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1. CHOOSE
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Choose the vocational training *you* like from the categories currently available. Your Army recruiter will give you all information and advice you need.

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Take aptitude and physical examinations . . . to be eligible, you must have a qualifying aptitude score and meet minimum physical requirements for your choice.

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. . . before enlistment!

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CHOOSE, QUALIFY and KNOW . . . without the slightest obligation to enlist! You *get* the Army vocational training you like—guaranteed in writing—or you *don't enlist!* This week, ask your local Army recruiter for complete details about the new Army system which lets *you* do the choosing.

NEW "CHOOSE-IT-YOURSELF" VOCATIONAL TRAINING SYSTEM

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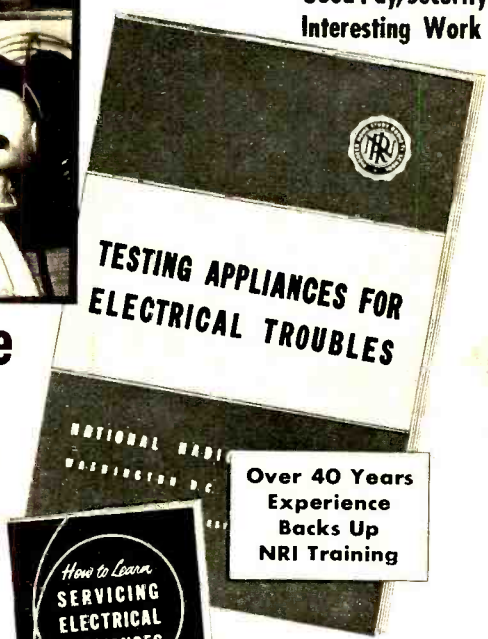

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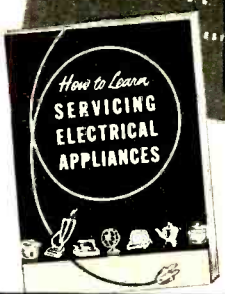
Appliances are necessary to comfortable, convenient living. Owners pay well to keep them in repair. The field is amazingly big. In addition to major appliances such as electric ranges, air conditioners, refrigerators, there are over 40,000,000 electric irons, 5,000,000 electric blankets, 15,000,000 coffee makers, plus more millions of vacuum cleaners, fans, toasters, mixers, etc.



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ELECTRONICS ILLUSTRATED

A Fawcett Publication

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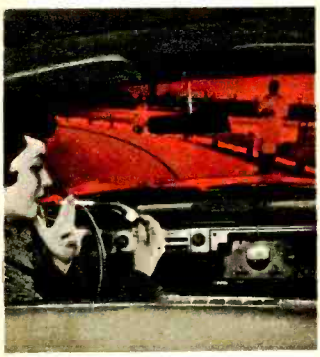
Contents



Cover Photo by Mike Bonvino

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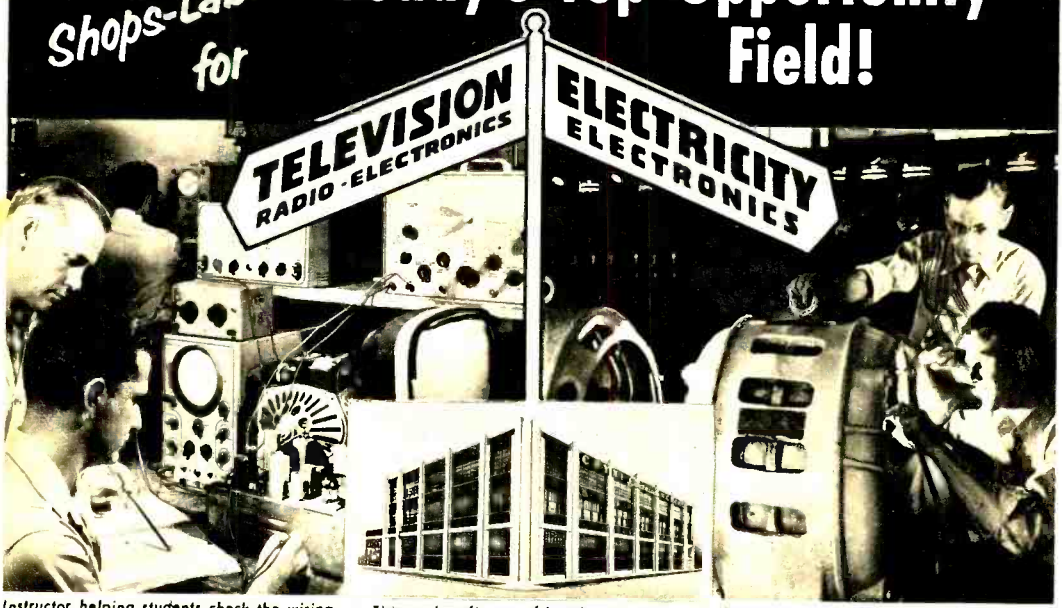

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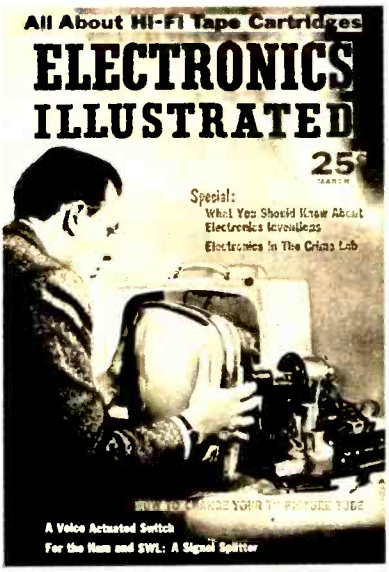
A Message From the Editor



The transistor revolution is over—long live the Maser! It seems that only yesterday we were learning to live and work with that startling minute chunk of rock called the transistor. You our readers were probably in the vanguard learning what it was and how to use it. Now the consumer is becoming accustomed to the word and to seeing the transistor in his portable radios, etc. Well, here we go again. Normally close-mouthed engineers and scientists are predicting great accomplishments for another unlikely looking device called the Maser. What it is, how it is used and what it may do in the future is explained in our article starting on page 64.

Shown here is the cover of the next issue of *EI*. Before deciding to do the story "How to Change TV Picture Tubes" (in our next issue) we obtained a new 17" Zenith portable TV set and actually removed the tube to see how difficult it would be. It's not an easy job, but it is one that can save you upwards of twenty dollars if you have some mechanical aptitude and can follow instructions carefully. (Zenith and some other manufacturers include instructions in the consumer booklet accompanying each set.) And you must observe some safety rules. For the complete story read the article in the March issue.

We have long had book clubs for book lovers and record clubs for record lovers, now we have a hi-fi club for—you guessed it—hi-fi fans. The Institute of High Fidelity has just been formed by the I.H.F.M. (Institute of High Fidelity Manufacturers) to serve the peculiar needs of hi-fi enthusiasts. The materials they offer and their program is interesting. Anyone wanting to find out more about them should write to the I.H.F. at 125 23rd Street, New York 10, New York. The annual membership fee is $10.

Incidentally, our West Coast readers may be interested in learning that the annual High Fidelity Music Show will be held in San Francisco between February 7th and 10th and in Los Angeles between February 18th and 22nd. This is the show in which most hi-fi manufacturers display their latest wares for the approval of the consumer.

We have a report in this issue on an amazing new device called the Synchroreader. Developed in Japan, this may revolutionize the printing industry in the future. It is a method of combining sound with print in such a way as to give the reader-listener three dimensional information at one time.

There is good news for radio-control model fans and for

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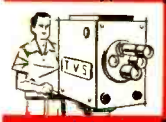

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others who are thinking of using limited two-way voice communication such as between home and office, ship and shore, etc. The F.C.C. has just released new regulations opening parts of the 27 megacycle band (formerly the 11 meter ham band) to increased power and for voice operation. Now if you want to operate a radio-controlled model airplane, etc., on 27.255 megacycles you may use a power up to 30 watts input to the last stage of your transmitter. Of course your transmitter must be crystal controlled as previously and you must obtain F.C.C. approval for your equipment. Forms are available from the F.C.C. for this purpose. The previous maximum power permissible was 5 watts. For voice use there are a number of new frequencies now available close to 27 megacycles on which you can use crystal controlled equipment of up to 5 watts rating for two way communications. We plan to have a complete article on this subject in a future issue of *EI*.

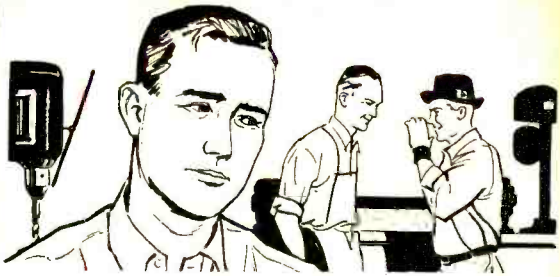
Anyone with any mechanical aptitude at all has probably at one time or another thought up some idea which had possibilities as a useable invention. The difficulties in getting a patent and even more, in getting the idea into producible form are probably insurmountable to most. However, many of those who do develop their ideas and eventually market a product have been well rewarded. Next month *EI* presents an exclusive report on what inventions are needed and how you may follow through on some of your ideas to your eventual profit.

Also next month in *EI* you will read how electronics is used in the most advanced crime laboratories all over the country to apprehend criminals who formerly went scot-free, how to build a voice actuated switch and all about the new hi-fi tape cartridges which may make tape recorders as popular as record players.

Of course our regular features, the Electronic Brain, Hi-Fi Clinic and A B C's of Electronics will appear in this issue also.

Charles Tuttle

"HOW A 'CRAZY RUMOR' GOT ME PROMOTED!"



What I overheard one morning shook me right out of a rut!

"Company's getting ready to cut back . . . bound to be layoffs," I heard them say. "Just another crazy rumor," I told myself.

Just the same, I took quick stock of myself that night. Came up with four good reasons why the company would keep me on:

Three years' experience
Getting along with foreman
Turning out acceptable work
Prompt and dependable

And four just-as-good reasons why they might let me go:

Making no real headway
Others better qualified
Still rated "semi-skilled"
Needs special training

I wasn't in trouble. But I sure wasn't "in solid" like I should be. That's when I made up my mind to enroll for training with I.C.S.

I picked I.C.S. because it's the oldest and largest with 259 courses. The training is quick and thorough. It's recognized by my company and accredited by the National Home Study Council. You study in your spare time and get personalized, practical instruction—know-how you can apply next day on the job.

That was a year ago. There have been two layoffs since then. While some of the others were just hanging on or being released, I was moving up. My I.C.S. training started something. Not only did it get me promoted (with a fat pay hike), but it put me in line for real advancement.

Don't wait for a "crazy rumor" to set *you* straight. Take out your "job insurance" right now. Mail the coupon and get full, free details on how I.C.S. has helped thousands, how it can help you. No obligation—and you get three valuable books *free!* (1) How to Succeed; (2) Catalog of opportunities in the field of your choice; (3) Sample lesson (math).

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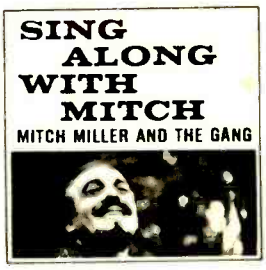

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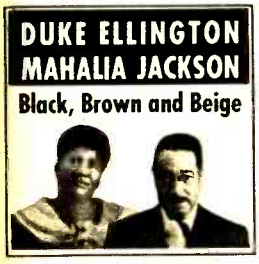

9. The finest performance ever of the Duke's masterpiece

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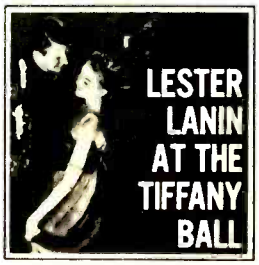


6. 43 hits for listening and dancing—in the smooth Lanin style

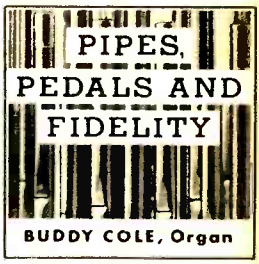
7. The ingratiating Miss Holliday in her biggest Broadway hit

8. Bernstein's exciting performances of two colorful scores

10. A truly magnificent performance of this majestic symphony

11. The great tunes from Rodgers and Hammerstein's fabulous hit

12. The two fiery Roumanian Rhapsodies—plus 2 more works



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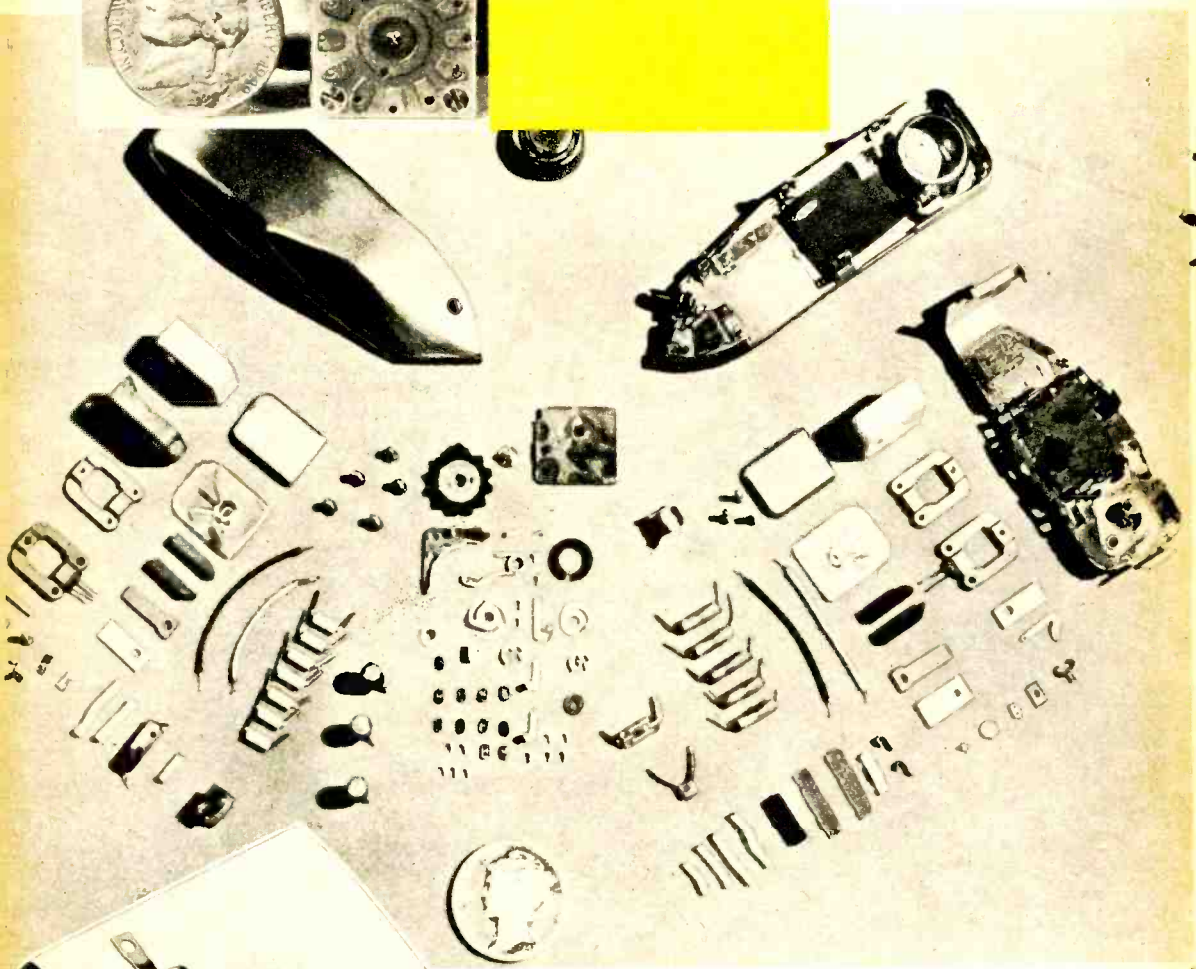
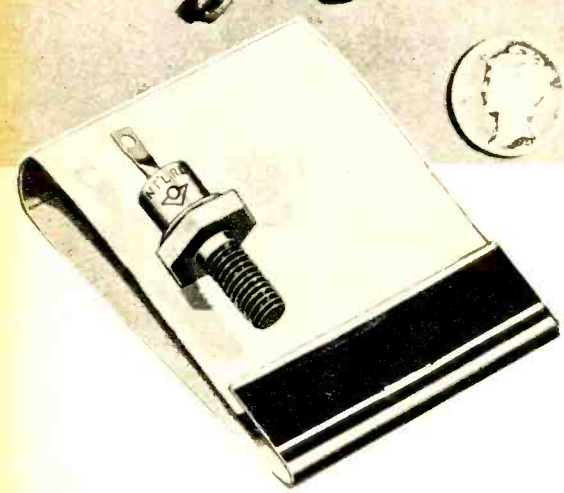
2. Grofe: Grand Canyon Suite
3. Sing Along With Mitch Miller
4. Grieg Piano Concerto; Rachmaninoff Rhapsody
5. 'S Marvelous — Ray Conniff
6. Lester Lanin at the Tiffany Ball
7. Bells Are Ringing — Original Broadway Cast
8. Firebird; Romeo and Juliet
9. Black, Brown and Beige
10. Beethoven: Eroica Symphony
11. Percy Faith Plays "South Pacific"
12. Roumanian Rhapsodies 1, 2; plus two more works
13. Pipes, Pedals and Fidelity
14. Cugat Cavalcade
15. Tchaikovsky: Pathetique Symphony
16. Listening in Depth (Available in stereo only)

Electronics in the News





Electronics parts are getting smaller all the time. At top of page is a 12-position switch, no bigger than a dime, made by Avion Div. of ACF Industries for sub-miniature ground and airborne radio uses. All (152) items in the center fit into 6/10" of space, and compose a hearing aid to fit into eyeglass frames or be worn behind the ear, by Sonotone. At left, from International Rectifier Corp., a tiny new diffused junction silicon rectifier for industrial equipment which provides currents to 6 amps, and an inverse voltage range from 50 to 500 volts. Compare its size to that of the matchbook.

BUILD 16 RADIO CIRCUITS AT HOME

with the New Deluxe 1959 PROGRESSIVE RADIO "EDU-KIT"®

Reg. U.S. Pat. Off.

only $22.95

A Practical Home Radio Course

Now Includes

- ★ TRANSMITTER
- ★ SIGNAL TRACER
- ★ 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 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 16 Receiver, Transmitter, 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 $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, 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 16 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, 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 & 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 the 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 troubles in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the Dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

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

FROM OUR MAIL BAG

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, schools and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

By popular demand, the Progressive Radio "Edu-Kit" is now available in Spanish as well as English.

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc., for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc., has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

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

☐ Send "Edu-Kit" Postpaid. I enclose full payment of $22.95.
☐ Send "Edu-Kit" C.O.D. I will pay $22.95 plus postage.
☐ Send me FREE additional information describing "Edu-Kit."

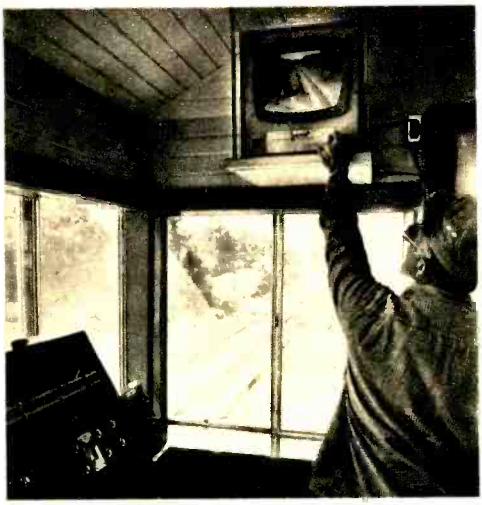
Name .....

Address .....

.....

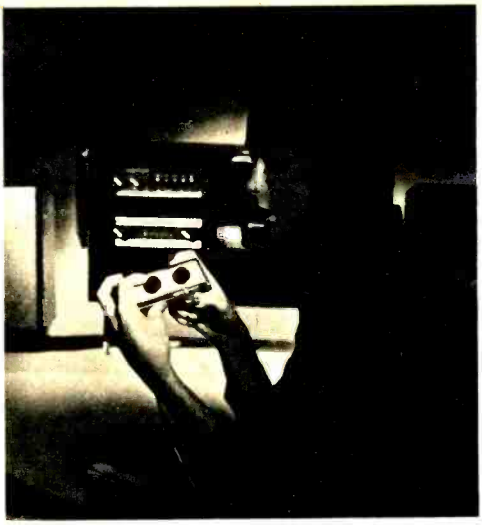
PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 508AE, Hewlett, N. Y.

. . . News



Closed circuit TV contributes to railroad safety. Engineer sees switching engines approaching the main line half a mile away from the TV monitor. Equipment is from G.E.

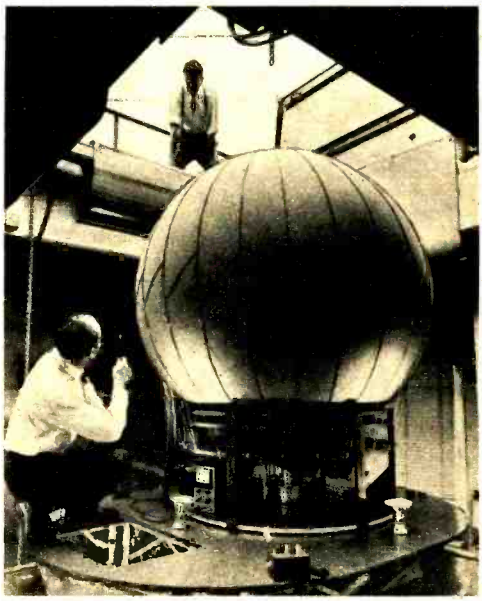
—o—



This lady is receiving stereophonic sound tuned from the actual listening point. She's using General Electric's remote control unit for stereo amplifiers, which allows adjustment of both channel balance and volume as far as 30 feet from the amplifier. $15.

—o—

. . . News

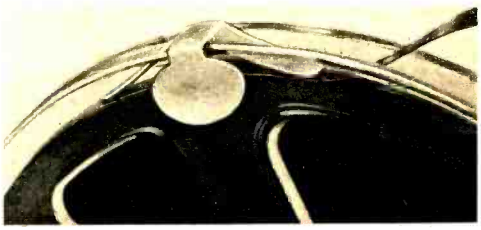


It looks like a cloth balloon, it's really a radar antenna. Made of ordinary drapery material interwoven with metallic threads, the Westinghouse Helisphere produces a rotating radar beam without the rotation of the antenna structure itself. Radar waves are reflected by helical patterned threads on one side of the cloth structure, emerge unaffected on the other side.

—o—

Two new products to facilitate printed circuit repairs are Silver Print and Copper Print, from the Walsco Electronic Manufacturing Company.

—o—



A college education has paid off for 2 students at U. of Southern Cal., who are marketing the Reel-Neat tape clip. 5 for $1.00 from Toyco Prods., 1712 W. Florence Ave., Los Angeles 47, Cal.

—o—

UPGRADE YOUR INCOME

through Grantham Training and an F.C.C. License!

What's in Your Future?

Are you *planning* your future or just drifting into it? Now is the time to get ahead in electronics—the world's fastest growing major industry. Now is the time to add technical knowledge and an F.C.C. license to your practical experience. Now is the time to prepare for higher pay—time to make your future secure.

Grantham Training Prepares You

Grantham School of Electronics specializes in quality training in communications electronics, preparing students to pass F.C.C. operator license examinations. This training is available either by correspondence or in resident classes.

The Grantham Communications Course does not include actual work with practical kits or other equipment. That is, for example, it does not teach you how to solder or how to remove a TV chassis from the cabinet, etc. It is not a repair course but, instead, is bona fide technical training which teaches you to understand electronic theory—which teaches you the *"why"* of electronics.

If you are a beginner in this field, the Grantham course will give you the kind of detailed training in radio-electronics theory and operating practices that will enable you to obtain your first class F.C.C. license quickly. Then, this license plus your knowledge of theory will qualify you for certain types of employment, and you can improve your practical ability while on the job earning a salary.

If you already have practical experience in radio-electronics, the Grantham course can add a knowledge of theory and an F.C.C. license to that practical experience. This should qualify you for higher pay and greater job security.

Train by Correspondence or in Resident Classes

RESIDENT CLASSES—The Grantham Communications Electronics Course is offered in both DAY and EVENING classes in Washington, Hollywood, and Seattle. The DAY course meets five days a week, from 9 a.m. until 1 p.m., and prepares you for a *first class* F.C.C. license in 12 weeks. The EVENING course meets two nights a week, from 6:30 p.m. until 10:30 p.m., and prepares you for a first class F.C.C. license in 30 weeks. All courses "begin at the beginning"—NO previous electronics training required or assumed.

CORRESPONDENCE TRAINING—The Grantham Communications Electronics Course is offered by correspondence from all Divisions of the School—Washington, Hollywood, and Seattle. The course has two major objectives—(1) to *teach* you a great deal of electronics, and (2) to prepare you to pass all F.C.C. examinations required for a *first class* license.

This course can prepare you *quickly* to pass F.C.C. examinations because it presents the necessary principles of electronics in a simple "easy-to-grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

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.

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
Walter Mengel, Jr., 423 James St., Crystal Lake, Ill.	1st	8
Serge G. Miller, 1315 W. 15th St., San Pedro, Calif.	1st	12
John A. Hayes, 1519 Madison Ave., Memphis, Tenn.	1st	14
Robert A. Morgan, 25 Barrow St., New York, N.Y.	1st	9
Hal Moon, Cook Hotel, 1334 Central, Kansas City, Mo.	2nd	5
W. R. Smith, 1335 E. 8th St., Long Beach, Calif.	1st	12
Erskin D. Davis, 4220 Clay St., NW, Washington, D.C.	1st	12
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Robert H. Moore, 307 Grace St., Baldwin, L.I., N.Y.	1st	12
Otis A. Towns, 3638 Bates St., St. Louis, Mo.	1st	12

THREE COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains three complete schools—one in Washington, D.C., one in Hollywood, Calif., and one in Seattle, Wash. All schools offer the same rapid courses in F.C.C. license preparation, either home study or resident classes.*

MAIL COUPON FOR FREE BOOKLET: Our free booklet, *Careers in Electronics*, gives details of how you can prepare quickly for your F.C.C. license. For your free copy of this booklet, clip the coupon below and mail it to the Grantham School nearest you.

GRANTHAM
SCHOOL OF ELECTRONICS

821-19th Street, N.W.	408 Marion Street	1505 N. Western Ave.
Washington 6, D. C.	Seattle 4, Wash.	Hollywood 27, Calif.
(Phone: ST 3-3614)	(Phone: MA 2-7227)	(Phone: HO 7-7727)

(Mail in envelope or paste on postal card)

TO: GRANTHAM SCHOOL OF ELECTRONICS

821-19th, NW Washington • 408 Marion Seattle • 1505 N. Western Hollywood

Please mail me your free booklet telling how Grantham training can prepare me quickly for my commercial F.C.C. license. I understand there is no obligation and no salesman will call.

Name _____ Age _____

Address _____

City _____ State _____

I am interested in: ☐ Home Study, ☐ Resident Classes 98-B

. . . News

Among the wonders of things to come will be this electronic window which automatically closes when rain or snow falls, when a strong wind blows against it, and when temperature inside the house gets below a pre-determined setting. Still in the experimental stage, this window was designed by the Truscon Division of Republic Steel.

—o—

The Model 6 Hi-Fi Stereo Adapter from the Marantz Co. will convert any 2 preamplifiers into a stereo control system, if they are equipped with tape monitor and recording output facilities. A master function switch selects phono, tuners, tape and TV in either stereo or monophonic modes. $45.

—o—

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

....AT A PRICE YOU CAN AFFORD!

*21 INCH
Receiver Kit included

COMPLETE **COLOR** INSTRUCTION INCLUDED

Yes, this great course costs *far less* than *any* training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

Think of it — a complete training program including over 120 lessons, Eleven Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . *ALL at a really big saving to you.* How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)
OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP
We Want 100 More Shops This Year

This 37 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, 36 such shops are NOW IN BUSINESS AND PROSPERING. We are signing contracts with ambitious men to become future owners and operators of these shops in all areas.

FOR UNSKILLED INEXPERIENCED MEN ONLY — WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

RTS APPROVED SERVICE SHOP

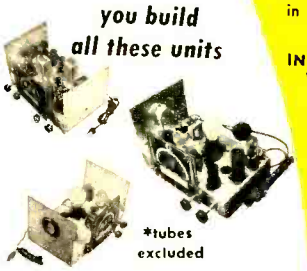
Get your free book on the
FAMOUS RTS BUSINESS PLAN
find out how you can open
A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words *we will stake you* . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build all these units



*tubes excluded

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5100 S. VERMONT AVENUE
LOS ANGELES 37, CALIFORNIA

Est. 1922

ACT NOW!

ASSOCIATION OF HOME STUDY SCHOOLS

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

ALL THESE FREE!

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Los Angeles 37, California

SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

Name _____ Age _____

Address _____

City & State _____

300

. . . News

An electronic measuring technique for providing daily, or even hourly, reports of corrosion attack, promises to sharply reduce cost of controlling internal corrosion in process equipment and pipe lines. Developed by the Crest Instrument Co., the equipment can detect as little as a millionth of an inch of corrosion. Two probes are used, one exposed to the corrosion, the other protected. As the exposed element corrodes its resistance increases.

—o—

WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID

RADIO-TELEVISION SERVICE TECHNICIAN

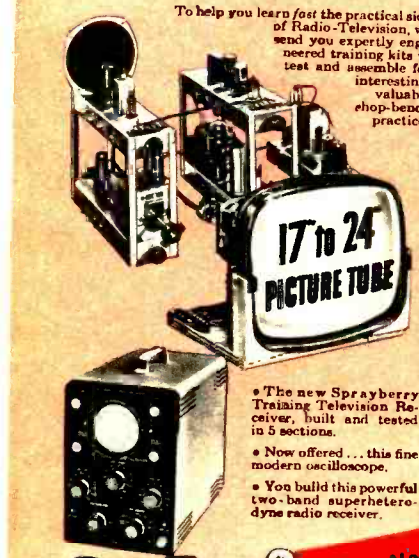
NOW — Just $6 Starts You Training in

RADIO-TELEVISION

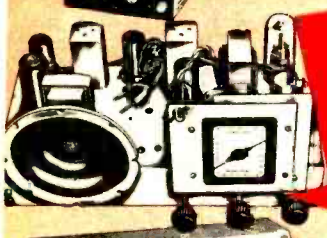
the SPRAYBERRY "Learn-by-Doing" Way . . .

25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

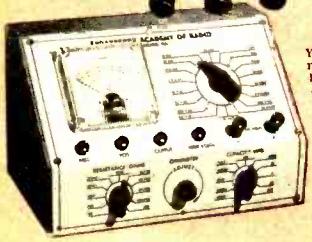
To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!



- 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.



Big New CATALOG AND Sample Lesson FREE!



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

★ ★ ★ ★ This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!

Men by the thousands . . . trained Radio-Television Service Technicians . . . are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now — *just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need . . . to step into a fine job or your own Radio-Television Service Business.

Complete Facts Free—Act Now; Offer Limited

Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once . . . mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free*. No obligation . . . no salesman will bother you.

HOME STUDY TRAINING IN SPARE TIME

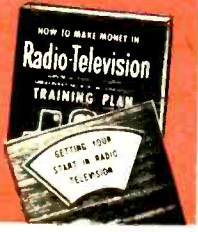
Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today . . . let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity in store for you!

SPRAYBERRY Academy of Radio-Television
1512 Jarvis Avenue, Dept. 120-R, Chicago 26, Illinois

Mail This Coupon Now—No Salesman Will Call



Sprayberry Academy of Radio-Television
Dept. 120-R, 1512 W. Jarvis Ave., Chicago 26, Ill.

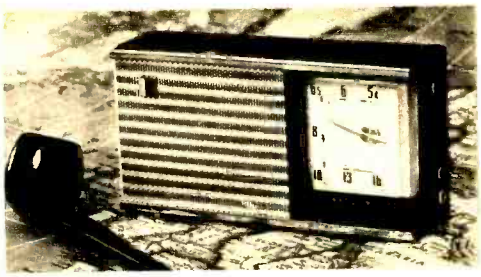
Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... Age.....

ADDRESS.....

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

. . . News



The world's largest manufacturer of TV antennas, Channel-Master Corp., now has two transistor radios on the market. The Model 6506, above, has 6 transistors, 1 diode, 1 thermistor. $50 also gets you batteries, carrying case, extension antenna and earphone.

—o—

The light that dances—a chance to see music—and it's all done with mirrors. That's Colorobot, an electronic device that converts musical sound into abstract mobile color patterns. Any low impedance audio voltage from a record or tape player, radio, etc., fed into the sound input is amplified to actuate relays controlling various circuits: motors, lights, color filter, texture. The synchrometer, a 2-channel printed circuit controls the concave mirror systems that project dancing beams of colored light in rhythm with music fed to it. Smaller than a table model TV, which it resembles, this unit by Stereo-Color is under $100.

—o—

A radio paging system for airplane crews is now being installed on jet airliners. The Selcal decoding system features fully transistorized circuitry and modular construction. Selcal, developed by Motorola, provides for in-flight alerting of an aircraft crew to an ensuing radio message, by transmission of a tone code which is received in the plane. When the right series of tones is present a chime and/or light in the plane is activated, signaling the crew that it is wanted on the radio. Pan-American World Airways is equipping its entire jet fleet with the Selcal.

—o—

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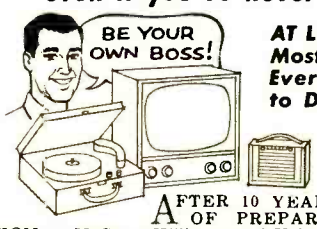

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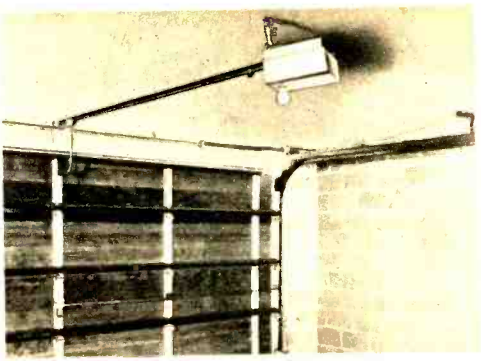
. . . News



At the press of a button on your dashboard, your garage door opens, the garage light goes on, and you can park your car. Press another button in the garage and the light goes off, two minutes after the garage door closes, allowing you to return to your house in safety. These conveniences are features of the Perma-Power Radio-Controlled Garage Door Operator, Model G-500. Simple to install. List price $200.

—o—

New catalogs and bulletins are now available. From Harvey Radio, 103 W. 43 St., New York 36, N. Y., 304 pages listing industrial service, components and equipment. From Allied Radio, 80 N. Western Ave., Chicago 80, Ill., comes a stereo record and tape catalog. Write Dept. PR 832, for Stock No. 68 R566. A 48-page booklet covering basic information on transistor theory and circuit applications, "Transistor Fundamentals and Applications" can be obtained from RCA through tube and semiconductor distributors. The first two bulletins in a series called "Stereo-Talk" are now on hand at CBS-Hytron Advertising Service, Parker St., Newburyport, Mass. "An Introduction to Stereophonic Sound" is just what its name implies. The other 4-page bulletin describes the Columbia CD Stereo Cartridge and tells how to install and use it, besides discussing stereo systems in general.

—o—

EI offers congratulations to RCA Institutes, this year celebrating its Golden Anniversary of training in the electronics field —

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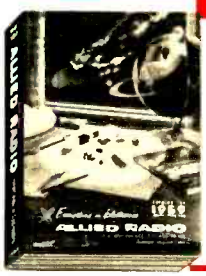

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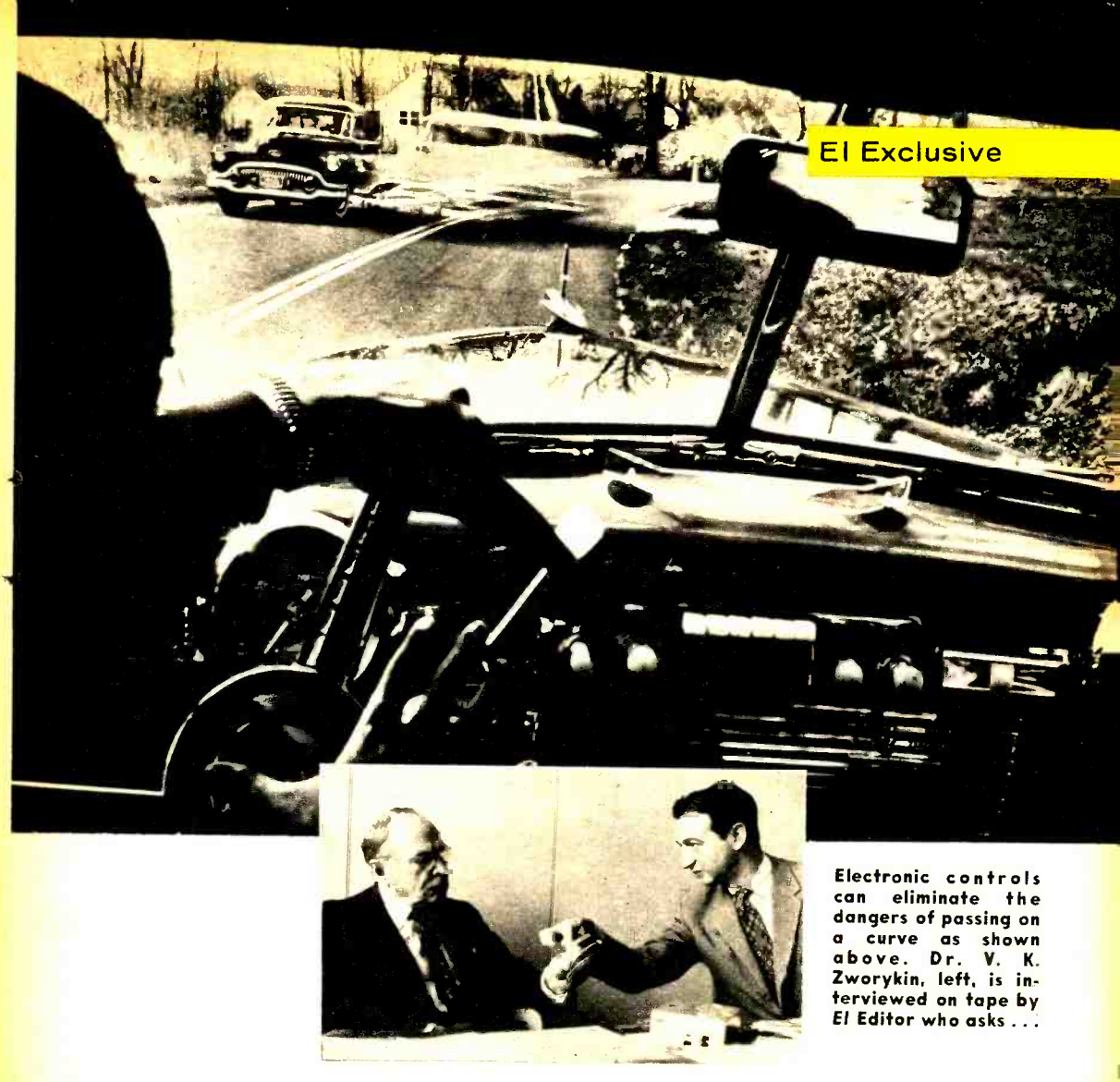


Electronic controls can eliminate the dangers of passing on a curve as shown above. Dr. V. K. Zworykin, left, is interviewed on tape by *EI* Editor who asks . . .

how soon before

Electronics Drives Your Car?

Outstanding scientist predicts highway of tomorrow will electronically relieve you of driving chores.

EXACTLY how important is the traffic and highway accident problem in America? It has been predicted that unless a major scientific breakthrough is made in safety research, by 1975 cars will kill over 150 men, women, and children each day! That's 55,000 people a year!

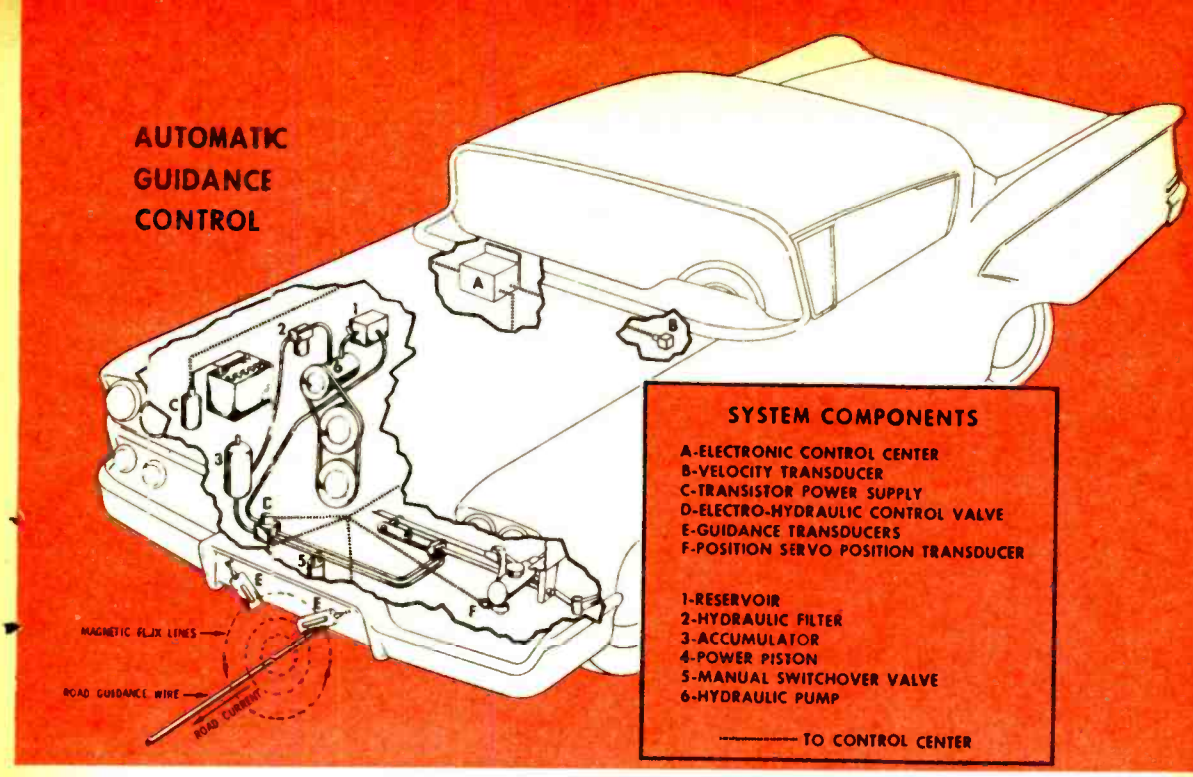
How far has this research progressed? How much further must it go before the human error factor is taken out of driving? The editors of *Electronics Illustrated*, believing that the science of electronics may provide many of the answers to the

Automatically guided vehicle in GM system permits no-hand driving on special test track. Car is steered by magnetic path produced by cable in pavement. Pickup coils on front bumper (bracketing license plate) feed voltage variations to computer in glove compartment which, in turn, sends electronic commands to power steering unit keeping auto on magnetic path. In this system, driver must retain control of accelerator and brake. Only automatic feature is the steering mechanism.

accident problem, interviewed via tape recording one of the electronic geniuses of our time, Dr. Vladimir K. Zworykin, Honorary Vice-president of RCA. Dr. Zworykin has conceived and directed the development of an electronic vehicle control system at RCA's research center in Princeton, N. J. The system is not based on any fantastic flights into the future, but upon feasible ideas presently being proved in experimental use. Dr. Zworykin talks about this system on the following pages, the essential functions of any electronic driving control system, the problems that have impeded its development, and what we might expect of electronics on highways of the future.

The questions and answers begin on the facing page.

A report on RCA's electronic highway was presented at a conference on electronic safety controls recently sponsored by Teachers College, Columbia University, and the American Automobile Association. For the first time experts in all fields concerned with electronic driving controls were brought together. Electronic scientists, highway and safety engineers, auto manufacturers and lawyers carefully examined what has been done, what can be done, and what should be done to reduce traffic accidents through electronics. The complete conference report may be purchased for $1.00 from: Safety Education Project, Teachers College, Columbia University, 525 120th Street, New York 27, N. Y.



Above drawing of General Motors' electronic steering shows components in road, car.

Ques. *Dr. Zworykin, what are the elements of an electronic highway safety system?*

Ans. First of all, for full control, there must be reliable detectors in the road which indicate the presence of a particular car at a particular place on the road. Any car, equipped with electronic instruments or not, must produce information the road needs to control the traffic flow. This information may go to, and activate, the gates of a controlled-access highway and operate traffic lights, computers to evaluate road conditions, and warning signs along the side of the road. In addition, it can tell the individual driver, through indicators and in-car warning devices that he is going too fast or deviating from the proper lane. In complete control, it can take over the actual driving of the car.

Ques. *What is involved in complete control?*

Ans. In effect, there are three functions essential to any compatible electronic vehicle control system. First of all, the indicators in the road can be called simply detectors, and take care of the first function: detection. This is necessary to give the traffic control authority complete information on traffic conditions. Any auto on the road will produce information through the detectors to be used for the other two functions, which are: *guidance* and *collision prevention*. Guidance involves keeping the cars centered in a desired traffic lane, or changing lanes or routes when conditions warrant a change. Collision prevention means speed control and lane selection to avoid contact with other vehicles or objects.

Ques. *How are these three functions achieved in your system? Take the first phase, where the road alone is modified—what is the detection device?*

Ans. Buried in the roadbed are various induction loops in sequence. These loops, which are fed by high-frequency cable along the side of the road, establish a magnetic field above the highway lane. When an auto goes over a loop, currents induced in its body react on the loop circuit producing a signal. This signal may be used to light warning signs, or control traffic lights. It may also be propagated along antenna wires inserted in the roadway to the rear of the loops, so as to activate indicators, or eventually, automatic speed controls in cars following behind.

Ques. *Is such a detection device currently in use?*

Ans. We have installed a practical demonstration of transistorized equipment at the RCA laboratories in Princeton, N. J., which guards the entrance to the parking lot. This is not a complete system, just the beginnings of electronic control. The main purpose of this installation is to evaluate this transistorized equipment. We have over four months experience with it and have not had a single failure.

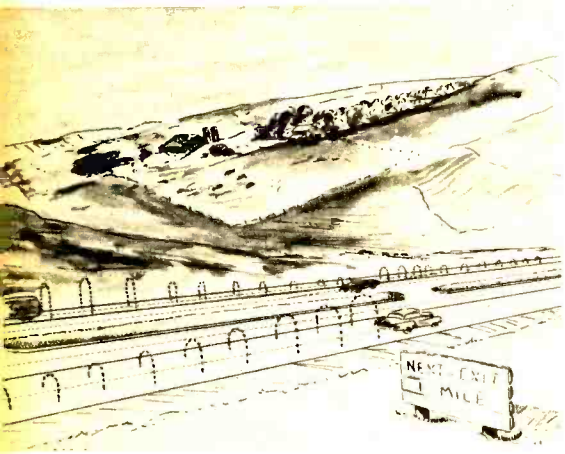
Ques. *What is the nature of this transistorized equipment?*

Ans. A detector in the road senses cars passing toward the parking lot. We attached to this installation a refinement in the form of a car speed indicator. A sign is in sight which sets the speed limit at 20 miles per hour. This is in the nature of a psychological trick. We realize that everyone going past the detector will exceed 20 miles per hour just to see the system work, but of course that is exactly the reaction we want. So we set the detector for about 24 miles per hour and added an extra feature: If you exceed 24 miles an hour, an additional sign further down the road lights up requesting that you slow down. Both detector and sign work perfectly.

Ques. *We understand that you had previously installed an auto detection system with the detectors on the side of the road along a strip of US Highway 77 in Lincoln, Nebraska. Was this installation with transistorized equipment?*

Ans. No, it was with tubes. It was a demonstration installation and

Car moving over buried induction loops in RCA system produces "flying tail" magnetic field which varies in strength as car moves on.



Installation at Lincoln, Neb., uses vacuum tube car detectors in boxes on posts at side of road. Electronic detection unit lights warning bulb.

we were not concerned too much about power consumption. In addition, that installation, which was very successful, was done before we had completed a transistorized system.

Ques. *Would you say now that transistorized equipment in the detectors at Princeton is stable under all conditions of weather and traffic?*

Ans. Yes, as far as we have been able to tell. But the temperature stability of the condensors for the speed measurement device proved somewhat less reliable. This has been corrected now for radical changes in temperature and we are ready to hold a complete road test. We would like a minimum of a mile of road for the complete test. But so far the money has not been forthcoming from the various parties interested in electronic driving controls. We were assured by automobile manufacturers that when a test road and additional control equipment is available, they will supply the cars. We finally decided to design a full scale test track ourselves at Princeton, an aspect of the work that we should like to have seen undertaken by others.

Ques. *How much will this electronic test track cost in construction?*

Ans. Under a million dollars. It will be equipped with all the features we would like to have in a completely automatic system.

Ques. *But the present installation at Princeton and the demonstration at Lincoln, Nebraska, only used detection and external warning equipment. They do not incorporate other desirable features. Yet you're ready to build a completely automatic control test road?*

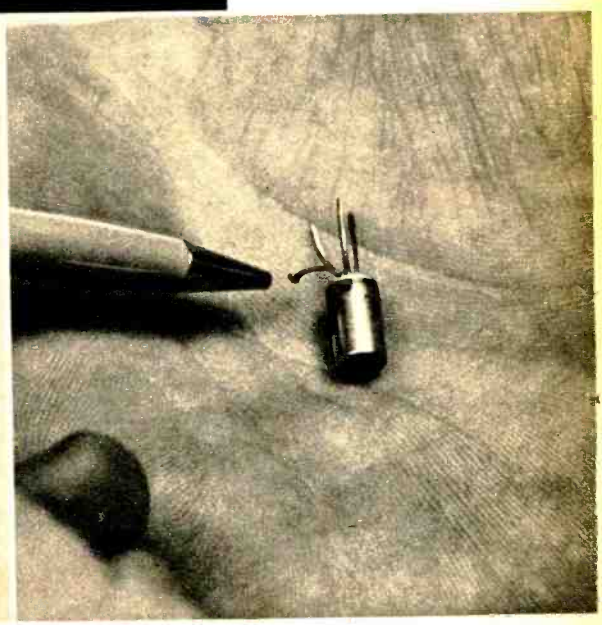
Ans. That's right. We believe this system of ours has features which other systems do not have, primarily in detection of autos on the road. Treadles, electromagnetic devices, photocells and a great number of other things designed to detect cars on the road exist, but they all have their drawbacks. Already there are some 3,000 treadles in New Jersey, but they have to be replaced at the rate of 600 per year. Rubber tubes are not used because snow renders them useless. Our system, on the other hand, is designed to have the road equipment, detectors and loops, buried in the concrete where they cannot be affected by snow or weather. As a matter of fact, [*Continued on page* 98]

Transistors have replaced tubes in RCA detectors because they greatly reduce power consumption and vastly increase reliability.

When car exceeds speed limit on approach to RCA Princeton labs, signal from buried detector lights "Slower Please" sign in background.

The extra large knob seen on the receiver case provides a gear reduction for tuning.

Bent wire on transistor is the internal shield lead (not used), kept clear of other wires.



1-Transistor FM Radio

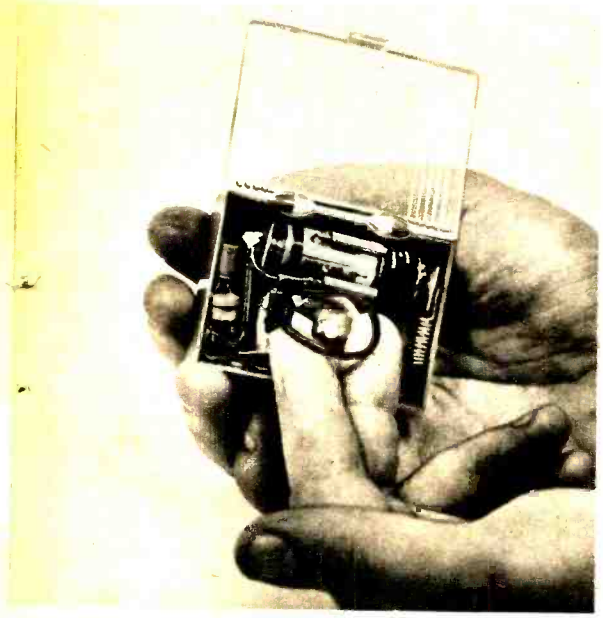
By Herb Cohen

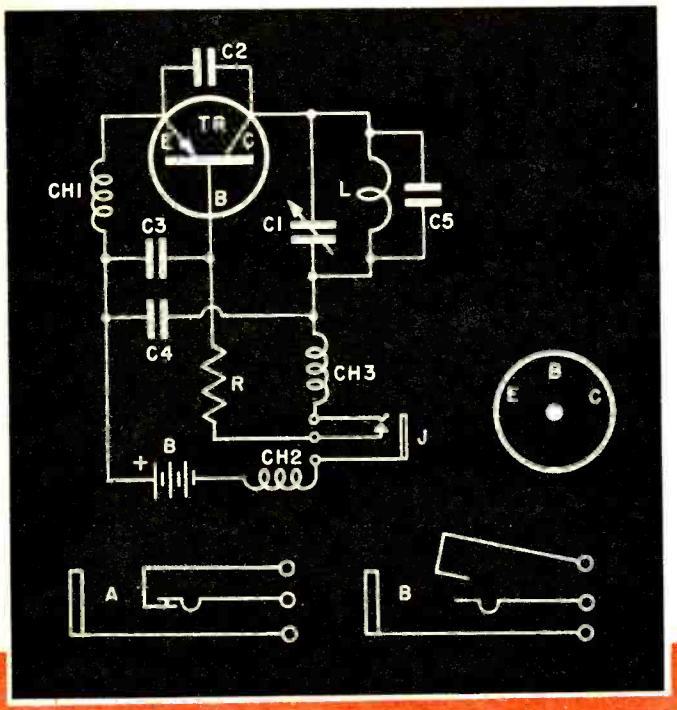
The first complete FM receiver using *one* low cost transistor may be built into a pocket size case.

FOR less than $10 you can build an FM receiver that is almost half the size of a pack of cigarettes. It needs no external antenna and draws only a tiny amount of current from its single battery. This unit was made possible by the availability of a transistor that will operate in the high frequency range of the FM band at a cost within the reach of the home builder. Add the old principle of superregeneration and you have a 1-transistor circuit that will tune, amplify, and provide audio output to drive an earphone.

The sound quality is not in the hi-fi category but certainly suffices. High sensitivity makes it possible to receive stations in suburban areas without an antenna. Its ability to separate signals is also good. A brief word of caution before embarking on this project. This is not the kind of portable you can stroll down the street with, whistling to the music coming over the earphone. The extraordinary simplicity of the circuit imposes some limitations. After a station is tuned in, the case must be held in a fairly fixed position. Otherwise changing body capacity will detune it.

Lower left points out coil L. This loop is wound from solid, insulated wire and pushed down parallel to the tuning capacitor. Other photo shows earphone jack on side of case. After modification, it is also an on-off switch.

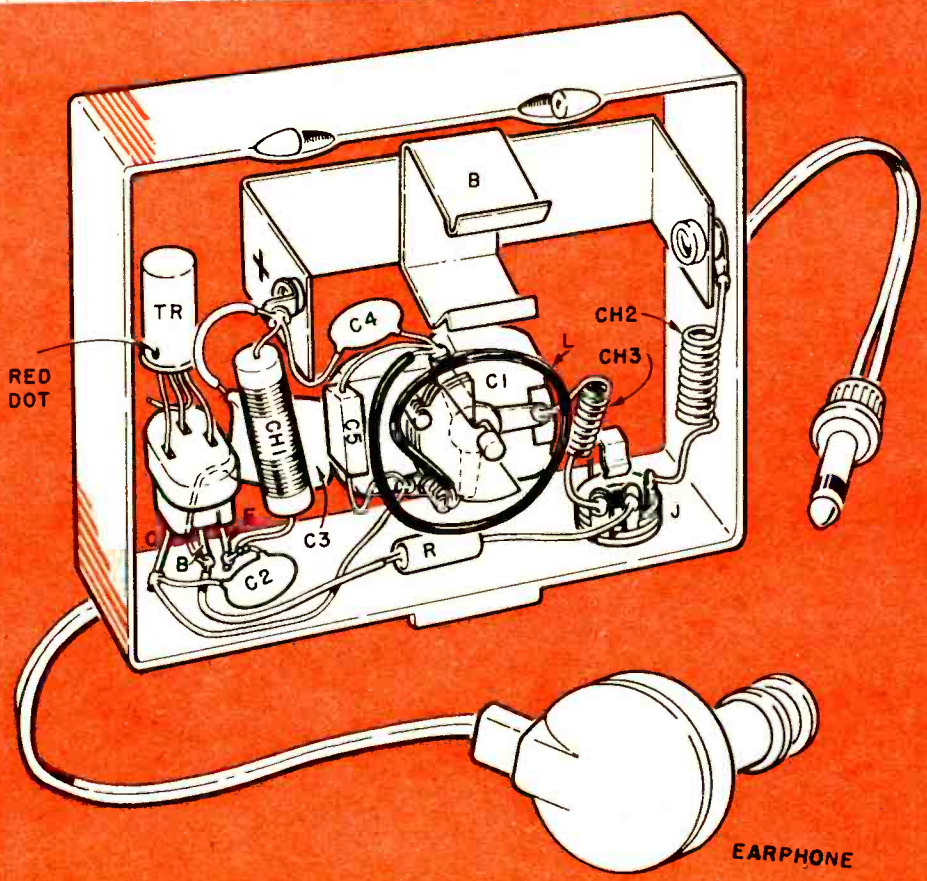


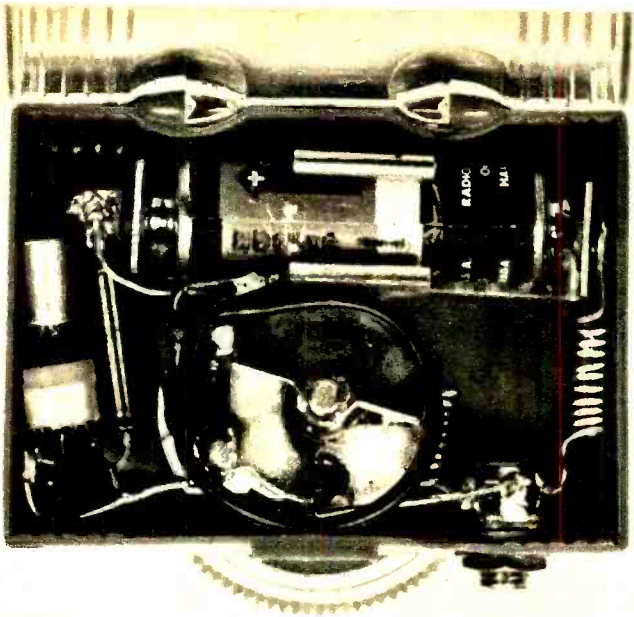


Next to schematic is base diagram of TR. White dot in the center is unused shield pin.

Below schematic is earphone jack modification. A is original, B, how top contact is bent.

On wiring guide below, note + side of battery holder. Red dot on TR indicates collector.





The plastic case will provide sufficient room for mounting parts without excess crowding.

A novel feature in the construction is that the complete receiver is built into the case that the earphone is packed in. Of course if you already have an earphone of 3000 ohms, any plastic case of the approximate dimensions will do. Don't use a metal one or the signal pickup will be cut down.

After accumulating all the necessary parts it's a good idea to physically arrange them in the case according to the position illustrated in the photos. This will serve as a guide for their final placement. The tuning capacitor is mounted first. The holes for its screws may easily be made with the tip of a warm soldering iron. This is a much safer process than attempting to drill it.

Make the one hole for the earphone jack in a similar manner. Before mounting the jack, modify it according to the diagram included in this article. Once this is done, the receiver will automatically go on when the earphone jack is plugged in, obviating the need for a separate on-off switch.

The battery holder is simply glued into place with Duco or any similar household cement. Mark one end of it in some manner to indicate the plus side. As with any transistor circuit incorrect battery polarity can prove disastrous to the transistor. The same precaution applies to inserting the transistor into its socket. A base diagram is included with the schematic. Check with it to make sure the emitter lead goes to the same socket pin as CH1.

Once you have mounted the tuning capacitor and earphone jack you'll notice that the lid of the plastic case will not close completely. The remedy for this is to clip the projecting lugs (three) of the capacitor until the lid snaps into place.

[*Continued on page* 104]

PARTS LIST

C1—25 mmfd. variable capacitor (Hammarlund APC-25B)
C2—5 mmfd. disc ceramic
C3—.1 mfd. disc ceramic
C4—.001 mmfd. disc ceramic
C5—6.8 mmfd. mica
L—Tuning coil, 1¼ turns #20 solid insulated wire, approx. 1⅛" diameter
CH1—10 microhenry choke
CH2,CH3—About 10 turns of solid wire, ⅜" diameter
R—680,000 ohm
TR—RCA 2N384 transistor
B—9-volt battery (RCA VS309), with battery holder
Earphone—3000 ohm dynamic type. (Lafayette AR-46 includes the earphone, plastic case, and earphone jack)
Misc.—Transistor socket, plastic knob, two 4-40x¼" machine screws for mounting C1

Your method of reading this magazine someday may be changed by new electronic device that lets you . . .

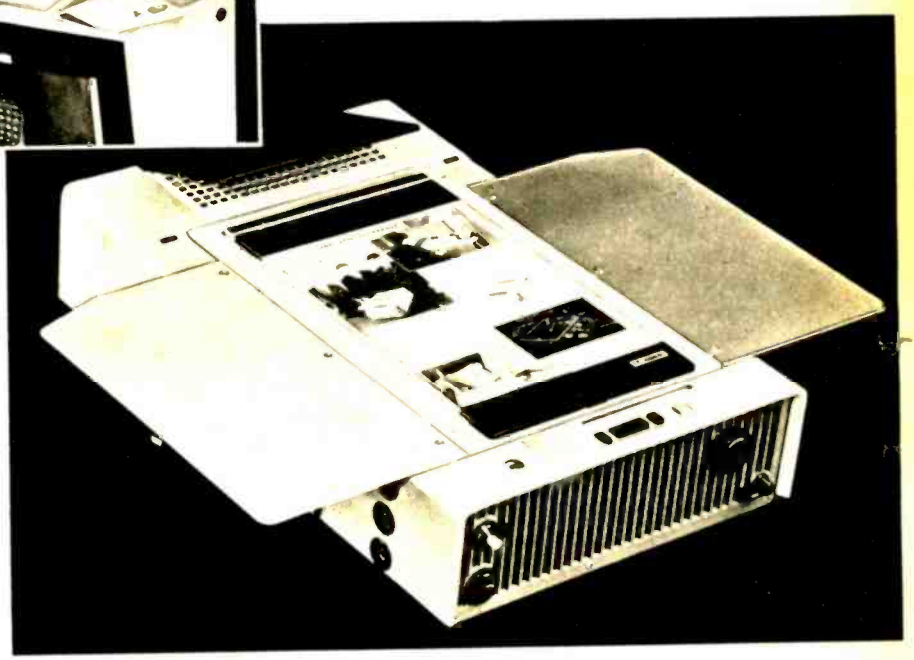
Listen To A Printed Page

By Edward Nanas
Feature Editor

IN THE not too distant future it is entirely possible that you will pick up a copy of *Electronics Illustrated,* turn to a do-it-yourself project and actually *hear* the author's voice explain that more-complex-than-usual wiring diagram while you follow along visually.

The communication of ideas is the basis of civilization, and man has always searched for new and better ways to communicate. We have come a long way from carvings on cave walls. We have printing presses, magazines, newspapers, radio and television. Now, from Japan, comes a new tool for the communication of ideas—the *Synchroreader,* which may well mark the birth of the talking page.

Just imagine being able to study a foreign language from a book that not only charts the grammar and vocabulary, but



Compact Synchroreader is shown below with transparent plastic plate holding pamphlet page in place. Reverse side of page has been treated with a ferrite magnetic recording film. The machine, set into desk at left, permits operator to read page, make notes, listen, or record her comments all at a button's touch.

actually lets you hear pronunciation and accent.

Picture yourself turning to the amusement section of a newspaper, reading the review of last night's concert, and hearing excerpts of the music as it was played! And when the morning mail arrives, the hometown news from Aunt Tilly (the woman with the world's worst handwriting) will be entirely understood because Aunt Tilly, no longer trusting her sentiments to her poor penmanship, has elected to record them on the back of her latest snapshot.

The name *Synchroreader* describes the instrument which makes it possible to record and play back sound on a printed page. The page itself is so unusual that it, too, has a special name: *Synchrosheet*. Both were developed by Professor Yasushi Hoshino, of Tokyo Institute of Technology. Although neither is available in this country as yet, prototype models were demonstrated at the Brussels World's Fair.

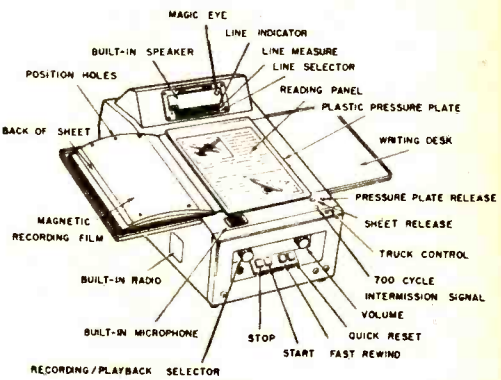
Originally, the *Synchroreader* was designed to enable a person to read a printed, handwritten or illustrated page and at the same time hear accompanying voice, music, explanations of diagrams, sound effects, or a reading of the actual printed text. However, there is nothing to prevent one from *only* listening, or *only* reading.

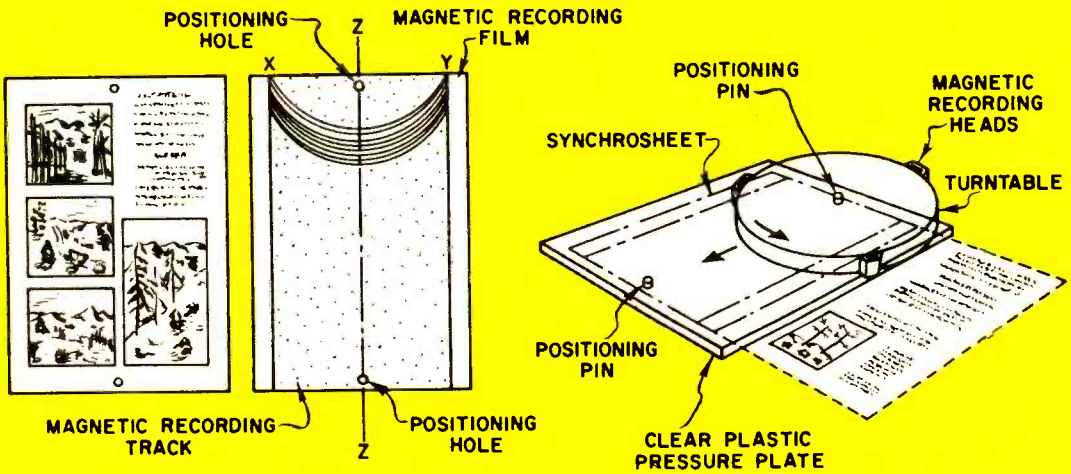
But when sight and sound join forces, the effect is likely to leave a never-to-be-forgotten impression. The action in a novel may be underscored with dramatic music much in the same way as action is highlighted by the background music of motion pictures. But unlike the movies (or television) the actual setting and character appearances are still left to the reader's imagination. A photo of Times Square on New Year's Eve might make a more vivid impression if one could hear the noise of the crowd. A complex series of mathematical and chemical formulas can be explained to the student by a sympathetic voice which takes him through the maze step by step.

In order to understand the operation of the *Synchroreader*, we must first examine the *Synchrosheet*. Very simply, it is any piece of paper, coated on one side with a ferrite magnetic material which produces a broad expanse of mag-

This model has *Synchrosheet* removed to reveal turntable containing record ng heads.

Diagram of basic *Synchroreader* points out external parts of the neat, functional design.





Both sides of *Synchrosheet* are shown above. Between X and Y is thin coating of magnetic film. As turntable moves down film, magnetic lines of force corresponding to sound are imparted.

netic recording film, such as that on the back of your recording tape. Text, photos, or whatever, are printed on the untreated side.

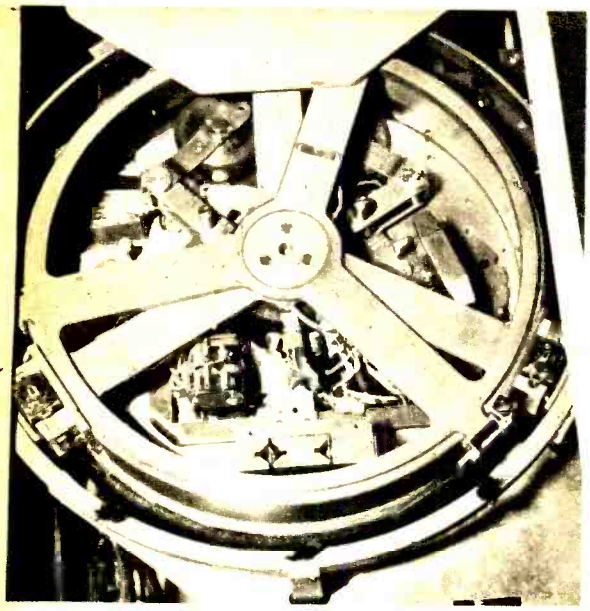
Now let's take a look at the *Synchroreader*: The accompanying diagram of a prototype model points out many self-explanatory parts. But its most important feature is a turntable with three evenly-spaced magnetic recording heads on its perimeter, similar to those used in standard tape recorders. This turntable rotates counter-clockwise, and at the same time moves from the top of the page toward the bottom.

For recording, a *Synchrosheet* is placed magnetic film side down in contact with the turntable's recording heads. Position pins and a clear plastic pressure plate hold the sheet in place. As the turntable spins and moves slowly down the page, voice currents (or music, sound effects, etc.) are fed through a built-in microphone (or radio, or other sound source) to the recording heads. The contact of the recording head (one is always moving across the sheet) generates magnetic lines of force in an arc-like pattern down the page.

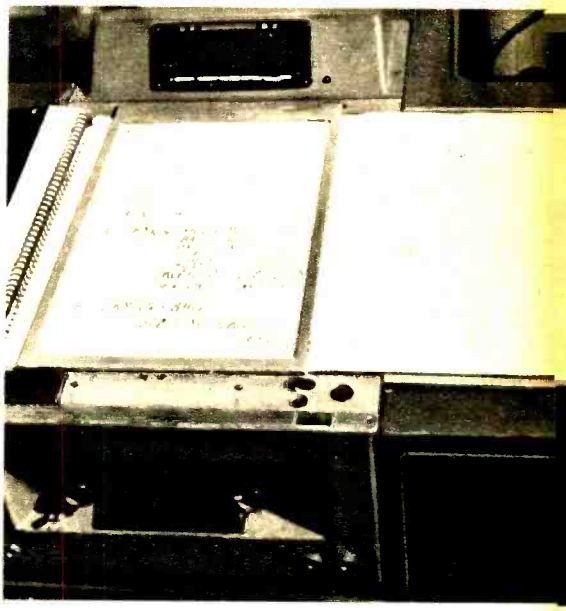
In effect, instead of tape moving past a recording head, as in a tape machine, the recording head is moving while the *Synchrosheet* remains stationary. When the recording is completed, the turntable is returned to the top of the page, or to any spot along the way as selected by a line indicator, the switch is set to playback, and the identical movement of the turntable down the magnetic film reproduces the sound much in the same way as a conventional tape recorder.

One of the big advantages of the *Synchrosheet* is its use of paper as a base. Magnetic recording tape, movie film and records involve the use of plastics which cannot be written or printed upon readily, cannot be folded or bound together, and are comparatively expensive. For basic person-to-person communications, the recorded *Synchrosheet* can be folded like regular letter paper and mailed in an envelope. In tests, crumpled sheets have been smoothed out to produce clear sound.

Mass production will probably bring the price of the individual *Synchrosheet* down to one cent or less, making it truly a mass medium of communication. Present recording times are either five or ten minutes per sheet, and the re-



Two of three recording heads, similar to tape heads, are visible on close-up of turntable.



Complex chemical formulas, diagrams lend well to simultaneous verbal explanation.

cording of a particular sound or spoken passage can be spotted at any given place on the page.

The flat sheet of recorded and printed material has the distinct advantage of being easy to handle. It can be inserted into the *Synchroreader* in about three seconds, as opposed to the 30-odd seconds it takes to set up a reel of recording tape. But like the tape, the *Synchrosheet* can be used again and again, providing the printed text or photo (which can't be altered) is applicable to the new recording. Magnetic erasing can clear an entire sheet in less than a second, permitting the correction of mistakes.

In an effort to meet one of the major requirements of a mass communications medium, a way has been found to print the sound portion of a *Synchrosheet* by mass production. For instance, if the printing of one *Synchrosheet* took as much time as was required for the original recording, mass distribution would be impossible. Daily newspapers and magazines are printed with schedules that call for hundreds of thousands of copies to come off the presses in a matter of hours. To achieve speed, a magnetic sound printer has been developed. It involves a process similar to that of printing photographs from a negative film. The master sheet of recorded sound is placed on a blank *Synchrosheet*, film-coated sides facing each other. With the flick of a switch, the entire recording is "printed" on the blank in less than .01 second. This sound printer can be linked with an ordinary printing press where the type is printed first on the roll of paper, the underside of the paper is automatically coated, the recording is printed on the film side, and the completed *Synchrosheet* is cut to size, folded and bound into magazine, book, newspaper, pamphlet or catalog.

Use of the *Synchroreader* need not be limited to *Synchrosheets* that are factory made. Say, for instance, you want to send a friend an article clipped from this magazine. You also want to add some verbal comments. Simply place a transfer sheet of magnetic recording film on the reverse page, go over it with a hot electric iron, and presto! you have a *Synchrosheet*. With these thin sheets of transfer ferrite film, any standard sheet of paper may be

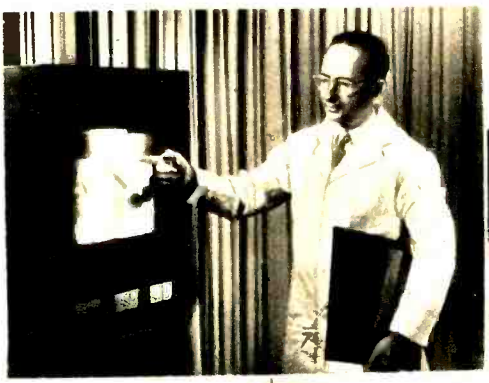
[*Continued on page* 111]

X-Rays..Safer Than Ever

Your next X-ray exam may involve new techniques giving brighter images with *less* radiation dosage.

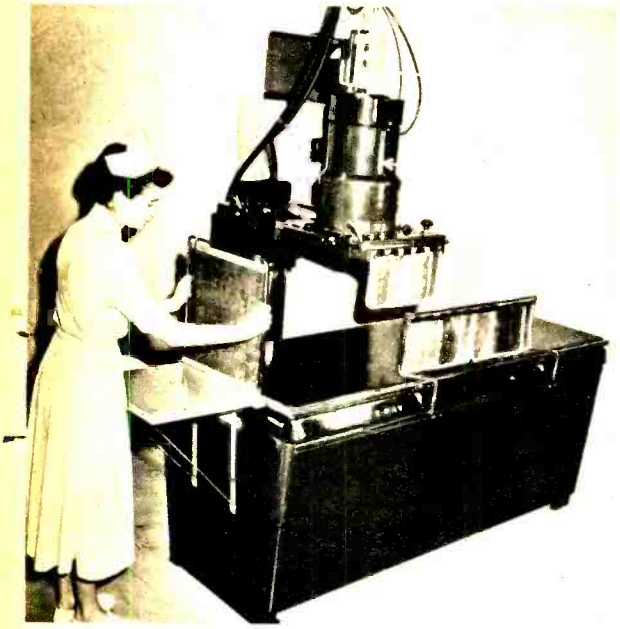
FLUOROSCOPIC X-rays, long an important diagnostic aid to your doctor, is not without its drawbacks. Examination by X-rays has to be short to prevent both patient and doctor being overexposed to possibly harmful radiation. In addition, some X-ray devices designed for viewing moving parts of the body do not provide bright enough images for doctors to determine what they need to know.

New developments by three major companies (RCA, Westinghouse, and Rauland) have increased the brightness of fluoroscopic X-ray pictures 100 to 350 times *without increasing the X-ray dosage to the patient.* These new viewing systems provide



Thighbone, hypodermic and assorted junk imbedded in wood having X-ray absorption comparable to human flesh show up clearly on new RCA screen, adapted to fluoroscope, below.

Rauland's large X-ray image tube is housed in regular Picker unit, (A). Note TV camera, (B).



Stomach and other organs are seen with Rauland tube. Dotted circle is conventional view.

medical men with images that can remain on the screen even after the patient is removed from the device and the radiation discontinued.

The RCA image amplifier is a thin screen resembling a conventional fluoroscopic screen. Two special materials are sandwiched between transparent electrodes to form the screen. The first material is a photoconductive powder which conducts current only when it is exposed to X-rays or light (visible or invisible). The second material is an electroluminescent phosphor which emits a bright light when electric current is passed through it.

If no X-rays or light are present when a voltage is applied across the "sandwich" screen, the photoconductor becomes an insulator, blocking the passage of current and resulting in a blank screen. When an X-ray or light image falls on the photoconductor, the material becomes an electrical "valve" which permits current to move through the electroluminescent phosphor in the same pattern as that of the original X-ray image. What results is a brighter reproduction of the image as amplified by the phosphor. Because of this amplifying action, only low X-ray dosages are required for examination.

A hundred times brighter than a conventional fluoroscope screen, this device can be viewed in a lighted room. The image will remain on the screen up to 30 seconds after the X-rays have been shut off. An electronic "erasing" technique permits the screen to be cleared in a fraction of a second for immediate viewing of a new part of the body.

In an effort to keep images on the viewing screen for longer periods without exposing the patient to excessive radiation, RCA has experimented with cadmium selenide (a photoconductive material) and has determined that its conductivity increases sharply and remains high for long periods after the X-ray or light source has been cut off. By using this material as the photoconductive layer in the amplifier panel, the physician may examine the image long after the patient has been removed from the device.

The Westinghouse "electroenhancement" fluoroscope screen works on

[*Continued on page* 109]

A Wireless Intercom

By Jay Hollander

Simply plug these units into any AC outlets and talk! No wiring between stations is necessary.

THESE two units have never failed to startle various friends seeing them in operation for the first time. The simple act of plugging them into any two AC outlets provides instant communications between two points in the home. The advantages over the conventional type are many; no wiring between stations, their portability permits the use of any two AC outlets, and new stations may be added easily at any time.

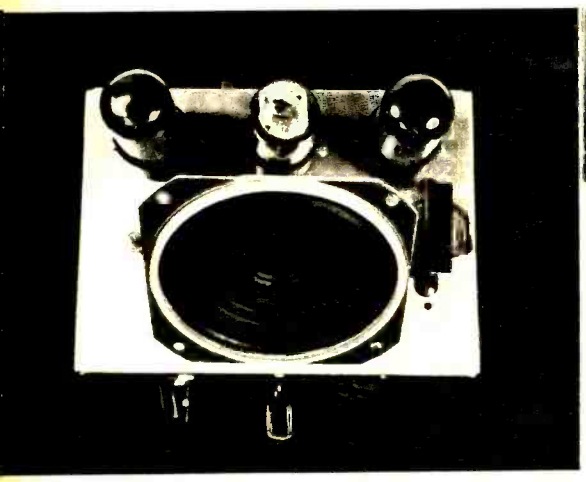
How do they work? Each unit is actually a transmitter-receiver that sends signals over the house wiring. An important feature is that no FCC license is required though radio frequencies are used since the signal is confined exclusively to the lines.

The range of the signals is usually governed by the location of the large power transformer on the pole outside the house. It acts as a choke and blocks the path of the intercom signal. However, it freely flows in the house circuits and is available at each outlet. Of course it does not affect the operation of radios, lamps, or other appliances being used simultaneously.

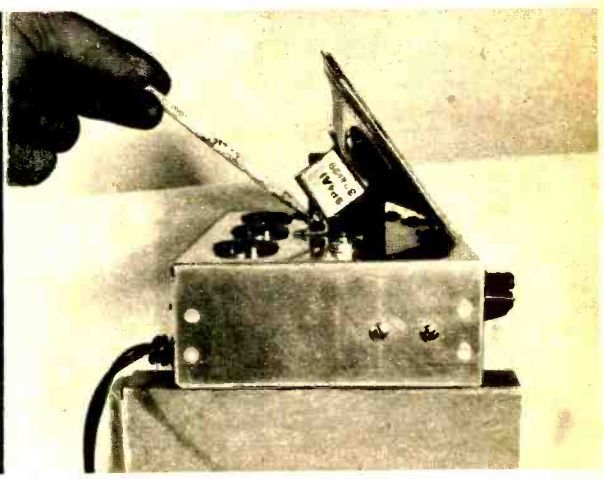
The circuit operates in this fashion. In the SEND position the speaker acts as a microphone. Its small voice voltage is built up by audio amplifiers V1 and V2 and then impressed on V1, the oscillator. Here, the audio and 180 kc RF are mixed (amplitude

On the facing page are the two complete units. The wooden cabinet is important since it acts as the speaker baffle, preventing a loss in volume.

Top chassis view. Along the upper edge, from left to right, are the tubes, V1, V2, and V3.

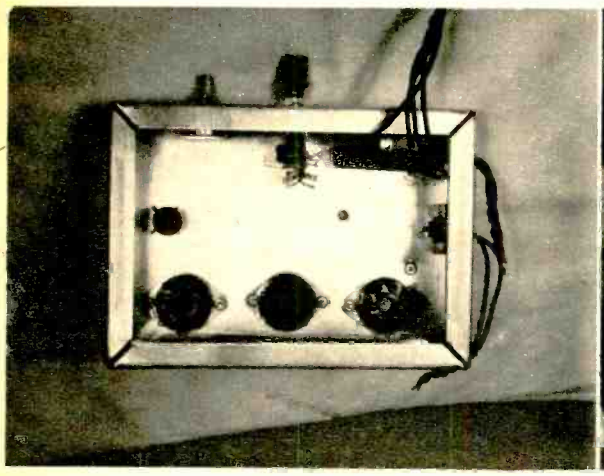


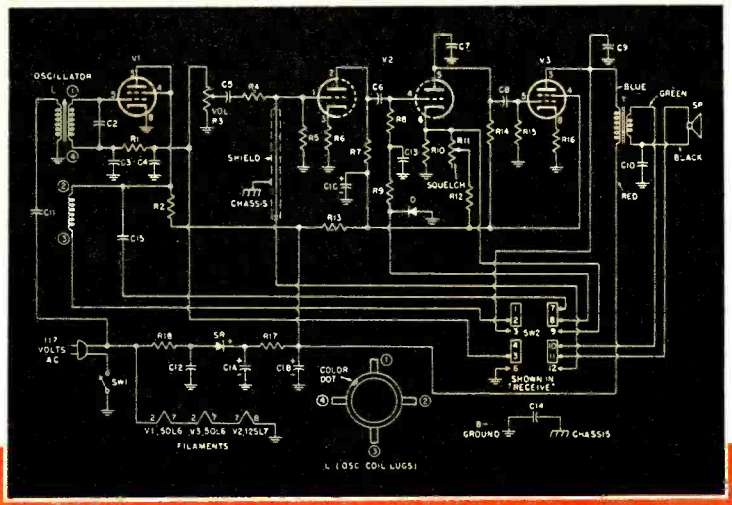
Two L-brackets hold speaker. Holes on front and rear of speaker frame are already drilled.



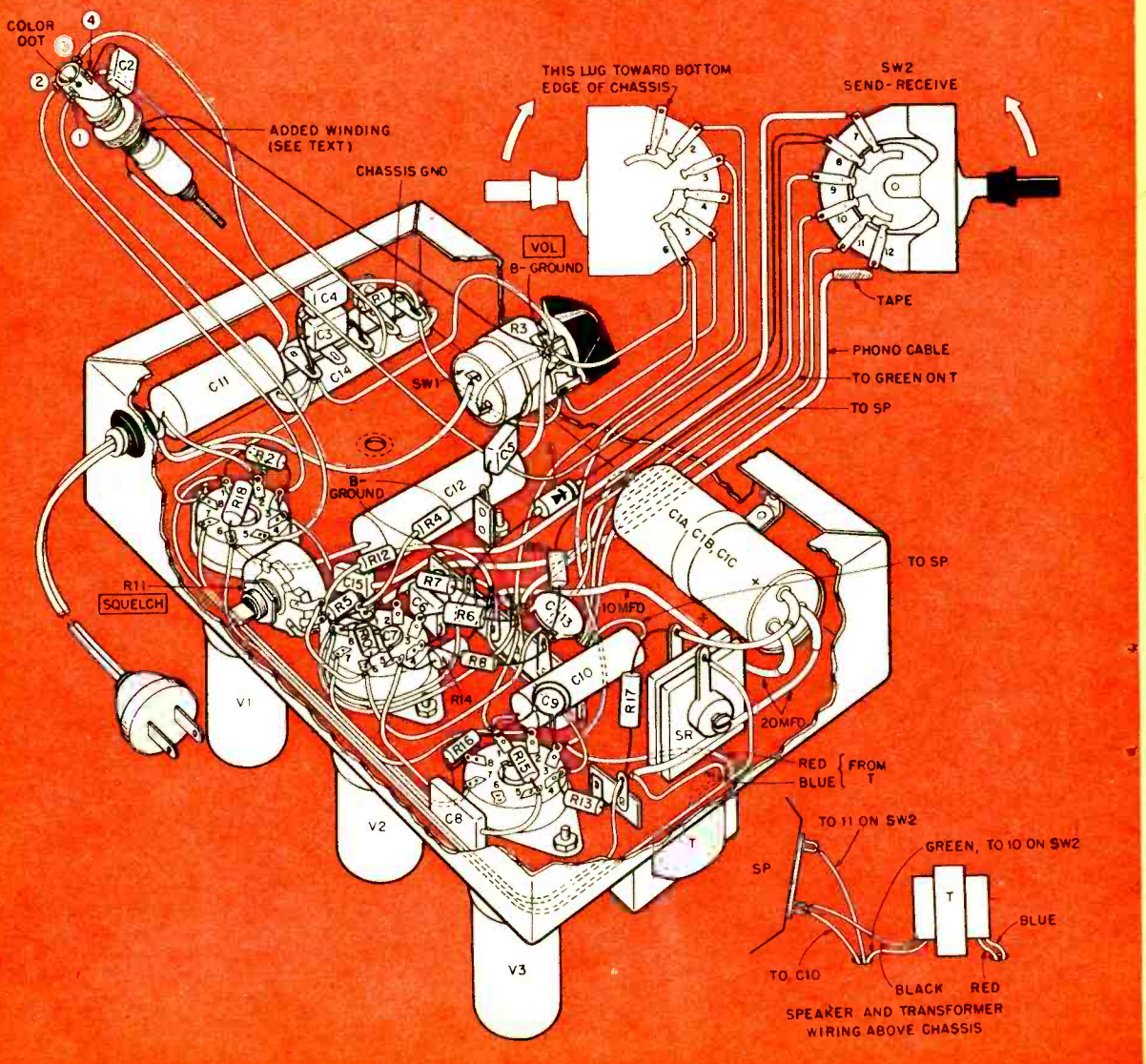
When mounting SW2, be certain that lever (top center) operates in downward direction.

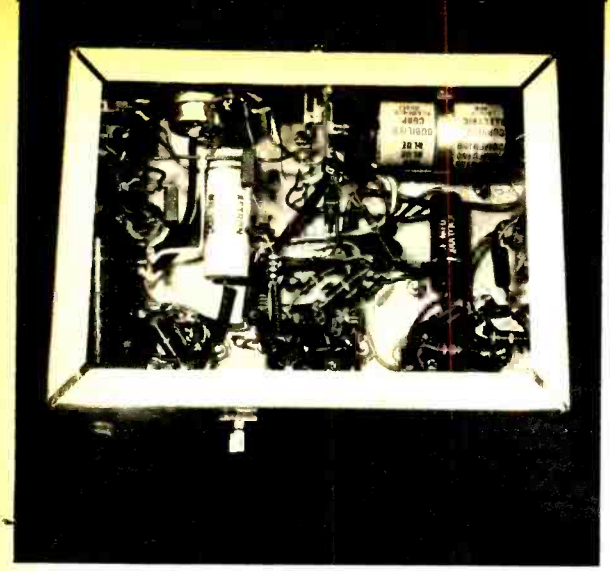
Building the second unit takes less time since the completed one serves as a guide.





The schematic and wiring guide. Three units have been moved from their positions for clarity; oscillator coil, speaker and transformer, and SW2. Note that the two halves of SW2 have been spread apart and drawn to show lug connections.





Below chassis view of the wiring. Squelch control may be seen along the bottom edge.

A simple wood cabinet encloses the unit. It is anchored to speaker frame and chassis.

modulation) and coupled into the power line by C11. In the RECEIVE position, V1 is a detector and reverses this process. The audio is demodulated from the RF and amplified through V2 and V3. The voice is then heard in the speaker.

The two units are identical in every way. After the first is completed, it may be checked out using a home broadcast receiver. Notice that coil L has a tuning screw. It is possible to raise the oscillator frequency sufficiently for it to be picked up on the radio. For this reason, one unit can be used as a wireless "baby sitter," the radio acting as the receiver.

Actual construction is started by prewiring the SEND-RECEIVE switch and terminal strip next to the volume control. Study the wiring guide and see which components may be wired before actual installation in the chassis. This will avoid soldering in tight corners. Then mount the major parts on the aluminum chassis. It is of utmost importance that SEND-RECEIVE switch is mounted with the correct side up. Cut out the mounting holes and hold the switch in place with your hand. When you operate the lever it *must* move toward the *bottom edge* of the chassis and when released it must return to the center RECEIVE position. Double check this before soldering any wires or parts to it. Otherwise, your completed model will operate on SEND when the lever is pushed up. Also, the connections will not conform to the wiring guide.

The oscillator coil used in this circuit is originally intended for a low fre-

[*Continued on page* 94]

PARTS LIST FOR EACH UNIT

All resistors ½ watt unless noted
R1,R4—47,000 ohm
R2—100,000 ohm
R3—.5 megohm audio taper potentiometer, with switch
R5, R12—33,000 ohm
R6—1000 ohm
R7—200,000 ohm
R8—1 megohm
R9—4.7 megohm
R10—10,000 ohm
R11—.5 megohm audio taper potentiometer
R13—4700 ohm, 1 watt
R14—240,000 ohm
R15—470,000 ohm
R16—150 ohm, 1 watt
R17,R18—100 ohm, 1 watt
C1A,C1B,C1C—3-section electrolytic, 40-20-20 mfd, 150 volt
C2,C15—100 mmfd 400 volt
C3,C4—47 mmfd 400 volt
C5—470 mmfd 400 volt
C6,C8—.001 mfd 400 volt
C7—330 mmfd 400 volt
C9—.01 mfd 400 volt
C10,C11,C12,C14—.1 mfd 400 volt
C13—.02 mfd 400 volt
L—Oscillator coil (see text), (J. W. Miller X 5495-C)
T—Output transformer. 7000 ohm to 50 ohm (Triad A51X)
SW1—On-off switch, part of volume control R3.
SW2—4 pole-2 position spring return switch (Centralab 1457)
D—Germanium diode 1N34A
SR—Selenium rectifier 65 ma.
V1,V3—50L6
V2—12SL7
SP—4" speaker, 45 ohm voice coil (Utah SP4A1)
Misc.—Aluminum chassis 5"x7"x2", 3 octal sockets, one 5-lug with 2 lugs grounded, one 1-lug, one 4-lug terminal strips, about 8' plastic insulated phono cable.

Sight the cartridge by viewing its reflection on the record. Any unevenness will show up.

The cartridge must be mounted squarely in the tone arm, or shell, as in the type above.

further notes on

Adding A Stereo Pickup

By Robin Lanier

Check the mounting and connections of your stereo cartridge with these hints for top performance.

IF you want that bundle of ultra-refinement, your new stereo pickup, to come up with all of the 3-D fidelity on your stereo records, you have to give it the right set of working conditions.

Luckily the stereo installation rules are fairly easy to follow, including just a few beyond those we've worked with for a long time with monophonic pickups. Here is the story in brief.

First, the cartridge must be closely parallel to the record surface *in all planes* when it is in operation. If the cartridge "rolls" on its long axis it will not get the right messages from the stylus motion. Each sound channel is represented by stylus motion along a line at 45 degrees to the record surface. If the pickup is turned at an angle to the record, 45-degree stylus

motions will no longer be at 45 degrees to the cartridge, which will then interpret them as a mixture of the two channels.

As little as 3 degrees of turn from a parallel position will produce measureable distortion and also loss of stereo separation. The sounds of the spread-out instruments will tend to bunch together in the center, between the speakers. So when you fasten your cartridge into a plug-in shell or arm housing, be sure it is seated squarely. Be sure the arm is so installed that when the stylus is resting on the record, the cartridge is "straight up and down."

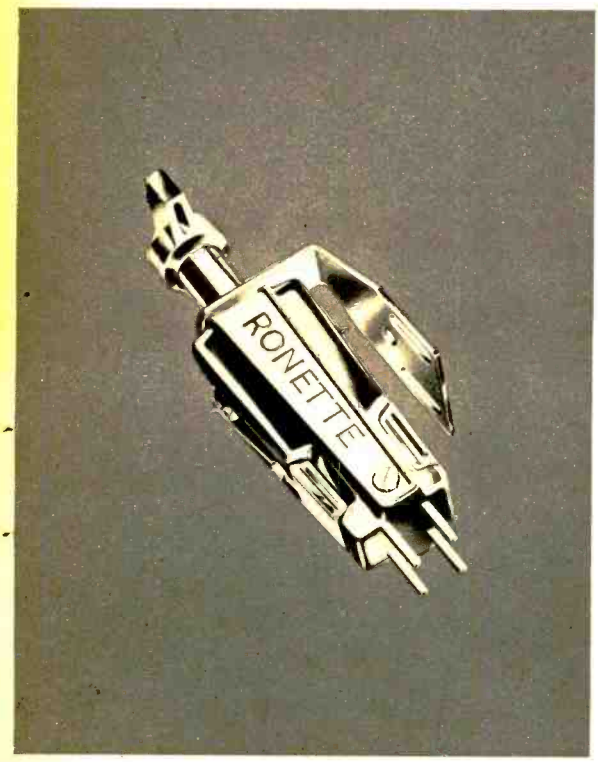
Some hi-fi engineers believe that 4 or 5 grams is the absolute top vertical stylus force that should be used on stereo records. A lot depends, of course, on getting a pickup that has very low stylus mass and high stylus compliance. The pickup must "track" at the force you use. A good general rule (with both monophonic and stereo cartridges) is to set the stylus force at the lowest value that will make the pickup play the heaviest passages on your records without distortion.

However, this rule may need amendment with some stereo pickups. Remember that the stylus must be centered in *the vertical direction* when the pickup is resting on the record, for low distortion. Follow the manufacturer's stylus force recommendations, rather than any you arrive at experimentally, if there is a wide difference.

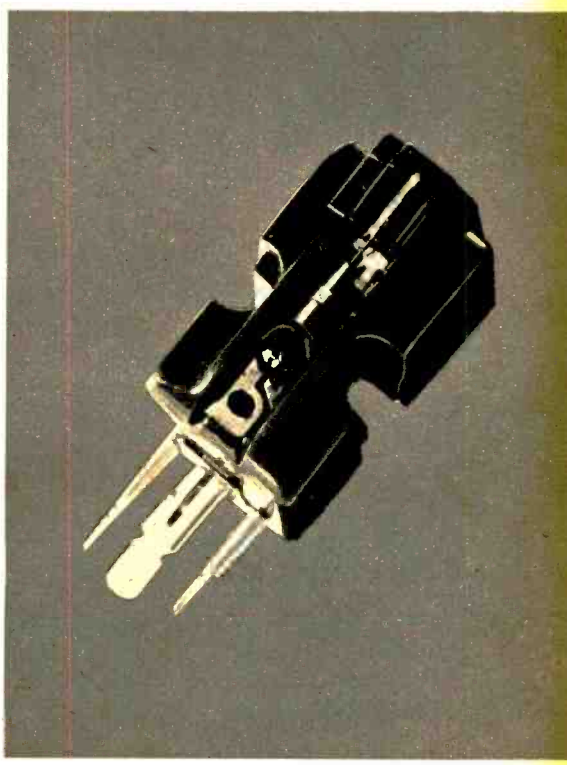
The resistive load the pickup works into, the resistance across each of your two preamp inputs, must be right for the pickup you are using. With each moving iron and moving magnet pickup—GE, Pickering, Shure, Miratwin, etc.—the manufacturer recommends a load value, and you should follow it closely.

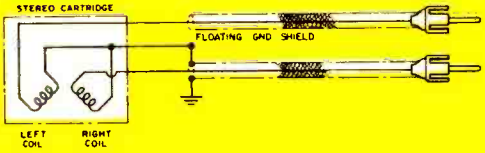
With magnetic pickups, the two cables from pickup to preamplifier must be of

The 4-terminal cartridge features separate ground pins useful for preventing hum loops.



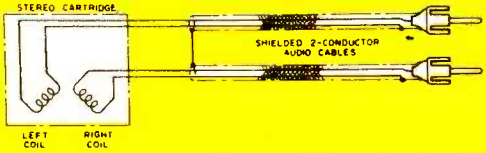
The 3-terminal cartridge has common ground pin for both channels. See diagrams page 48.





3-terminal cartridge feeding separate preamps. Upper shield grounds at plug end only.

4-terminal pickup keeps internal and external grounds isolated until they reach preamp(s).



Persistent hum may be cured by using two 2-conductor shielded cables grounded at plugs.

low-capacitance type and fairly short, not more than three or four feet long. Your objective is to keep the total capacitance in each cable, between the outer shield and inner lead, below 100 mmfd, and the less the better. The specification on the cable, easily furnished by your hi-fi dealer will read "25 mmfd per foot," for instance.

The control of hum with stereo pickups is a subject worth an article all its own. We can give a brief summary here. First: never use the shields of signal cables from pickup to preamplifier as ground leads for pickup arm and motor. The pickup arm and the motor should each be grounded separately, by a separate wire, to a point at, or close to, the preamplifier input.

"Ground loops" are the most common cause of high hum with a stereo pickup. A ground loop is formed when the ground sides of the two channels are connected together at more than one point, with separation between, as, for instance, when you have a three-terminal cartridge (grounds together right at the cartridge) and two separate preamplifiers which are also grounded together at some other point.

Three rules which will cover most cases:

(1) Three-terminal cartridge and two preamplifiers on separate chassis: do not ground the preamps together at any point, at least initially (see below). Note that the shell of the phono plug grounds the shield to the preamp chassis.

(2) Three-terminal stereo cartridge and combined dual preamp on one chassis: The shield of *one* pickup cable should not be connected to ground at any point along its length, except right at the preamp input—it "floats" at the pickup end.

(3) Four-terminal stereo cartridge: avoid any connection between the two shields (grounds) at any point along their length, except right at the preamp input. With two separate preamps, ground them together right at the input.

With two separate preamplifiers, and various amplifiers, turntables, tuners, etc., complicated hum-bucking situations exist which may require modification of Rule 1. Try grounding preamps together; pull all plugs and reverse them. Use whatever reduces hum.

Further hum reduction methods: the two cables from pickup to preamp should be the same length, and should be twisted tightly together right up to the preamp connectors. The pickup, if it is a magnetic type, should be mounted so that it does not pass directly over the motor, in its travel across the record. Keep amplifier chokes and power transformers at least two or three feet away from magnetic pickups.

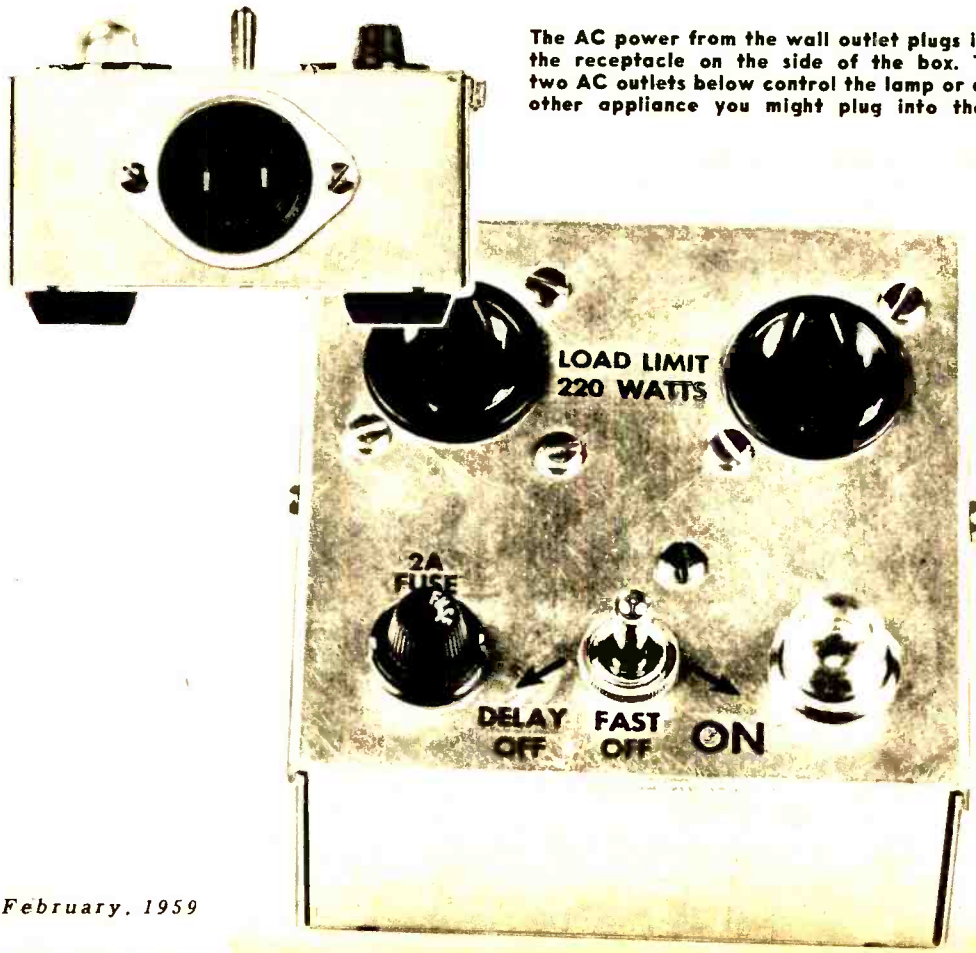
A Time Delay Switch

By Ronald Ives

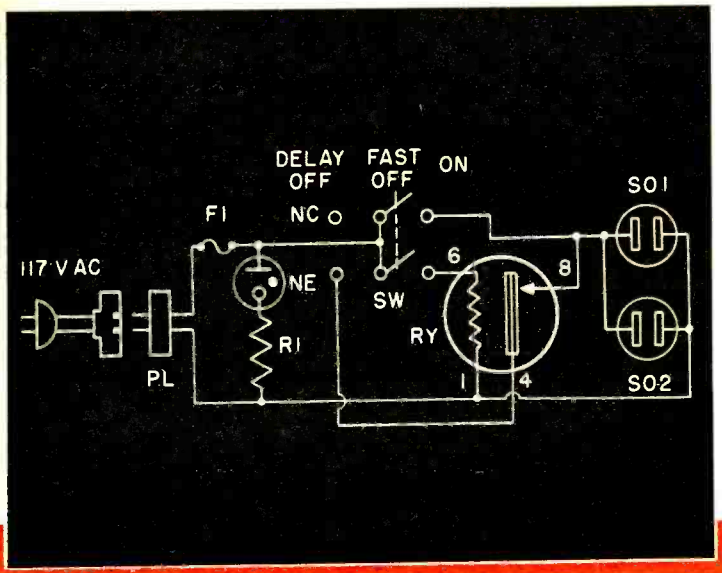
Don't trip in the dark! This unit automatically keeps a lamp on 20 seconds after it's switched off.

IN a wide variety of situations in the home, office, and shop, it would be most convenient if a lamp or other device could be made to remain in operation for a half minute or so after the switch was turned off. Several devices to perform this function have appeared on the market from time to time but most of them, due to high price or unreliable performance, are no longer available.

With easily acquired parts you can construct a thermal time delay unit that has proven highly satisfactory in daily use. The relay, switches, and connectors are quite inexpensive and perform well. The design is such that any lamp or appliance may be plugged in if the ratings of the relay contacts are not exceeded. The load limit is 220 watts, a figure that should accom-



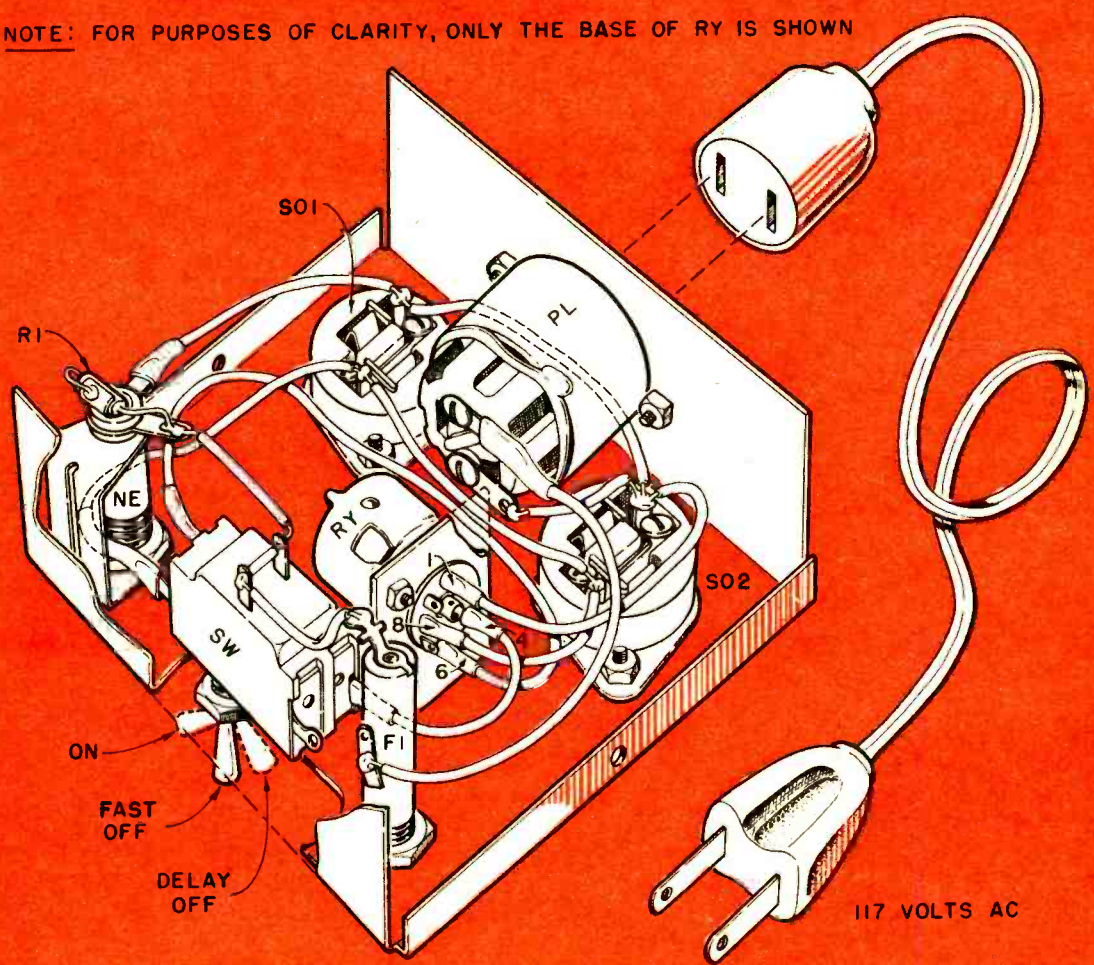
The AC power from the wall outlet plugs into the receptacle on the side of the box. The two AC outlets below control the lamp or any other appliance you might plug into them.

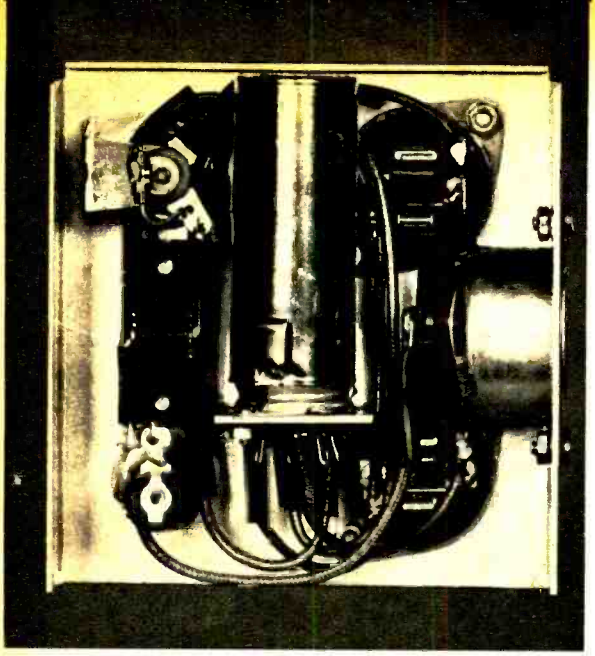


Schematic. Neon bulb NE remains lit constantly but draws little current.

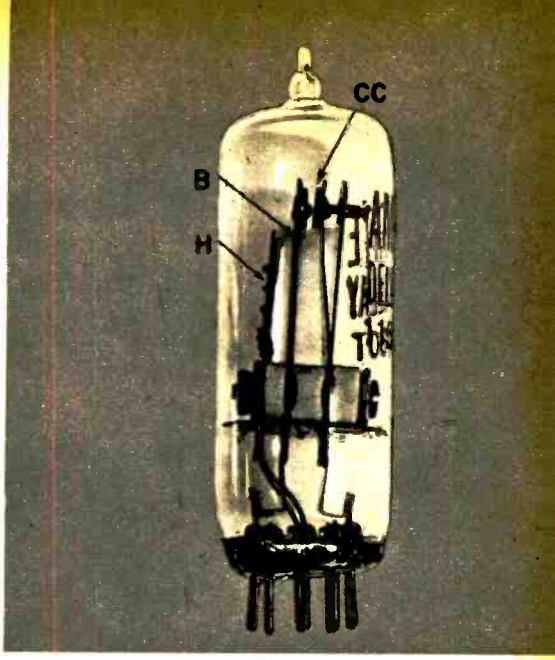
The 9 pin tube base for RY is mounted on an L-shaped bracket.

NOTE: FOR PURPOSES OF CLARITY, ONLY THE BASE OF RY IS SHOWN





Underside view of the chassis shows compact arrangement of parts. Tube shield at center prevents the thermal relay from jarring loose.



Thermal delay relay. H is the heater that causes contact B to bend (like a thermostat) and touch the CC contact to close the circuit.

modate all but the most heavy-duty equipment.

The fundamental circuit is shown in the schematic. The wiring guide will serve to show the various connections while building. When the switch is thrown to the ON position the load (lamp, etc.) is connected to the AC line. Simultaneously, the heater of the time delay relay receives power and the internal contacts close. They remain closed as long as the switch is ON. Don't be concerned over the fact that the relay heater remains on while the appliance is in use since the amount of power it consumes is very low.

When the switch is thrown to the DELAY OFF position, current flows to the load through the contacts on the time delay relay whose heater is now de-energized. When the heater cools in about 20 seconds these contacts open and break the load circuit.

Thermal time delay relays are made to operate in various time periods from 2 to 180 seconds. A choice of operating voltages are also available. The one chosen here is a 115 NO 20 T which indicates 115 volt heater, normally open contacts, 20 seconds delay, and miniature 9 pin base.

Wiring of the unit is done with No. 14 stranded, insulated wire to allow an ample margin of safety in both current carrying capacity and insulation. All connections are soldered and sleeving (spaghetti) is used over most exposed lugs and socket terminals. Use of good wire, careful layout, and good workmanship in the initial construction will prevent blown fuses and trouble shooting later.

When the wiring is complete and checked, the top of the chassis box with all electrical components is slipped over the bottom which carries only the rubber feet. It is held in place with two 6-32 binding-head machine screws.

To put the unit into service first plug

[*Continued on page* 111]

PARTS LIST

SO1,SO2—Chassis mounted AC receptacles
RY—Thermal time delay relay (Amperite 115 NO 20 T)
SW—Double-pole double-throw toggle switch
NE—Neon bulb NE51 with jewel and socket
R1—100,000 ohm ½ w
PL—Chassis mounted male AC plug
F1—2 amp. fuse (3AG type with panel mount holder)
Misc.—Chassis box 4"x4"x2" (LMB-143), 9 pin miniature tube socket (shell-type for holding the tube shield), line cord with AC plug on one end and cable-mount female AC receptacle on the other, # 14 wire

Hi-Fi Clinic

Mail in any question on hi-fi—how to install, how to adjust, or how to repair. The clinic answers all of your queries.

Conversion To Hi-Fi

I have an old jukebox amplifier that I would like to convert for use in a hi-fi system. Would many changes be required?

Samuel Menniti
Johnsonburg, Pa.

I have an old console radio that I have removed from its cabinet. Would it be feasible to alter the circuits in order to achieve hi-fi?

Robert B. Barton
Holliday, Texas

A modern hi-fi amplifier is a precisely designed unit with all components operating in a specific relationship to all others. In effect, it is a "chain with *no* weakest link." Before attempting to redesign any particular radio or amplifier to bring it up to hi-fi standards it would be necessary to be thoroughly familiar with the circuits and to be able to check out your new design with tests every step of the way. You can see how difficult it would be to undertake such a project by remote control.

There is a simple change or addition you *could* make which would result in a decided improvement. Try hooking up a separate speaker in a baffle such as the two systems outlined in *EI* (May 1958, and September 1958).

Speaker Specs

Does frequency response specifications in speakers and tweeters mean anything any more? My catalogs list a $3.95 tweeter that seems to have the same specifications as a $25 model. Who's kidding whom?

Milton Grant, Bryant, Texas

A statement that a speaker has a response of from 40 to 13,000 cycles, for example, tells very little about how it will sound. For all we know it may have a 10 db peak at 10 kc and drop immediately beyond that frequency. The net result of that response curve is a "brilliance" of tone but with an emphasis of the distortion and noise from the associated equipment.

Down at the other end of the audio spectrum a large resonant peak at 70 or 80 cycles causes the speaker to sound like a jukebox. The fundamental sound of real bass would be missing.

In short, frequency response is not the whole story—it isn't even the most important part of the story. Unless the response is expressed in plus or minus so many db from the lowest to the highest frequency covered, it is meaningless. Other factors such as transient response, damping, dispersion, etc., in the final analysis will prove to be far more important to your ear in terms of listening fatigue over a long period.

Tape Spillover

My tape recorder is a dual track type. As long as I use only one track for my recordings everything is fine. However, when both tracks are used, the sound seems to spill over from one track to the other. What is causing this?

Clyde Stanton, South Orange, N. J.

The probable cause of your difficulty is vertical misalignment of the tape heads. If the gap in the head isn't properly positioned with respect to the tape traveling over it, a portion of the other channel will either be overlappingly recorded and/or played back. A few recorders (usually those without pressure pads) show the same symptoms if the tape guides are improperly positioned. In either case, there is an easy way to eliminate the fault. First record one track of a blank tape; then play back the blank side and vertically adjust the playback head or guides for minimum pickup. Erase the tape or use a fresh portion of it and repeat the process. —

new ways to keep food fresh . . .

Radiation Does The Trick

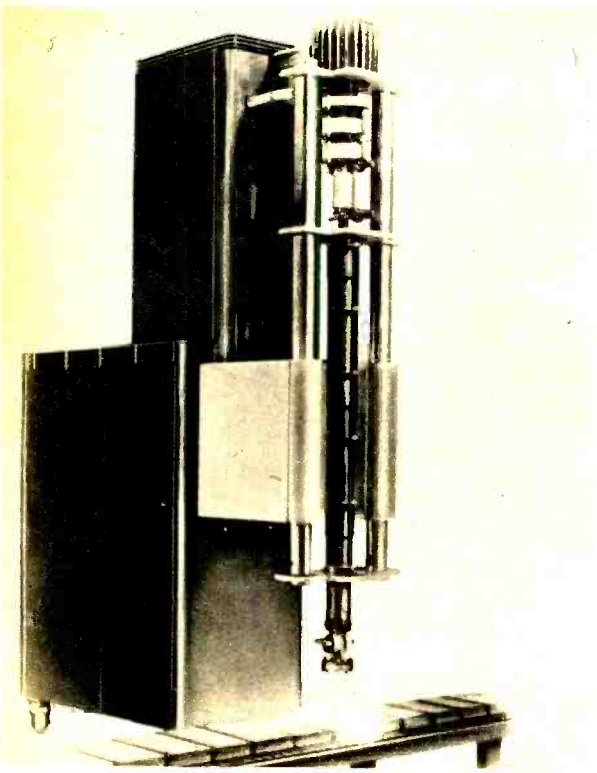
By Harold McKay and Leo G. Sands

FROZEN foods and your deep freezer might very well become obsolete in two or three years. Research now being conducted at Walnut Creek and Palo Alto, Calif., is developing a food preservation system that will let you pick out your favorite cut of steak at your neighborhood supermarket from an *unrefrigerated* display counter. You will be able to buy fresh, *unfrozen* berries out of season. Canned soups will have that freshly made flavor, and dairies will be able to pasteurize milk right in the bottle or can.

Strong doses of energy generated through electronics already cooks meat in minutes and pops corn in the bag before your eyes in less than ten seconds. Now, much stronger electron beams irradiate foods so that they can be stored without refrigeration and without changing their natural flavor.

Ever since the aborigine hung strips of animal flesh to dry, man has been trying to preserve today's food supply for tomor-

Accelerator sends 10,000,000 electron volts into food, which does not become radioactive.



Lemons on conveyor to accelerator will receive dose of radiation to keep them fresh.

row's use. The American Indian had his pemmican; the Civil War soldier feasted on dried "meat biscuit"; and World War II soldiers ate "C" rations.

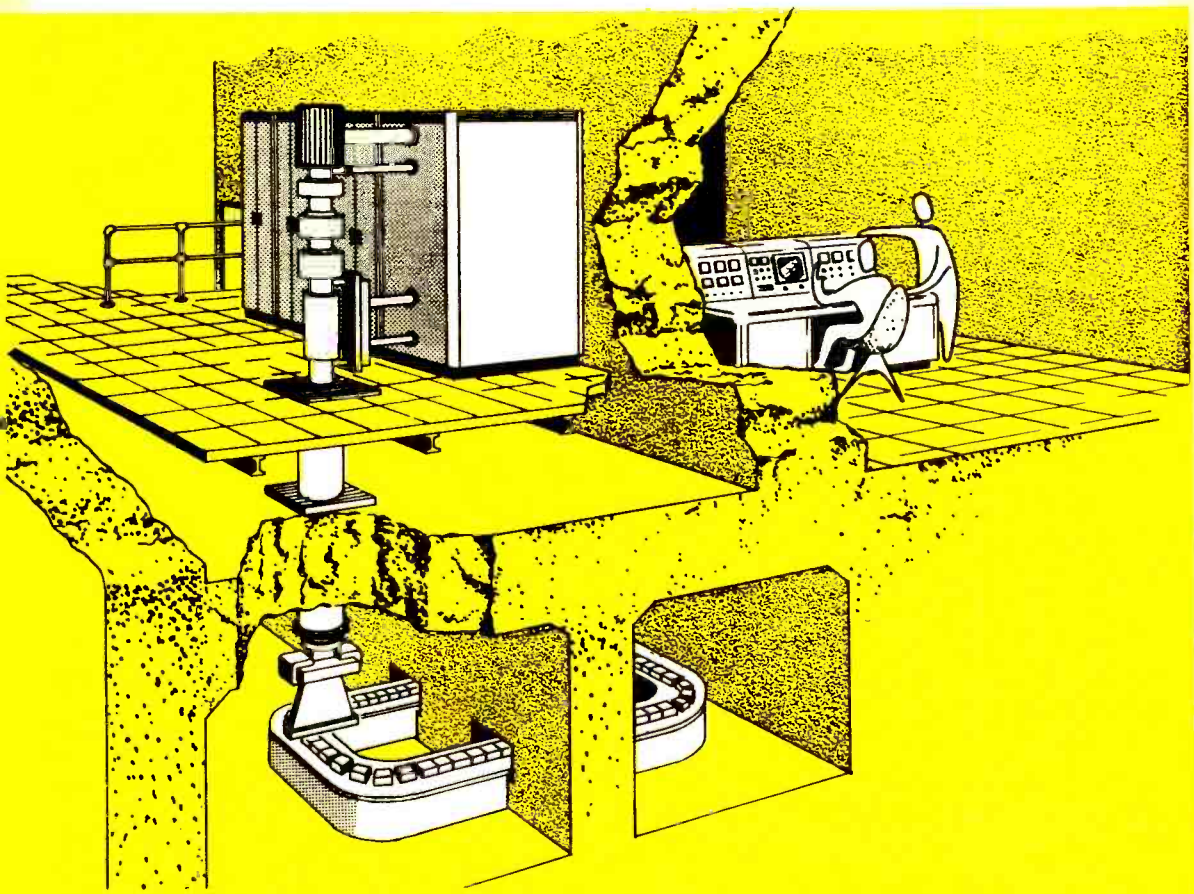
Foodstuffs decompose because of three factors—bacteria, enzymes and oxidation. Preservation of foods has been directed at removing one or more of these causes through salting, drying, smoking, banishing air and adding antiseptic chemicals. To this list must now be added radiation.

The idea of using radiation for preserving food is not new, but progress in atomic energy research has accelerated ideas that could be made practicable only with inexpensively obtainable radioactivity. The by-products of atomic bomb research promised a supply of cheap radioactive materials, but oddly enough, it was not cheap radioactive substances which made irradiation of food possible. The instruments developed to study the general nature of the atom proved to be the answer.

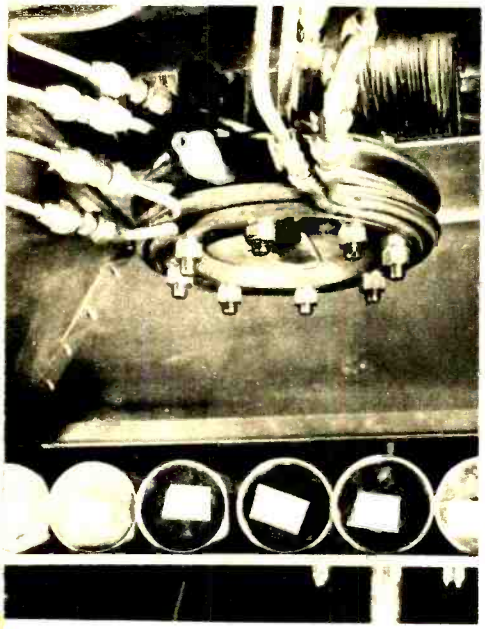
By-products of atomic research are inexpensive enough. Some, in fact, must be buried because they are unwanted. However, because of special handling precautions, it is more expensive to transport these products to where they can be used than it is to generate radioactive rays electronically on the spot. A machine which generates radioactivity by accelerating electron particles has the added advantage of being able to be turned off when not in use, thereby presenting no hazard. A continuously radioactive substance, on the other hand, is always dangerous.

The machine used for irradiation of food is the linear accelerator, consisting of a klystron vacuum tube coupled to a wave guide. The klystron, which

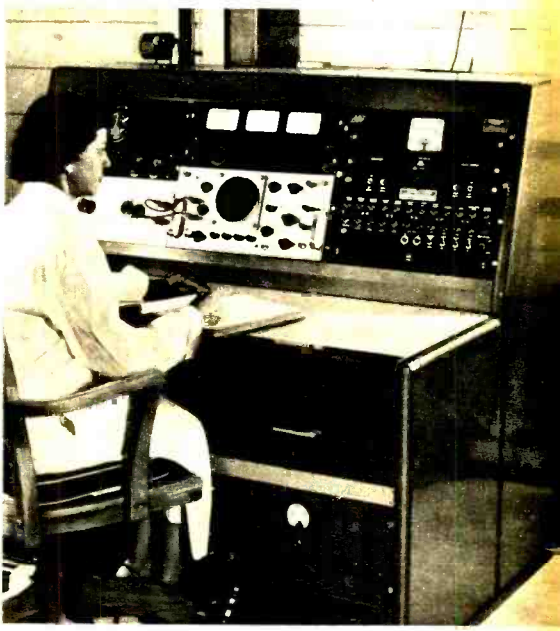
In electron food processing plant, operators are shielded from radiation hazards by concrete.



Food may be sterilized right in the can through radiation, thereby preserving the flavor.



Console for ARCO accelerator permits operator to control irradiation from safe distance.



made modern radar possible, emits electrons. These are speeded to very high velocities, then released through a metal "window" at the end of the accelerating tube. Magnets focus the electrons into a beam which then can be used to irradiate food.

The already packaged food is fed into the powerful electron beam by a conveyor system. The beam is directed downward into the package. Some reflection of the rays occur, but the food itself does not become radioactive, because the dosage is not strong enough to be absorbed by the food; just strong enough to kill the bacteria. However, the reflected rays can be highly dangerous to humans. The amount of radiation required to adequately process food may be in the order of four- to five-million rads (units of radiation). As little as 400 rads can be fatal to a human. Therefore, accelerators used for food processing are being installed underground, surrounded by thick concrete walls, and furnished with a conveyor system which can be loaded and unloaded at a safe distance from the radiation source.

The linear accelerator used for this purpose is actually small compared to the huge atom smashers called synchrotrons and bevatrons. Originally designed only for governmental atomic research, this instrument is now a commercially manufactured product. For instance, a California wire manufacturer runs insulated wire from a huge spool through a particle accelerator. After irradiation, the wire is respooled and sold for a much higher price. By subjecting the wire's plastic insulation to irradiation, the plastic undergoes a chemical change which improves its insulating characteristics in high temperatures.

When foods are subjected to radiation, cooking or freezing for preservation is not necessary as all three methods accomplish about the same thing, the hindrance of bacterial growth on the food. Irradiation does not supply complete protection against spoilage. It stops only one of the three causes of spoilage—the action of bacteria.

Bacteria is perhaps the major cause

[*Continued on page* 110]

A Metronome

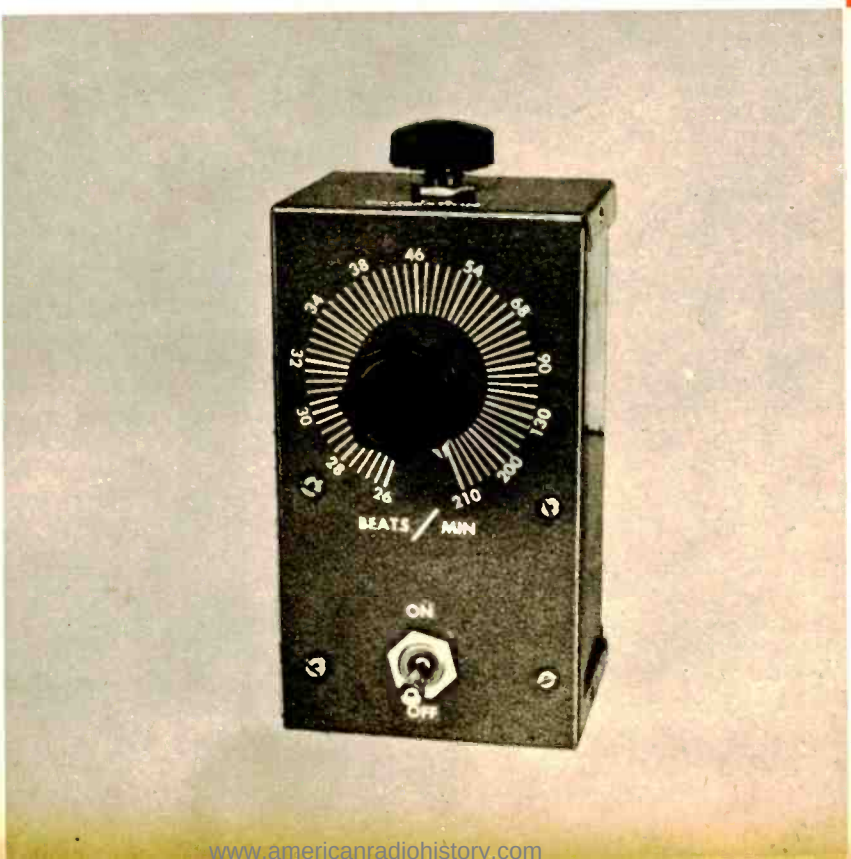
By Harvey Pollack

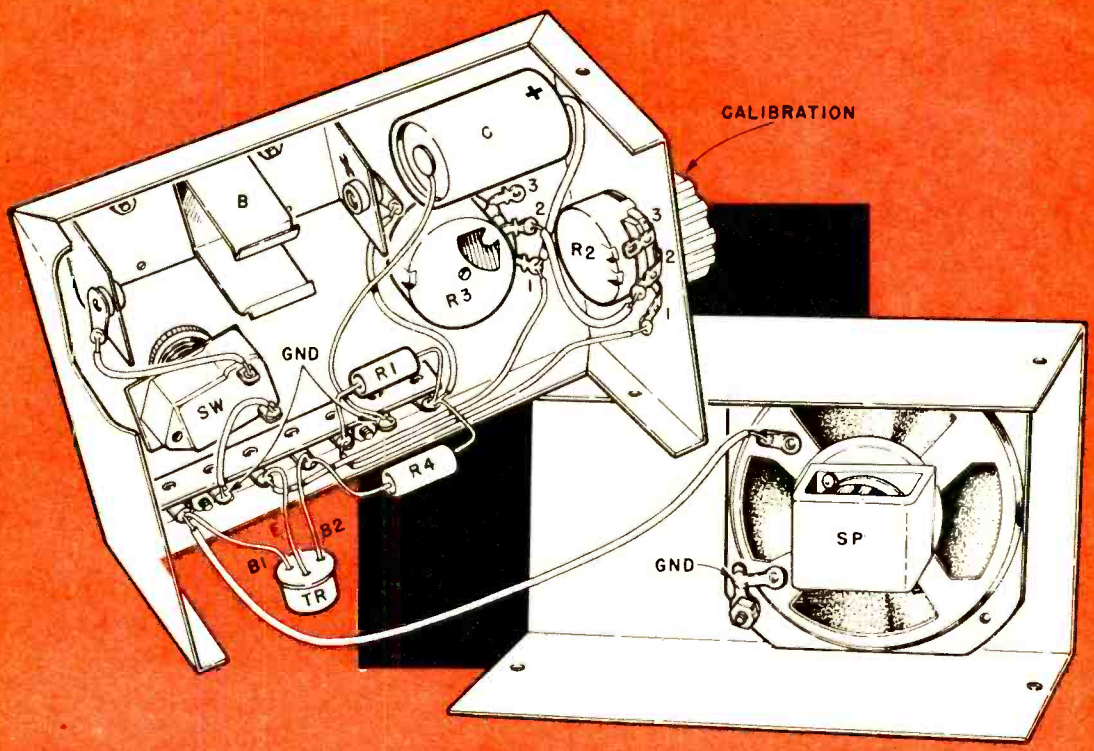
A helpful instrument for music students, this unit provides a range of clear, accurately-timed beats.

IF YOU play a musical instrument you will be interested in building and using this electronic metronome or, if you are not a musician yourself, it makes a wonderful gift for some talented relative or friend.

Look over these features and you will see why we are so enthusiastic about this new metronome. Its stability is so good that, after running for over two hours, its count rate did not change by more than 0.7%. The output from the little speaker is really loud enough to be heard over the tones of any musical instrument. Also it is more compact than any similar instrument previously described. Since it is battery operated it needs no line cord or AC receptacle for plugging in, yet the average current drain is only 5 milliamps during operation. This assures long battery life. Perhaps most important of all, it is so simple and foolproof that it can be completely assembled and calibrated in a single evening. The total cost is only a fraction of the price of commercial electronic or mechanical metronomes.

The metronome, requiring no AC line cord, is battery operated. The knob atop the case is for calibration. Front panel knob selects the beat rate.



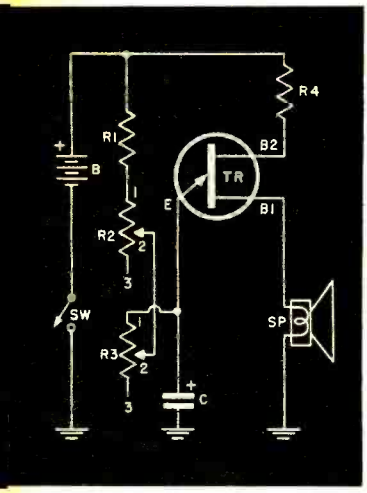


Above, only one wire goes to speaker. Metal case serves as ground connection.

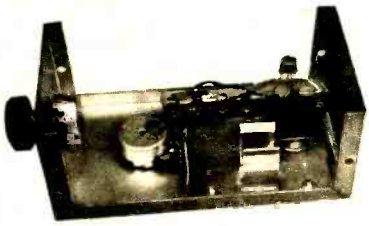
A miniature 2¼" speaker is used with this case to avoid obstructing other parts.

A piece of perforated board mounted on the rear panel (upright) protects speaker cone.

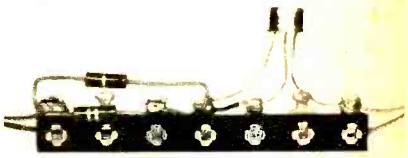
February, 1959



R2 is calibration control. R3 adjusts beats per minute.



Rear cover removed. Placement of wires isn't critical.



Terminal strip with R4 (upper resistor), R3, and TR.

Although the illustrations tell a rather complete story of parts layout and assembly here are a few suggestions regarding construction. A terminal strip having a minimum of five *ungrounded* lugs is used as the support for all of the small parts—R1, R4, and the unijunction transistor (TR). The terminal strip may be wired before mounting in the case with six-inch color coded leads brought out for later connections in the circuit. Leave the transistor leads at least one inch in length and, when soldering them to the lugs, grip the lead with a pair of long-nose pliers near where the joint is to be. This soldering method conducts heat away from the transistor and prevents damaging it by allowing the lead to pass its heat into the pliers.

Ground connections shown in the diagram are made directly to the metal case. Thus, only one wire lead is required from one half of the case to the other where the speaker is located. The second speaker connection is made directly to the minibox. It is important, of course, to observe polarities when installing both the electrolytic capacitor (C) and the battery (B). If you want your metronome beat speed to increase as the timing control is rotated clockwise, you must use the potentiometer lugs indicated in the wiring guide. Note that lug No. 3 is not used on either the calibration or timing potentiometer.

Commercial metronomes have a range of 40 to 208 beats per minute. The electronic model has a slightly extended range (26 to 210 beats per minute) to permit its use as a slow-speed counter in the darkroom as well as a metronome. If you would like to reduce its range to the commercial scale, merely use a 75K linear carbon potentiometer in place of the 100K type shown as R3 in the drawing.

The calibration procedure is easy and straightforward. The calibration potentiometer has no appreciable effect on the beat rate at the low end of the range, hence all calibration is performed at the high end. Merely rotate R3 fully clockwise, and using a kitchen clock or wristwatch with a sweep second hand, adjust

[*Continued on page* 107]

PARTS LIST

C—20 mfd electrolytic, 150 volt
R1—10,000 ohm ½ w
R2—10,000 ohm potentiometer, linear taper
R3—100,000 ohm potentiometer, linear taper
R4—1000 ohm ½ w
B—30 volt miniature battery (Burgess U-20 or equiv.)
SW—SPST toggle switch
SP—Miniature 2¼" speaker with 3.2 ohm voice coil (Lafayette SK-65)
TR—Unijunction transistor GE 2N489
Case—5¼"x3"x2⅛" aluminum (Bud CU2106)
Misc. Battery holder, 7-lug terminal strip (2 lugs grounded), knobs

Antarctic Trailblazer

Deep, uncharted crevasses in trackless snow might have blocked exploration except for this detector.

MOST terrifying hazard of all in the ice-covered area surrounding the South Pole is the unknown. What may look like solid footing from a few feet away or from the safety of a hovering helicopter in reality may be a thin bridge of ice or snow across a deep crevasse just waiting to swallow both man and machine. Navymen and IGY scientists now avoid these snow-hidden chasms with a crevasse detector designed to find safe trails. On the standard, snow-creeping "weasel" are mounted spars which support several pan-like electrodes. The electrode sleds move up and down independently as the boom array sweeps over irregular snow surfaces. An alternating current is imparted to the ice by two transmitting electrodes, producing a three dimensional current density pattern in the surrounding ice. An AC meter is connected between the two other electrodes, detecting current change in the volume of ice. When passing over the air space of a bridged crevasse, the voltage changes, actuating an alarm box and graph readout in the weasel's cab. When a crevasse is encountered, the signal rises from background of .1 milliampere to .6 or .8—a clear indication of nearby danger.

Bowl-shaped electrodes are mounted on tracked snow vehicle called "weasel." They form part of system to detect unseen chasms in ice fields. Pathfinding teams like these aid Navy's Operation Deep Freeze near the Pole.

The ABC's of Electronics-8

By Donald Hoefler

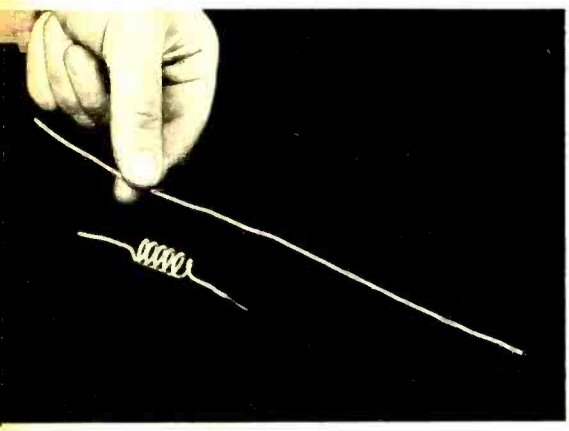
Our series continues with alternating current and how it is affected by inductance and capacitance.

WE have already noted that the flow of current through a DC circuit is limited by the amount of ohmic resistance in the circuit. This resistance is determined by the nature of the path through which the current flows. If it is copper wire, the resistance is relatively low and the current high. But if it is a carbon resistor, the resistance will be much higher and thus the current will be reduced.

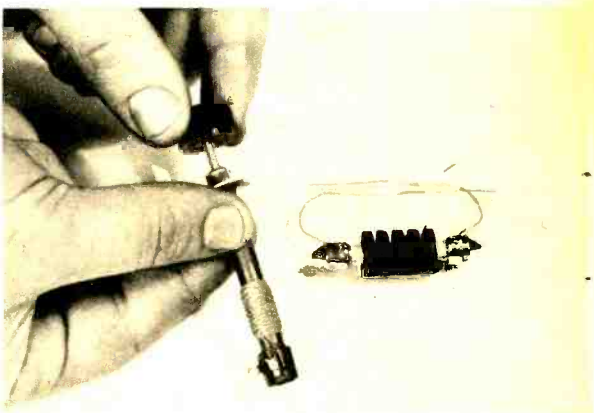
In AC circuits the behavior of pure resistance is the same as with DC, but in addition there are other effects that retard current. One is *reactance*. There are two types; inductive and capacitive.

Unlike resistance, which is determined mostly by the physical composition of the conductor, reactance is determined by the changing magnetic field of AC. Inductive reactance is due to a property of coiled conductors called *inductance*. This in turn results from the fact that every current-carrying conductor has a magnetic field surrounding it.

You can prove this by the simple experiment shown in the compass illustration. This is Oersted's famous discovery made in 1819 when he was trying to prove to a group of students that electro-magnetism did *not* exist. He proved himself wrong, for when current flows from the dry cell through the wire, the compass needle will immediately swing around at right angles to the



Straight wire leaves AC unaffected. Coil it and current is reduced by resulting magnetic field.



A variable inductor being tuned, and a fixed RF choke used for blocking high frequencies.

wire. When the polarity of the current is reversed, the needle will swing to right angles in the opposite direction.

While this is an interesting phenomenon with DC, it assumes much more importance with AC. Since the current is constantly changing in both intensity and direction, the magnetic field around the wire will similarly expand and contract. In a straight wire this is not particularly noteworthy, but when that wire is twisted into a coil, both the inductance and reactance increase tremendously.

The magnetic field is regarded as consisting of "lines of force." As they expand and contract around the coil they intersect the turns of wire in it. When the lines of force "cut" through these conductors, they induce a voltage in them. This induced voltage is a "back emf," or voltage, because it is always opposite in polarity to the applied voltage. Hence the induced voltage bucks the applied voltage and thus reduces it. Since the current flow is proportional to the voltage which drives it, the current will be less when the inductance is introduced into the circuit. This then is a new kind of voltage drop. Instead of being wasted in heat, it is actually a second opposing voltage which subtracts from the source voltage.

The inductance of an air-core coil is determined by the number of turns as well as the overall size and shape. If the turns are wound around an iron core, the inductance will increase many times, depending upon the *permeability* of the core material. The permeability of air is taken as 1, while the permeability of core materials may be many thousands of times greater. It is therefore a simple matter to increase the inductance of a coil many times simply by providing it with a high-permeability core.

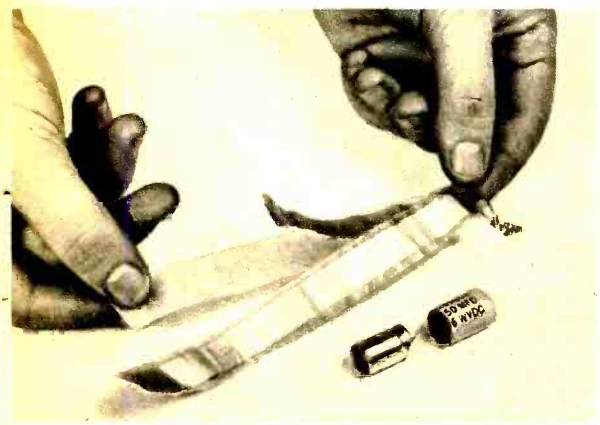
The unit of inductance is the *henry*, defined as the inductance of any circuit in which a current changing at the rate of one ampere per second will induce an emf of one volt. The symbol for inductance is the letter L. The values of L encountered in electronic work vary from a few microhenries (millionths) up to perhaps 50 henries.

The unit of inductive reactance is the ohm just as in the case of resistance. Its symbol is X_L and is determined by the inductance and the frequency of the current flowing through it, using this simple formula:

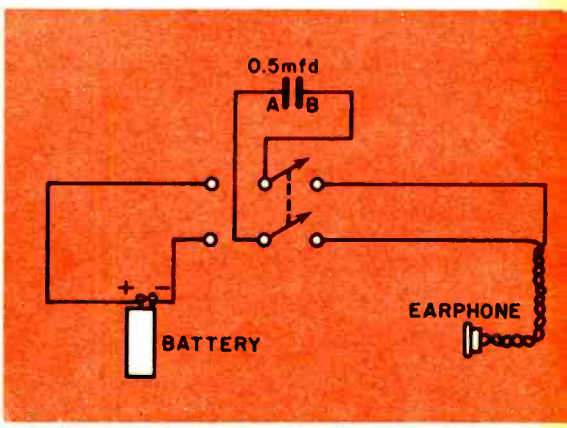
$$X_L = 6.28 \times F \times L$$

where X_L = inductive reactance in ohms.
F = frequency in cycles per second
L = inductance in henries

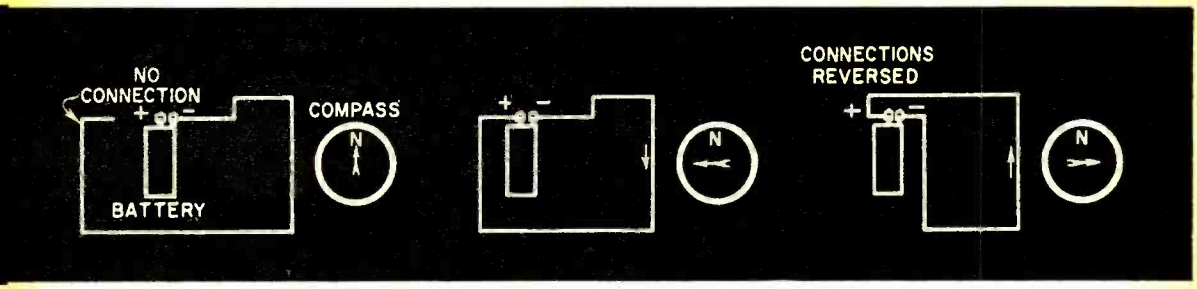
As an example of the application of this formula, suppose we have an RF choke coil rated at 8.2 microhenries and designed to operate at 79 megacycles. To find its reactance we must first con-



Opening a capacitor shows two plates (metal foil) separated by dielectric (wax paper).



As described in text, this set-up demonstrates apparent flow of current through a capacitor.



A flow of current produces a magnetic field that attracts or repels the point of the compass.

vert both the inductance and the frequency to the correct units, henries and cycles. Then:

$$X_L = 6.28 \times 79{,}000{,}000 \times 0.0000082$$
$$= 4{,}068 \text{ ohms}$$

This formula can also be used to find some other unknown. Suppose, for example, your junk box turns up an audio choke rated at 8 millihenries and 75 ohms. At what frequency is it intended to operate?

$$75 = 6.28 \times F \times 0.008$$
$$F = \frac{75}{6.28 \times 0.008}$$
$$= 1{,}493 \text{ cps}$$

Still another reactive device often found in electronic circuits is the capacitor. This is usually an arrangement of two or more metallic plates, separated from one another by air or some other insulating material known as a *dielectric*.

When a DC voltage source is connected across the capacitor, electrons will be drawn away from one set of plates toward the positive battery terminal, and they will simultaneously be forced out of the negative terminal and into the opposite set of plates. This action will continue until the capacitor is fully *charged*. The amount of charge it can take is determined by the number, area, and spacing of its plates contributing to its *capacitance*.

Since there is no such thing as the perfect insulator there will be some leakage through the dielectric as the excess electrons try to get back to the opposite plates and fill up the deficiency. But for the most part the capacitor will remain charged until an external return path is provided for the conduction of electrons.

This can be proved by the experiment illustrated with a single dry cell, an earphone, a 0.5 microfarad condenser and a double-pole double-throw switch. When the switch is thrown to the left, electrons from the negative battery terminal will pile up on plate A of the condenser while electrons from plate B will drain into the positive terminal of the cell. When the switch is thrown to the right, the charge will be equalized as the excess electrons on plate A will rush through the headphone circuit and back to plate B. At the same time, a distinct click will be heard in the phone, proving the momentary current flow.

The unit of capacitance is the *farad*, which a capacitor would have if its voltage were raised one volt by a current of one ampere for one second. Such a capacitor, however, would be physically huge so this unit is almost never encountered in practice. Electronic circuits use capacitors rated in microfarads, or even micromicrofarads.

Current doesn't actually flow through the capacitor but goes around the circuit, back and forth between the plates. Since the alternating current is impeded, depending on frequency, by this continuous charging and discharging there is a *capacitive reactance* to AC, while DC is blocked altogether. This is one important application, to block out DC from a circuit where it isn't wanted, while permitting AC to pass.

The formula for capacitive reactance is different from the one for the inductive type. Note that as the frequency is raised, it passes through the capacitor with less opposition.

[*Continued on page* 106]

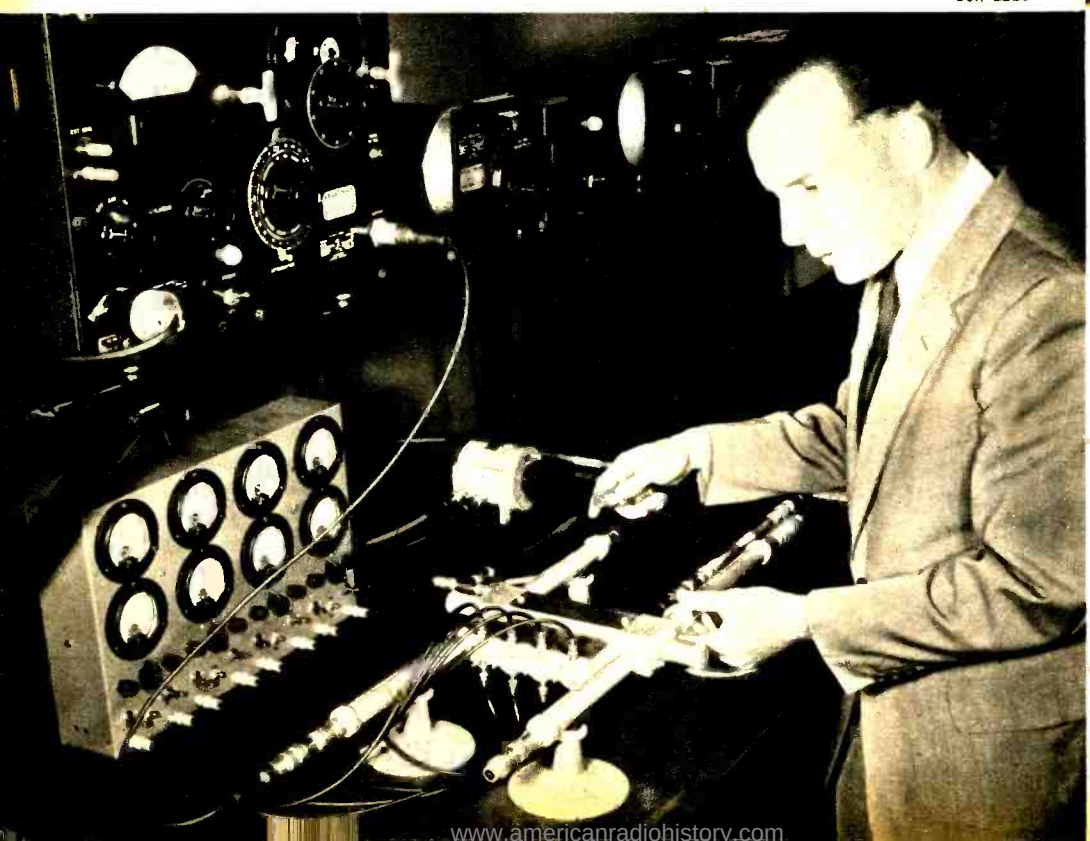
Those Amazing Masers!

By Harold S. Renne

Revolutionary new devices amplify almost negligible signals, reduce effects of noise.

THERE'S a revolution going on in electronic amplification. New, radically different types of amplifiers are being designed and constructed—so new and so different that if you saw one chances are you wouldn't recognize it as an amplifier. Yet modifications of these units may someday soon find their way into your home radio, TV and hi-fi sets—and make them play better than ever before. At present, however, these amplifiers have been limited in design for work with very weak, extremely high frequency microwave signals.

Noise is the arch-enemy of microwave receivers. It can completely obliterate a radar image, blank out a communications channel at a crucial moment, and make reception a general nightmare. We are talking about the noise generated within a microwave receiver itself—thermal noise, tube noise, etc., which can markedly limit receiver sensitivity. Design engineers are working hard in an effort to eliminate or minimize this noise, and thereby permit the receiver to utilize weaker and weaker signals. In radio astronomy, radar, and space communications, reduction in noise is a vital factor for success.



Bell Labs

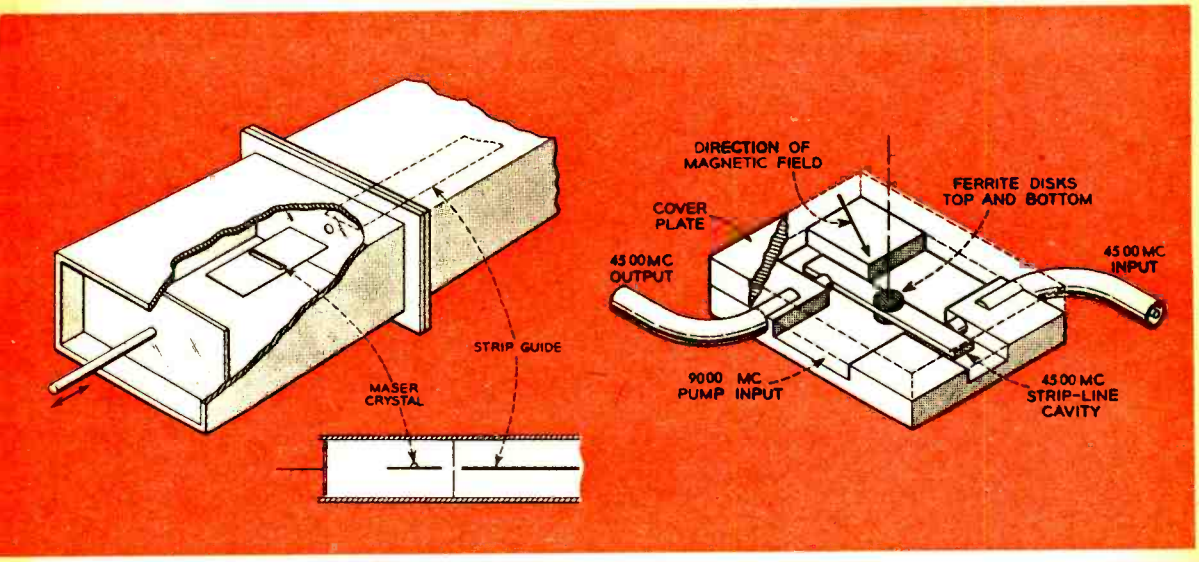
GE Research Lab

Above, the theory of maser operation is studied with complex equipment which includes magnetic resonance spectrometer, waveguides, cavities.

Left, a traveling wave type of parametric amplifier is assembled for tests. This amplifies microwaves via variations in circuit reactance.

At right, cryostat containing liquid helium is adjusted. Similar apparatus keeps temperatures near absolute zero, a necessity for maser operation.

Bell Labs



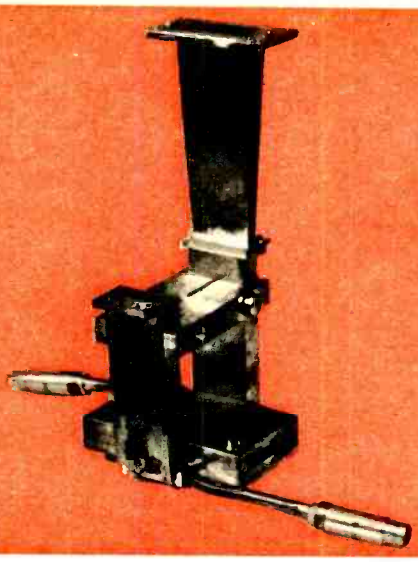
Recent break-throughs in research on solid materials such as germanium, silicon, ferrites, etc., have provided new tools which have resulted in the design of new microwave amplifiers as revolutionary in concept as the transistor. These amplifiers minimize noise. No vacuum tubes or electron beams are employed—instead most of them rely on semiconductors, the stuff that makes transistors tick. Since some of the active materials used are not, strictly speaking, semiconductors, the general term solid-state is used to identify them.

The two new major types of solid-state amplifiers, "masers" and "parametric amplifiers," somewhat resemble each other in end result, but are quite different in the way they achieve it.

"Maser" stands for "microwave amplification by stimulated emission of radiation." In simpler language, the atoms in a chunk of enclosed solid-state material are forced into an excited state by a magnetic field and microwave radiation. When an incoming microwave radio signal strikes them they calm down somewhat. In the process of dropping to a lower energy level they emit radiation of the *same frequency* as the incoming signal. This adds to the incoming signal, producing amplification.

Not all solid-state materials behave this way. The element gadolinium does. For use, it is formed into a crystal network of separate atoms by mixing about ½% of gadolinium with a compound called lanthanum ethyl sulfate. To achieve the active condition, the crystals are placed in a magnetic field which sorts out and aligns the individual electron spins. These electron spins have a certain amount of energy associated with them. Strangely, it has been discovered that this energy can exist only in certain distinct levels, or steps.

Most electrons normally exist in the lowest of three energy levels, where their energy is at a minimum. However, because of stray radiation, thermal effects, etc., some electrons move up to the second energy level, some even to the third or higher. We will limit our attention to the first three levels, as has been done in the three-level maser. The magnetic field is adjusted so that the energy difference between the first and second levels is equal to the energy of the microwave frequency which we want to amplify—called the signal frequency. The incoming energy of this frequency causes shifting of electrons between first and second levels. If the electrons move from the first to the second level, energy is absorbed and the signal is likely to be lost. If the shift is from the higher to the lower energy level, energy is radiated. Normally, there are many more electrons in the first level than in the second, and there



Far left, we see how maser crystal is positioned in a cavity, part of a waveguide circuit. It oscillates at microwave frequencies.

Center is diagram of experimental ferrite amplifier at Bell Labs. Cavity basically takes signal, adds to it with pump, then sends it out.

Completely assembled, microwave cavity resembles plumbing. Hollow tubes make efficient carriers of extremely high frequency signals.

would therefore be more absorption than radiation.

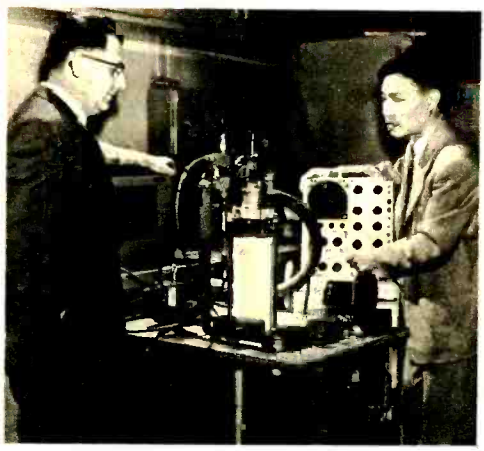
Our problem then is to produce a condition reversing this normal state of affairs, resulting in more radiation than absorption, thereby amplifying the signal frequency. This is accomplished by radiating the active material with a locally generated microwave frequency known as the "pump" frequency. This pump then becomes the source of power for the amplifier, much like the DC plate supply in a vacuum tube amplifier. The frequency of this pump is adjusted so that its energy is equivalent to the energy difference between the first level and the third level which is, of course, higher than the second.

To get the spin energies to drop from level 3 to level 2, an impurity is added to the maser material. The energy produced by this drop is then absorbed as heat.

We now have more atoms in energy level 2 than in level 1. Incoming radiation will stimulate transitions between 1 and 2, and since 2 is now more densely populated than 1, the net effect will be amplification of this incoming signal frequency.

One condition that must be satisfied for proper operation is that the material must be kept at temperatures near absolute zero, —459.6° F. This is generally

[*Continued on page* 92]



Portable maser at GE labs is checked with an oscilloscope. Equipment still remains bulky.

Semiconductor diode (in right hand) is mounted in unit which tests amplifying properties. Bell Labs

EI assembles

A VTVM Kit

The Paco V-70 is a sensitive instrument that will measure a wide range of voltage and resistance.

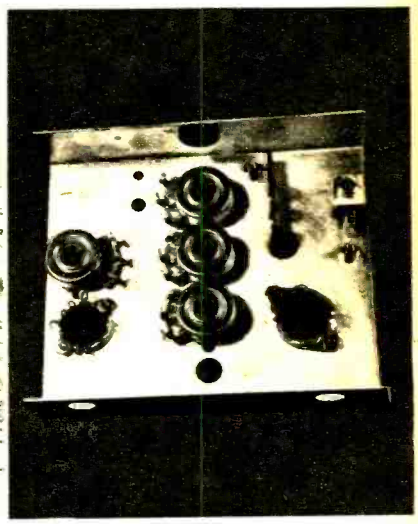
WHY a *vacuum tube* voltmeter? The perfect test instrument is one that does not change the operation of the circuit you are testing, but simply measures it. The VTVM is a good step in this direction due to its high sensitivity. Less expensive types will drop the circuit voltage somewhat and give inaccurate readings though they are excellent for many types of non-critical testing. They have the advantage of not requiring an AC outlet and are portable. The VTVM, however, is essential for checking out oscillators, automatic volume control (AVC), tube grids, and other high impedance circuits.

Another advantage of the VTVM is its meter protection feature. Though excessive voltages are applied, the vacuum tube will "saturate" and not pass sufficient current to burn out the fragile meter movement.

The Paco V-70 VTVM incorporates these advantages. Its input resistance is 11 megohms, a fairly standard figure for most VTVM's. The operation of this unit centers around a 12AU7 tube acting as a "bridge." Your test voltage upsets the balance of this bridge and causes the meter to indicate. Note the knob labelled "Zero Adjust." It permits you to bring the needle back to zero in case of changes in line volt- [*Continued on page* 108]

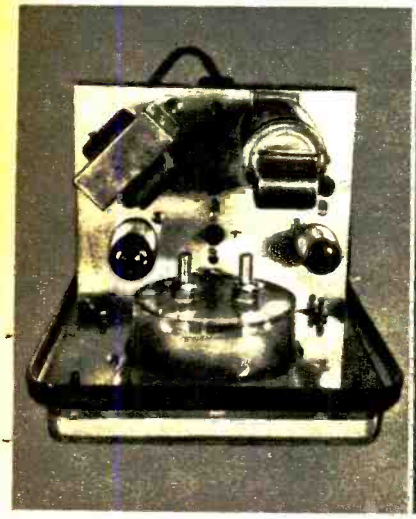
All the parts supplied with the kit are first spread out and checked against the parts list in the manual.

To avoid the need of working in a crowded corner of the chassis, this range switch is wired first.

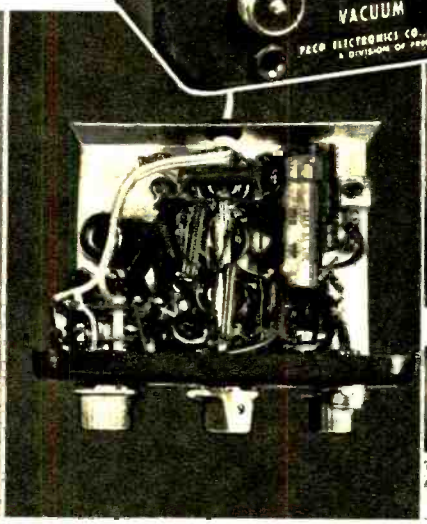


Underside view of chassis prior to wiring. Two tube sockets are along bottom. Note the 4 calibration pots.

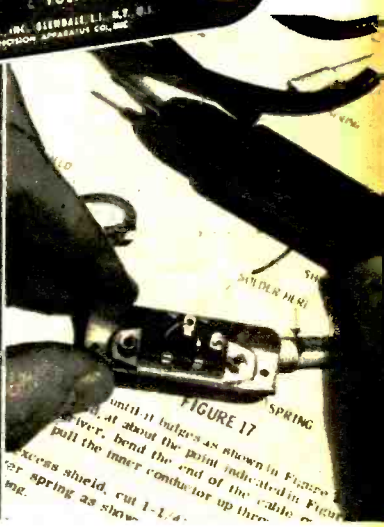
The nine scales on the meter face indicate measurements of AC and DC volts, decibels, and ohms. The probe will connect to INPUT. Ground plugs in, below it.



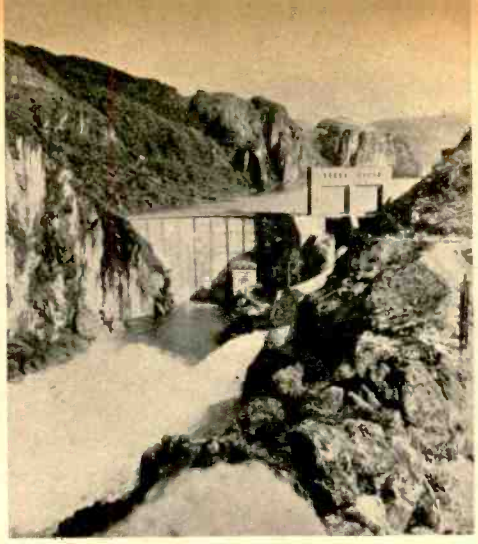
In this top view the chassis is seen bolted to the front panel. Power transformer and battery are along top.



Underchassis is now completed by adding the two function switches (left and center control panel knobs).



A resistor is wired to the thumb switch that fits into the body of the probe. This selects AC-ohms or DC.



Water from Arizona's Canyon Lake pours through spillway gates of remotely controlled Mormon Flat Dam toward what was once a desert miles downstream.

new fields for electronics

Desert Into Oasis

By Henry F. Unger

Unique dam in Arizona mountains has irrigation and power regulated by electronic remote controls.

Aerial photo shows rugged terrain surrounding Mormon Flat Dam. One man operates dam from 31 miles down road, right. Canyon Lake is behind dam.

IN a small switching station at Mesa, Ariz., a man pushes a button and starts a chain of events that literally turns desert into oasis. Some 31 miles up the Salt River from that small building, nestled in a range of rugged mountains, huge Mormon Flat Dam arouses from its slumber. In response to the operator's touch, the dam's turbine valve slowly opens. Four minutes later a light flashes on the board downstream and the operator knows the valve is fully open.

A few more buttons are pushed to actuate water gates and load limit controls. Less than three minutes later the 11,000 kilowatt capacity Mormon Flat Dam is an operating part of the team of dams called the Salt River Project.

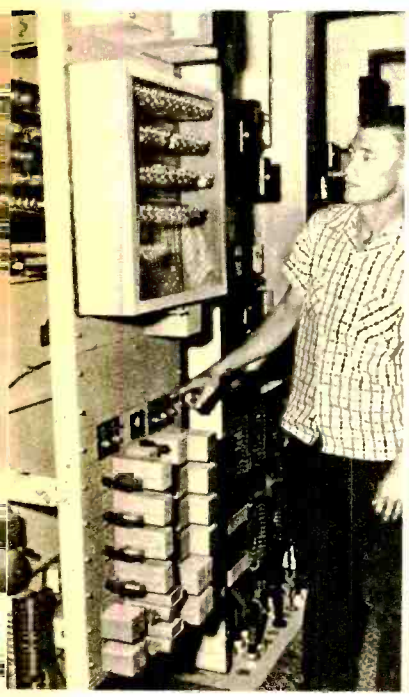
These huge dams have more of a mission than simply generating hydroelectric power for the vast Southwest. Water is scarce in this normally desert area. But thanks to the ability of these dams to store and properly distribute irrigation water, one of the greatest reclamation projects in the country is well underway.

Mormon Flat Dam is unique in the string of four project dams which irrigate about 240,000 acres. Backing up Canyon Lake with its vast reservoir, Mormon Flat is the only dam operated by remote controlled electronic switching. Located 51 miles from Phoenix, Mormon Flat was recently singled out for the automatic and remote control conversion in an effort by project officials to reduce personnel at the remote dam and cut down operating expenses. In doing this, the officials placed deep faith in electronics to manipulate the huge, isolated dam from a closer-to-headquarters location.

Only one operator handles the dam, which is linked with two dams up-river (Roosevelt and Horse Mesa) and one dam below (Stewart Mountain) to funnel irrigation water into 1,400 miles of

[*Continued on page* 113]

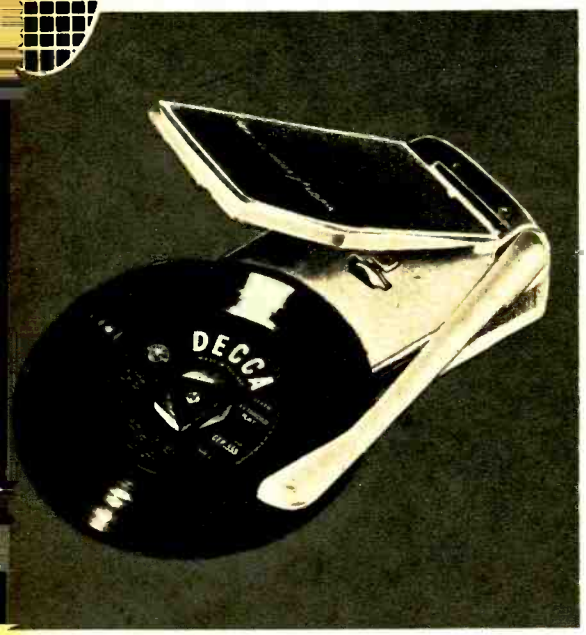
Carrier cabinets behind control station switchboard feature relays, alarms and circuits to operate the dam.



Small, simple control panel can govern huge water gates on the distant dam to meet irrigation schedules.

Mesa switching station is surrounded by power lines. Remote control equipment is housed in this low building.

EI Picturescope

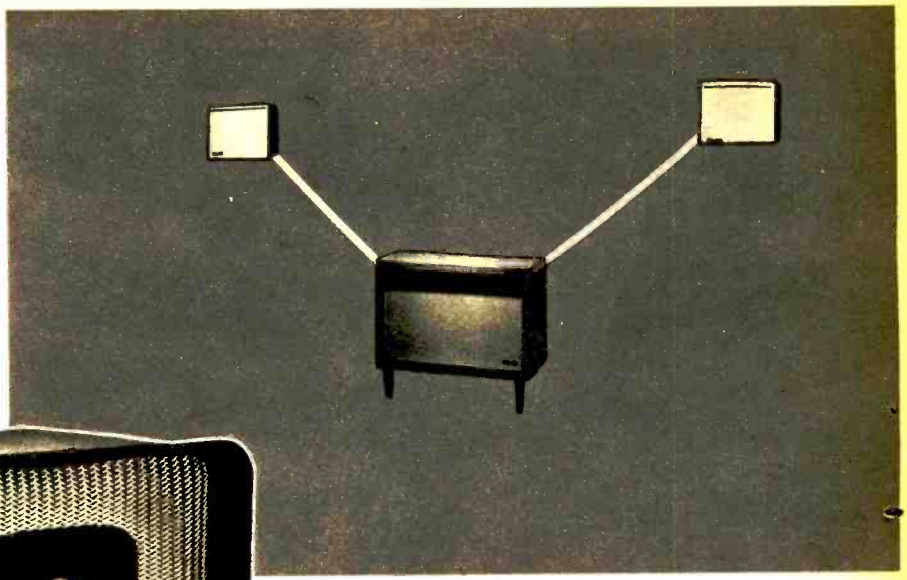


First came pocket tape recorders and now, from Britain, comes this pocket battery operated record player. It handles 12" LPs or 45 rpm records and adjustments are automatically governed by size of record. A 4-ohm speaker is built right into 4-by-8 inch package, which will sell for about $49 in U. S.

Do-it-yourself hypnotism is possible with this device called a "brain wave synchronizer" by its inventor, Sydney Schneider, of Skokie, Ill. He claims it will hypnotize half of those who gaze at flickering light and gives others feeling of tranquility.

The lieutenant in the picture is 6'2" tall and is holding a 3,000 word message typed by a new Army teleprinter in one minute flat! Printer is 50 times faster than conventional teletypes. It has no keys in ordinary sense, but rather shoots beams from electrode "guns" at paper. Beams correspond to printed letters and numbers.

Patients in hospitals may now see and talk with youngsters not permitted beyond lobby thanks to Minneapolis-Honeywell's bedside control center's closed-circuit TV feature. Tuner-speaker may be placed under pillow. Other controls change room temperature, drapes, lights, bed adjustments.



University add-on units work with existing woofer. One woofer supplies all bass needed.

Model of Stereoflex speaker at left is under $50, and claims 150 to 15,000 cps response.

2 New Stereo Speakers

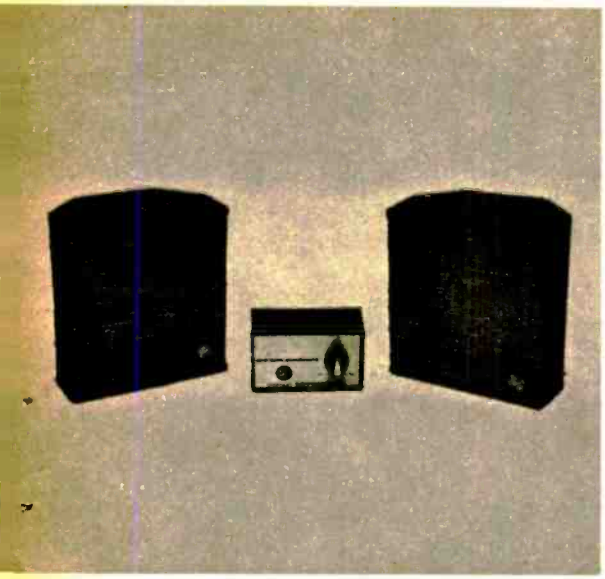
You can use your present speaker with either of these to get stereo hi-fi—with no "hole" in the middle.

THIS special report concerns two new stereo speaker systems which are as ingenious in concept as the Electro-Voice "Stereon" and Jensen "Director" described in the November *Electronics Illustrated* stereo survey. These new entries are the Stephens "Stereodot" and University "Stereoflex Add-on" systems.

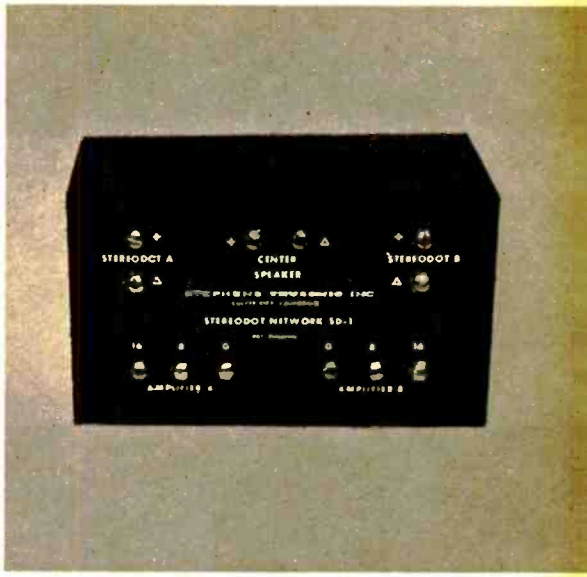
Like the "stereon" these two systems are "wooferless"; that is, they themselves do not contain a low frequency speaker, but make use of the woofer from any speaker system already in the room.

The "Stereodot" not only is "wooferless," but is also a three channel stereo speaker system. It consists of a pair of eight inch, free-suspension speakers in small cabinets ("Dots") each of which reproduces one channel of stereo music; the existing speaker carries the third channel. The two "Dots" make no attempt to reproduce any frequency below 600 cycles per second. Lower frequencies are carried by the woofer of the main or wide range system.

In order to appreciate how the system works, a bit of explana-



Above, closeup of two Stephens' Stereodot speakers flank the mixer and master level control unit for the novel stereo speaker system.



Here is a rear view of the stereo mixer and level control box showing connection points for various components of high fidelity rig.

tion of "Sum and Difference" stereo is in order. Most of the sounds from the various musical instruments in an orchestra arrive at a microphone about the same time. At this point they are "in phase" and add together to form a Sum signal containing most of the musical content. At any other point the various sounds do not arrive in phase. For example, at the right side of the orchestra the sounds from the instruments on the right arrive before those from the left side, which are played at the same instant. These "out of phase" sounds form a Difference signal which is essentially the key to directionality. Thus, in the home, if a centrally positioned speaker reproduced only the Sum signals and two side speakers reproduced the Difference signals we would have realistic stereo.

The "Stereodot" system, in effect, connects two channel stereo signals into Sum and Difference signals and feeds the latter to the two "Dots." Within the Stereodot network, part of the output from two amplifiers or two channels of a stereo amplifier are fed to a mixer where all in-phase signals are combined and then fed to the center speaker. Most in-phase or Sum signals are low frequency or bass orchestral instruments.

The outputs of the two amplifiers are also connected to the two "Dots." These do not reproduce the in-phase low frequencies, only the high and upper middle frequencies (above 600 cycles), most of which are out of phase.

The level control of the "Stereodot" network is used to control the amount of "center" by adjusting the volume of the center speaker.

The University system operates in a similar manner except that it was primarily designed for use with University dual voice coil woofers. The low frequency in-phase signals are mixed in the voice coils rather than in a mixer network. Choke coils are furnished to keep the high frequencies out of the woofer and are then fed to the two small "Stereoflex" speakers. University also makes a separate mixing network for those who wish to use the "Stereoflex" speakers with a woofer that does not have dual voice coils.

Both systems fill the "hole" that some listeners detect when listening to two channel stereo. Since they also make use of existing speaker systems and cost about $50 each, they are certainly worth the serious attention of hi-fi listeners.

All About Short-Wave Listening-3

FROM your home listening post you can tune programs at all hours. How to tune, log and reply to stations was covered in the two previous issues of *EI*. Station power, time of day, the season and the sunspot cycle influence reception, for better or worse. Most SW stations are received in this country because their radio waves "skip" over long distances. Those frequencies within our broadcast band (1.6 mc and lower) will be difficult to pick up because their skip is usually under 1,000 miles. Tune carefully and note time, frequency and signal strength.

Listed on this and the following pages are the major locations in the world from which short wave broadcasts emanate. This list is not complete, no list ever can be. There are constant changes with regard to time of broadcasts and frequency. You may never hear some of the stations listed here, on the other hand, you may pick up some stations not listed, this is part of the excitement of short wave listening.

The times given are in GMT (Greenwich Mean Time). Subtract 5 hours if you are in the Eastern Zone, 6 hours if in the Central Zone, 7 hours if in the Mountain Zone and 8 hours if in the Pacific Zone. The frequencies are in megacycles.

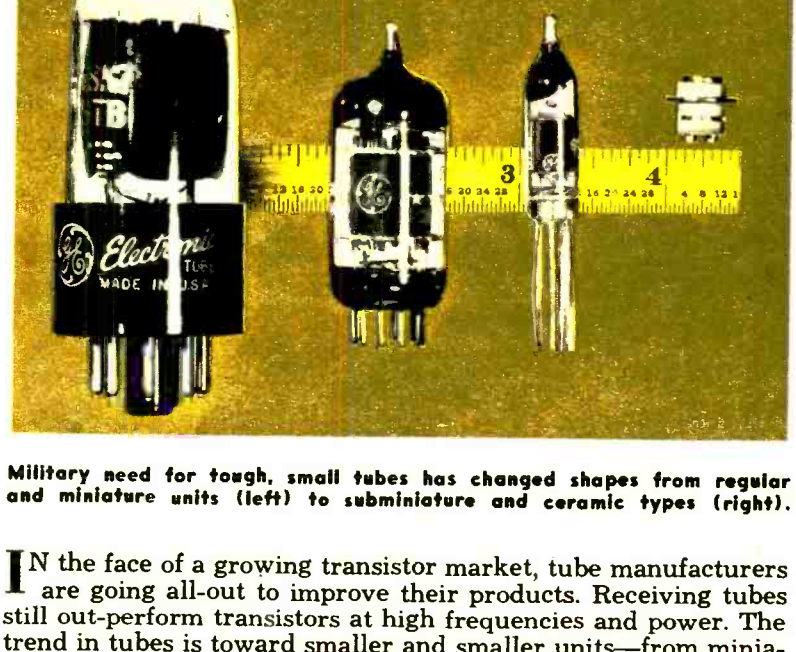
COUNTRY	CITY	STATION	FREQUENCY	TIME (GMT)
Aden		Aden Broadcasting Service	7.17	1430-1500
Afghanistan	Kabul		18.64	1500-1630
Albania	Triana	Radio Triana	6.9	2200-2230 0430-0530
Algeria	Algiers	Radio Algerie	11.835	2000-2145
Andorra	Roc de Les Anelletes	Radio Andorra	5.978	2030-2230
Angola	Luanda	Radio Angola	9.765, 11.862	2300-2345 (Sat.)
	Benguela	Radio Clube de Benguela, CR6RF	9.502	1300-1700
Antigua	St. Johns	Radio Antigua	3.255	1000-1100
Argentina	Buenos Aires	LRA	9.69	2100-2400 0400-0500
		Radio Belgrano, VLA11, LRY1	9.76	0945-0415
Australia	Melbourne	Radio Australia	11.77	1215-1345
			11.81	1330 (Sun.)
Austria	Vienna	Osterreicher Rundfunk	7.245	0930-1030
	Innsbruck	OE120	6.0	2020
Azores	Ponta Delgado	CSA93	4.865	2230
Bahrain Island	Manama	Bahrain Broadcasting Station	0.61	1200-1430
Bechuanaland	Mafeking	2NB	8.23	0900-1000 1500-1700
Belgian Congo	Leopoldville	Radio Congo Belge, OTM2	9.38	0500-0608
Belgium	Brussels	World's Fair Radio	15.335	1030-1100 2400-0100 (Mon.)
			9.655	2315-0100 (Sat.)
Bermuda	Hamilton	Bermuda Broadcasting Corp.	1.235	1400-0800
Bolivia	Sucre	Radio Libertad, CP25	9.2	0104-0202
Brazil		Radio Cultura de Bahia	15.225	0225
	Fortaleza	Radio Drago Mar	4.775	0100
	Recife	R. Clube de Pernambuco, PRA8	6.015	0215
	Rio de Janeiro	Agencia Nacional, PSH	10.22	2215-2300
British Guiana	Georgetown	ZFY, Radio Demerara	5.981	0955-1017
			6.035	0915
			9.44	2315-0245
British Honduras	Belize	BHBS	3.3	2400-0700
British Somaliland	Horgesia	Radio Somali, VQ6MI	7.126	0630-0700
Bulgaria	Sofia	Sofia Calling	9.7	0100-0130 0400-0430
Burma	Rangoon		9.543	1500-1530
			7.117	1500-1515
Cambodia	Phnompenh	Radio Phnompenh	7.19	1200-1400
Cameroon	Douala	Radio Douala	9.27	2030-2230
Canada	Montreal	CKCX	15.190	0055-0145
		CHOL	11.720	
		CKNK	11.945	0255-0335
		CKLP	9.585	
Canary Islands	Las Palmas	Radio Atlantico, REM34	7.0	1300-1530 1900-2400
			9.49	1300-1530 2200-2400
Canton Island		Radio Station Kibs	1.5	1100-2200 (Tues.-Sun.)
Cape Verde Islands	S. Vincente	Radio Clube Mindelo, CR4AB	4.755	2030-2200
Ceylon	Colombo	Radio Ceylon	4.87	1600-1610
Chile	Santiago	Radio Nuevo Mundo, CE1174	11.755	2330
China	Peking	Radio Peking	17.745, 17.72, 15.35, 15.118	0300-0330
Colombia	Bogota	Radiodifusora Nacional de Colombia, HJCA	4.955	2400-0500
Cook Island	Raratonga	Radio Raratonga	4.965	0400-0530
Costa Rica	San Jose	The Lighthouse of the Caribbean, TIFC	6.037, 9.647	0400-0500
		Radio Casino, TIQ	5.952	0509-0600
Cuba	Camaguey	Voz del Camagueyano, COJK	9.62	1800-0930
	Havana	Radio Siboney, COCY	11.74	1800-1300
Cyprus	Limassol	ZJM4	1.484	1730-1900
	Nicosia	Forces Broadcasting Service	1.086	0830-1900
Czechoslovakia	Prague	Radio Prague	9.585, 6.170, 6.105, 6.055	0030-0100 0300-0400
		Radio Prague	7.255, 9.55, 11.835	0200-0430
Dahomey	Cotonou	Radio Cotonou	4.9	2030
Denmark	Copenhagen	The Voice of Denmark, OZF	9.520	0200-0230 0330-0400

COUNTRY	CITY	STATION	FREQUENCY	TIME (GMT)
Dominican Republic	San Cristobal	Voz de Fundocion, HIIR	6.175	2400-0105
East Germany	Berlin	Radio DDR	9.730	2230-2300
Ecuador	Quito	Voice of the Andes, HCJB	15.115, 11.915, 9.745	0200-0300
	Santa Anada Catacochi	Radio Catacochi	5.760	2400-0305
El Salvador	San Salvador	YSUA	6.188	0445
Ethiopia	Addis Ababa	Radio Addis Ababa	9.620, 15.080	1000-1100
Faeroe Islands	Torshavn	Faroe Radio	1.367	1830-1945
Falkland Islands	Stanley		3.958	2315-2400
Fiji	Suva	Fiji Broadcasting Commission, VRH4	3.98	0630-2230
Finland	Helsinki	Finland Calling	17.800, 15.190	1200-1400
Formosa — See "Taiwan"				
France	Paris		9.492, 9.680, 11.845, 15.365	2255-0200
			17.85, 21.74	1730-1750
			7.24	1400-1500
French Equatorial Africa	Brazzaville	Radio Brazzaville	11.970, 9.625	0115-0200, 0245-0300
			11.970	0515-0530
			11.745, 5.97	2245-2255
French Guinea	Conakry	Radio Conakry	4.91	1830-1945
French Senegal	St. Louis	Radio Mauritanie	6.045	2120
	Dakar	Radio Dakar	11.895, 7.171, 5.96	2230-2240 (Tues, Thurs., Sat.)
			4.893, 1.304	0315-0325
French Sudan	Bamako	Radio Soudan	4.835	1900-2100
French Togo	Lome		5.038	1600-1630
Germany	Cologne	The Voice of Germany	5.98, 11.795, 9.640	0230-0500
	Berlin	RIAS	6.005	0415-0430
	Hamburg	Nordwestdeutscher Rundfunk	6.075	0600-0700
	Munich	Bayerische Rundfunk	6.16	0600-0615
Ghana	Accra	Ghana Broadcasting System	4.915	2115-2215
Gilbert Islands	Tarawa	Radio Tarawa	6.05	1930-2100 (Fri.)
Goa	Cidade de Goa	Emissora de Goa	6.025	0930-1000
Great Britain	London	North American Service	17.7	1500-1715, 1800-2100
	London	General Overseas Service	17.7, 15.31, 9.008	2100-2215
			15.31, 11.93	2215-2315
			11.93, 9.825	2315-0300
			25.65	0945-1400
Greece	Athens	SVD2	17.775, 15.345, 7.3	1730
Greenland	Angmagssalik	Radio OZL	7.570	1400-1450
Guam	Agana	KUJ39	9.49	
	Agana	Radio Guam	0.61	1000-0400
Guatemala	Guatemala City	TGNA	9.668, 5.952	0300-0445
Haiti	Cape Haitien	The Evangelistic Voice	15.39, 9.638	1300-1430
			15.4, 9.656, 6.105	0100-0330
	Port-au-Prince	Radio Commerce, 4VC	9.482, 9.545	2200-2230 (Sun.)
	Port-au-Prince	Radio Haiti, 4VHW	6.192	0230-0400 (Thurs.)
	Cape Haitien		9.625	1000-1100 (Sat.)
	Cayes	Lo Voix de Sud, 4VBS	5.75	
Hawaii	Honolulu	Voice of America	6.075, 9.65, 11.775	1900-0200
Honduras	San Pedro Sula	Radio Supaya, HRQ	6.125	0200
	Tegucegalpa	HRN	5.875	
Hong Kong		Radio Hong Kong	3.94	1315-1345
Hungary	Budapest	Radio Budapest	11.910, 9.833	0030-0100, 0400-0430
Iceland	Reykjavik	TFJ	12.175	1200-1315
				2000-2100
India	Bombay		11.95	1200
	Delhi	All India Radio	17.72, 15.16	0030
			17.83, 15.16, 11.71	0230
			15.25, 11.71, 17.725, 15.17	1945-2045
Indonesia	Djakarta	Voice of Indonesia, YDF6	9.71	1115, 1430
			4.91	1430-1530
Iran	Teheran	Radio Teheran	15.1	2015
			9.68	2000-2030
			17.7	1830-2030
			1.25	0100
Iraq	Baghdad	Radio Baghdad	7.18	2040-2110
Ireland	Dublin	Radio Eireann	1.25	1600-2230
Israel	Jerusalem	The Voice of Zion	9.008	2130-2220

COUNTRY	CITY	STATION	FREQUENCY	TIME (GMT)
Italy	Rome	Italian Broadcasting & TV System	9.575, 6.01	0015-0035 0225-0245
	Rome	Radio Roma	9.57	0305-0325
Italian Somaliland	Mogadiscio	Radio Mogadiscio	4.978	1300-1500
Ivory Coast	Abidjan	Radio Abidjan	4.94	2130-2230
Jamaica	Kingston	Voice of Jamaica	17.493	2145-2200
Japan	Tokyo	JOA22	17.825	2300-2330
		JOB9	15.235	2300-2330 0030-0050
		JOA4	11.705	0030-0050 0330-0400
		JOB24	21.62	0750-0820
Johnston Island		Armed Forces Radio Service	1.25	0600-0800
Jordan	Ramallah	Hashemite Radio	6.06	1130-1200
Kashmir	Srinigar	Radio Kashmir	3.277	1430-1730
Kenya	Nairobi	African Broadcasting Service	4.934	1500-1530
Kuwait			5.0	1400-1700
Laos		Radio Lao	7.145	1330-1430
Lebanon	Beirut		8.007	2110-2200
Leeward Islands	Antigua	Radio Antigua	3.255	1400-1500
Liberia	Monrovia	ELWA	9.65, 21.535	0100-0230
Libya	Tripoli	Radio Tripoli	1.052, 6.14	1700-2015
Luxembourg	Luxembourg	Radio Luxembourg	6.09	2300-0400
Macau		Emissora Vila Verde	1.005	1500-0800
Madagascar	Tananarive	Radio Tananariva	7.155, 3.386	1930-2100 0600-0900
Madeira	Funchal	Radio Clube de Madeira	1.484	2100-0300
Malaya	Singapore	BBC Far Eastern Station	21.655	1600-1650
	Singapore	ZHP3	7.2	1130-1143
Marianas Islands—See "Guam"				
Marshall Islands	Eniwetak	WXLE	1.385	0600-0300
	Kwajelein	WXLG	1.14	0600-0300
Mauritius	Forest Side	V3USE	15.06, 15.09	0330-0415
Mexico	Mexico City	XEQ	6.078	0300
	Chihuahua	Radio Universidad, XELUU	15.3	1800-2100
	Merido	XEQM	6.105	0300-0400
Midway Island		KMTH	0.9	0500-2200
Monaco	Monte Carlo	3AM3	6.035	0530-0830
		3AM4	7.14	2205-2235
Morocco	Robat	Radio Sebaa-Aioun	5.968	0725-0830
Mozambique	Lourenco Marques	Radio Clube of Mozambique	15.08	1930-2015
Nepal	Kathmandu	Radio Nepal	7.1	1130-1250 (Wed.)
Netherlands	Hilversum	Radio Netherlands	15.365, 11.95	2115-2145
			9.59, 11.95	0230-0310
	Hilversum	The Happy Station	11.95, 9.159	0230-0400 (Sun.)
			6.025	0230-0300
Netherlands Antilles	Oranjestad, Aruba	Radio Kelkboom	1.435	2030-2230
Netherlands New Guinea	Biak	Radio Omroep Nieuw Guinea	7.19	0900-1230
New Caledonia	Noumea	Radio Noumea	6.035	0800-0900
New Guinea	Port Moresby	VLT6	6.135	0900
New Zealand	Wellington	Radio New Zealand, ZL2	9.54	0930-1030 0630-1045
		Radio New Zealand, ZL7	6.08	0930-1030 0630-1045
		Radio New Zealand	11.78	0815-0845 (Sun.)
Nicaragua	Bluefields	Radio Atlantico	7.753	0300-0400
	Granada	Radio Oriental, YN8X	7.675	
Nigeria	Koduna	Nigerian Broadcasting Corp.	3.326	0700
North Borneo	Jesselton	Radio Sabah	7.18	0300-0400
North Korea	Pyongyang	Radio Pyongyong	6.25	0500-0600
North Vietnam	Honoi	The Voice of Vietnam	9.935	1330-1400
Northern Rhodesia	Lusako	Central Africa Broadcasting Station	3.914	1600-1700 (Thurs.)
Norway	Oslo	Radio Norway	15.175, 11.735, 9.54	0200-0220
Pakistan	Karachi	Radio Pakistan, APK	17.75, 15.335	0100
Panama	Panama City	Circuito RPC, HOH7	9.685	0400-0504
	David	Voz del Baru, HOU31	6.045	0230-0300
Paraguay	Asuncion	Radio Paraguay, ZPA10	6.025	1415-0700
Peru	Lima	Radio Panamericana, OBX4M	5.98	0515-0600
	Chiclayo	Radio Delcar, OAX1A	6.7	2400-0500
Philippines	Manila	The Call of the Orient	11.855, 9.730	1400-1600
			17.805, 15.30, 11.855, 9.730	0800-0915
Poland	Warsaw	Radio Warsaw	17, 15.12	1100-1130
			17.8, 15.12	1215-1315
			9.525, 6.025	0030-0130 0230-0300

COUNTRY	CITY	STATION	FREQUENCY	TIME (GMT)
Portugal	Lisbon	Radio Lisbon	21.495, 17.88	1315-1415
			9.636	0340-0400
			15.08	2100-0200
Portuguese Guinea	Bissau	Emissora da Guine	3.975	2230-2400
Puerto Rico	Guyama	Guyama Broadcasting Co.	1.59	
Reunion	St. Denis		7.17	0415
Rumania	Bucharest	Bucharest Calling	11.937, 9.57	0300-0330
Ryukyu Islands	Okinawa	VOA	6.145, 11.83	0430-0500
Samoa	Apia	2AP	1.42	0445-0730
Sao Tome		Radio Sao Tome	17.667	1230
Sarawak	Kuching		9.565	0400-0530
			7.160, 4.95	0800-1430
Saudi Arabia	Djeddah		11.85	1100-1120
Seychelles	Mahe	Seychelles Broadcasting Service, ZCQ3	4.99	1115-1215
Sierra Leone		Freetown Calling	3.316	0645-0800
Solomon Islands	Honiara	VQO2	5.96	0100-0200
Somaliland	Hargeisa	Radio Somali	7.126	1830-2115
Southern Rhodesia	Salisbury	Federal Broadcasting Service	9.505	1100-1110
South Korea	Seoul	Korean Broadcast Service, HLKA	11.925	0800-0630 1430-1500
South Vietnam	Saigon	Radio Saigon	7.29	1330-1400
Spain	Madrid	The Voice of Spain	9.36, 6.13	0315-0400; 0415-0500 0515-0600; 0815-1100
	Madrid	Radio Nacional Emissora, RNE	9.59	0325
			2.51	0340
	Valencia	Radio Alerta	6.95	2000-2100
Spanish Guinea	Santa Isabel	Emissora de Radiofusion Santa Isabel	7.16	2100-2300
St. Vincent		Radio St. Vincent	3.305	
Sudan	Khartoum	Sudan Broadcasting Service	6.2, 4.972	2100-2130
Surinam	Paramaribo	PZC	15.407, 4.752	0100-0130
			15.406	0100-0105 (Mon.)
Sweden	Stockholm	Radio Sweden	17.84, 11.88	1315-1345
			9.62	0100-0130
			15.155	0500-0530 1600-1615
Switzerland	Berne	Switzerland Calling, HER5 & HER4	11.865, 9.535	0130-0315 0415-0500
		Switzerland Calling, HER3	6.165	0130-0315
Tahiti	Papeete	The Voice of France in the Pacific	6.135	0730-0745
Taiwan (Formosa)	Taipei	The Voice of Free China	15.225, 11.815	0500-0530 0630-0700
		BED67	15.345	1200-1300
Tanganyika	Dar-Es-Salaam	Tanganyika Broadcasting Corp.	1.25, 7.167	0015-0140
Tangier		Report from the U.S.A., VOA	16 meter bands 19 meter bands 31 meter bands	2100-2130
		The Voice of Tangier, WTAN	9.418	2030-2300
		Radio Eurafrico	7.126	1630-2300
				1000-1400
Thailand	Bangkok	HSK9	6.085	1400-0200
Trinidad	Port of Spain	Radio Trinidad	1.421	1030-1230
Tunisia	Tunis	Radio Tunis	9.515	2315-2400 2115-2145
Turkey	Ankara	Radio Ankara	15.16	2100-2145
			5.026	2130-2215
Uganda	Kampala	Uganda Broadcasting Service	11.78	1550-1615
Union of South Africa	Johannesburg	South African Broadcasting Corp.	25.8	1100-1800
United Arab Republic	Cairo	UABS	11.919	2030-2200
	Damascus		15.165	1930-2030
United Nations	New York, U.S.A.		11.87, 17.83	0300-0400
Uruguay	Montevideo	Radio Sarandi, CXA71	9.515	0030-0230 (Tues. & Fri.)
U.S.A.	Boston	WRUL		
U.S.S.R.	Moscow	Radio Moscow	11.937, 11.89, 11.845, 11.825, 11.805, 11.74, 11.7, 9.7, 9.665	2300-0600
	Uzbec	Radio Tashkent	17.865, 15.14	2300-0600
			11.69	1230-1300
Vatican City		Vatican Radio	9.646, 11.685, 15.12	1500-1515 2015-2030
Venezuela	Caracas	Radio Mil Cinquenta	5.055 9.505	0300
	Borquisimeto	YVX5		
Windward Islands	Grenada		5.01	2230
Yemen	Sanaah	Radio Sonaah	5.985	0100-0200 1400-1500
Yugoslavia	Belgrade		6.1	2215
			15.23	2230-1300
Zanzibar		Voice of Zanzibar	4.795	1000-1200

New Look In Tubes



Military need for tough, small tubes has changed shapes from regular and miniature units (left) to subminiature and ceramic types (right).

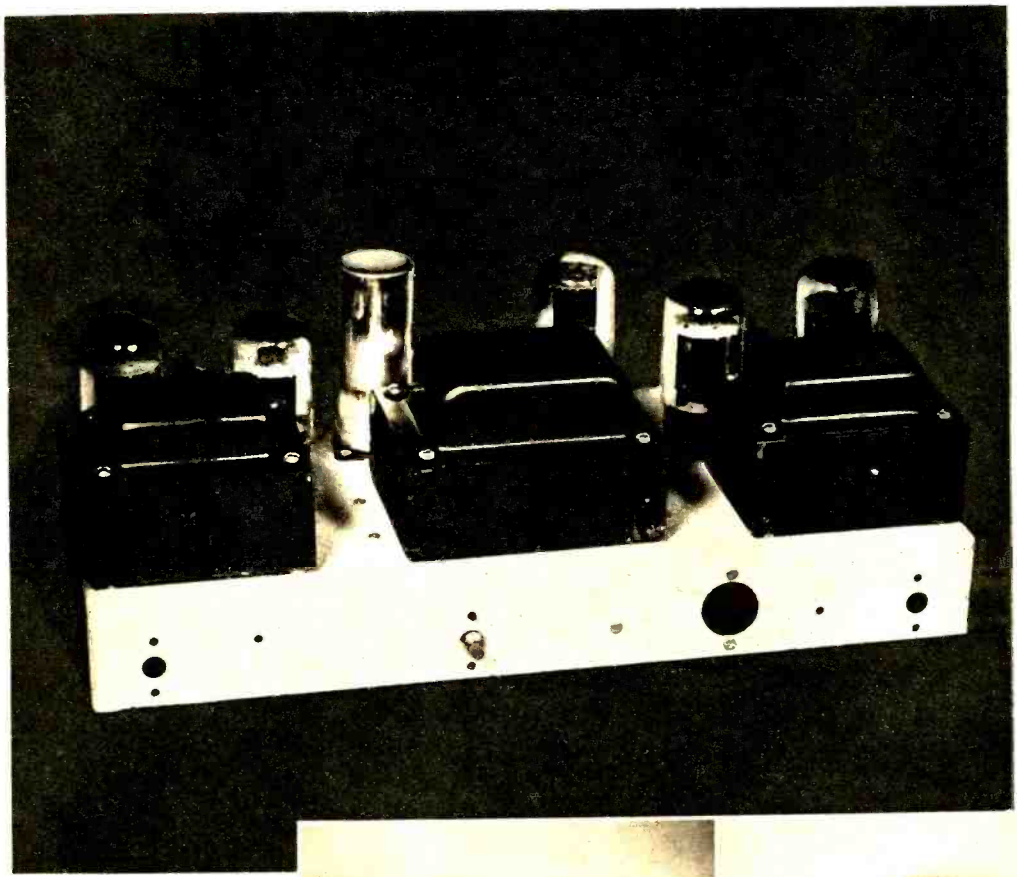
IN the face of a growing transistor market, tube manufacturers are going all-out to improve their products. Receiving tubes still out-perform transistors at high frequencies and power. The trend in tubes is toward smaller and smaller units—from miniature, to subminiature, to tiny ceramic triodes. New materials, such as special aluminums, carbons, leads, ceramics and glass are being incorporated into more reliable, longer-lasting designs. Where one tube previously performed one function, some of the newer designs stack "several tubes" in one casing for tube versatility. GE "service designed" features, such as tapered base pins, have been adapted to consumer tubes—at no extra cost to the consumer. New Westinghouse "match box" is ideal for printed circuit use, it hugs the board.

Sylvania's "stacked-tubes-in-glass" (here without glass envelope) feature all elements around one axis, ceramic spacers replace mica.

Westinghouse "match box" tube envelope has resulted in improved circuits. Tube stem is eliminated and all leads are in one plane.

Stereo Amplifier Kit

The Arkay SPA-55 features two power amplifiers on a single chassis, providing 30 watts per channel.



Above, rear of chassis. Power supply occupies center section. Along rear apron are Bias adjust (center control) and preamp power socket to the right. Photo at right shows all parts prior to assembly. First they are checked against parts list and then mounted on chassis.

THE SPA-55 is a basic amplifier. It must be used in conjunction with a stereophonic (or two separate) preamplifiers. The unit itself consists of two amplifiers with a common power supply, each amplifier capable of thirty watts of output. A third channel is available to fill the gap often heard in dual-channel stereo.

The kit is furnished with a prepunched and painted chassis and all necessary components. In preparing the material for assembly sort out all parts according to type and then remove the transformers from the boxes. While it is true that in the majority of cases the amplifier will be concealed, a professional appearance can only be achieved by professional techniques. Toward this end, cover the tops of the transformers with masking tape to avoid scratching the paint while the chassis is inverted on the table.

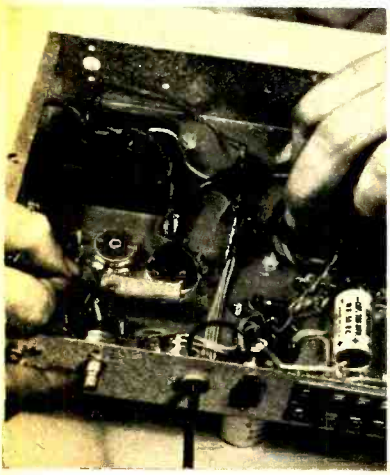
Take pains to follow the diagrams and instructions provided, which are clear and concise. A wise move would be to thoroughly study the manual and diagrams so you are familiar with them before starting the actual work. An important factor in the assembly of this kit is patience. Take care that all machine screws are tightened thoroughly, and the tube sockets are placed in the chassis with their keyways properly oriented.

When soldering, be sure that the solder has had sufficient time and heat to flow through the joint before removing the iron. Speaking of solder, the safest move would be the use of a standard core type of relatively small diameter. Under no conditions should you use an acid flux or even additional resin flux. The extra paste might interfere with a good electrical connection.

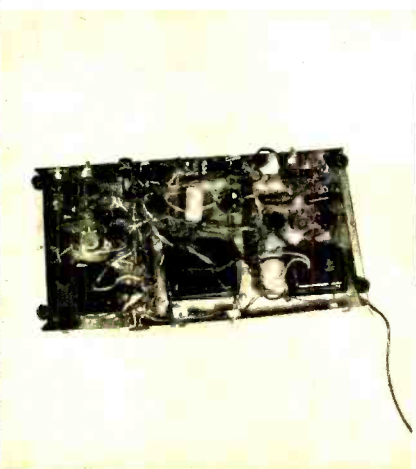
When the wiring is complete carefully recheck your work to insure that all steps have been taken and all joints are soldered. Inspect the chassis for loose bits of solder or wiring clippings which may cause trouble. When satisfied that the underside of the chassis is complete, put the bottom plate on and attach it with the sheet metal screws provided. Invert the chassis and install the tubes in their respective sockets, except the 5U4 rectifier.

Connect the AC line cord to a wall outlet. Without the 5U4, the filament power is applied without the high voltage going on. Check to see if the tubes light and if they do, remove the line cord from the outlet and plug in the 5U4. One objection to this kit is the lack of identifying labels on the input jacks and output terminal strips. It is inconvenient to pull out the large drawing each time the connections are changed. Decals or other type markings should be added.

Curved needlenose pliers aid in crimping lead to lug.



Underside view of completely wired 2-channel amplifier.



If all filaments light, then the rectifier is plugged in.

How To Strip Wire

By Len Buckwalter
Associate Editor

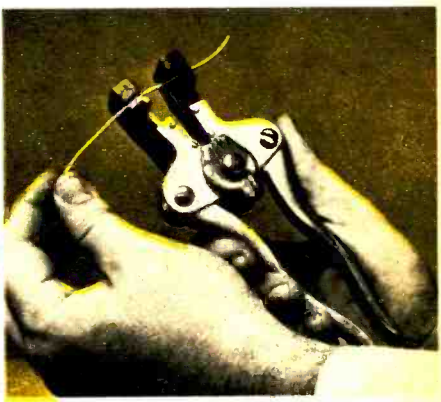
One of the simplest operations in building a kit or project can be improved with these techniques.

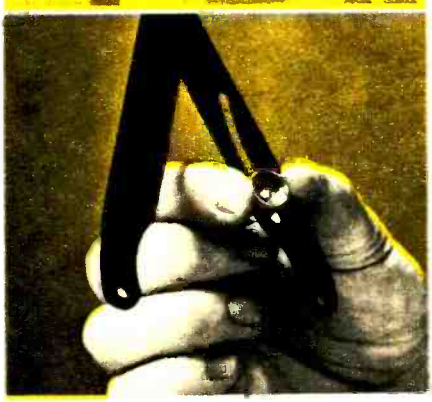
A VARIETY of wire stripping aids are available to the home builder. They will not only help to speed up work but reduce the possibility of damage to the wire itself. The common practice of pulling the wire through a cutters will often result in uneven strands. In the case of solid wire, small notches inadvertently caused by the cutting jaws can contribute to early failure.

Perhaps the most unconventional means of removing the

1. The tough coating on enamel wire melts quickly and cleanly with this solvent.

2. With just one squeeze of the handle the Speedex both grips and strips the wire.





3A. The slider on this type permits fast adjustment to accommodate any wire size.

3B. The jaws will then cut through the insulation only as the wire is pulled out.

insulation from wire is shown in the first photo. Magnet wire, used extensively for winding coils, is coated with enamel. Since most coils call for wire ranging from thin No. 22 to hairlike No. 30, removing the enamel can be a tricky process. If it is scraped with a sharp knife or razor, bare copper is usually shaved off along with it. Then, as it is bent around a lug it often breaks.

The answer is a solvent. Dip the end of the wire in, wait about 10 seconds, and wipe it with a cloth. The result is a clean and shiny copper wire ready for soldering. The solvent is especially effective for Formvar insulation, a far tougher coating than enamel. Along with the other devices described here, the solvent is available at many parts distributors and the mail order houses.

One wire stripping technique not illustrated here is the "pushback" type. The insulation is designed so the tinned wire is exposed merely by pushing it back with the fingernails. It remains in this position without inching back. The convenience of this wire is slightly offset by its somewhat higher price per foot.

One of the most difficult wires to strip is the kind used in army surplus headphones. Many end up in either a nonstandard plug or just two wires. These leads consist of stranded enamel conductors, each of which is twisted with additional cotton insulation.

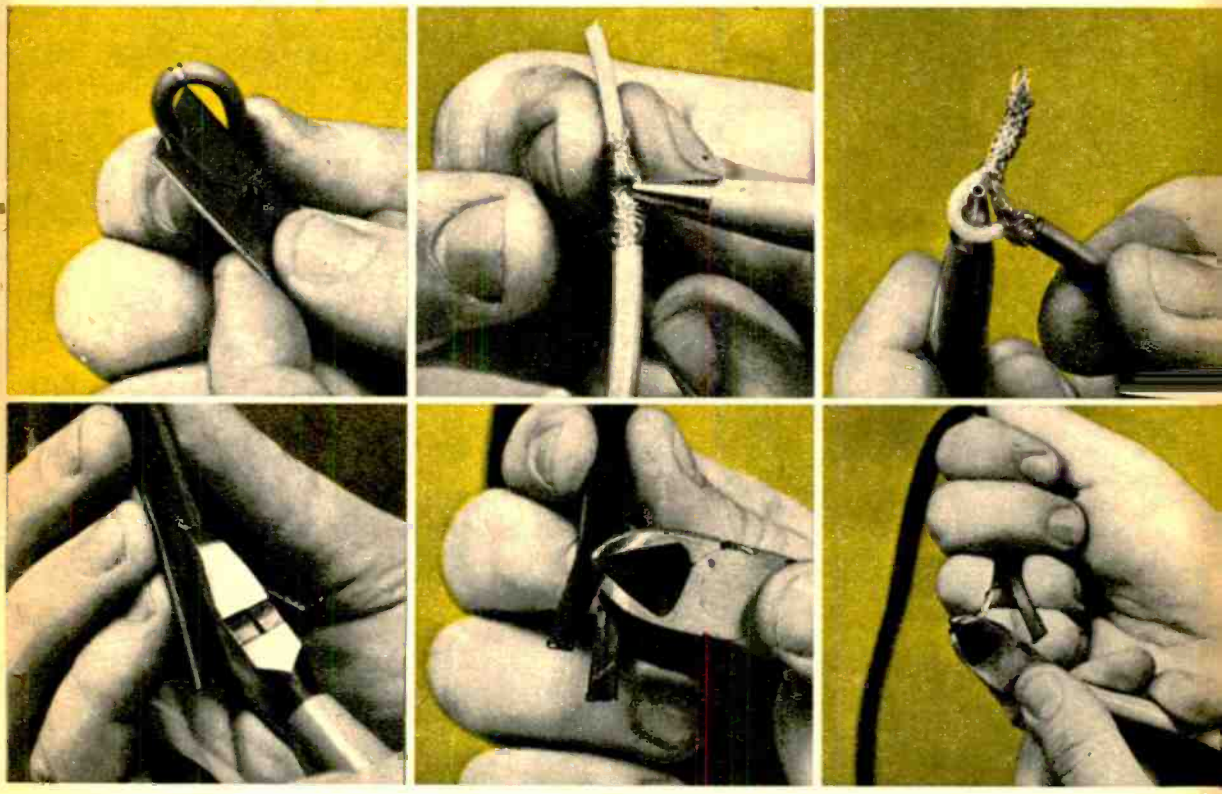
Each strand is unwound from the intertwining cotton so you end up with as

[*Continued on page* 106]

4A. Strip shielded cable this way. First remove plastic jacket carefully with razor.

4B. Push back the braid until it bulges. Gently work an opening in it as shown.

4C. Form a loop with the inner conductor and pull it out of the hole in braid.



5A. Strip TV twinlead with cutters. First cut an inch up the center of the plastic.

5B. Then make this crosscut being careful not to touch any of the copper strands.

5C. Pinch edge of plastic without cutting through and twist off. Bare wire remains.

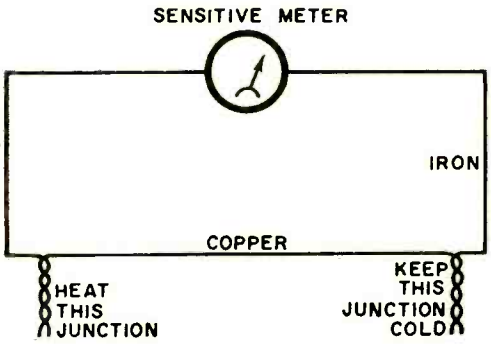
The Electronic Brain

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

Thermocouple and Solar Battery

What is the difference between a thermocouple and a solar battery? Is there any relationship between them at all?

Glen H. George, Littleton, Colorado



A thermocouple gives rise to a voltage when its temperature is changed. A solar battery produces voltage when the radiant energy falling on it is raised.

The only relationship between the two effects is that they both represent energy conversions due to changes that occur in their atomic or molecular structure.

Simple thermocouples can be made by forming junctions of twisted wires. A sensitive meter connected as shown will register a definite electric current when one junction is heated.

Crystal Set Interference

I have a crystal diode radio designed for the broadcast band but find that I can sometimes receive short-wave stations from foreign countries on it. Can you explain why this should happen?

John D. Miller
New Kensington, Penna.

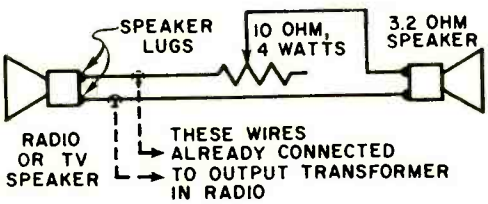
According to the schematic diagram that accompanied your question, you apparently have accidentally selected an antenna length which just resonates your coil to some of these powerful overseas short-wave stations. This is the equivalent of tuning the crystal radio to these frequencies.

A diode detector is characterized by very broad tuning. Coupled to an antenna accidentally chosen to resonate in a short-wave band your receiver behaves much like an unselective "funnel," catching any strong signal on either side of its central frequency. Such signals are detected and amplified just like the desired signal and appear simultaneously with it in the headphones.

Adding A Speaker

I have a 6-tube radio (RCA Model 66X2) to which I should like to add a 3-inch speaker (3.2 ohm voice coil, 2-watt rating). Can you give me instructions for this addition?

E. S. Wilkinson, Perth Amboy, N. J.

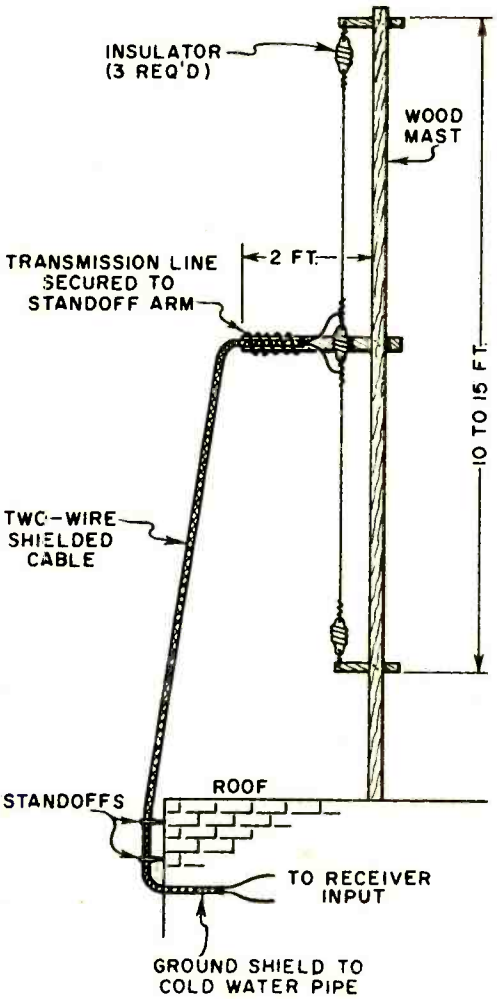


The radio you describe is already equipped with an 8 ohm voice coil speaker. In order to add a speaker with a 3.2 ohm voice coil and have both speakers provide approximately equal volume, it will be necessary to connect them as shown. The 10 ohm variable resistor should be a 4-watt wirewound type available at an electronics distributor. Merely solder the additional wires to the voice coil lugs on the speaker in the radio, insert the potentiometer in series using either end lug on the resistor and the center lug, and connect the 3-inch speaker as shown. Adjust the potentiometer for approximately equal speaker output and the radio volume control at higher setting.

Vertical Short-Wave Antenna

Circumstances prevent me from installing a horizontal antenna for short-wave reception on my roof. I have just purchased a new short-wave receiver and would like to know whether a vertical antenna would be satisfactory.

Charles P. Baurer, Toronto, Canada



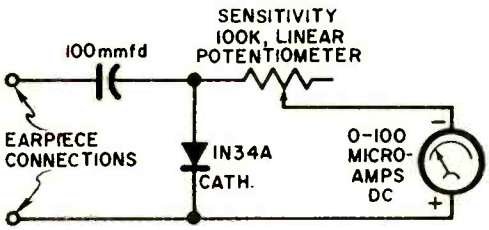
Modern short-wave receivers are generally tunable from the broadcast band down to 56 mc. We shall start by assuming that this is the type you have.

You should first examine your receiver specifications to determine whether or not the antenna input system is balanced to ground. Since most good receivers utilize this arrangement, we shall assume that your receiver does, too. In that case, you will want a vertical doublet from ten to fifteen feet in length, located well away from metallic surfaces such as copper flashing and gutters, center-connected through a shielded two-conductor cable to your receiver. As the diagram indicates, a guyed wood mast would probably be the least expensive approach. Note that the transmission line should be led away from the antenna proper at right angles for a distance of at least two feet. This will prevent undesirable interaction between the line and the antenna.

Meter For Metal Locator

I have a metal locator having high impedance output that now feeds a crystal earpiece. Can you provide instructions for adding a meter to the locator for visual indications?

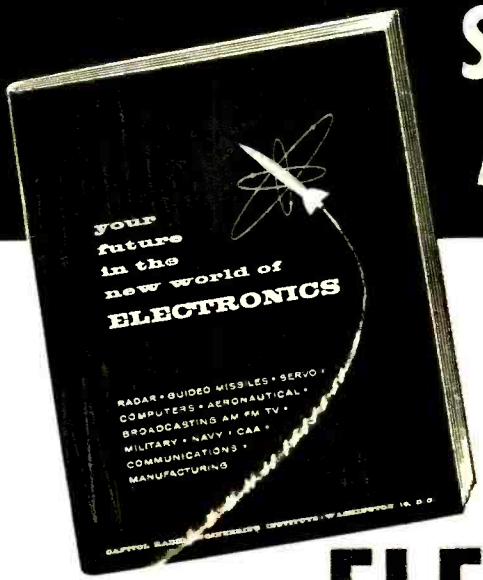
Guy Fischetti, Bronxville, N. Y.



Most metal locators that are designed to operate into an earpiece are of the beat-frequency type. That is, they contain two oscillators, one fixed in frequency and the other connected to the search coil of the locator. As metal is approached, the second oscillator frequency changes causing the beat note to rise or fall in pitch. The easiest way to add a meter indicator to equipment of this variety is shown in the drawing.

In use, the SENSITIVITY potentiometer is first adjusted so that the meter reads exactly half-scale when the search coil is isolated from metal. As the search coil is brought into the vicinity of a metallic mass, the meter needle will either dip downward or rise abruptly. The direction of movement will be determined by the tuning of the search coil oscillator; that is, whether the variable oscillator is initially higher or lower in frequency than the fixed oscillator.

This book is a GOLD MINE Send for it... *immediately!*



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Those Amazing Masers!

Continued from page 67

done by immersing the active elements in liquid helium. It may be possible to find materials for room temperature operation, but this has not been achieved as yet.

Another condition is that the maser active material must be placed in a microwave cavity, adjusted to match the pump and signal frequencies for optimum transfer of energy. A microwave cavity is usually a waveguide, which might resemble a round or rectangular hollow pipe.

We have been talking about the "cavity" type of maser, whose bandwidth is somewhat limited because of the nature of cavities. To get around this bandwidth limitation, an entirely new type of configuration has been developed at Bell Telephone Laboratories. It is called a "traveling wave" maser, or TWM.

In the TWM, ruby is used as the active material. Ruby is aluminum oxide, or sapphire, to which a small amount of chromium has been added. Chromium provides the desired electron spins and the aluminum oxide is a diluting substance. Ruby in the TWM permits amplification in one direction only, so that a very stable, wideband amplifier results. An experimental TWM has been built with a bandwidth of 25 megacycles at a center frequency of 5900 mc and which can be tuned over a 350 mc range. The TWM can boost sensitivity of a microwave receiver 100 times over its vacuum tube counterpart.

Another type of maser worthy of mention is the gas maser. It was developed before the solid-state maser, and has an extremely narrow bandwidth. However, because of this narrow bandwidth, it makes an extremely stable oscillator. The gaseous maser utilizes the difference in electron spin energy between only two energy levels as opposed to the three-level solid-state maser. It is now being used as a primary frequency standard and for accurate clocks.

Parametric amplifiers, the second major new development in amplification, are so called because their basis of operation is the variation of a parameter or circuit characteristic such as inductance (inductive reactance) or capacitance (capacitive reactance).

A microwave signal can be amplified by feeding it to a reactance which is being varied at roughly twice the signal frequency.

Theoretically, a variable reactance amplifier would add no noise whatever to the signal frequency if a pure reactance were employed—that is, a reactance which had no resistance associated with it. In any practical device, however, some resistance is present, resulting in some noise. This noise can be reduced by careful design of the reactance element.

One approach has been to place a piece of ferrite material in a suitable waveguide structure and feed to it a pump frequency which causes its inductance to vary. This varying inductance can then be used to amplify the signal frequency.

Another approach is to use a variable capacitor semiconductor diode as the variable reactance element. This is a diode whose capacity varies as the voltage across it is changed.

Again, the diode is placed in a suitable waveguide and fed with the pump frequency. This varies the capacitive reactance and permits amplification of the signal frequency. As with the maser, no DC power is required—the only power source is the pump frequency.

The Future

Both masers and parametric amplifiers have great potential in the future of electronics. The maser amplifier has the lowest noise but must be operated at a temperature near absolute zero. This means the setting up of a cryostat and a source of liquid helium. It also normally needs a magnetic field. Such a system will find its most logical use in large, fixed installations such as radio telescopes and space communications receivers. A ruby maser has already been used for radio astronomy, and a commercial ruby maser amplifier is on the market.

The variable capacitor parametric amplifier is not as low in noise as the maser, but neither does it require extremely low temperatures nor a strong magnetic field.

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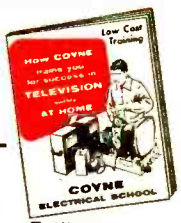

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A Wireless Intercom

Continued from page 45

quency receiver and requires one simple modification. It is the addition of ten turns of #24 enamel wire. Wind 10 turns (2 layers of 5 turns each) close wound, and adjacent to the large winding. See the wiring guide for its exact position. Do this before mounting the coil. Be certain to face the coil color dot in the correct direction so you solder to the right pin numbers.

Another feature of the wireless intercom is the squelch located on the rear of the chassis. It keeps the speaker silenced except when receiving signals from the other unit. Without the squelch you would hear the hash or other noise on the AC line.

It is imperative that the B— ground and metal chassis ground be kept separated. In other words, make no wiring connections to the chassis except the two indicated. They are C14 and one end of the braid of the shielded phono cable. The chassis ground for the braid of the phono cable is not readily visible in the wiring guide. It connects to a ground lug fastened by one of the nuts and bolts that hold V1 socket in place. The other end of the phono cable goes to the switch (center conductor of shield). The shield at this end is insulated by tape.

After the first unit has been built and checked out for error, plug it into an outlet. Turn the volume control to maximum and the squelch to the side where a soft hum is heard in the speaker. Turn on a broadcast receiver and tune it to the lowest clear frequency, about 560 or 570 kc on the dial. Press the intercom switch to SEND and start turning the oscillator screw counter-clockwise until the radio picks up the signal. This should occur as the brass screw almost reaches the top of its travel. With the radio in another room have someone listen for your voice as you talk into the speaker. At this point the unit serves, if necessary, as a wireless baby sitter. Just strap the switch in the SEND position.

The cost for the one unit snould run approximately eighteen or nineteen dollars, less if you have some suitable junkbox parts. The second chassis is identical to the first in every way.

The two units are adjusted in the following manner to get them on the same frequency. Turn one oscillator screw to its mid-position and talk. Tune the screw on the other one for maximum received volume. If an AC meter is available peak up the second unit to the first by placing the probe on the side of C11 that goes to the oscillator coil L. The ground lead of the meter goes to B— ground. The reading on the author's unit was a little under one volt (AC) when receiving a signal from the transmitting unit.

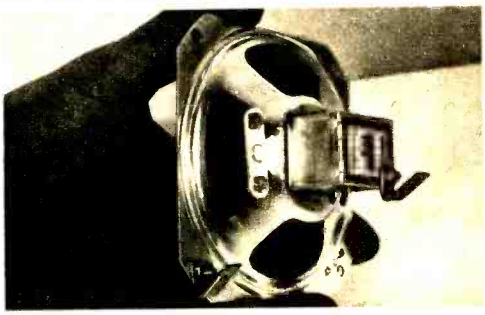
Adjust the squelch on one unit while someone talks in the other. Rotate the control at the rear of the chassis until the voice just cuts out. Then, reverse the squelch about an eighth of a turn so the voice is heard again. Leave it in this position and occasionally readjust it if the volume changes.

It is a good idea to house the metal chassis in a wooden cabinet. Though the metal chassis is not connected to the AC line, the cabinet acts as double insurance against picking up leakage current.

If excessive hum is experienced try reversing the intercom AC plugs in their receptacles, one at a time. This should also be tried to achieve maximum volume and the best overall performance.

The wireless intercom system illustrated here has worked between several floors of a 6-storey apartment house. As long as the two AC outlets are on the same distribution system with no intervening power transformers (usually on the pole outside) their range should cover most points in a particular building.

Position of two L-brackets on speaker frame.



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- Model 77 uses new improved SICO printed circuitry.
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AS AN ELECTRONIC OHMMETER:

Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER:

Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

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• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS**: —10 db to + 18 db + 10 db to + 38 db. + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

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R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

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The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only

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(1) **Turn the filament selector switch to position specified.** (2) **Insert it into a numbered socket as designated on our chart (over 600 types included).** (3) **Press down the quality button—**

THAT'S ALL! ***Read emission quality direct on bad-good meter scale.***

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82 will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

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• Tests over 600 tube types. • Test OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82 comes complete, housed in portable, hand-rubbed oak cabinet with removable cover. Only **$36.50**

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Model TW-11 — TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.
- NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycle A.C. Comes housed in a beautiful hand-rubbed cabinet complete with portable cover.

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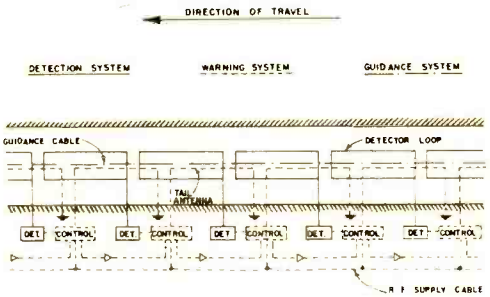
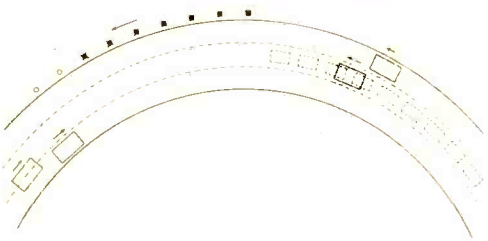
- ☐ Model 82 .....Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TW-11 .....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

Electronics Drives Your Car

Continued from page 31



RCA system has wire loops embedded in road, detector units which respond to change in inductance when car passes. Each detector has control for a "flying tail" warning signal.



Curve in highway shows one application of RCA system. Car in center lane, moving right to left, activates lights which flash around curve to warn cars moving in opposite path.

burying the devices tends to minimize variations that may be caused by temperature changes.

Ques. *Can the detectors be buried in existing roads?*

Ans. Yes, providing no existing metal reenforcement exists that will jam the magnetic loops. Diamond saws are used to cut slots in the concrete road.

Ques. *What are some of the other features of your system?*

Ans. Highway engineers are interested in the middle lane of a three-lane highway, around a corner, on a curve, etc. They are also interested in the indication of slow speed and a device to remind the driver that he is going too slowly. From their point of view, the slow driver is almost as dangerous as the fast driver, especially on turnpikes and high speed roads. Another desirable feature would be a method by which law enforcement or highway authorities can talk to the individual driver or a group of cars, to impart some special information such as an approaching junction, light, fog condition, motel facilities, etc. Our system provides this feature because it would be very easy to add radio. When the entire system has been installed, traffic authorities will be able to control the space between cars and their speed according to road conditions.

Ques. *Is this done through changing the magnetic inductance of the loops buried in the road?*

Ans. It is generally more convenient to vary the amplitude and wave shape of the currents fed into the supply cable. The antennas fed by the loops buried in the road radiate along a highway lane, the radiation fields of successive antennas overlapping to produce a "flying tail" of signals whose character changes with distance from the car. The length of the tail or the rate of change of the signals can be varied by highway authorities by controlling the currents fed into the supply cable. The "flying tail," or the change in signal occurring when a car is present on the road results in a warning flashed to the car behind. Of course, if the car behind is not equipped with the proper gear, he will not receive that warning in the car, but will be able to receive it on a roadside sign. If an equipped car deviates from the center of the lane, a needle indicator, like those in airplanes, will tell the driver how far off course he is. In a completely automatic system, this same signal can be applied to the car's steering, which is already hydraulically operated in a great many of our cars.

Ques. *Dr. Zworykin, in your experience in the development of RCA's electronic highway system, what are some of the problems you have had to keep in mind?*

Ans. We must realize, of course, that it would be impossible to convert all the millions of miles of road in the United States overnight, just as it is impossible to compel all car owners to buy equipment to convert their cars. Therefore, we had to develop a system—a compatible system—in which conversion could be accomplished gradually. Elements of the system must be used for more than one purpose, such as measuring speed, governing crossroads, warning motorists of excess speed, warning

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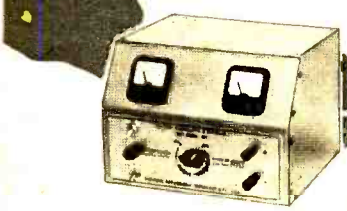

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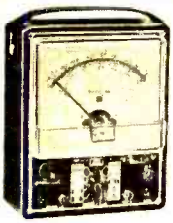

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of the approach of cars and other dangerous road conditions.

Ques. *Does a car have to have special equipment to benefit from this electronic highway?*

Ans. At first none of the cars operating on our system will be equipped, yet all will benefit. Equipment on the cars is a refinement, wholly feasible, but in the future. When equipped, cars can then take full advantage of the system.

Ques. *Your system is essentially an electromagnetic system. What about proposals of systems to use radar, infrared, ultrasonic or phototropic (light) sensing devices?*

Ans. Our system uses none of these because they require immediate installation of equipment in the cars themselves and are not compatible—that is, only the equipped car benefits. Also, radar can be confused by objects on the side of the road, such as trees. Radar cannot bend around corners.

Ques. *Is an electronic driving control system necessary in city traffic?*

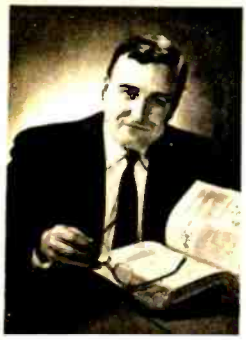
Ans. I would put it this way: It is more necessary on turnpikes and freeways. We are ready for that right now. Experience with the installations on turnpikes will pave the way for electronic driving controls in cities. Right now some electronic devices, such as radio-controlled traffic lights, are useful at intersections.

Ques. *Aside from the test track to be built at Princeton, is there anything holding up the establishment of a test road?*

Ans. New ideas are always slow to be accepted. Secondly, there is the financial aspect, which is slowing down several projects of highway engineers, electronic engineers, law authorities and auto manufacturers. Some of our highways under construction cost up to a million dollars per mile. Now, we don't expect that the installation of detection equipment in new highways will add more than $5,000 or $10,000 per mile. Compared to $1,000,000, this cost is actually very small.

Ques. *Of course, if you can save one life, the expenditure is worth it.*

Ans. That's just the point! We sacrifice 50,000 lives each year with several hundred thousand accidents which cost a terrific amount. If this accident loss



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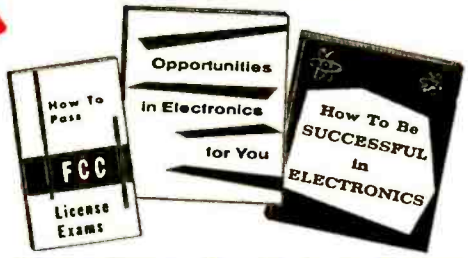

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EI-5

money could be collected in a lump sum, you could probably pay for the equipped roads in just one year! Whose problem is it? It is everybody's problem.

Ques. *Do you feel that highways of the future actually will be set up with complete automatic electronic driving control?*

Ans. Absolutely. But again I advocate gradual introduction of the electronic controls.

Ques. *If a person wants to go from an electronically controlled lane to a lane that is not an automatic control highway, could he do so easily?*

Ans. Yes. We visualize in our system that ultimate control will be left up to the driver. The moment he removes his hand from the steering wheel, the car goes on automatic control. When he replaces his hands on the wheel, he has manual control. He will still be free to pass the car in front, unless it is dangerous to do so.

Ques. *How soon can I as a driver expect to have electronic controls in my car?*

Ans. Not soon. The safety devices in the road will come first. If we start now with an experimental road we will be able to get all the information we need in one year's time. After that I would allow three years more for construction of equipment and road, and it will probably be five years before an appreciable stretch of turnpike is fully equipped.

Ques. *Dr. Zworykin, we know that you have been one of the leaders in the field of medical electronics as well as television. How does this present emphasis on electronic driving controls fit in with your work in medical electronics?*

Ans. Why, it is just another branch of medical electronics. After all, the same purpose exists—to save human life. When I retired three years ago I decided that all of my electronic research would be for humanitarian purposes. I think we have a good system of electronic driving controls, one that is capable of saving many lives. We are not interested in gadgets, but in a complete, compatible system, and I think driving in the future will be safer because of it.

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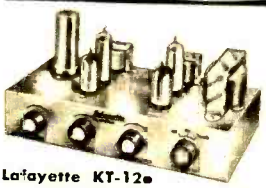
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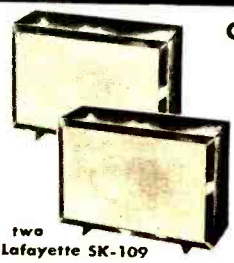
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CUT OUT AND PASTE ON POSTCARD

Transistor FM Radio

Continued from page 35

The rest of the construction is straightforward. If there is danger of any bare component leads touching, use spaghetti sleeving. Do all the wiring except for the resistor [R]. The recommended value of 680,000 ohms will work but the circuit may be refined even further. If you have a milliammeter, adjust the resistance by a 1 megohm potentiometer wired in temporarily. The meter should read *under* two milliamperes with the potentiometer rotated for a high pitched squeal in the earphone. If this condition is not present, recheck your wiring. When the circuit is operating properly, measure the resistance of the potentiometer and substitute a fixed resistor.

The circuit gets its sensitivity from the superregenerative detector principle. C1 and L select the station and it is amplified. C2 feeds back some of the signal for reamplification.

Battery life should be extremely good. The original unit used in the model pictured here has been going strong for 100 hours and shows no signs of decrease. Don't insert the battery into its holder with the transistor in its socket to avoid damaging surge currents. In fact, the last step in construction, after all soldering has been completed, should be to insert the 2N384 in its socket.

Several steps were taken to reduce the critical tuning of the receiver. Don't attempt any of them until you are sure the circuit is working properly on FM.

First, take a pair of needlenose pliers and gently twist off one of the rotors (moving plates) of the tuning capacitor. Rotate the plates to an open or unmeshed position before doing this to prevent damage to the stationary ones. The remaining two rotor plates will "bandspread" the tuning.

Another modification is to add an extra turn on coil L. This is easily done though the receiver construction is complete. Instead of starting with 1¼ turns, try another complete loop for a total of two turns. Cut and try different lengths until an improvement in tuning is noted.

ABC's Of Electronics

Continued from page 62

$$X_C = \frac{1}{6.28 \times F \times C}$$

where X_C = capacitive reactance in ohms
F = frequency in cps
C = capacitance in farads

As an example of its use, suppose we have a resistance-coupled audio amplifier with an interstage coupling condenser of 0.01 microfarad. This condenser must block the DC plate voltage from the succeeding grid, but it should permit the low bass frequencies to pass with ease. What is the reactance of this condenser to 16 cps?

$$X_C = \frac{1}{6.28 \times 16 \times 0.00000001}$$

$$= 10 \text{ megohms (approx.)}$$

Obviously this is out of the question for a hi-fi amplifier, and a larger condenser would have to be used.

How To Strip Wire

Continued from page 85

many free enamel ends as possible. Then they are dipped in the solvent to clean away the enamel. Since these wires are fragile it is best not to use them directly under the terminal screw of the phone plug. Tightly wrap about 5 or six turns of tinned wire (No. 20 solid or stranded will do) on the clean headphone wire and flow on some solder. The new end now connects to the plug. For physical strength, start wrapping the new wire on the cotton insulation of the headphone lead for two or three turns before contact is actually made with the clean wire.

A razor blade in this rotary type stripper neatly cuts through coax outer insulation.

A Metronome

Continued from page 58

R2 until 210 beats per minute are obtained. Work your way back from the maximum speed setting of R3 without touching the calibration potentiometer after making its initial adjustment. R2 has been placed where it is readily available only because you may want to change the calibration for different applications. After many sessions with the metronome, the voltage of the battery may begin to drop. This will not affect the calibration of the instrument until the voltage has diminished to possibly 25 volts or less. Even then you can get many more useful hours of life from the battery by recalibrating.

The heart of the metronome is the unijunction transistor. This tiny control device displays a relatively high resistance between base 1 and base 2 (B1 and B2 in the schematic) when the emitter (E) is at zero potential with respect to B1. Under these conditions, the current flowing through the 3.2 ohm speaker coil is very small (about 3 ma) and steady so that no sound is heard. As time passes, the top of capacitor C charges positively through the resistors R1, R2, and R3. The potential of the emitter with respect to ground is, of course, the same voltage as that which appears across C at any instant. When E becomes positive enough, a very fast rise-time regenerative current flows from the emitter to ground, reducing the resistance between B2 and B1 so that a sudden surge of current flows through the voice coil of the speaker. This produces a sharp and very distinct click. The moment C discharges through the E—B1 circuit, the condition is restored to normal, there is no sound, while C proceeds to charge once again at the same rate as before. In this action, the unijunction transistor is very similar to a thyratron. The tremendous advantage over a thyratron in this application is that virtually no heat is produced to cause changing beat-rate. In addition, the unijunction transistor, being battery operated, is not subject to line-voltage transients. Such transients often cause gas thyratrons to trigger at the wrong time.

A VTVM Kit

Continued from page 69

age or tube aging. A 6AL5 completes the 2-tube lineup. It serves to rectify, or change to DC, any AC voltages measured with this meter before applying them to the bridge tube.

The meter face is calibrated in two ways; RMS and P-P. RMS (root mean square) is the most common way of identifying AC. For example, your 117 volt house current is really 117 volts RMS. If you measure it with this meter the scale just below 117 volts reads 331 volts P-P. This is a "peak-to-peak" value, often used in TV and allied types of servicing.

The other scales are marked in decibels for running frequency response curves on hi-fi gear, and a zero center feature necessary for aligning FM tuners.

Although this is the kind of meter a beginner usually doesn't acquire until he graduates from the "crystal set" class, Paco has geared the construction manual to him. Soldering techniques are extensively described along with hints on mounting components.

The quality of components in the kit is excellent. Avoid damaging the more delicate ones, mostly precision resistors, by too much heat or solder. A hot iron quickly touched to the lug appears to be the best method—as long as the solder becomes hot enough to flow and dries shiny.

Total construction time ran five and a half hours with about 45 extra minutes for the simple calibration procedure.

At $31.50, the Paco V-70 represents a good buy for the hobbyist or serviceman in need of a sensitive meter.

Probes are shorted to zero-in the ohms scale.

X-Rays . . . Safer Than Ever

Continued from page 41

basically the same principle of electroluminescence. With this device, the physician can fluoroscope his patient, remove him from the apparatus, then make the image reappear on the screen simply by turning on the X-ray again. The retentive quality of the screen can last for 17 hours, but in that time the image can only be re-viewed once for 30 seconds.

In another electronic departure, the Rauland Corporation has introduced an X-ray image amplifier tube which provides a picture 350 times brighter than conventional fluorescent screens. The image is not only brighter, but larger, permitting the physician a view of, for example, an entire adult heart, or a complete stomach, or the entire colon while radioactive barium salts are moving through the various parts of the body. Its exceptional brightness eliminates the problems involved in viewing portions of the human body which are too thick to penetrate.

The Rauland image tube has a pick-up screen of 41 square inches, whereas ordinary medical X-ray image tubes have viewable fields of only 16 square inches. The increased viewing area permits the doctor to quickly locate the region he wants to examine and orient himself to other parts of the body. The dosage of X-rays to the patient can be cut with this image tube to one-tenth of what was previously required. This allows longer examination under X-rays and may be used to observe the heart or other organs while the patient is undergoing surgery.

Various methods of X-ray presentation are possible with this extra-bright tube, such as direct viewing of the magnified image through an optical system built into the X-ray equipment, viewing via closed circuit TV, consultation between doctors in different cities, and the taking of movies of the image.

These new X-ray devices will keep medical radiation at a level which is harmless to doctors, patients and the future of the human race, yet at the same time give your physician a tool more efficient than ever before.

Radiation Does The Trick

Continued from page 55

of spoilage, but if an electron beam is strong enough to kill all bacteria, the flavor of some foods may suffer. Too much radiation will change a steak's flavor and color. The taste of pork and chicken, on the other hand, is not changed by radiation, no matter how strong the dose of electrons. Some foods, such as berries, require only surface treatment to kill spoiling bacteria. However, since it is impractical to rotate each berry under the beam of an accelerator, the beam must be strong enough to penetrate an entire package.

The future of irradiated foods may lie in pasteurization (the killing of some bacteria) rather than sterilization (the killing of all bacteria). Spoilage will be retarded, not indefinitely of course, but flavor will be retained. Using this process, fresh food can be kept for a few weeks instead of only a few days without cooking or refrigeration. Enzymes—chemicals occurring naturally in food—can be destroyed where necessary by partial cooking, scalding or blanching.

Irradiation of foods is bound to result in better and cheaper foods due to the lower transportation costs (no refrigerated cars necessary), less spoilage en route, on the grocer's shelves, and in the consumer's home. Some foods may be held long beyond the normal season without expensive cold storage. The housewife who habitually forgets to thaw her frozen hamburger for the evening meal need never worry if her hamburger is irradiated. It wouldn't have been frozen in the first place.

When will irradiated foods be available to the public? Not for a couple of years yet. Under United States food and drug laws, food which is processed by any new method cannot be placed on the market until "feeding tests" have been made for several years. In these tests, the irradiated foods are fed to rats and results are observed for several generations of these animals. Tests of this sort were made over the past two years and two more years of tests and evaluation are required before irradiated foods may be used in trade.

A Time Delay Switch

Continued from page 51

the AC supply cord into the rear connector and the lamp or other load into either of the top connectors. When the switch is thrown to ON the load is connected. Throwing it to FAST OFF cuts the power immediately. When, after the load has been connected for a short while, the DELAY OFF position is used, the load will turn off automatically after 20 seconds. Of course the delay time may be changed by plugging in another thermal delay relay of the same heater voltage but different delay period.

The life of the device is estimated at more than 10,000 operating cycles. The load limit, as constructed is approximately 220 watts. As long as the electrical circuit remains unchanged the physical format may be modified to fit any individual needs.

Listen To A Printed Page

Continued from page 39

converted for use with the *Synchroreader*. Work is being done to develop a transparent magnetic recording film to permit both printing and sound on both sides of the paper.

The possibilities for *Synchroreader* use are limitless: Photograph albums that talk, blueprints with spoken directions, talking letters, international picture magazines with texts spoken in many languages, school textbooks that talk, written music with orchestral accompaniment on the back for home practice, newspapers that achieve their impact by recording news sounds on the spot, etc., etc.

The *Synchroreader* has been recognized as a significant invention in the audio field. Canon Camera Co., Inc., one of Japan's leading export manufacturers, is collaborating in the manufacture and distribution of the *Synchroreader*. Tokyo Electrochemical Industries, Ltd., is developing the *Synchrosheet*. Their introduction on the world market will be another step, a giant step, toward better, more interesting communication between the peoples of the world.

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Desert Into Oasis

Continued from page 71

canals and onto farms once barren desert. Thanks to this controlled water supply, this desert is now producing multi-million dollar cotton, citrus and grape crops. Drought, a nasty word in the Southwest, is not the destructive ogre it once was.

Mormon Flat is tied to the distant Mesa switching station by a 25-cycle carrier current in a power line. At his duplex switchboard, the Mesa operator can make periodic checks on how the dam is functioning simply by glancing at a set of meters and dials. A loud alarm or a flashing light signals emergency trouble that can be rectified by other remote controls.

Once the operator has pushed the starting switch, electronics takes over through multitudes of relays to guide pre-set amounts of water from Canyon Lake into the main turbine penstocks through several lesser penstocks and water gates. After power has been generated, the water drops into the tail race and then flows on to Saguaro Lake of Stewart Mountain Dam, where it is again used for hydroelectric generation. From there it's used as irrigation water.

To put into operation the vast conversion at Mormon Flat, engineers had to install end devices on the multi-purpose line connecting the dam with the switching station to select out the carrier current. They had to install load limiting controls, synchronizing motors for the water gates, vast numbers of switches, relays and circuit breakers to actuate temperature, oil flow, air pressure and emergency shutdown equipment. Alarms of every description had to be placed where they would provide fail-proof operation.

Salt River Project officials are convinced that the conversion of Mormon Flat Dam to automatic remote control contributes greatly to its high efficiency, and plans for the conversion of another dam are now on the drawing boards.

Now, with this Salt River Project, the Arizona farmer can pick up his telephone and order water without waiting for uncertain rainfall. And from his position before the small switching panel in Mesa, the dam operator is not only controlling the 224′ high Mormon Flat Dam 31 miles away, but in a sense he is controlling the destiny of thousands of persons living in an area which without irrigation water would soon return to desert.

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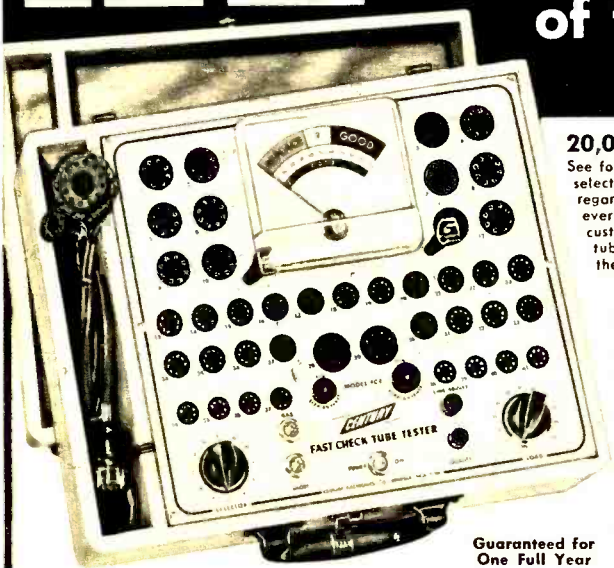

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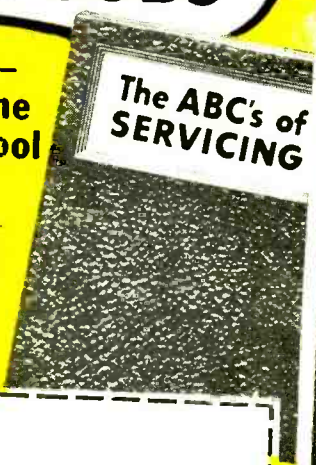

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