C10—.1 mfd paper, 600 volt
C11—.01 mfd paper, 600 volt
C12—22 mmfd mica, 500 volt
C13—220 mmfd mica, 500 volt
C16,C17—365 mmfd air variable (Miller 2111)
C20—500 mmfd disc ceramic, 1000 volt

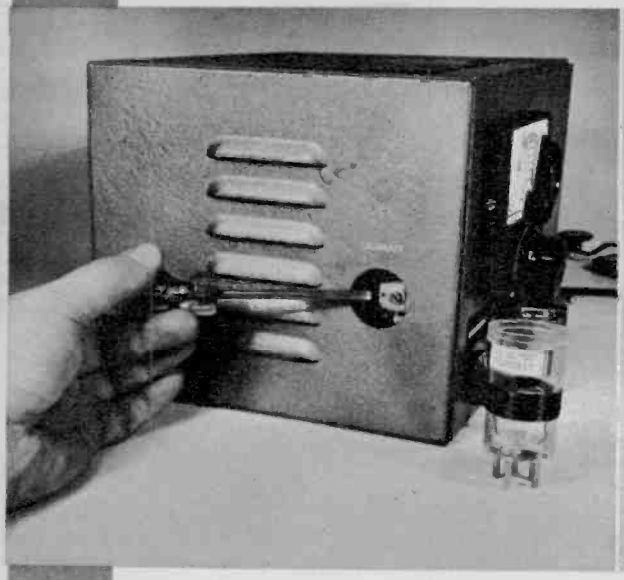
Tubes
V1—6U8 V2—6V6 V3—5Y3
SO1,SO2—5-prong tube sockets

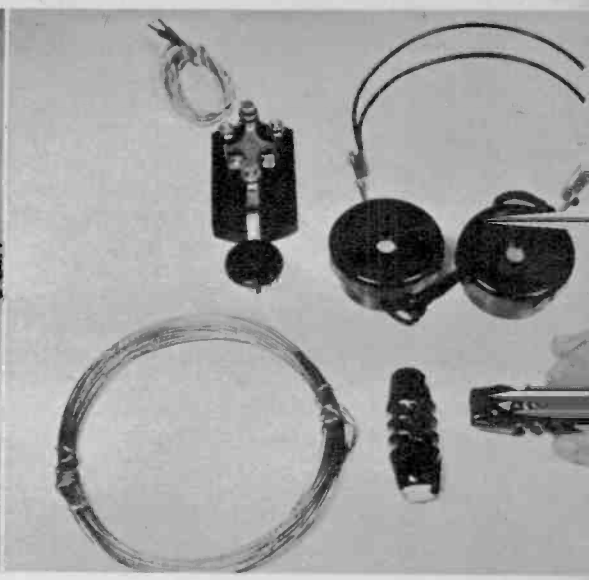
RFC1 to RFC4—2.5 MH RF choke (National R-50)
CH1—Filter choke, 7 henries @ 50 ma
J1 to J4—Pin tip jacks; 2 red, 2 black (remove insulating washers on black ground jacks)
TB1—2-screw terminal strip for antenna connections
XTL—Crystal (see Novice Frequency Chart)
M1—0-50 ma DC meter
T1—Power transformer; 117-volt pri.; 325-0-325 volt sec @ 40 ma; 5 volt @ 2 amp.; 6.3 volt @ 2 amp. (Stancor PM-8406 or the equiv.)
SW1—SPST toggle switch
SW2—DPDT slide switch
L1—Receiver coil (see chart) wound on 5-pin coil form (Amphenol 10039)
L2—Transmitter coil (see chart) wound on 5-pin coil form (Amphenol 10039)
Misc.—Crystal socket, ½" spacing; two octal tube sockets, one with 4 ground lugs for V2; one 9-pin miniature tube socket with centerpost; Multiccale Dial (Millen 10039); aluminum chassis, 9½"x5"x2"; four 5-pin coil forms (Amphenol 24-5P); length #20 enamel, #24 enamel wire; four terminal strips (check wiring guide for lug layout); rubber grommets; AC line cord and plug; three knobs for ¼" shaft; cabinet 10"x7"x6" (Bud C993)
Accessories—Telegraph key; antenna wire, insulators; headphones, 2000 ohm or higher

Complete schematic of novice rig. Receiver plug-in coil has three separate windings, A, B and C. Transmitter section is V2 in X-tal oscillator circuit.




SW1
XTL
SW2
C17
C16
C15
C11
C12
C13
C7
CH1
V3
R4
R3
R2
GND
C5
C4
V2
R10
RFC4
RED
YEL
GRN
C10
RFC2
V1
R5
RFC1
C14
RFC3
R12
C18
C19
BLK
GRN
GRN-YEL
NOT USED
C11
RED-YEL
C20
R9
R6
R7
R8
SO2
R1
C9
C3
C8
SO1
GND
J2
J1
TO M1
T1
TB1
J4
J3
TO C2
C1
TO C2 (ROTOR)
GND





Hole is made in cabinet for easy access to calibration capacitor. This capacitor should be fully clockwise and temporarily remove transmit coil.

Novice rig accessories include key, pair of earphones and roll of antenna wire. Hand holds standard insulator which is used for antenna tie-points.

antennas of various lengths. Since it is fed through blocking capacitor C15, there is no dangerous power supply voltage on the coil. High voltage does not appear anywhere above the surface of the chassis, leaving just one point of precaution; the tubes run quite hot in normal operation.

Construction Tips

Before cutting any holes in the chassis, shift the parts around (tube sockets, etc.) to find their exact mounting locations. Use the illustrations as a guide, but the parts themselves are the best templates. A point of possible conflict is the large filter capacitor can (C7) touching J1 and J2. This can be prevented by positioning power transformer T1 as close to the rear of the chassis as possible. Mount C7's metal mounting wafer (comes with capacitor) close to the transformer and check for clearance between C7 and the rear of M1.

There is one economy measure used in the rig which could cause confusion to beginners. The sockets used for the tubes and coils have several unused or "dead" lugs. In some cases they are used as convenient tie-points for the wiring and have nothing to do with the coil or tube itself. Lug 5, for example, on transmit coil socket SO2 has five wires soldered to it—with none connecting to the coil itself.

The use of tube socket punches greatly facilitate the metal-working aspect of the construction. Square holes can easily be made with a "nibbling" tool, listed in the electronic catalogs. Another indispensable aid is a rat-tail file for coaxing a hole to the correct diameter—the crystal socket, jacks, etc.

Putting the Rig on the Air

After construction is completed, the license and operating accessories acquired, you're ready for the first on-the-air check. It is very helpful when putting a new rig on the air for the first time, to have a neighboring ham listen for your signal—but not absolutely essential. The bands are loaded with stations ready to be of assistance.

Setting Up

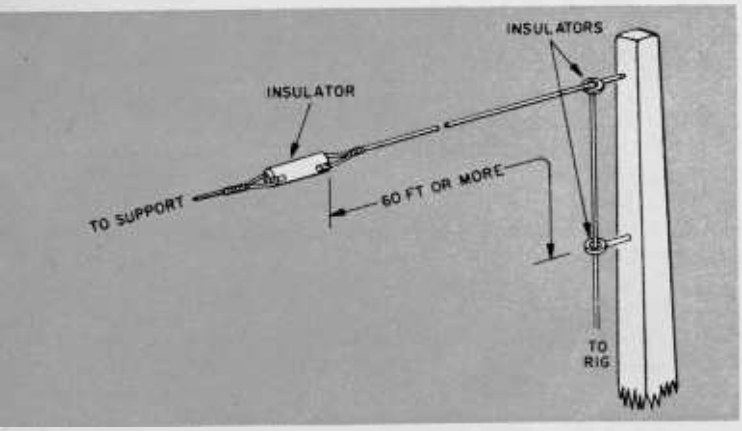
The initial tune-up should be on the 80-meter band since the adjustments are less critical than on 40. Plug the receiver and transmitter coils into their respective sockets. The key, headphones and crystal may be inserted into their sockets without regard to polarity. When ordering the 80-meter crystal, avoid the risk of operating out of the band by choosing a frequency not closer than 5 kc from the band edges. Thus, the frequency should be somewhere between 3705 kc and 3745 kc. Rotate the three knobs; *Regeneration, Plate,* and *Antenna,* to their counterclockwise positions and flip the *Send-Receive* switch SW2 to *Receive.* Insert a screwdriver into the *Calibrate* hole on the side of the cabinet and gently screw the capacitor in a clockwise direction (toward its maximum capacity).

Before proceeding, we'll pause to consider one of the most important elements for success—the "sky hook."

Antennas

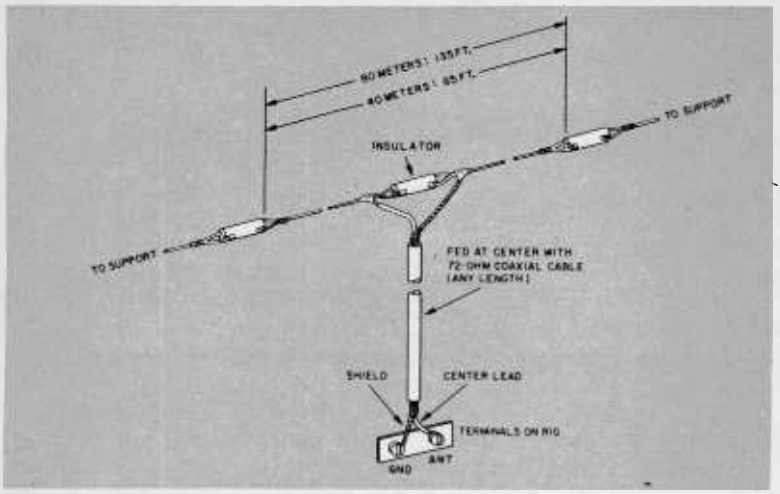
Although a great variety of antennas exist for ham radio, two of the simplest (but effective) types are shown here; the long wire and the dipole. The long wire is just a random lead run from the antenna terminal to a tie-point outdoors. Its minimum length should be about 60′. Height is also a factor. You don't have to clear every tree or nearby building, but get it up as high as you can. Some amount of zig-zagging of the wire is permissible; too much will squeeze the radiation pattern and limit your coverage. Ideally, the long wire looks like an inverted "L," running up the side of the building and horizontally to its far tie-point.

A long wire antenna is perhaps the simplest to set up. 60 feet should be its minimum length. Mount it as high as possible.



Insulators are essential to keep power from being lost. A look through the catalogs will reveal the types of insulators needed for your particular installation. The long wire will operate on both 80 and 40 meters.

A dipole on each band is more effective and less of a compromise than the long wire. It doesn't radiate along the feed line, and it places the power where you want it—up high. The dipole is bi-directional, e.g., the maximum power is transmitted broadside to the wire. As shown in the



A dipole antenna for each band is more effective than a long wire. 72-ohm coaxial cable doesn't need stand-off insulators.

diagram at left, the feed line is 72-ohm coaxial cable, which can be permitted to touch the side of the house as it runs up to the radiating portion of the antenna.

Calibration of the Receiver

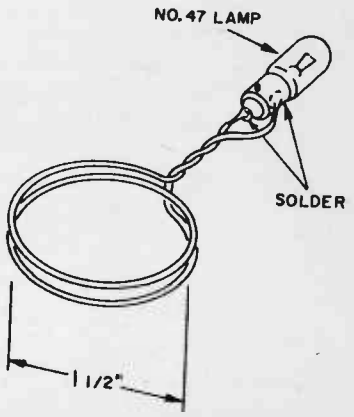
Since the antenna feeding a regenerative receiver can affect its frequency, the receiver should not be calibrated until the antenna has been permanently installed. A ten minute warmup period is also recommended. It allows the circuits to reach operating temperature and minimizes drifting. The regeneration control should now be advanced to about half-way open.

Receiver dial calibration is accomplished with the aid of the transmitting crystal. Using the photo of the author's rig as a guide, rotate the tuning knob so it points to the place on the dial which corresponds to the frequency marked on the transmitting crystal. Notice that the 80 meter Novice band appears at the upper right hand corner of the dial face. Now, pull the transmitting coil out of its socket completely, and depress the key. This procedure will cause the crystal to oscillate sufficiently to provide a calibrating signal without blocking the receiver.

Keeping the key down, insert a screwdriver into the calibrating hole and unscrew capacitor C1 *slowly* until a loud tone is heard in the earphones. Keep tuning slowly until you pass a dead spot in the tone (known as the "zero beat"). The receiver will be tuned to the transmit frequency when calibrated on zero beat.

It is possible that after two or three turns of C1 no tone is heard. This can be corrected by changing the position of the *Regeneration* control R4 slightly and trying again.

With the key up, it should now be possible to receive stations. Starting at its minimum position, slowly advance



Transmitter output and tuning may be checked with this RF indicator. Solder wire to bulb.

R4 until a "pop" is heard (usually accompanied by a soft rush of atmospheric noise). Tune around the band for signals and then use R4 to peak them up.

With the antenna connected, *Send-Receive* switch on *Send* and the transmit crystal and coil in their sockets, the transmitter section is ready for tune-up. Depress the key and slowly advance the *Plate* knob. At one precise point in tuning, a dip in plate current, as indicated by the meter, will occur. Shift over to the *Antenna* knob and try to bring the current up two or three milliamperes. Now back to the *Plate* for re-dipping.

The idea of this tune-up is to load as much current as possible (up to 40 ma) from the tube into the antenna. It's a back and forth process between *Plate* and *Antenna* knobs; up to the point where Antenna knob will produce no further increase in plate current.

There is, however, a possibility of error in the above procedure. You can bring the current way up with the Antenna knob, dip the plate, and end up with no output power. The check on this is simple. Make up the little RF indicator shown. While tuning, hold the loop as far above the turns of the transmit coil without losing the glow. By placing the indicator around upper rim of transmit coil and leaving it there while operating, you'll always have a positive indication of output power.

NOVICE BANDS		
BAND	FREQUENCIES	OPERATION
80 METERS	3700 KC — 3750 KC	CW
40 METERS	7150 KC — 7200 KC	CW
15 METERS	21,100 KC — 21,250 KC	CW
2 METERS	145 MC — 147 MC	CW OR PHONE

Proper key technique consists of grasping key gently and imparting an up-down wrist action.

Colorful QSL cards, confirming contacts, can make a very colorful, interesting wall display.

Questions and Answers for the Novice Exam

The questions listed below are representative of those you'll encounter on the test. If you become thoroughly acquainted with the material you'll probably breeze through the actual exam. Of course, the real understanding comes during the year of apprenticeship the Novice license provides.

Ques. *What is the maximum input power permitted to the final stage of a transmitter operated by a Novice?*

Ans. **75 watts. Thus, if you want to operate a friend's 100-watt transmitter, the input power must be reduced.**

Ques. *What is the maximum penalty for violation of FCC rules and regulations?*

Ans. **A fine of up to $500 for each day during which the offense occurs, revocation of the station license and suspension of the operator's license.**

Ques. *On which bands may a Novice operate?*

Ans. **3700 kc-3750 kc, 7150 kc-7200 kc, 21,100 kc-21,250 kc, 145 mc-147 mc.**

Ques. *On which bands may a Novice operate on radiotelephone?*

Ans. **145 mc-147 mc.**

Ques. *What is a station log, what information must it contain and how long must it be preserved?*

Ans. **A log is a written record of transmissions. It must contain: date and time of transmission, type of emission, call sign of the station called, transmitter power input, frequency, signature of each licensed operator, and name of any unlicensed person who speaks over a radiotelephone transmitter directly, or by recording, or operates a teleprinter keyboard, location of station and message traffic handled.**

Entries which do not change may be entered once: power, station location, etc. Logs and message traffic must be saved for one year.

Ques. *What is the term of a Novice Class license?*

Ans. **The Novice license is good only for one year and may not be renewed.**

Ques. *What are the rules regarding the transmission of improper language, false signals, or malicious interference?*

Ans. **They are prohibited and there are heavy penalties for violations.**

Ques. *What are the rules regarding purity and stability of emission?*

Ans. **Spurious radiation below 144 mc must be reduced in accordance with good engineering practice.**

Ques. *What method of frequency control is required to be used in the transmitter of a station licensed to the holder of a Novice Class license?*

Ans. **The frequency must be crystal controlled. Variable frequency oscillators (VFO) are not permitted.**

Ques. *What are the rules regarding the measurement of frequency?*

Ans. **The frequency of emission must be measured regularly and must be done by a means independent of the means to control the transmitting frequency. Accuracy must be high enough to ensure operation within the frequency band used.**

Ques. *Who may operate the transmitter licensed to the holder of a Novice Class license?*

Ans. **Any amateur radio operator.**

Ques. *Under what circumstances may an amateur radio station be used by a person who does not hold a valid license?*

Ans. **An unlicensed person may not operate an amateur radio station. However, he may speak over the microphone or use the keyboard of a teleprinter if a licensed operator controls the emissions.**

Ques. *What is the maximum permissible percentage of modulation of an amateur radiotelephone station?*

Ans. **100 percent.**

Ques. *At what intervals must an amateur station be identified by its call sign. May any transmission be made without station identification?*

Ans. **Identification must be made at the beginning and end of each transmission and at least every ten minutes if a single transmission lasts**

longer than ten minutes. No transmission may be made without identification except during a sequence of transmissions each less than three minutes long, in which case the call sign need be given only once every ten minutes as well as at the beginning and end of the work.

Ques. *Under what conditions is notice of portable or mobile operation required to be given, and to whom in each case?*

Ans. Notice of intended mobile or portable operation must be given the FCC Engineer-In-Charge of the district in which such operation is contemplated only when the operation is or is expected to be for longer than 48 hours.

Ques. *What are the recognized abbreviations for: kilocycles, megacycles, Eastern Standard Time, Greenwich Mean Time, continuous wave, frequency modulation, amplitude modulation?*

Ans. *Kilocycles*—kc, *megacycles*—mc, *Eastern Standard Time*—EST, *Greenwich Mean Time*—GMT, *continuous wave*—CW, *frequency modulation*—FM, *amplitude modulation*—AM

Ques. *What is the relationship between a fundamental frequency and its second harmonic; third harmonic, etc.?*

Ans. Second harmonic is twice the fundamental frequency, the third harmonic is three times the fundamental frequency, etc. Note that the fundamental is the same as the first harmonic.

Ques. *What is the relationship between a cycle, kilocycle and a megacycle?*

Ans. One *kilocycle* is 1000 cycles. One *megacycle* is 1000 kilocycles (or 1,000,000 cycles).

Ques. *What instrument is used to measure: electrical potential, electrical current, electrical power, electrical energy?*

Ans. *Electrical potential*—voltmeter
Electrical current—ammeter, milliammeter or microammeter.
Electrical power—wattmeter
Electrical energy—watt-hour meter

Ques. *What is the purpose of: a modulator, amplifier, filter, rectifier?*

Ans. *Modulator*—varies the amplitude, frequency of phase of the transmitter output for the purpose of transmitting intelligence, or information.
Amplifier—increases amplitude, or power, of a signal.
Rectifier—changes alternating current into pulsating direct current.
Filter—reduces undesired frequencies without affecting desired ones. A power supply filter, for example, attenuates pulsating current and passes direct current. A band-pass filter rejects frequencies above and below a given band.

Ques. *What is meant by: amplification, modulation, detection, attenuation?*

Ans. *Amplification*—the process of increasing the power level or amplitude of a signal.
Modulation—the process of varying the amplitude, phase or frequency of transmitter output, primarily to super-impose information on it.
Detection—the process of recovering the information super-imposed (by modulation) on a radio-frequency signal.
Attenuation—the reduction of amplitude, or strength.

Ques. *What is the purpose of: a radio-frequency choke, an audio-frequency choke, a filter choke?*

Ans. A *radio-frequency choke* opposes the flow of radio-frequency current, permits audio frequencies and direct current to flow.
An *audio-frequency choke* opposes the flow of audio-frequencies and permits direct current to flow.
A *filter* choke smooths out the ripples in the direct current output of a rectifier.

Ques. *How is the power input to the tube or tubes supplying energy to the antenna of an amateur transmitter determined?*

Ans. Input power is determined by multiplying the plate voltage and plate current of the final tube(s). For example: the input power of a tube with a plate voltage of 250 volts and a plate current of 40 milliamperes is 10 watts. Note that milliamperes must be changed to

amperes before multiplying with plate voltage. Thus, 40 milliamperes becomes .04 amperes. 250X.04 = 10.

Ques. *Why are a rectifier and filter required in the plate power supply system of an amateur transmitter when operated from alternating current?*

Ans. The rectifier changes alternating current into direct current and the filter smooths out the ripples, or pulsations. According to the regulations, adequate power supply filtering must be used on operating frequencies below 144 mc.

Ques. *What is a frequency multiplier?*

Ans. This is a device, often a vacuum tube, which delivers output at a multiple of its input frequency. Output will be a harmonic of the fundamental, or applied frequency.

Ques. *What are the undesirable effects of overmodulation in radiotelephony?*

Ans. The generation of spurious sidebands which lie outside of the operating channel. They cause interference to other stations both in and out of the band through an effect called "splatter."

Ques. *What is meant by a "parasitic" oscillation?*

Ans. An oscillation which is not essential for operation and often occurs on a frequency different from the operating frequency.

Ques. *What is the purpose of a key-click filter and when should it be used?*

Ans. A key-click filter reduces spurious radiation produced by a radiotelegraph transmitter and should be used whenever such suppression is required.

Ques. *What is Ohm's Law?*

Ans. This expresses the relationship between voltage, current and resistance in a circuit. The symbols used are; I = current in amperes, E = potential in volts, R = resistance in ohms. Three expressions of Ohm's Law are:

$$E = IR \qquad I = \frac{E}{R} \qquad R = \frac{E}{I}$$

Ques. *What precautions should be taken to avoid danger of shock from high-voltage electrical circuits?*

Ans. Such circuits should not be exposed where accidental contact can occur. Work on equipment with the power turned off. Power supply capacitors should have bleeder resistors across them to discharge the capacitors after power has been turned off.

Ques. *What is the relationship between the frequency and the wavelength of a radio wave if its velocity in space is 300,000,000 meters per second.*

Ans. Frequency (in cycles) multiplied by wavelength in meters equals 300,000,000. Wavelength is inversely proportional to frequency. The formula is:

$$\text{f (frequency in cycles)} = \frac{300{,}000{,}000}{\text{Wavelength (in meters)}}$$

Ques. *What symbol is used in the amateur rules to designate amplitude-modulated telegraphy without the use of modulating audio frequencies (on-off keying)?*

Ans. *A1.* "A" is for amplitude modulation, and "1" indicates telegraphy by on-off keying.

Ques. *What is the ruling regarding eligibility for re-examination?*

Ans. An applicant who fails an operator examination may not take another examination for the same or higher privileges within 30 days. This does not apply to an examination for a General Class license following a mail examination for a Conditional, Novice or Technician Class license.

Ques. *What factors are responsible for harmonic radiation and what practical means can be used to detect and correct such condition?*

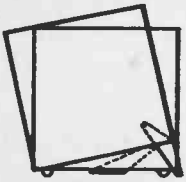
Ans. Factors which favor harmonic radiation are; excessive excitation voltage to the final radio-frequency amplifier, poor shielding and filtering of transmitter, improper tuning and improperly matched antenna. Harmonics can be detected by tuning to their frequency with a receiver or a field-strength meter. Steps to correct harmonic radiation: use of minimum final-stage excitation voltage; shielding of all RF circuits; filtering audio and power leads to RF circuits; harmonic traps in the final stage; low-pass filter and antenna tuner between final stage and antenna; correct matching to antenna.

NC 270

At Your National Distributor September 15.

THE "COSMIC BLUE" NATIONAL'S NEW HAMBAND RECEIVER

This newest and finest precision double conversion amateur receiver with 6 meter coverage, brings you an ease of sideband tuning previously available only in the most expensive equipment. The NC-270 features an exclusive "Ferrite Filter" for instant upper-lower SSB selection and a degree of selectivity to conquer even the toughest AM and CW signal conditions. The solid 1/8" steel panel, ceramic coil forms, double-spaced tuning gang, and full ventilation cabinet combine to give mechanical and thermal stability that will surprise even the most critical operator. Even the color of the NC-270 is outstandingly different, National's new duo-tone "Cosmic Blue." Write for detailed specifications.



And National Radio's patented "Flip Foot" makes operating the NC-270 so easy.

Only $24.98 down*

Suggested cash price: $249.95. NTS-3 Matching Speaker: $19.95 (slightly higher west of the Rockies and outside the U.S.A.). *Most National distributors offer budget terms and trade-in allowances.

NATIONAL RADIO COMPANY, INC.

A WHOLLY OWNED SUBSIDIARY OF NATIONAL CO., INC. MELROSE 76, MASS.

Export: AD AURIEMA, INC., 85 Broad St., New York, N. Y.

Canada: CANADIAN MARCONI CO., 830 Bayview Ave., Toronto 17, Ont.

"Ferrite" Filter Patent Pending

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Paychecks By Microwave

IN sunny California the computers are speaking to each other—via microwaves. An average of 44-million words a day flash 30 miles from the Rocketdyne plant in Canoga Park to the Los Angeles location of the parent company, North American Aviation. Six big IBM computers are involved in the high-speed chit-chat, (500 times faster than human speech). The topics of "conversation" may include test and scientific data on F-1, a huge rocket engine with thrust of 1½-million pounds, cost factors, schedules —and payrolls. The Santa Monica Mountains bar line-of-sight transmission, so data is first beamed to a dish atop Oat Mountain nine miles from Rocketdyne.

High-speed printer at North American Aviation's Los Angeles Division turns out 400 paychecks per minute from microwaved info.

Microwave dish such as this handles computer traffic between two divisions of company, relaying line-of-sight waves over mountaintop.

EI assembles an

RF Signal Generator

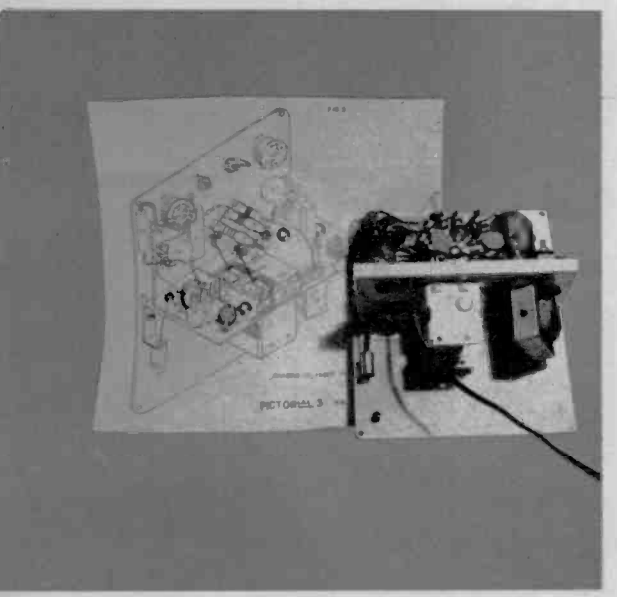
ENTER any radio-TV repair shop, from the elaborate to the most modest, and you will find two pieces of test equipment common to all; a multitester and an RF signal generator. With this RF signal generator (Model SG-3), the latest addition to their kit line, Arkay is catering to one of the most basic needs of servicemen and electronic experimenters. In kit form, this low cost package allows even the home experimenter to have the advantage of professional-type test equipment for his own use.

Construction

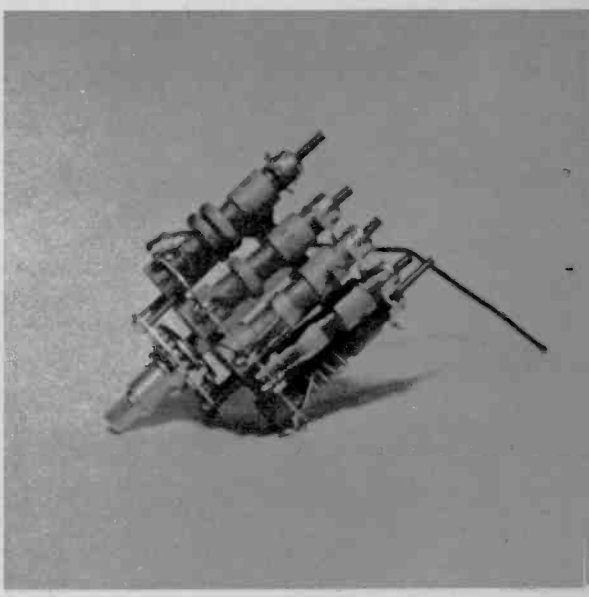
A Novice constructed the kit easily in two evenings of work. The instruction book was adequate and the pictorials large and easy to follow. When you check the parts list note that the component identified as an "AF Oscillator Coil" (L6) resembles a small choke or transformer rather than a coil.

The first order of business in constructing the generator is mounting the switches and potentiometers on the front panel. The range selector switch is wired and set aside to be mounted later. Wire up the basic chassis patiently—since short leads are essential, you'll be working in tight quarters often. Mount the chassis to the front plate and make the final connections.

At this point check over all previous work. Inspect the wiring to see that components are dressed properly and all solder con-



Large fold-out pictorials simplify construction. Unit depicted is shown partly completed.



Five slug-tuned coils mounted on range selector switch provide RF from 160 kc-110 mc.

nections made. Make sure you remove all excess solder splashes, wire clippings and the like. Tubes are mounted, chassis slid into its case, knobs installed and with the final step, that of making up the test leads, you are now ready to use your unit.

Calibration and Design

A unit of this type is only as good as its calibration. Arkay supplies this kit with factory pre-aligned coils. Assuming that the wiring is done as per instructions, no further calibration should be necessary. The unit *EI* built was checked according to the instructions and it was perfectly aligned—no further calibration was needed.

The SG-3 is transformer operated, allowing it to be used safely with any type of radio or tuner. Its simple two-tube circuit consists of a 6C4 audio oscillator and a 12AT7 RF mixer-oscillator utilizing a cathode follower output. The fundamental frequency range of the SG-3 is 160 kc to 110 mc, in 5 ranges with a second harmonic range to 220 mc. It can provide a pure or modulated RF source depending on what is needed. The modulation is accomplished by an internal audio signal of 400 cps and, in addition, the RF can be modulated by an external source. There is also a jack that provides an audio signal output.

The main use of a signal generator is, of course, to align receivers. However, it is worth noting that, in addition, a signal generator is an invaluable aid in repair. By putting an RF signal into the set under repair, defective RF or IF stages are easily located. The AF signal output is also useful in checking the stages of the unit under repair.

Although primarily intended as a test instrument for the serviceman, the unit's ease of construction and low cost make it a worthy addition to the test bench of the experimenter or part-time repairman. At $26.95, Arkay's RF Signals Generator is a Good Buy.

Inset: Jubilantly, ARRL calls long-silent hams back to the air at end of World War I shutdown. Radio then mushroomed as a hobby. Above, radio club of 1920's, with latest gear.

A Page from the Past

By Howard S. Pyle, W7OE

THE past sometimes seems so far away, but for radio it wasn't very long ago. Radio and electronics have come so far so fast that we speak seriously of "antique" radio gear—referring to equipment that isn't half as old as a piece of furniture would have to be to deserve that honor.

Yet, in its young life, radio has had a romantic history, and there were not only horse-and-buggy days, but *pre*-horse-and-buggy days, all in the lifetimes of men still in their prime. Like geologists, radiomen can divide time into epochs, and we can discern the dawn of our "modern" era in [*Continued on page* 106]

Spark-gap transmitters were standard for all stations before World War I. Low-power amateur set, right, had limited range. Hams paced the change to vacuum tube CW rigs.

Comprehensive courses in Electronic Fundamentals TV Servicing – Color TV – Electronics for Automation – Transistors

SEND POSTAGE-PAID CARD TODAY FOR ***FREE*** *64-PAGE HOME STUDY BOOK!*

Check Home Study Box.

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

Resident school courses in Los Angeles and New York City offer college-level training in any field of electronics you may choose. Classes begin four times each year. Free Placement Service.

SEND FOR FREE RESIDENT SCHOOL BOOK!

Check Resident School Box.

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

The Most Trusted Name in Electronics

Electronic Brain

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

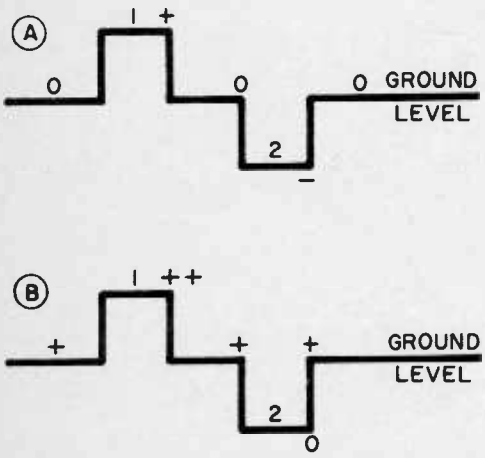
Negative Polarity

If the word "negative" means an excess of electrons, why do circuit diagrams show the negative end of a power supply connected to a chassis. Doesn't this place an excess of electrons on the chassis, thereby making it dangerous?

L. G. Long, Sacramento, California

Although it is perfectly true that in the study of static electricity, "negative" refers to a body in which there is an excess of electrons as compared to its proton content, the word loses this precise meaning when we begin to deal with current electricity.

The negative end of a power supply is



negative only with respect to the positive end. By this we mean that electrons will flow from the negative to the positive terminal if connected by a conductor. We might even conceive of a condition in which the negative terminal of a power supply has an *equal* number of electrons and protons, making it electrically neutral from an absolute point of view. In this case, the positive terminal of the supply would have a *deficiency* of electrons. Hence, even though the so-called negative end of this power supply is neutral, it will feed electrons to the terminal that is deficient in them.

Thus, in current electricity, "negativeness" and "positiveness" are *relative* terms. They merely express the polarity or direction of a difference in potential that tells us the direction in which the electron flow will occur. When the negative terminal of a power supply is connected to the chassis, this *does not* place an excess of electrons on it in any absolute sense; it merely establishes the chassis as the point from which all other negatives and positives are measured.

In diagram *A*, ground level is referred to as zero level while the hill (1) is called + and the hole (2) is called −. Thus, when we choose our references this way, the hole is negative with respect to ground while the hill is positive with respect to ground.

Now look at diagram *B*. In this case, we have elected to call the level at the floor of the hole the zero level. This makes ground positive with respect to the hole, and the hill even more positive than the ground. BUT WE HAVE NOT CHANGED THE TERRAIN BY CHANGING OUR CHOICE OF REFERENCE! That is, it's still the same hole, the same ground, and the same hill! Thus, it is clear that absolute negativeness and positiveness have no real meaning; a thing is negative or positive only with respect to some reference potential.

900 Volt Power Supply

Have you ever published a circuit for a transistor power supply that provides about 900 volts at low current?

R. C. Irvine, Valley Stream, N. Y.

You will find a schematic diagram of a 900 volt transistor power supply in the September, 1958 issue of *Electronics Illustrated.*

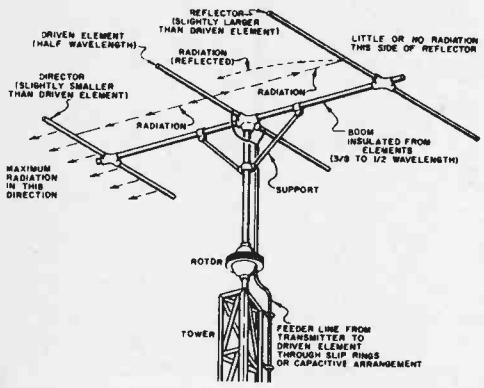
15 Meter Antenna

What type of antenna array for 15 meters would you suggest that would give me maximum performance and the least trouble in construction? I have the materials for making a 3-element beam, a cubical quad, a shortie (center-loaded) beam, or I could go out and buy one.

Dudley L. Pope, Jr., Baton Rouge, La.

We have a lot of faith (from both experience and hearsay) in the directional 3-element beam antenna. When this antenna is cut and proportioned properly, there are few others that can out-perform it. Since you have the lightweight conduit already, it seems a "natural" for you to build.

Assuming that the antenna is to be cut for about the center of the 15 meter ham band, that is, 21.25 mc, we would



recommend the following dimensions.

Driven element length:	22 ft., 2 in.
Reflector length:	23 ft., 1 in.
Director length:	21 ft., 4 in.
Spacing: (0.2 w.l.)	9 ft., 0 in.

The gain to be expected from this array is very close to 8 db. Obviously, these figures cannot be considered as absolutely exact since they will vary slightly with height above ground, method of feed, etc. They are close, however, and should give excellent results without too much fussing with adjustments.

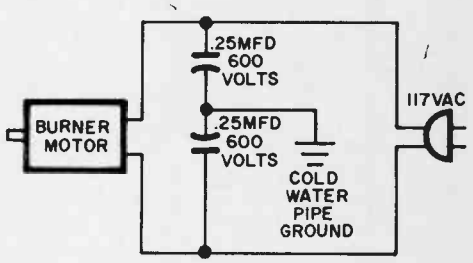
AC Motor Hash

How can I eliminate interference on my radio caused by an oil burner motor in my home? The motor is a standard 120 volt, AC type.

W. A. Dulley, Pointe Claire, Quebec

This is not difficult to do, but it does necessitate stripping the insulation from the wires that feed the motor, as close to the motor as you can work.

First, throw off the oil burner switch to be sure that voltage will not appear across its terminals while you are working on it. Then connect the simple noise filter shown in the diagram across the feed wires, being certain that the capacitor junction is run to a good



ground such as a cold water pipe. Use a grounding clamp to insure good contact and permanent connection. Generally, a basic capacitor filter of this type does the job well. If the noise persists, it may be necessary for you to purchase a commercial inductance-capacitance noise eliminator for the radio as well. These are available from all of the larger mail-order electronic distributors.

Auto Radio, 6-12 Volts

What is the easiest and least expensive way to install a 6 volt radio in an automobile having a 12 volt battery?

C. G. D., Cambridge, Mass.

Most distributors and retailers of electronic components now stock a conversion resistor that sells for less than $2.00 suited for running a 6 volt radio on a 12 volt battery. Since various auto radios require different total currents, you must know the make and model number of your receiver before you can purchase the right size.

In using a conversion resistor, the owner should be aware that there is as much power dissipated in the resistor as there is in the radio. Thus, the resistor should be mounted in a position where it can be adequately ventilated, well away from fiber or other substances that might char when they come in contact with the warm resistor.

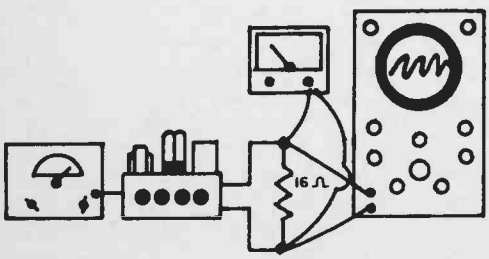
El's Hi-Fi Doctor . . . .

When a hi-fi manufacturer claims that his amplifier has a 20-watt rating—exactly what does he mean?

Let's review quickly the basic technique for determining amplifier wattage. The equipment that's needed is an audio generator, a load resistor of 4, 8, or 16 ohms with a wattage rating of about twice the expected wattage output of the amplifier, a VTVM with a frequency response at least equal to the audio generators and an oscilloscope.

The resistor, let's make it 16 ohms, is connected to the 16-ohm output terminals of the amplifier. The VTVM and scope are connected right across this resistor with the VTVM set for an AC reading of 50 volts. Now connect the audio generator to the input of the amplifier (*aux.* or *tuner* on an integrated amp.), switch everything on and you are ready to make the test.

Set your audio generator to 1000 cycles and slowly turn up its output control. You'll notice a sine wave start to grow on the face of the scope and the VTVM's meter needle will start to climb. Continue to turn up the generator output and the point will be reached where the sine wave will display a slight flattening at its positive and negative peaks. This is the "clipping" point. Back off the generator output control until you are at the point where the clipping is just visible. In a well designed and functioning amplifier, the clipping point tends to occur at about 1% second harmonic distortion. To determine the amplifier wattage at this point divide the square of the voltage reading by the load resistance.



Well, you might think, all of that is pretty straightforward and doesn't leave much room for argument. Unfortunately, the only thing the above test shows is the amplifier's wattage output at *one* frequency. And here we get to the crux of the problem. Some manufacturers call their amplifiers 20-watt because they start to clip at 20 watts at 1000 cycles. Other manufacturers call their amplifiers 20-watt because their *peak* power output is 20 watts. (Peak power mathematically is just about double the rms power that everyone else uses.) Some manufacturers feel they have a 20-watt amplifier when it can struggle up to 20 watts output even though the distortion reaches 10% and the sine wave is a mess.

To add to the confusion, there's also the "musical wave forms" or "integrated program material" approach. You'll find when testing amplifiers with a steady sine wave (which does *not* resemble the constantly varying musical wave forms) the B-plus voltage falls as the amplifier is driven to a higher and higher output wattage. This drop is due to the increased current drain of the output tubes. The lower than normal B-plus voltage, in turn tends to lower the wattage capabilities of the output tubes. The manufacturer feels that since pure continuous sine waves are seldom encountered in music, it is legitimate to test out an amplifier's wattage with an external highly regulated power supply instead of the amplifier's own built-in power supply. Their logic is that the amplifier's filter capacitors hold a charge long enough to sustain the B-plus voltage during momentary large power demands. This is true most of the time, however the output of a pedal organ is *not* a momentary demand and their 20-watt amplifier acts as a 10-watt job when driven to the wall.

(Continued next month)

and Clinic

Hi-fi questions are all answered by mail. If of general interest they will appear in this column.

Motorboating

After 2 years of use, my amplifier kit has developed a strange rumbling or thumping sound which comes through the speaker. Tube changes don't help and the amplifier acts that way whether or not there is an input signal.

R. Plitman
Orlando, Florida

The "rumble" you hear is probably low frequency oscillation, more commonly known as motorboating. As your problem has just arisen, we may safely conclude it is not inherent in the design of the amplifier. A common cause of motorboating is a filter and decoupling capacitor that has "opened" or changed in value. You can check this by temporarily clipping a 20 mfd capacitor (with a working voltage equal to the original unit) in parallel in each section of the can. If at some point this motorboating is eliminated, replace the *entire* capacitor rather than only the section at fault. Make sure that any can-type filter capacitor's lugs are well grounded.

An infrequently encountered, but possible source of your problem is leakage in a coupling capacitor. The shift toward a positive bias (due to leakage of the LI 6 grid of the next) may cause a type grid blocking to develop, resulting in a thumping sound on loud signals.

Another possible cause is the lowering in resistance of the feedback resistor because of overheating or aging. Simply replace it with a resistor of the proper value.

Wanted: More Gain

I have a Japanese stereo tape recorder and recently tried to tape from records (with a stereo magnetic cartridge) and got only a weak response with the volume on full. The cables from the changer are plugged into the phono input of my tape recorder. How can I make it work well enough for me to get good tapes?

Capt. John Marks
Fort Benning, Georgia

The input on your tape recorder marked phono is probably for a high level signal and the phono cartridge is probably not putting out enough voltage for the tape recorder to be used effectively. The least expensive solution is to purchase a crystal or ceramic cartridge with an output of at least .5 volts and install it in your changer instead of the magnetic cartridge. If you have a stereo preamp, then of course, use its tape output jacks.

Conversion Questions

I am working to a complete stereo outfit and wonder if you can help me on a couple of questions: How many ohms are there in an 8" speaker? I am thinking about removing a record changer from a table model phonograph. Would it be practical to install a new tone arm on this changer or would you suggest a new changer?

David Kaiser
Vicksburg, Michigan

There is no necessary correlation between speaker size and impedance. Generally, small speakers used in phonographs, radios, and TV sets are 3-4 ohms.

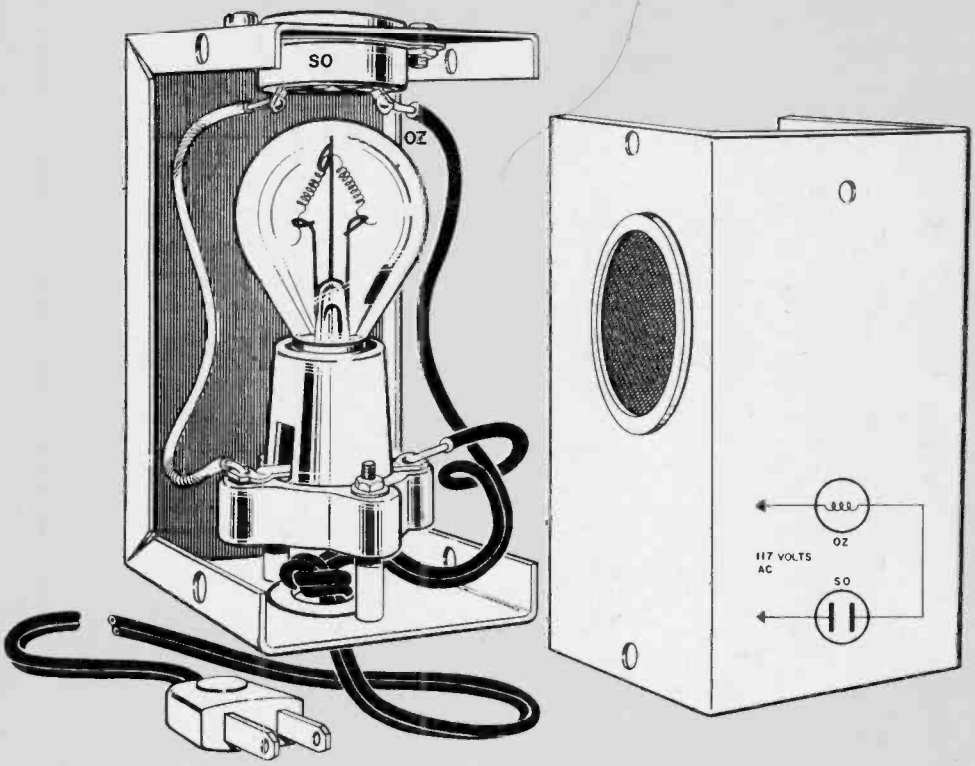
It is not practical to use an inexpensive record changer in a quality stereo system because of poor speed regulation, high rumble, etc. For the same reasons, it is certainly not practical to install a new tone arm on the unit. Your best bet would be to replace the changer.

Electronic Deodorizer

By Leon Wortman

SMOKE-FILLED rooms, hot kitchens, bedrooms, bathrooms, cellars, dens and closets can be made to lose their stuffy odors and mustiness. In fact they can be given some of that nostril-delighting scent of mountain air. And you can do it inexpensively, quickly, noiselessly with a simple ozone-producing lamp. It's the G.E. OZ4S11 developed specifically to destroy or substantially reduce odors in enclosed spaces.

The ozone generated by one of these little lamps is effective in spaces up to 1000 cubic feet. According to G.E., ozone chemically changes odors, but does not remove them from the air. For example, it can help eliminate stale tobacco odors (cigar smokers please note) but will not physically dissipate the smoke. A starter is not required for this lamp. It can operate from a special ballast designed for the purpose. (G.E.



Pictorial diagram shows simple wiring. 40-watt lamp plugs into top socket (SO).

#89G418) or in series with a 40-watt incandescent lamp as in the author's model. The ozone lamp has an estimated life of 4,000 hours of continuous operation. That's more than 2 years before it should have to be replaced.

The ozone bulb (OZ) is mounted in a candelabra screw-type base and a female AC receptacle for the incandescent lamp plug is mounted at the top of the aluminum box. Two 1" vent holes are drilled into the cover of the box and plugged with perforated vent snap-ins to protect the bulb from damage.

To use the deodorizer, plug a 40-watt lamp into the top socket (SO) and the line cord from the aluminum box into an AC outlet. Switch on the incandescent lamp and the ozone bulb will glow a pretty violet-blue. Switch off the incandescent lamp and the ozone bulb goes out too. The ozone bulb should be treated like any source of ultra-violet rays; *avoid looking directly at the ozone bulb when it is lit.*

Ultra-violet radiation from glowing mercury vapor in tube produces ozone, ionized oxygen molecules.

On a 117-volt AC line, the 40-watt lamp will have approximately ¾ of its normal light output and 2½ times its rated life. Two, three or four ozone lamps may be operated in series with a standard 50-watt lamp. The incandescent lamp should be placed above or to one side of the OZ4S11 ozone bulb to avoid heating the ozone lamp and reducing its output.

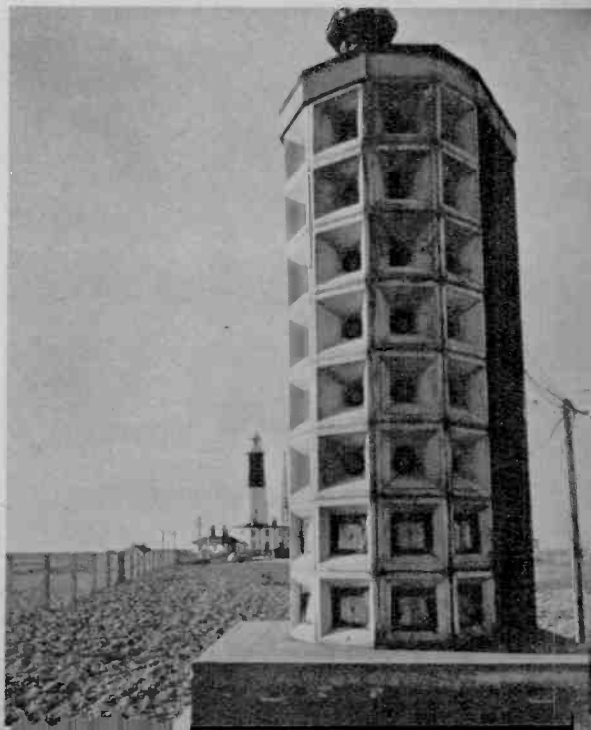
If desired, instead of mounting the ozone bulb in a metal cabinet, you can install it on a 6" x 4" piece of pine board. Both the ozone and 40-watt lamp sockets should be angle-mounting types with the lamp socket above the ozone socket to prevent damaging the ozone bulb with heat.

It's not a better mousetrap, but a better altitude chamber —scaled down to mouse-size by Republic Aviation's space environmental research. It can test rodent reactions to conditions simulating those found at 50,000 feet (about 10 miles). This chamber is a duplicate of a man-size one being built and permits measurement of the mouse's heartbeat, breathing.

E I Picturescope

British ale houses are waging a war on drunk driving with the aid of a unique reaction meter. Drop a 3-pence coin into slot. Seconds later bell rings, coin drops down chute. Press button to stop coin. Halt it quickly and you get it back. Meter gives reaction time and distance car would go before you touched the brakes.

Comely lass on water skis will be able to take command of the action with aid of "Ski Talkie," a two-way communication device between skier and boat. Microphone and speaker are handle; wires are woven right into the towline.



High fidelity outdoors? No, this is the foghorn of the new, fully automatic lighthouse (in background) at Dungeness, England. The foghorn sends its warning seaward from dozens of public address speakers arranged on column.

FROM HEATH...
MORE NEW HOBBY KITS!

AD-10 **$33.95**

STEREO RECORD PLAYER KIT (AD-10)

Made by famous Garrard of England to superb specifications. "Plug-in" cartridge feature. Rubber matted heavy turntable is shock-mounted, and idler wheels retract when turned off to prevent flat spots. Powered by a line-filtered, four-pole induction motor at 16, 33⅓, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. Assembles in minutes; mechanism and vinyl covered mounting base preassembled, arm pre-wired. With 12″ record on table, requires approximately 15″ W. x 13″ D. x 6″ H. Color styled in cocoa brown and beige. 10 lbs.

Mechanism Only: Less cartridge, base and cables. Model AD-30, 8 lbs., ... **$22.95**

AA-50 **$79.95**

HI-FI RATED 25/25 WATT STEREO AMPLIFIER-PREAMPLIFIER KIT (AA-50)

A complete 25/25 watt stereo power and control center (50 watts mono) . . . 5 switch-selected inputs for each channel . . . new mixed center speaker output . . . stereo reverse and balance controls . . . special channel separation control . . . separate tone controls for each channel with ganged volume controls . . . all of these deluxe features in a single, compact and handsomely styled unit! Five inputs for each 25 watt channel are provided: stereo channel for magnetic phono cartridge (RIAA equalized); tape head input; three high level auxiliary inputs for tuners, TV, etc. There is also an input for monophonic magnetic phono cartridge, so switched that monophonic records can be played through either or both amplifiers. The automatically mixed center speaker output lets you fill in the "hole-in-the-middle" found in some stereo recordings, or add extra monophonic speakers in other locations. Nearly all of the components are mounted on two circuit boards, simplifying assembly and minimizing possibility of wiring errors. Handsome cabinet features new "visor" effect, with vinyl-clad steel cover in black leather-like texture with gold design. 30 lbs.

AA-20 **$34.95**

AA-30 **$45.95**

ECONOMY PREAMPLIFIER KIT (AA-20)

Although these two new Heathkit models are designed as companion pieces, either one can be used with your present stereo system. The preamplifier (AA-20) features 4 inputs in each stereo channel (RIAA "mag" phono, "xtal" phono, and two auxiliary inputs). A six-position function selector switch gives you instant selection of "Amplifier A" or "Amplifier B" for single channel monophonic; "Monophonic A" or "Monophonic B" for dual channel monophonic using both amplifiers and either preamplifier: "Stereo" and "Stereo Reverse". Self-powered. (AA-20) 8 lbs.

HI-FI RATED 14/14 WATT BASIC STEREO AMPLIFIER KIT (AA-30)

Two 14-watt high fidelity amplifiers, one for each stereo channel, are packaged in the single, compact, handsomely styled amplifier (AA-30). Suitable for use with any stereo preamplifier or with a pair of monophonic preamplifiers, it features individual channel gain controls, speaker phase reversal switch and convenient pilot light. Output accommodates 4, 8 and 16 ohm speakers. Handsome satin black expanded-metal cover, gold colored chassis. (AA-30) 21 lbs.

ORDERING INSTRUCTIONS

Fill out the order blank below, giving us your name and address in the space provided at right. Include charges for parcel post according to weights shown. Express orders are shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice. Dealers and export prices slightly higher.

QUAN.	ITEM	MODEL NO.	PRICE

Ship via ☐ Parcel Post ☐ Express ☐ C.O.D. ☐ Best Way

FREE CATALOG
Describes over 150 different and exciting kits in HI-FI, Test, Ham Radio, Marine and Hobby fields. Send for yours today!

HEATH COMPANY Benton Harbor 39, Mich.
Please send my free copy of your complete catalog.

NAME

ADDRESS

CITY ZONE STATE

first of a series designed to teach the fundamentals of electronics . . .

EK-1
$19.95

EDUCATIONAL KIT (EK-1)

Youngsters and oldsters alike will find this kit a priceless introduction into the wonderful world of electronics. Now, at less than the cost of several standard textbooks on the subject, Heath offers a complete basic electricity course, resulting in a finished test instrument of a thousand and one uses. The EK-1 is a combination kit and text-workbook designed to teach the principles of voltage, current, and resistance —the basic "yardsticks" of electronics to students of junior high level. Adults also will find the project beneficial as a beginning or refresher course in electronics. When finished with the project the student will have learned the theory and construction of direct current series and parallel circuits, voltmeter, ammeter and ohmmeter circuits and the application of ohms law to these circuits. The completed meter will then be used to verify ohms law and the maximum power transfer theorem, one of the most important theorems in electronics. The finished kit, a practical volt-ohm-milliammeter, may be used to make measurements of voltage, current and resistance in a wide variety of applications.

Procedures for checking home appliances and automobile circuits are included with the kit. The EK-1 will serve as a prerequisite to following Heathkit Educational Kits. Get started NOW in this new and exciting series. 4 lbs.

XR-2P
$29.95
(5 lbs.)

XR-2L
$34.95
(7 lbs.)

6-TRANSISTOR PORTABLE RADIO KIT (XR-2 series)

Dependable portable entertainment wherever you are —wherever you go! Choose the gleaming, two-tone molded plastic model or the handsome simulated leather-and-plastic combination—both feature a gracefully curved grille in smart beige plastic. The XR-2P complements the handsome grille with a mocha colored case of high-impact plastic, while the XR-2L encases the grille in sun tan color Sur-o-Lon simulated leather. Vernier tuning control gives you smooth, precise station selection. Six Texas Instrument transistors are used for quality performance and long life; a large 4" x 6" PM speaker provides "big set" richness of tone. Ready to play after simple assembly—transformers prealigned. Six flashlight batteries used for power (500-1000 hrs.) (batteries not included).

HW-19 (10 meter)
HW-29 (6 meter)
$39.95

10 & 6 METER TRANSCEIVER KITS

Complete ham facilities at low cost! Ideal for beginning and veteran hams for "local" net operations. Transmitter and receiver are combined in one easy-to-use instrument. Features neat, modern styling, press-to-talk transmit/receive switch, built-in AC power supply, variable gain control and built-in amplifier metering jack. Operates mobile using vibrator power supply. Microphone and two power cables included. Styled in mocha and beige. Less crystal. 10 lbs.

Vibrator Power Supplies: VP-1-6 (6v.), VP-1-12 (12v.). 4 lbs. kit; **$8.95** ea., Wired: **$12.95** ea.

ORDER DIRECT BY MAIL OR SEE YOUR HEATHKIT DEALER*

*The convenience of Local Heathkit Sales and Service costs but a few dollars more.

Brains for Trains

Continued from page 64

the New York subways. Every day, between the hours of five and six in the evening, about a quarter of a million people pass through the Grand Central subway station on the East Side of the city, with an equal number using the Times Square station on the other side of town. Between the two, shuttle trains transport over 100,000 hurrying, scurrying rush-hour passengers from one side of town to the other. This great moving mass of humanity has been a source of constant concern to the city's Transit Authority, which has for years been seeking a means of quicker and more efficient shuttle operation. The task seemed hopeless until recently, when new developments in cybernetic control promised a solution.

On an isolated stretch of track in Brooklyn, four new subway cars shuttle between two test stations set up to simulate the distance from Grand Central to Times Square. Aboard these trains, teams of engineers test and monitor every phase of operation and have achieved a remarkable degree of trouble-free performance. Technicians assigned by Westinghouse and General Electric, working with experts from the car and signal manufacturers and officials of the Transit Authority have overcome the tremendous problems involved in replacing manned trains with automated cars controlled by electronic brains. Controls aboard the trains are combined with banks of relays in the station to form a computer control which gauges the speed of each train and applies the brakes with uncanny precision. Doors open automatically, controlled by other circuits which can operate only after the train has stopped. At the proper time, the doors are closed, reactivating the trains' motors and sending the loaded cars swiftly on their way. The passengers are hardly aware of the absence of conductor and motorman.

Another phase of train automation—automatic routing—is in operation on the Queensboro subway. A round gadget, 18 inches in diameter, is attached to the first car of each train, projecting in the direction of travel. Called "The Doughnut" by motormen on the line, this device is an induction coil with variable impedance which can be set to any one of four positions, depending upon each train's route and destination. As a train passes a series of grids mounted on metal cases close to the track, a voltage is induced which activates the electronic "towers" along the route. If the train is an express, switches move and signals turn from red to green to allow it a clear route to the proper track. Local trains, with their coils set accordingly, activate the control relays so as to keep themselves scheduled properly.

At the Flushing terminal, not very long ago, an old-time motorman in the midst of the usual horse-play in the crew-room told a towerman, "Boy, I'm glad they finally got wise and replaced you with a machine."

"You would be, you big goon," the towerman shouted angrily, "how do you figure that monster is better than I am?"

"Well," the motorman shot back as he ducked for the door, "at least I don't have to blow my whistle to wake it up every time I pass Rawson Street!"

But train and route operations are not the only phases of railroading improved by electronic automation. Passenger safety, too, has gotten its share of consideration. At the lower tip of Manhattan Island, far beneath the park which once surrounded the old Aquarium, a subway train runs along sharply curved tracks which follow the contours of the harbor's edge. Because of the curve, the distance between the car doors and the platform's edge is over two feet in some places. When a train arrives at the station, a contact shoe mounted between the wheels on one side of the train engages a short section of rail, activating a bank of relays set beneath the level of the platform. Long metal fingers reach for the train at each door, forming a walkway of steel to close the gap. Simultaneously, a pre-recorded tape comes through the loudspeakers mounted along the station walls:

"Please step back from the moving platform until the train stops." When the train is ready to depart, another tape cuts in: "Please stand clear of the moving platform and step to the concrete platform." When the train starts to move, the contact is broken and platform segments slide back into place. The speakers are silent, ready for the next train to arrive.

Automation has been a source of concern to railroadmen and their labor organizations. In one union headquarters, a delegate related the wonders of one of the new trains to his listening colleagues, ending up with "and they're untouched by human hands!"

"What're they using—chimpanzees?" a burly engineer asked in a hurt tone.

But in most cases, no jobs are lost or men

. . . symbol of

RAD-TEL FIRST QUALITY

INSIST ON RAD-TEL FOR EVERY TELEVISION AND RADIO TUBE NEED

Super-Special!

KIT OF 100 Bi-Pass CONDENSERS

Over 50% Are 600V at LESS THAN 4¢ each

Goodall Semi-Molded Paper and MYLAR

Made up of approx. 16-200V, 20-400V and 64-600V. Values .001 to 1 mf

$3.95

Up To 75% OFF on BRAND NEW TUBES

GUARANTEED ONE FULL YEAR! You Can Rely On Rad-Tel's Speedy One Day Service!

Not Used — Not Pulled Out Of Old Sets · Each Tube Individually and Attractively Boxed!

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
___	0Z4M	.79	___	4BZ7	.96	___	6FV6	.40	___	6DE6	.58	___	12AE6	.43	___	12CR6	.54	___	17D4	.69
___	1AX2	.62	___	4CS6	.61	___	6FW8	.89	___	6DG6	.59	___	12AF3	.73	___	12CU5	.58	___	17DQ6	1.06
___	1B3GT	.79	___	4DE6	.62	___	6FX4	.65	___	6DQ6	1.10	___	12AF6	.49	___	12CU6	1.06	___	17L6	.58
___	1DN5	.55	___	4DK6	.60	___	6FX7	64	___	6DT5	.66	___	12AJ6	.46	___	12CX6	.54	___	17W6	.70
___	1G3	.73	___	4DT6	.55	___	6EA6	49	___	6DT6	.53	___	12AL5	.45	___	12DB5	.69	___	19AU4	.83
___	1J3	.73	___	5AM8	.79	___	6EC5	54	___	6EU8	.79	___	12AL8	.95	___	12DE8	.75	___	19BG6	1.39
___	1K3	.73	___	5AN8	.86	___	6EC7	94	___	6EA8	.79	___	12AQ5	.52		12DL8	.85	___	19T8	.80
___	1L6	1.05	___	5AQ5	.52	___	6EC8	97	___	6H6GT	.58	___	12AT6	.43	___	12DM7	.67	___	21EX6	1.49
___	1LN5	.59	___	5AT8	.80	___	6ED6	58	___	6J5GT	.51	___	12AT7	.76	___	12DQ6	1.04	___	25BQ6	1.11
___	1R5	.62	___	5BK7A	.82	___	6EE6	55	___	6J6	.67	___	12AU6	.50	___	12DS7	.79	___	25C5	.53
___	1S5	.51	___	5BQ7	.97	___	6EF6	44	___	6K6	.63	___	12AU7	.60	___	12DZ6	.56	___	25CA5	.59
___	1T4	.58	___	5BR8	.79	___	6EG6	1.66	___	6S4	.48	___	12AV5	.97	___	12EL6	.50	___	25CD6	1.44
___	1U4	.57	___	5CG8	.76	___	6EH6	65	___	6SA7GT	.76	___	12AV6	.41	___	12EG6	.54	___	25CU6	1.11
___	1U5	.50	___	5CL8	.76	___	6EH8	87	___	6SK7	.74	___	12AV7	.75	___	12EZ6	.53	___	25DN6	1.42
___	1X2B	.82	___	5EA8	.80	___	6EJ6	62	___	6SL7	.80	___	12AX4	.67	___	12F5	.66	___	25EM5	.55
___	2AF4	.96	___	5EU8	.80	___	6EK7	85	___	6SN7	.65	___	12AX7	.63	___	12F8	.66	___	25L6	.57
			___	5J6	.68	___	6EL7	1.00	___	6SQ7	.73	___	12AZ7	.86	___	12FM6	.45	___	25W4	.68
___	3AL5	.42	___	5T8	.81	___	6EN4	57	___	6T4	.99	___	12B4	.63	___	12K5	.65	___	25Z6	.66
___	3AU6	.51	___	5U4	.60	___	6EN6	74	___	6U8	.78	___	12BA6	.50	___	12SA7M	.86	___	35C5	.51
___	3AV6	.41	___	5U8	.81	___	6EQ5	55	___	6V6GT	.54	___	12BD6	.50	___	12SK7GT	.74	___	35L6	.57
___	3BA6	.51	___	5V6	.56	___	6EQ6GT	1.05	___	6W4	.57	___	12BE6	.53	___	12SN7	.67	___	35W4	.52
___	3BC5	.54	___	5X8	.78	___	6ER7	35	___	6W6	.69	___	12BF6	.44	___	12SQ7M	.73	___	35Z5GT	.60
___	3BE6	.52	___	5Y3	.46	___	6ER8	78	___	6X4	.39	___	12BH7	.73	___	12U7	.62	___	50B5	.60
___	3BN6	.76	___	6AB4	.46	___	6EU8	70	___	6X5GT	.53	___	12BL6	.56	___	12V6GT	.53	___	50C5	.53
___	3BU8	.78	___	6AC7	.96	___	6EV6	54	___	6X8	.77	___	12BQ6	1.06	___	12W6	.69	___	50DC4	.37
___	3BY6	.55	___	6AF3	.73	___	6EW6	54	___	7AU7	.61	___	12BY7	.74	___	12X4	.38	___	50EH5	.55
___	3BZ6	.55	___	6AF4	.97	___	6EZ7	37	___	7A8	.68	___	12BZ7	.75	___	17AX4	.67	___	50L6	.61
___	3CB6	.54	___	6AG5	.65	___	6C4	43	___	7B6	.69	___	12C5	.56	___	17BQ6	1.09	___	117Z3	.61
___	3CF6	.60	___	6AH6	.99	___	6C86	54	___	7Y4	.69	___	12CA5	.59	___	17C5	.58			
___	3CS6	.52	___	6AK5	.95	___	6C96	1.32	___	8AU8	.83	___	12CN5	.56	___	17CA5	.62			
___	3CY5	.71	___	6AL5	.47	___	6CF6	54	___	8AW8	.93									
___	3DK6	.60	___	6AM8	.78	___	6CG7	60	___	8BQ5	.60									
___	3DT6	.50	___	6AN4	.95	___	6CG8	77	___	8CG7	.62									
___	3Q5	.80	___	6AN8	.85	___	6CM7	56	___	8CM7	.68									
___	3S4	.61	___	6AQ5	.50	___	6CM7	55	___	8CN7	.97									
___	3V4	.58	___	6AR5	.55	___	6CM6	61	___	8CX8	.93									
___	4BC5	.56	___	6AS5	.60	___	6CS6	57	___	8EB8	.94									
___	4BC8	.96	___	6AT6	.43	___	6CM5	58	___	10DA7	.71									
___	4BN6	.75	___	6AT8	.79	___	6CM6	1 08	___	11CY7	.75									
___	4BQ7	.96	___	6AU4	.82	___	6CY5	70	___	12A4	.60									
___	4BS8	.98	___	6AU6	.50	___	6CY7	71	___	12AB5	.55									
___	4BU8	.71	___	6AU7	.61	___	6DA4	58	___	12AC6	.49									
___	4BZ6	.58	___	6AU8	.87	___	6DB5	69	___	12AD6	.57									

USE THIS AS YOUR MAIL ORDER FORM

Name .....

Address .....

City .....

State .....

PLEASE PRINT NAME AND ADDRESS CLEARLY

SEND FOR FREE TROUBLE SHOOTER GUIDE AND NEW TUBE & PARTS CATALOG.

RAD-TEL TUBE CO.

55 Chambers St
Newark 5, N. J.

EI-960

TERMS: 25% deposit must accompany all orders — balance C. O. D.
$1 HANDLING CHARGE FOR ORDERS UNDER $5. Subject to prior sale.
Please add postage. No C. O. D.'s outside continental U. S. A.

Not Affiliated With Any Other Mail Order Tube Co.

laid off because of electronic advances. Normal attrition—men retiring or quitting —more than makes up for jobs replaced by automated techniques. Those remaining are being increasingly assigned to duties which require ingenuity and initiative—things no one has yet been able to build into a machine.

A Page from the Past

Continued from page 90

electronics. This is some time back, a decade or two before many of our present readers were born.

Things were so different, in many ways, before then, that we can talk of the change-over from spark-gap transmitters (and what exciting things they were, especially the big ones!) to silent, efficient vacuum-tube gear (almost spooky, what those "audions" could do!) the way geologists talk about the end of the Ice Age, and the beginning of History.

As everybody knows, the spark ruled the airwaves before World War I, and it was a long time dying. It was the International Telecommunications Conference of 1937 that finally killed the spark. By that time, however, hardly anybody was using it. Quiet, compact, versatile vacuum tubes had usurped the crown almost two decades before.

During World War I, every belligerent ordered the shutdown of all radio stations, *and* the dismantling of receivers, except for its own government and armed-forces stations. For quite a while after the end of the war, it looked as if amateur radio was finished. The number of non-amateur stations had multiplied, the "state of the art" at that time did not permit full use of the frequency spectrum, and the universal splattery spark signals and primitive, unselective receivers had made the interference problem acute.

The American Radio Relay League, today still the world's greatest organization of radio amateurs, began its fight to get the "hams" recognized again. It had barely gotten started before the war came; the war had scattered and killed many members; memberships had lapsed and the publication of its organ, *QST*, had been suspended. Yet the League mounted a courteous, diplomatic, but unrelenting battle in Congress and various government bureaus. It was close, but it took less than a year, and in October, 1919, the *QST* presses stopped for the jubilant bulletin.

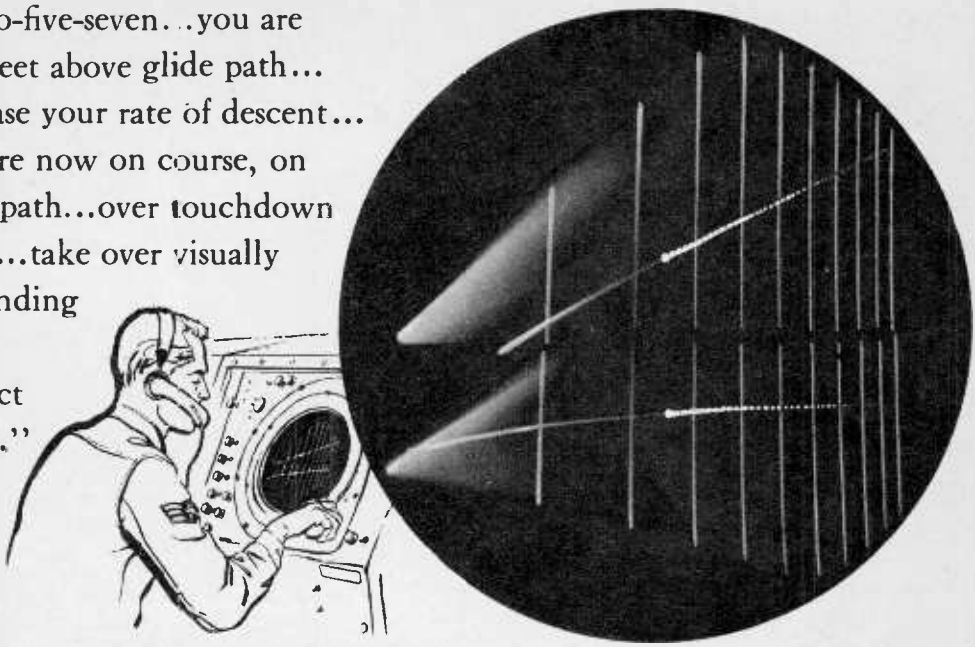
Not long afterwards, amateurs were relegated to wavelengths "below 200 meters" (above 1500 kc.) since these were considered "useless" by the other radio services. This did not stop the hams. Within a few years they had made "impossible" transatlantic contacts using *one* hundred meters, relatively low-power gear, and vacuum-tube transmitters at that. They also proved the mettle of the superheterodyne receiver while they were at it. Here we had the birth of "short wave" and the acid test of the vacuum tube. Modern electronics really began in the young years of the 1920's.

It was a ham who pointed out to Congress that an antenna—or any wire—"couldn't help" picking up radio signals and had no effect on the signals themselves —it created no interference. Therefore Congress decided not to require a license for receivers, and this is what opened the door to the development of the broadcasting industry. When KDKA, Pittsburgh, went on the air with the 1920 election returns, "broadcast" rather than sent point-to-point, for the benefit of whoever tuned in rather than a specific recipient, two things would have been missing if receivers had been licensed: there would have been fewer listeners to begin with, and the fact that *anybody* could pick up information so fast would have stirred up little interest. Why study and take an exam and/or pay a fee when the morning paper will carry the news? But since the law placed no restrictions on receivers, radio became a fad even with the non-experimenter—like high fidelity today. As the number of listeners rapidly mounted, advertisers saw the possibilities, and *voila!* broadcasting was born. Today, in many countries, a license (with fee!) is required for home radio and TV sets, but America pioneered the idea of entertainment and news broadcasting, and the world followed suit.

It was not only the amateurs who pulled radio along the path of progress. Every "service" made its contribution. Everybody will be heard from as, from time to time, we turn a "Pioneer Page" in our album.

With this article by Mr. Pyle, who "was there" through most of radio's development, we open a new series. Other radio old-timers who may wish to submit reminiscences and photos should write to the Editor, Electronics Illustrated, *67 W. 44th St., New York 36, N. Y. Any material accepted will be paid for at our standard rates. Valued photos will be returned, as will unacceptable manuscripts.—Editor.*

"Zero-five-seven...you are fifty feet above glide path... increase your rate of descent... you are now on course, on glide path...over touchdown point...take over visually for landing and contact tower."



YOU MAY HANDLE A SITUATION LIKE THIS...

If you measure up to the Aerospace Team

The man in command of this situation is an Air Force Ground Control Approach Radar Technician. And those "blips" on the glide paths of his radar screen represent an aircraft coming down blind through bad weather. This is the kind of man whose dependable skill and calm judgement make him a key member of the Aerospace Team...he is the kind of man who can meet the qualifications of the U. S. Air Force.

Are you that man? As a trained and experienced Air Force technician, you will have an opportunity to build a career for yourself in the Aerospace Age—the age of air and space travel. Such a career offers you valuable training and education, steady advancement and an assured future.

If you are the kind of young man who could learn to handle situations of increasing responsibilities, we of the Air Force would like to talk to you. If you are interested, just clip and mail this coupon.

U.S. AIR FORCE

There's a place for tomorrow's leaders on the Aerospace Team

PASTE COUPON ON POSTCARD AND MAIL TO:
Airman Information, Dept. ME09, Box 7608, Washington 4, D. C.

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

Name_____

Address_____

City_____ **Zone**_____ **County**_____ **State**_____

Phono Accessories

Continued from page 35

companies produce two versions of the "dust bug"—one to be used with changers, the other for manual turntables. The "dust bug" consists of two brushes. One traces the record groove and dislodges the dirt which is then absorbed onto a soft pad that has been previously moistened with the liquid supplied.

Even when a record itself is clean, it can become dirty if played on a machine that has been exposed to dust. For this reason, players should be installed under a cabinet lid or in a slide-out drawer. If yours is installed in the open, you might consider some kind of plastic cover that fits over the unit. A very useful one is Audiotex's "Phono Guard." This cover has a metal frame that keeps it rigid so that it may be placed over the machine during use. Less expensive covers, which protect the player only when not in use, also are widely available.

When not being played, records are best stored in thin slip-covers, such as the polyethylene plastic type, which are then slipped into the cardboard envelope. Some records come with the plastic bags; for those that do not, you can buy covers by the package for as little as 4 cents apiece.

Installation Aids

Aside from cleanliness, correct installation of the record player and the stylus is a must for best sound. A little attention to a few details here can go a long way in preventing serious trouble later. To begin with, the player must be perfectly level. "Levelling kits"—such as those produced by Walco, Fedtro, Robins, Wellcor—supply adjustable screws that may be turned under the player base to bring the unit into true level. A small level indicator, included with the kit, is placed on the unit to help you arrive at precisely the correct settings. A cruder and cheaper method is simply to shove little snips of folded cardboard under the player base and use any level indicator that is handy, such as one from a carpenter's tool box. The adjusting screws, of course, have the advantage of precision and convenience. In passing, we might mention that on the new Fairchild SA-12 tone-arm, a true-level indicator is included right in the mounting base so that the user may always tell whether his turntable is levelled. Let's hope this idea catches on with other tone arm manufacturers.

Other items that may or may not be useful in specific installations include foam pads for placing on the platter, and thicker pads for placing under the machine. The former *sometimes* can reduce the effects of wow and rumble. The latter *sometimes* can minimize the chance of acoustic feedback and vibration in a system in which the components are fairly close to each other. Additionally, the one-inch thick acoustic insulation material sold by Robins ($2.25 list for one square yard) can prove useful in cushioning motor-driven devices as well as loudspeaker enclosures. Such padding reduces vibration and protects the shelf or floor on which a heavy component may be mounted.

To help prevent miscueing records on a manual turntable, and guard against accidental or clumsy setting down of the arm, there are arm-lift-and-cueing devices such as the "Dextrafix" and a similar model made by Audiotex.

For stylus care, there are any number of pocket-size magnifiers that can reveal worn or jagged tips. While handy, these devices are no substitute for the full fledged microscopes installed at many hi-fi and record dealers.

Visual inspection of stylus tips is important because your ears can play tricks on you, particularly if wear is gradual and you listen to your system regularly. The slow degrading of record quality that signals a worn stylus (loss of highs, distortion, fuzziness, etc.) may not be immediately apparent, and you may go on using a defective one that continues to gouge out your records more and more. Stylus inspection should be a regular thing, at definite intervals of, say, 500 hours for a diamond tip, sooner if possible.

Keeping track of playing time can be simple and foolproof with the use of a time-lapse indicator, of which fairly expensive models are made by Simpson and JBT. A suitable, low-priced version which may be used with any player or changer is Lafayette's "Stylochron," calibrated for up to 1,000 hours continuous timing.

Correct stylus pressure, or downward force, must not only be set initially, but should be re-checked from time to time. For this reason, a "stylus pressure gauge" is a good investment. There are any number of excellent gauges available, from the relatively costly Model 6385 by Scherr-Tumico ($11.65), a precision, clock-like instrument, to the simple yet accurate little balance levers made by a number of companies and selling for $1.00 to $2.00.

A final item useful in checking a stylus, particularly a stereo unit, would be a

small thin-glass mirror. By placing such a mirror on the turntable, and then setting the arm and pickup on it, you can tell whether the stylus is correctly aligned. If the stylus and its reflection form a straight vertical line, all is well. If not, readjustment of the seating of the cartridge in the arm, or of the arm itself, may be required. (*Never* try to move the stylus itself; permanent damage can result.) Oddly enough, not every pocket mirror will do for this test, since in some mirrors (the better ones, that is!) the glass is too thick to permit readily discerning the line-up of the stylus and its reflection.

Especially for Stereo

All the items thus far described, while eminently useful for stereo players, also pertain to monophonic phonos and were, in fact, developed before stereo. But stereo has brought in a few new items which are concerned with the use of two amplifiers and two speaker systems. Some, or all, are provided on the new stereo amplifiers and preamps as well as on stereo adapters. In any case, these too have definite value. Thus we find "outboard" versions of channel balance, channel reverse, phase reverse, and stereo-mono selector controls. The largest single producer of these switches and controls is Switchcraft, which has adapted many of its older items such as the "Mini-mix" to the needs of stereo. Vidaire is also producing a number of these devices, as well as Argonne (a subsidiary of Lafayette). A skillful hobbyist can rig his own stereo controls (using, for example, any double-pole, double-throw switch for phase-reversal, or a pair of suitably rated matched "pots" for balancing channels), but the packaged items, complete with simple instructions, make it easy for anyone to add the extra controls needed for stereo. A look at the controls presently available on existing equipment, plus a quick chat with a hi-fi dealer, should set any stereo owner straight on what accessories are needed and how they should be connected to round out the system.

One item that almost always must be obtained as an "outboard" unit is a "stereo indicator," or channel balance meter. A few stereo amplifiers have built-in indicators (e.g., the output meter on the Harman-Kardon "Citation II"; the one-inch scope furnished with the new E.M.I. amplifiers and preamps; the meters on some Pilot models), but most do not. Of course, you can balance a stereo system by ear, but the meter is a reliable and accurate electronic indication of channel bal-

ance and proper response up to the speakers. Once the electronic aspects of balance are settled, the acoustic aspects can be brought in line by speaker placement and relatively small adjustments of amplifier controls. Among stereo balance meters are the Kinematix ($14.95), Vokar Products' "Park" ($14.95), Radio Shack's "Realistic Stereo Analyst" ($19.95), and the Argonne "Stereo Indicator" ($11.95).

In a field as fast growing as this, it would be impossible to catalog all the accessories available. New models are appearing each week. Also, many companies package a variety of accessories under such titles as "Record Care Kit" and so on. Often these packages overlap in what they contain. The best way to accumulate a supply of accessories would be to determine what's missing from your own collection and then shop to avoid duplication.

EI's LIST OF RECOMMENDED PHONO ACCESSORIES

Records	Cleaning kit or "Dust Bug," etc. Plastic slip covers
Record player	Levelling adjustment and indicator Cover (if unit is installed in the open) Acoustic isolation pad (if needed) Foam mat for platter (if needed) Arm lift and cueing device (for manual players) Strobe disc
Stylus	Pressure gauge Inspection microscope Cleaning brush Running-time meter Small mirror
Stereo Amplifier	Stereo-mono selector Channel reverse switch Channel balance control Stereo balance meter or indicator
Speakers	Phase reverse switch

Model Radio Control

Continued from page 43

cost as well as dependability and range.

Actuators

The transmitter and receiver aren't quite enough, of course. The command pulse picked up by the receiver must be turned into mechanical *force* to move the rudder and other controls. Escapements and servos are the most common means of doing this. *Lafayette* supplies several inexpensive models of escapement, and also the servo pictured on page 42. Likewise, *Citizen-Ship* has an extensive line of escapements and servo actuators, and is the only company (at the time of this writing) to offer a servo kit. *Eck-Babcock's* products in this field are popular the world over, notably their Mark II super compound escapement. This unit weighs only ¾ ounce, yet with it, you can operate a plane with left and right rudder and elevator control, as well as motor control switch.

Models

As a rule, electronics hobbyists are not model builders to begin with, and their primary reason for getting into modeling is to see the radio equipment perform.

Many radio "hams" have been discouraged with their modeling efforts, because of a wrong step in buying models that were beyond their skills at the time purchase was made. The art of building models, whether they be planes or boats, does require some work and patience. Fortunately, there are a wide variety of models requiring a minimum of time and effort.

A leader in the field of quickly-assembled planes and boats is *Eck-Babcock*. Having scored favorably with their precision radio equipment, they now offer two all-plastic planes for radio control: Replicas of Aeronca and Piper's Tri-Pacer, with 39″ and 37″ wingspan respectively.

Both models are easily assembled within a few hours. They require no covering or doping. The plastic composition from which the parts are made is resistant to the powerful chemicals in model engine fuels.

Balsa wood models were once considered too difficult and time-consuming for the less experienced model builder, but years of design and development have licked many of the problems.

Today there are perhaps a dozen manufacturers producing model airplane kits for R/C that take reasonable assembly time and little pre-flight adjustment. More important, they are designed to last for years of use and abuse. With today's reliable equipment, the chances of a valuable model, costing many man-hours of work, being lost or crashing because of equipment malfunction are virtually nil.

A leader in the field is *Berkeley Models*, manufacturer of over two dozen R/C designs. Their models vary from simple R/C trainers, which can be assembled in a few evenings, to more ambitious projects that will take weeks of your spare time. One of their popular simple designs is Bootstraps. Of rugged construction, featuring tricycle landing gear, this neat-looking cabin model is easily trimmed and flown. For the more ambitious modeler, particularly those who like water, *Berkeley* offers its Custom

Privateer. This model's wing spans 9½ feet and its planing hull is patterned after full scale flying boats, for maximum efficiency. Since Privateer is amphibious it can be flown from land. Needless to say, models like this one are spectacular to watch, and thrill spectator and flyer alike. Another popular *Berkeley* design is its Cessna 170.

Sterling Models also has many popular designs which are built and flown by many modelers both here and abroad. Their Mambo is ideal for someone just getting started in R/C. Not only is it rugged and easy to assemble, but its design insures good flight penetration, stability, and immediate response to controls.

Sterling also offers scale models, such as their Piper Cub J-3. This model spans 54" and is so realistic in flight that it is difficult to tell the model from the real plane.

Jetco, a long-established firm in free-flight and soaring models, has produced some fine R/C kits in recent years, which are noted for their precision detailing down to the minutest part. Perhaps their most popular R/C design, and certainly their largest, is an authentic replica of the Fairchild PT-19 World War II trainer, which won awards for its designer, Chuck Hollinger, at the 1958 Model Nationals.

Prices

Considering what even the simplest units can do, and the care in engineering and manufacture required so that the equipment meets the FCC's tough requirements for the Citizens Band, prices are moderate, even low. Receivers run from about nine dollars (*Lafayette's* F-208, minus batteries) through twenty to twenty-five dollars for single channel models, and up to a hundred and fifty dollars or more for multi-channel units with selective front ends. Transmitters run from fifteen or sixteen dollars, for kits and single-channel models, on up, depending on the versatility and flexibility of the equipment. The more audio tones or channels it handles, and the more frequencies available, the more expensive the transmitter. Servos, escapements, relays, etc. cost two to five dollars.

All transmitters must be crystal controlled to meet FCC rules. To change your transmitter frequency, you must change crystals. Extra crystals run between three and five dollars.

The prices of models range from five dollars up. *Sterling's* Mambo is priced at $5.95, and the impressive *Berkeley* Privateer is $19.95. Certainly these prices are moderate. As in the case of transmitters, receivers and other hardware, you can spend as much or as little as you choose.

Electronic Fraud

Continued from page 28

Electronic Frauds. Because they swindle the victim out of something more precious than money—health or even life itself—the medical electronic fakes must be considered the most vicious of all. This category is probably the oldest of the electronic frauds. It can be traced back nearly 50 years to the late Dr. Albert Abrams of San Francisco. This one-time honest physician developed an "apparatus" that he claimed could diagnose the sex, race, and diseases of a patient from a few drops of the patient's blood dried on a blotter. The "electronic reactions" derived from the machines enabled Dr. Abrams to make an instantaneous diagnosis. When a sample of blood was not available, the doctor was willing to work from a sample of the patient's writing. On this basis, he determined, from a 78-year-old manuscript, that the revered American poet Henry Wadsworth Longfellow was a victim of syphilis!

Once Abrams found he could rake in $1000 to $2000 a week with his assortment of "electronic" devices, he started renting them for a fancy monthly fee. The rental contract contained one very significant clause: the rentee must agree *never to open the hermetically sealed machines.* Well over a hundred assorted chiropractors, osteopaths, naturopaths and auto mechanics rented Abrams' "oscilloclasts" and other machines. The true swindlers weren't satisfied with renting Abrams' products: they went into competition with him by building their own "electronic" marvels. They have been doing it ever since. Only a few weeks ago, Federal agents cracked down on a company selling a "sound therapeutic vibrator" for $500. It supposedly cured cancer by playing "Smoke Gets in Your Eyes."

By far the most ingenious of Dr. Abrams' successors is Mrs. Ruth B. Drown of Los Angeles. She goes one step further and treats patients without even seeing blood blots or samples of writing. When the late Tyrone Power had an auto accident in Italy some years ago, Mrs. Drown treated him by short wave from her "broadcasting room" in Los Angeles 6000 miles away. Despite many failures to prove the efficacy of her method before committees of responsible laymen and physicians, Mrs. Drown was not put out of business until a Federal court granted a permanent injunction against her in 1958.

One of the most recent medical frauds is the "Miracle Unit" advertised as a pain killer for victims of arthritis and rheumatism. It is nothing more than a pad made of ordinary mattress material sprinkled with a tiny amount of radioactive dust. Fortunately for the suckers who paid an average of $25 for this pad, the radiation level is very low, less than that from the luminous dial of a watch (see "Radiation Hazard," February, 1960, *Electronics Illustrated*).

Of course there are many genuine electronic devices used in medicine. We need hardly mention short-wave diathermy, which some doctors use for alleviating pain connected with certain conditions. X-ray and ultra-violet treatments, while not really "electronic" have electronic controls. Such things are used by, or under the supervision of, skilled physicians and qualified technicians.

How to Avoid Being Taken

The best way to avoid being taken is not to expect something for nothing. If a piece of equipment is as good as a well-known, nationally advertised product, the manufacturer can't possibly make it to sell for a small fraction of the price of competing products. The American electronics industry is much too competitive and vigorous for any company to gain such a great advantage.

As to imported electronic goods, because wage rates overseas are much lower, there are bargains to be had in foreign made equipment, but you had better find out whether parts are available and if there is reliable servicing and warranty coverage.

Often the really phony electronic gimcracks are advertised as "based on secret European inventions" or "miracle" components. Beware of all such claims. The American electronics industry is by far the largest and most advanced in the world. Every foreign electronic manufacturer is paying substantial royalties to one or more American companies for licenses to manufacture under American patents.

In addition to regular visits to Europe and Japan, American electronic experts study every foreign electronics publication. It is practically impossible for any foreign electronics manufacturer to produce equipment on principles unknown over here. And don't fall for the old cliche that RCA or GE or some other giant company is suppressing some unusual advance. Even if the management of a big company were so foolish as to hide some invention, the chances of the vigorous competition coming up with the same idea in short

order doom such suppressions to failure.

Tell all members of your family to be suspicious of electronic, radio or TV devices offered by door-to-door salesmen. The womenfolk in particular ought to be warned because highly respected, reliable companies in other fields do sell honestly-made, high-quality products door-to-door (Fuller Brush and Electrolux, for example). However, we do not know of any reputable *electronics* concern that does this. Beware, then, of over-priced, shoddy, or obsolete goods.

A favorite device of the fraudulent door-to-door salesman is to offer goods at a "special introductory price to which only leaders in the community are eligible." If you check around, you will find that every person who answered the doorbell that day automatically qualified as such a "leader."

Many frauds are too obvious to be sold through the mail by advertisements. They can only be sold by cut-rate stores or by street hawkers. As far as the bargain stores go, check the list of warnings on the "Seven Point Buying Guide" on page 27. As for the street peddlers, never, *never* buy any "miracle" radio static eliminators from street peddlers. Their demonstration sets are equipped with secret micro-switches that cut out concealed static makers when the phony plug or switch is inserted into the power receptacle.

If you suspect that some electronic device is a fraud, write to the Editor, *Electronics Illustrated*, 67 West 44th Street, New York 36, N. Y. for advice. If possible, include a copy of the advertisement. By checking our extensive files on frauds, we can quickly tell if the product is legitimate or not.

What to do if You've Been Taken

There are many agencies, official and private, for you to go to if you think you have been taken in by an electronic fraud. If the product was sent to you through the mails, and the company refuses to refund your money, call the Fraud Division of the main post office in your city or county. They will ask you to come down to their office and fill out a complaint.

If the product was purchased in a store, and the manager refuses to take it back or claims that you are not operating it properly, go to your district attorney. In many states, such as New York, the state's attorney will also take an interest in alleged frauds.

If you have the time, also communicate with the local office of the National Better Business Bureau. To find the address of the nearest Bureau office write to National

ELECTRONICS ILLUSTRATED

Classified Ads

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

SAVE MONEY • ORDER BY MAIL

• • • FOR SALE

GOLD-SILVER DETECTORS. Latest types. Five models including transistors. Violites for Tungsten etc. Geiger Counters. No finer instruments anywhere. Free information. Detectron, Dept. 9-WW, Sylmar, California.

CITIZENS BAND decal easily identifies your mobile unit as Ch-11 monitor. Four for Dollar. Clubs inquire. Harris, 114-D Danray Drive, Richmond 27, Virginia.

FREE! GIANT wholesale catalog on electronics, Hi-Fi, transistor, scientific, hobby, optics, photographic, housewares, jewelry, tools, novelties, toys. Write: Lektron, 2418 Everett Ave., Chelsea 50, Mass.

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

$1.00 EA., 5/8" ROUND Greenlee Chassis Punches—Telephone Dials. Add postage. MDC, 944 W. Tioga, Phila. 40, Pa.

USED CORRESPONDENCE Course In Radio Communications—License preparatory, trains you with the aid of a large number of photos and recordings. Complete, $37.50. D. Brown, 1305 Watson, Moberly, Mo.

SOUND EFFECTS—hard to get sounds every home movie maker should have. Tape and Record write for details. C. W. Wrightman, 213 So. Hawthorne Blvd., Hawthorne, California.

ANY RADIO, Phono, Amplifier Schematic 50¢, Television $1. Raybon, 150 Rockyford Rd., NE, Atlanta 17, Ga.

• • • BUSINESS OPPORTUNITIES

GROW MUSHROOMS. Cellar, shed and outdoors. Spare, full time, year round. We pay $4.50 lb. dried. We have 29,000 customers. Free Book. Mushrooms, Dept. 315, 2954 Admiral Way, Seattle, Wash.

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

• • • MONEYMAKING OPPORTUNITIES

GET LISTED for life! Receive hundreds free magazines, samples, special offers. Rush 25¢, stamped, addressed envelope. Columbia, 45-09-E Broadway, Long Island City, New York.

OUTSTANDING PROFIT Potentials. $10. monthly starts you in field gaining widespread acceptance. Free Brochure. Columbia, 45-09-LE Broadway, Long Island City, New York.

• • • EMPLOYMENT OPPORTUNITIES

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

• • • HI-FI

EXCLUSIVE FORMULA Cleans, lubricates and extends life of all phonograph records, $2.00. Satisfaction guaranteed. Peck's—890, 103 Citizens Avenue, Waterbury 10, Conn.

COMPONENTS, RECORDERS. Free Wholesale Catalogue. Carston, 125-G East 88, NYC 28.

• • • RADIO & TV

TRANSISTOR AMPLIFIES 300 Times $2.00 Each. Brand New PNP Miniature Type. Data included. No C.O.D. or stamps. Kramer, G.P.O. Box 1868, New York 1, N. Y.

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

15 DISTANCE ONE-TUBE Plans—25¢, with Transistor experiments, catalog. Laboratories, 1131-K Valota, Redwood City, California.

• • • TAPE RECORDERS

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

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

• • • EDUCATION & INSTRUCTION

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

• • • BUILD-IT-YOURSELF

PRINTED CIRCUIT layout kits. Materials, Instructions for three Printed Wiring Boards $3.95. State choice—Transistor receivers, Amplifiers, Power supplies. Advanced Designs Inc., 914 Lullaby Lane South, Vienna, Virginia.

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

• • • PERSONAL

LOANS BY Mail. $50 To $600 For Any Purpose. Employed men and women eligible. Confidential. 2 years to repay. Write for free loan application. American Loan Plan, City National Bldg., Dept. EI-8150, Omaha 2, Nebraska.

• • • STAMPS & COINS

ADULTS! LIKE Stamps? Start your own approval business. Our free guidance shows exactly how, makes it easy, profitable. Details free. Columbia, 45-09-L Broadway, Long Island City, New York.

• • • MUSIC

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

Better Business Bureau, Inc., Chrysler Building, New York 17, N. Y.

If the fraud involves an electronic machine operated by someone who claims to be some sort of doctor, call the local branch of the American Medical Association. You should also write to Oliver Field, Director, Bureau of Investigation, American Medical Association, 535 North Dearborn St., Chicago 11, Ill.

Although all of these steps to report accomplished frauds are important and will help to stamp out future frauds, they are in the nature of "locking the barn door after the horse is stolen." Once a con man has palmed off some junk masquerading as electronic equipment on his victim, it is difficult to obtain any redress. To stop the widespread electronic frauds, an ounce of prevention is worth far more than a pound of regret.

Test Bench Control Panel

Continued from page 61

worked on with no inconvenience.

The rest of the board was designed to integrate the author's work area. In this case the work shop was built into a closet in one end of the den. It has no electrical outlet closer than half a room away making it very awkward to use any electrical equipment. In addition, there were no good lights close by.

The control board changed all that. With it the author now has two outlets at his fingertips, two lights directly above which are controlled individually by one rotary switch (SW1) and, perhaps most important of all, a fused line to prevent blowing the main fuse in case of shorts or overloads.

The cost was nominal. The piece of scrap perforated Masonite board served as the panel. A 10-amp "Mini-Breaker" is mounted in a porcelain socket in the hot side of the line. Actually a circuit breaker, it can be reset when it "blows." You may find the "Mini-Breaker" won't make contact in the socket used. If so, drop a blob of solder on the socket's middle contact.

The lamps, wall-mounting on a scissor bracket, were $2.95 each. You can use any type you desire, but there's a little trick you must know to use the three-wire canopy switch SW1.

The schematic shows the hookup, but if you use a single duplex receptacle, such as the author did, you should first take it apart and cut into one of the sides and separate each of the connections. You can, if you wish, use two separate receptacles, and parallel one side, hooking the red and green to the other terminals separately.

Great Stalactite Organ

Continued from page 53

the plunger develops between one and two horsepower.

Another novel feature is that the organ can be played automatically much in the manner of the old-time player piano and music roll. The roll in this case is a thin but tough Mylar plastic belt with patterns of holes melted into it by a soldering iron. The holes correspond to notes and chord structures. Metal brushes scan the plastic roll, like an IBM sorting machine scans a punch card. When a hole is encountered, the "brush" closes a contact just as if someone had struck a key on the console. Total variations and volume changes are handled automatically and electronically.

Maintenance is a minor problem since the caverns boast a stable temperature of 57 degrees. Power consumption is relatively small and an electron tube lasts more than a year.

Magnifies Time 100,000 X

Continued from page 68

air driven turbine. Placed at the center of the circular film box, the mirror directs the light rays to the film along the inside rim of the circular box.

The new camera, developed by Dr. Albert T. Ellis, of the California Institute of Technology, is manufactured by Benson-Lehner Corp. Dr Ellis originally wanted to photograph gas bubbles in turbulent fluids. Such bubbles are born and die within a few thousandths of a second, but during their short life span they produce cavitation, a highly destructive effect in hydrodynamics.

Very intense illumination is needed to provide good resolution at ultra-fast exposure rates. Therefore, this camera is equipped with its own lighting system capable of producing 400,000,000 lumens with 3 milliseconds duration. That's about 60 times more illumination than from the most powerful flashbulb.

Professional Antenna Tips

Continued from page 46

remaining strands, etc. Three turns are enough for average-weight wires and average-length antennas. Trim with cutters and file and solder as for other splices.

Another useful splice, not illustrated, is the half-splice. This is used for attaching one wire to another, either where no weight is to be supported, or where the wires meet at an angle. It is made just like the back-splice, except that you use a second wire instead of bending one wire back on itself.

If you use a guyed pole or tower, now is the time to take a good look at your guy wires. Whether you use solid (galvanized) or seven-stranded galvanized guys, give them the same treatment as for copper or copper-clad antenna wires of the same type. However, if you are one of the comparatively few who use the very flexible steel cable called wire rope (or "tiller rope" in marine circles) the story is a bit different. Use the standard wire rope clips known as "Crosby" clips, which ought to be found in your local hardware or marine supply house. If not, the conventional "Kearney" connectors used almost universally for power line connections will serve you well. Most electrical dealers carry them, and power companies certainly do. They come in a variety of sizes. For stainless-steel "aircraft cable," used by boatmen, there are appropriate clips in the marine stores.

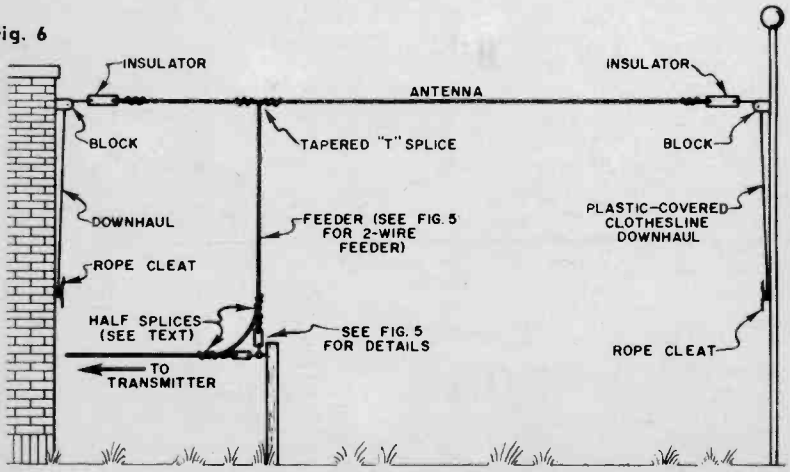
Unless you are using a Marconi-type long wire, feeders are a problem. They should be run out from the house to a post planted beneath the feed-point, so a vertical or right-angle approach to the flat-top can be made. This technique avoids excessive weight to be supported by the antenna and its insulators. The treatment (same for single or two-wire feeders) is shown in Fig. 5. Heavy screw-eyes in the post take pin-shackles to which feeder insulators are secured. Of course this breaks the feeder, since its whole point is to avoid sharp bends and mechanical strains in the feeder lines. Continuity is restored by jumpers from the horizontal to vertical portions, attached by half-splices.

Notice, in Fig. 5, that one jumper goes through the insulator holes, one does not. This simply indicates you can use either method.

The ends of your antenna should not be fastened to the masts or the house. Use a pulley and a downhaul at each end. This makes the antenna accessible for repairs, adjustments, and changes. The rope cleat used to secure the downhaul should be placed high, out of the reach of children. If one end of the antenna is supported by a tree, or a mast that can sway, don't secure the downhaul directly to the tree. Use a counterweight, so the tree can swing without yanking on the antenna. Run a slack line from the weight to the cleat on the tree. Keep the weight up out of reach, too, and the slack short enough to keep the weight from hitting someone if the antenna breaks anyway. See Fig. 6 for a good antenna feed line system.

For your downhauls, the plastic-covered, steel clothesline wire is excellent. Needless to say all iron or steel hardware used outdoors should be galvanized. Brass or bronze fittings are fine, but more expensive. Bronze or wood-block pulleys are worth an investment, however.

Fig. 6



A complete antenna. Dipole or long-wire would be treated same as this "Windom." Winter DX is now an indoor sport.