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POPULAR ELECTRONICS

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POPULAR ELECTRONICS Audio and Hi-Fi Section

DEPARTMENTS

(Also see page 6)

Cover Painting by Ed Valigursky

SEPTEMBER 1955

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ITEMS OF INTEREST

NEW PRODUCTS

COMING NEXT MONTH

POPULAR ELECTRONICS

Your Career in Electronics (Part 2)
A discussion of resident schools that teach electronics, TV, and radio—advantages of attending these schools; correspondence schools will be featured in November.

Electronic Sterilizer
Make your wife happy with this ultraviolet sterilizer in the clothes hamper.

Quality Tone Arms and Turntables
What to look for and how to buy the "best" in hi-fi equipment.

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Improving the range and versatility of a VOM to measure capacitance, millivolts, output watts, and r.f. energy.

Transistorized R/C Field Strength Meter
This inexpensive unit utilizes a CK-722 transistor to increase sensitivity.

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High-Fidelity Audio ▪ Kits ▪ Radio Control ▪ Short-Wave Listening ▪ What's New ▪ How It Works ▪ How to Make It ▪ How to Use It ▪ Carl & Jerry ▪ Tips & Techniques

IN THIS MONTH'S

RADIO & TELEVISION NEWS

(September)

How to Improve Your Hi-Fi Amplifier
Tape Recording
Modern FM Carrier-Current Transmitter
Emergency Portable Broadcast Receiver
Hi-Fi Amplifier Instability
A Tape Deck for the Home Music System

LETTERS FROM OUR READERS

Amplifier for Insect Sounds

■ I have heard that there is an amplifier so powerful that it enables you to hear the heartbeat of an ant or an insect walking across a microphone, and other insect noises that the human ear cannot detect. Could you print a diagram on how to build this device?

RAYMOND A. J. PASKEVITZ
Pittsburgh, Pa.

There is a commercially produced unit which is used for detecting insects in the manner you describe. An article describing this device appeared in the July issue of POPULAR ELECTRONICS. *An article containing construction details on a similar unit appeared in the December, 1954, issue of* RADIO & TELEVISION NEWS, *a copy of which may be obtained by sending 40 cents to the* Ziff-Davis Publishing Company, *Circulation Department, 64 E. Lake St., Chicago 1, Ill.*

Headphone Connection

■ On page 58 of the May issue, there is an article on headphones which interests me. I use headphones connected to the speaker wires from an a.c. tuner. The speaker is in a separate housing, disconnected. Is this risky?

WILLIAM SMITH
Northport, L. I., N. Y.

It shouldn't be.

Life of LP Records

■ How many times can a 33⅓- or 45-rpm record be played on excellent equipment? Can too much playing time be put on a record? I was wondering if the grooves on LP's were made too fine and small for long-lasting performance.

EUGENE OLSON
Shabbona, Ill.

Using a diamond stylus, a precisely weighted arm, a balanced turntable and much care in handling records, an LP disc should provide 500 to 700 plays of top performance.

Theremin: Comment and Query

■ As a very recent newcomer to the radio field, I want to say that I enjoy your magazine immensely. You may be interested to learn that at the University of Nebraska's "Engineering Week," I saw and listened to a model of the Theremin which was constructed from the diagrams published in your April issue.

R. G. BROCKMAN
Lincoln, Nebr.

■ Can the Theremin (April issue, 1955) be fed into an a.c.-d.c. amplifier? I have one with phono and mike connections, and want to know if I can use the mike input without damaging either the Theremin or the amplifier. I know that an a.c.-d.c. tuner should not be fed into a.c. amplifier

without an isolation transformer, although the theory is vague to me. Can you clear this up?

CHET L. KURRIER
Springfield, Mass.

The Theremin's output may be connected to the mike input of the amplifier if proper precautions are taken. If the chassis of the a.c.-d.c. amplifier is isolated from the power line by a capacitor, the ground lead from the Theremin output may be connected directly to the amplifier chassis. If no such isolation exists in the amplifier, a capacitor of not more than 0.1 μfd. must be inserted in the ground lead at the amplifier. The "hot" or "signal" output lead of the Theremin may be connected directly to the input terminal of your amplifier.

Obsolete Transformer

■ In an old copy of the *Radio Amateur's Handbook*, I found an article on how to build a "handie-talkie." The builder suggested that an *Inca* I-45 transformer be used. I have found that this is no longer made and would like to know what other transformer would work as well.

ALLEN C. MILLER
Phoenix, Arizona

Do any of our readers have any information that will help Mr. Miller?

Stereophonic Sound

■ In Mr. Eisenberg's article on "Solid Sound" (May, 1955), it is stated that the magnetic sound tracks are placed on the film so that the sound is required to be 28 frames ahead of the corresponding picture. If this were true, it would be impossible to obtain proper synchronization of

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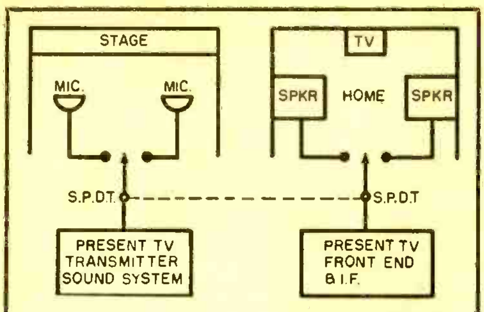

Proposed stereophonic sound system for TV. See letter and reply at right for details.

picture and sound, since the film passes through the sound head before it reaches the projector head. Actually, the sound for these films is recorded 28 frames *after* the picture as compared to the old standard of 20 frames ahead of the picture for optical sound tracks.

MARSDEN K. WURTSBAUGH
San Jose, Calif.

Actually we're both correct—the disagreement here is due to different terminology. It is true that the sound is recorded 28 frames after its corresponding picture. But, during playback, the film passes through the sound head before it passes through the projector head, as you have stated. This is what we meant in saying that the sound is ahead of its corresponding picture.

Stereosound and TV

■ With reference to page 25 of the story on stereophonic sound (May issue), separate tuners for multiple sound channels may not be necessary. In the accompanying diagram, "binaural" sound is represented. Stereosound might be possible by substituting rotary switches for the s.p.d.t. switches. In this way, additional sound channels could be accommodated. Additional amplification would be needed, and maybe better bandpass characteristics.

The horizontal pulse signal or the color burst signal is an ultrasonic synchronized signal already being used that probably could be adapted to operate the switches. Of course, the switches would have to be electronic. This system seems to be compatible with present TV.

LAVERNE LIVENGOOD
Morrill, Kans.

We conferred with Martin Bender, commercial engineer at Altec Service Corp., *New York, N. Y., on the contents of the above letter. According to Mr. Bender, switching with ultrasonic or high-frequency signals has already been accomplished in theatrical stereophonic sound systems. As an example, the "surround" speakers are switched on and off by a 12-kc. signal triggering an electronic switcher.*

The type of control mentioned by Mr. Livengood is entirely feasible. The danger that exists, though, lies in the permissible power to be transmitted at those frequencies, plus the fact that at

(*Continued on page* 16)

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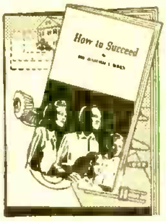

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Letters from Our Readers

(*Continued from page* 12)

the higher audio frequencies the signal-to-noise ratio approaches unity.

Mr. Bender concludes that "... while this method could not definitely be incorporated in amplitude modulation systems, there is a possibility that a revised version could be used in FM transmission systems."

Metal Detector

■ I was advised by the Coyne Electrical School that you ran an article on metal detectors. I would like a diagram on such a unit and would be glad to pay you for it.

J. W. Capps
Newark, Ark.

Such an article appeared in our June issue. A copy may be obtained by sending 30 cents to the Circulation Department of Popular Electronics, *64 East Lake St., Chicago 1, Ill.*

Simple Test Equipment

■ My friends and I really enjoy your magazine but think it would be a little more interesting if you could run articles on simple test equipment, for instance, signal tracers and multimeters, etc.

Bill Durbin
Battle Creek, Mich.

Thanks for the suggestion. Watch for construction articles on these items in the near future.

Checking a KWH Meter

■ With reference to "What's the PE Answer?" (July 1955, page 73, last question), a quicker way of checking a KWH meter is to count the number of revolutions per minute of the rotating disc, using a known load. A *Kh* number on the nameplate gives the number of watt-hours per revolution of the disc, e.g., "*Kh* 2" means two

"The r.f. and i.f. sections aren't missing—that's a P.A. system!"

watt-hours per revolution. The load in watts divided by 60 (minutes) gives watt-hours per minute. Dividing this figure by the *Kh* number of the particular meter gives the correct number of revolutions per minute which should be observed.

BRUCE H. EDWARDS
New London, Conn.

Tachometer on 12 Volts

■ I would like to inquire about the article entitled "Portable Electric Tachometer," which appeared in your May issue. Could I adapt this tachometer to a 12-volt automotive system, even though a 6-volt relay was used in the unit described?

RICHARD J. NARAS
Columbus, Ohio

There is no reason why a 12-volt relay shouldn't work on a 12-volt automotive system—if you can get the 12-volt relay. We suggest that you write to the relay manufacturer for specific information: Stevens-Arnold, Inc., *22 Elkins St., South Boston 27, Mass.*

Transistor Radio

■ Please send me any additional information you may have on the transistor receiver mentioned in your January, 1955, issue. Is a schematic available?

FRANK MELLKIN
Buffalo, N. Y.

The transistor radio receiver referred to above was also mentioned in the "Carl & Jerry" story in our May issue. A complete schematic and detailed description appeared in the January, 1955, issue of RADIO & TELEVISION NEWS, *a copy of which may be obtained by sending 40 cents to* Ziff-Davis Publishing Co., *Circulation Dept., 64 E. Lake St., Chicago 1, Ill. The radio is manufactured by* I.D.E.A., Inc., Regency Division, *7900 Pendleton Pike, Indianapolis, Ind. It is available at most radio outlet stores at a list price of $49.95.*

Correction on Tape Timing

■ Information on how to check a tape recorder's speed (page 77, July issue) ascribed to me is incorrect. Next to the last two paragraphs should read as follows:

In two minutes time, at 15-i.p.s. speed, 120 white sections and 120 plaid sections will pass any given point in the tape's path, if the recorder's speed is correct. Each section, regardless of coloration, is exactly 7½" long. At 7½-i.p.s. speed, just 120 sections, of both colors, will pass in two minutes or 120 seconds.

At 15-i.p.s. speed, if 122 white sections pass your measuring point, and tape stops at exactly the same point in the same color section as that in which you began to measure, the tape speed is two parts fast in 120 parts, or 1/60th too fast. This same method can be used to check a recorder with any standard tape speed.

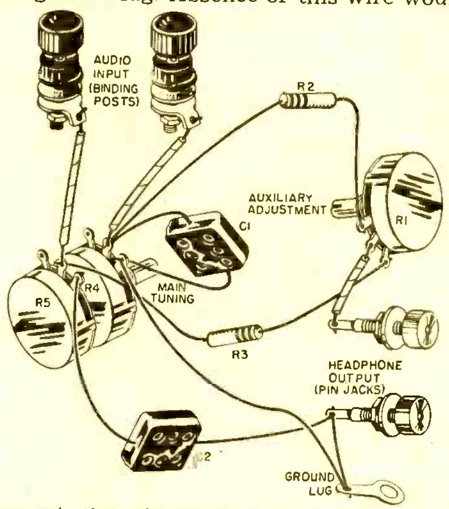
JOEL TALL
New York, N. Y.

Thank you for the correction, Mr. Tall, and we're sorry you were misquoted. Incidentally, we're looking forward to the appearance of your new book on tape recording in October. —30—

Out of Tune

BEGINNING this month, we will list any errors that may occur in POPULAR ELECTRONICS under the above heading. Although every effort is made to avoid errors, in a book of this size and scope a few will understandably crop up from time to time. If you find one, please let us know so that we may include it in this column for the benefit of all of our readers.

"Simple Audio Frequency Meter" (*July,* 1955, *page* 78). The wiring schematic is correct. However, the pictorial did not include a wire joining the junction of *C1* and *R4* to the ground lug. Absence of this wire would



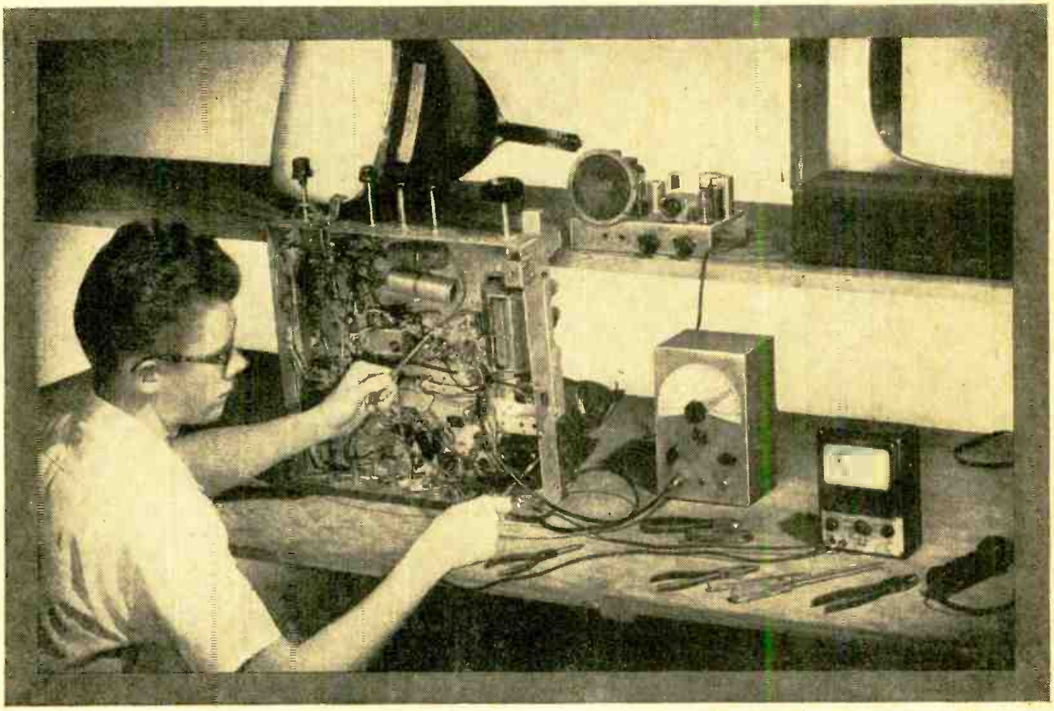
prevent the circuit from measuring frequencies. See drawing for correct version.

Home-Built 700 Volt Geiger Counter (*July,* 1955, *page* 28). In the parts listing that appears on page 31, the designations *B1* and *B2* have been reversed. The schematic is correct, and all references to the batteries in the text are correct.

Build Your Own Lie Detector (*May,* 1955, *page* 17). The pictorial diagram does not show a wire connecting the plus terminal of the v.t.v.m. to *S1* at *R5*. Absence of this connection would prevent the bridge from being balanced. The wiring schematic on page 17 is correct.

Power Supply Quiz (*May,* 1955, *page* 126). The answer to question No. 7 in this quiz was given as (b), or 10%. This is only an approximation and, as many readers have pointed out, the exact answer is 11.1%.

—30—



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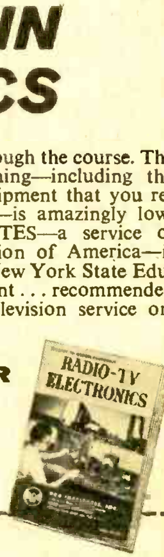

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POP'tronics BOOKSHELF

"THE NEW HIGH FIDELITY HANDBOOK" by Irving Greene and James Radcliffe. *Crown Publishers, Inc.*, New York, N. Y. 193 pages. Cloth bound. $4.95.

This is a "big" book in many ways: it deals with "big sound" in which a great many people are interested; it contains an enormous amount of material on hi-fi; and it is big even in its physical dimensions (oversize 8" x 11" pages).

As a practical guide to the purchase and assembly of a hi-fi system, this book is thorough and comprehensive. Moreover, it explains why certain rules prevail in hi-fi, and others do not. The result is an increased understanding by the reader of much of the reasoning and technology of audio reproduction.

Included are discussions of representative commercial components as well as ample material on living with the system after it is purchased. The chapters containing instructions on housing the equipment include wood-working data and plans galore, enough to delight the fancy of any do-it-yourself enthusiast. A section on servicing hi-fi systems details what can be done to maintain the equipment with a minimum of labor and expense.

Particularly valuable is the appendix which contains data on crossover networks. Also included is a real hi-fi exclusive: a symposium on the design of amplifiers, comprising discussions by leading manufacturers on what they are trying to do in this area.

"TECHNICAL DICTIONARY" written and published by the Technical Staff, *Coyne Electrical School*, Chicago, Ill. Distributed by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Cloth bound. $2.00.

Out of the current demand for standardization of the meanings of terms used in radio, TV, and other electronic applications has come this complete dictionary. Over 4000 terms are defined. In addition, a special section brings together valuable reference material covering wiring, mathematics, reactances, tube data, etc. The book is amply illustrated with charts, diagrams, and tables.

—30—

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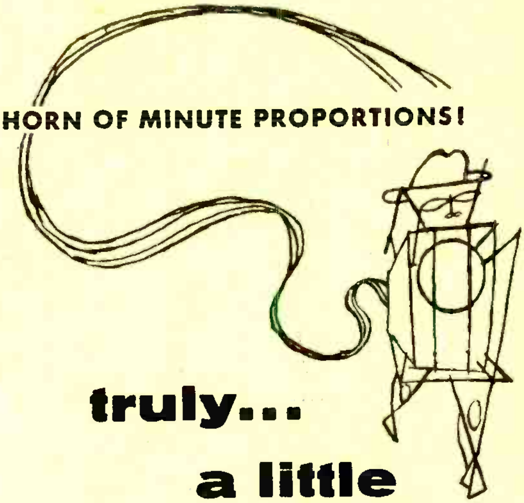

An amazing 20' high, the Rebel 5 design involves a cavity (capacitance); a slot (inertance) and a corner horn to provide back loading for a direct radiator speaker. The middle and extreme high ranges are preferably reproduced with corresponding horns and the resulting 3-way speaker system can be squeezed into the tiny space.

Reduction in size of speaker structure sacrifices one or more of the following: the maximum wavelength the system can produce; the smoothness of response (reduction of size invariably produces peaks in the bass range); introduction of distortion because of extreme diaphragm excursion if the enclosure is too small (this is usually associated with peaked response). All Rebels necessarily violate these principles. The trick in retaining a high level of quality typical of Rebel design is to coordinate the design of the low-pass filter with the short length of horn exterior to the housing and to introduce an effective cut-off of gradual slope such that the output, instead of becoming highly distorted in the extreme bass range, merely attenuates without presenting frequency doubling and resultant intermodulation of high frequencies.

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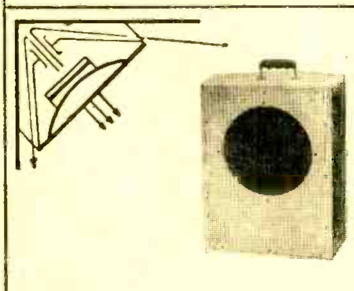	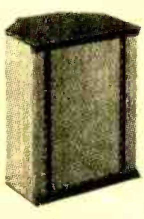	
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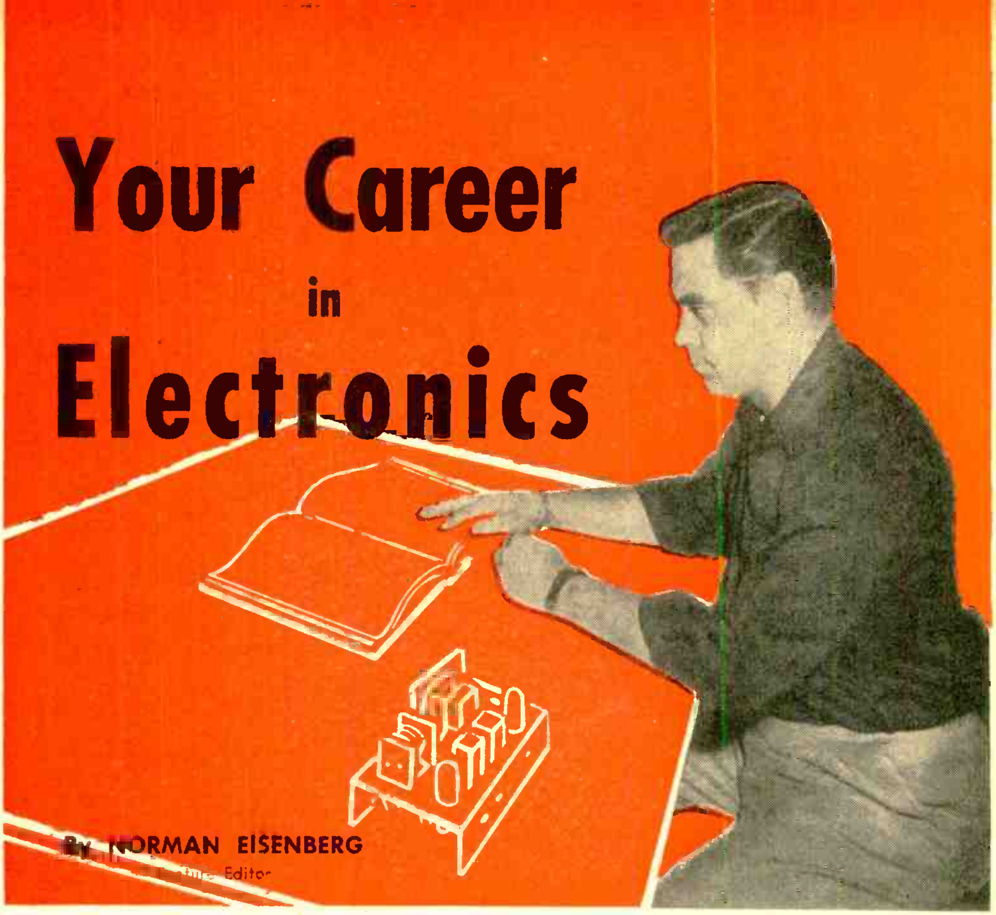
Your Career in Electronics



By NORMAN EISENBERG
Feature Editor

Technical training is the key to many well-paying positions

ONE of the most wonderful things in this age of electronics is the new horizon in well-paying careers that has been created. Man's control and use of the tiny, invisible source of energy has produced innovations, conveniences, and advances in every field of human endeavor. Electronic applications save lives, produce food, build houses and roads, provide entertainment and communication for the entire world.

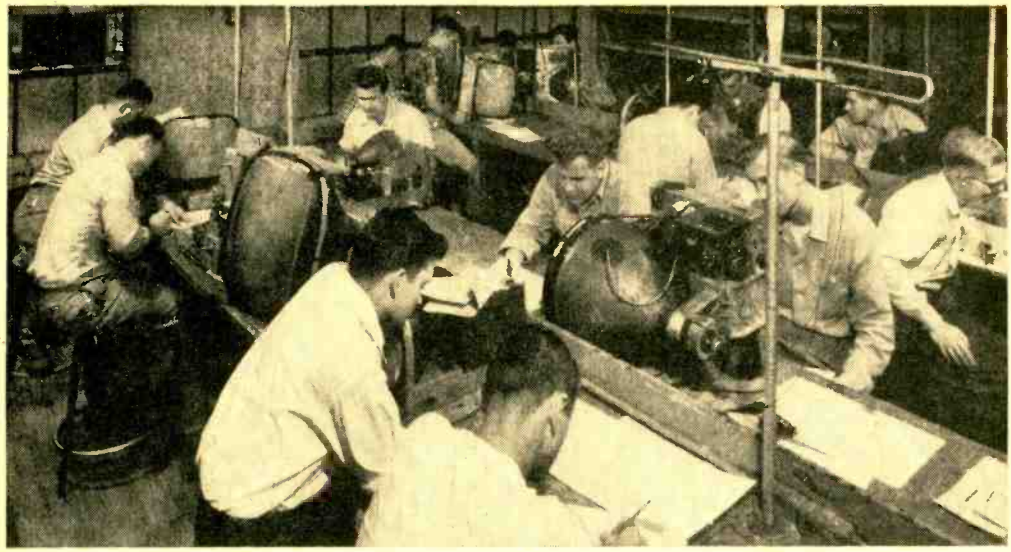
But in addition to the far-reaching influence electronics has had on our lives, it has also provided many with fruitful employment and a better standard of living. The technology and applications of the constantly increasing number of subdivisions of the over-all "field of electronics" embrace numerous occupations—from prospecting for uranium to sending messages from a shipboard radio shack; from stringing telephone wires across a desert to writing technical reports; from hunting disease virus with an electron microscope to selling components across a store counter.

The figures attesting to this widespread activity are staggering. In 1953, we as a nation consumed more than 500 billion kilowatt hours of electrical energy. In 1954, the number of persons employed by the radio-television industry alone reached about 700,000. There were 1,100,800 persons employed in the electrical machinery industry as of April, 1955, and another 709,000 in telephone and telegraphy jobs. These figures do not begin to describe the armies of personnel employed in industrial electronics—from top flight engineers to assembly line solderers. They do not take into account the multitudes who make their living through various services connected with electronics, such as teaching, selling, advertising, and editing magazines!

In radio and television, the total money spent in this country on home sets, broadcasting time, talent, accessories, phono records, repairs, and labor costs reached—for 1954—the fabulous figure of $4,936,400,000!

And all signs point to increases in both money spent and people employed for many years to come.

To select a career in electronics would, it seems, prove a wise choice for any man, and indeed, for many women as well. As one industrialist has put it, there are vir-



Scene in the television section of DeVry Technical Institute's laboratories in Chicago, where students receive valuable practical experience working on standard home TV sets.

tually no restrictions on how far a person can go in the field. Many who start as tracers in the drafting department of a large firm end up as design engineers—while still young enough to enjoy their increased incomes. Others who start by soldering pigtail leads on an assembly line evolve to foremanships. In a surprising number of cases, the line dividing the "engineer" from the "non-engineer" vanishes completely—many supervisory technical jobs are held by persons who do not have engineering degrees.

There is really one basic requirement, and it prevails at all levels and in all types of jobs in electronics. That requirement is —*education.*

Education Required

In the electronics industry, it is perhaps truer than in any other field that there is no substitute for sound training. Job experience is, of course, extremely important—but it is not worth more than equivalent schooling. In some cases, the schooling is worth more. A representative of the *Reeves Instrument Corp.* of New York City has pointed out that a person may work for 18 months on a job and be less valuable than another who has had six months of electronic schooling. If the job consisted of the same operation on the same piece of equipment, the former man would actually know less after 18 months than the trainee would after six months of training in the theory and diverse applications of electronics.

And the training does not necessarily involve a formal engineering degree. At *Reeves,* for example, out of several thousand personnel, about 25% are in the engineering division. Of this number, about 33% hold engineering degrees. But not all the top level and high-paying jobs are held by members of this group. The remaining personnel include people in lab work, drafting, planning, testing, and clerical positions. Many of these people, who have acquired years of practical experience in the electronic arts, earn pay equal to—and sometimes more than—that of degree-holders. These individuals combine outstanding ability with technical know-how and/or training to make better jobs for themselves. A significant number in this latter group are classified by the company as project engineers, positions which involve supervising many people, including those with degrees.

This is not to say that in all situations it is better not to have a degree than to have one. These figures do point up the fact that the key to a good-paying job is basically how much a person knows.

While "on the job" may be a good place to learn how and what to do, it may not often be the best situation in which to learn the "why" of what is going on. And in electronics, understanding theory—or the "why"—is of paramount importance. As a spokesman for *RCA Institutes* (N.Y.C.) stated: "It is generally just as important for an electronics technician to understand why a circuit behaves in a particular manner as it is for him to know how to wire it up."

The training needed to "get in" and to

Trainee (above) makes adjustments in broadcast transmitter installed under simulated operating conditions at RCA Institutes, N. Y. C. Complex professional equipment such as this is best mastered under supervised training available at resident schools. Right, sex is no barrier in electronics. TV receiver construction and servicing may be learned in resident schools or by home-study.

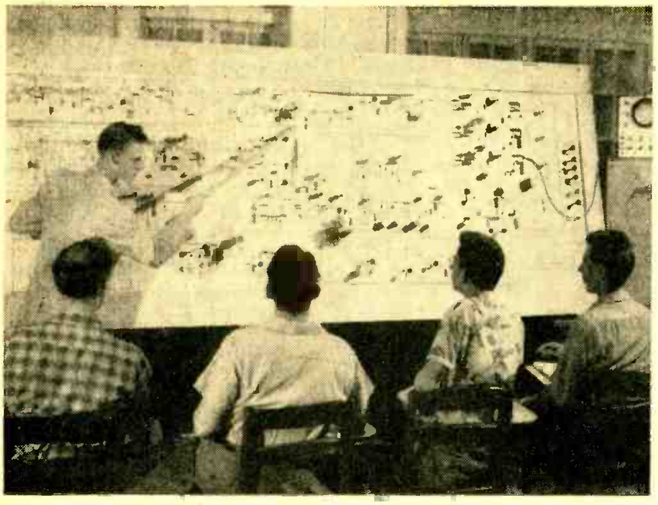
reach the top is readily available from a number of qualified schools located in most parts of the U. S. and Canada. Courses covering all phases of electronics from simple a.c.-d.c. theory to advanced radar can provide training to suit any need.

Courses are available on a resident or correspondence basis. The former involves actual attendance at the school, becoming part of a class of other trainees, attending lectures, demonstrations, working in laboratories, using first-class equipment, and receiving the benefit of personal instruction from seasoned electronics technicians. The correspondence course, also known as home-study, provides the trainee with a series of carefully planned lessons and specially designed equipment for use at home at his own convenience.

Home-study courses permit the trainee to relate his studies to his own work or job in a very direct way. His work is examined and graded, and suggestions offered, in much the same way as is the resident trainee's. Certificates and diplomas—in either case—are issued upon successful completion of a course.

As far as industry is concerned, it appears to make little or no difference in what manner a man has received his training. With few exceptions, the home-study method and the resident method are regarded with equal enthusiasm and favor when a man is evaluated for most jobs. The exceptions might be certain types of jobs in which the resident school graduate with some working experience in a school laboratory would be preferred to the technician with only home-study training. Many resident schools have gone to great lengths to simulate broadcasting studios, with professional operating consoles, etc. Others have real shipboard radio shacks. At least one school—the *Philadelphia Wireless Technical Institute*—is rapidly becoming known for its courses in radar operation and maintenance. These are specialized phases of the electronics field that are best learned at resident schools.

On the other hand, the challenge of the correspondence course is often regarded by industry as the measure of a student, and an indication of his willingness to get ahead. The chance to experiment and to profit by trial and error is a little more in favor of the home-study trainee. This is especially true of the student who receives



"Dynamic demonstrator" is widely used teaching aid. This class is studying color television at Capitol Radio Engineering Institute, Washington, D. C. Schools use many advanced devices to enhance instruction. Some send movies to home-study trainees.

a complete laboratory, or who can purchase one as part of his correspondence course. Most correspondence schools consider these points, and follow through with genuine equipment designed to train the student in truly professional techniques.

Training costs are generally fair and reasonable—in both types of training—considering what the schools offer and what advancement the training can bring to the student. In most cases, the cost is determined by the length and complexity of the course, rather than by the method of study chosen.

In other words, it is not necessarily cheaper to take a home-study course rather than a resident course, although it is obvious that only those who can devote a good portion of their daily time to it should enroll in a resident course. In addition, most schools make it easy on the trainee by permitting payment over a period of time, so that the student need not pay out a few hundred dollars at once.

Counseling and Placement

Contact with the school does not always end upon completion of training. Schools do find jobs for their graduates. School heads are well acquainted personally with various key figures in the electronics field. In addition, schools maintain special departments which serve as counseling and guidance bureaus and inform trainees of job openings. You are not only advised as to the kind of job you are best suited for, but more often than not will be steered directly to the job.

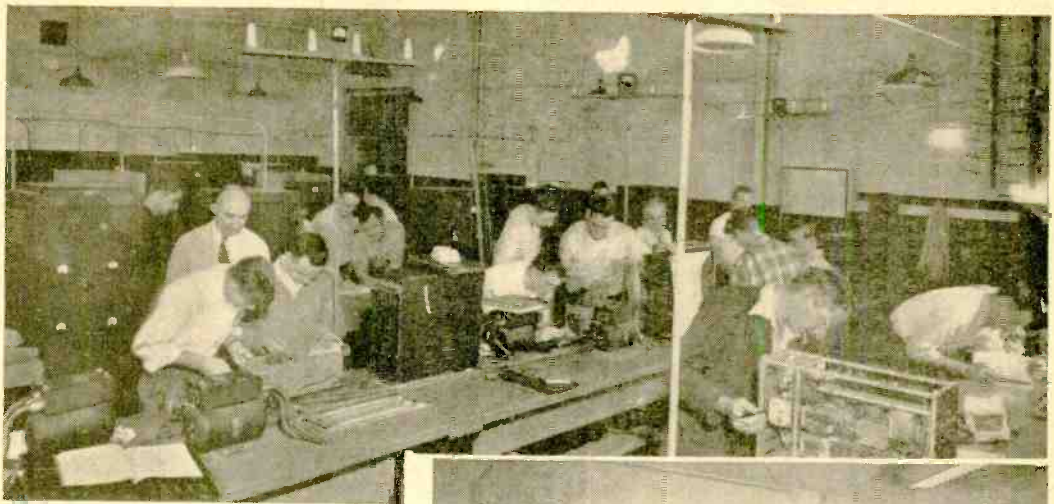
Of telling significance is the fact that industrial leaders constantly request new personnel from the school enrollees. Personal visits and letters from heads of companies to the school requesting new job applicants are quite common. In addition, many companies—upon hiring a new man—will recommend that he continue his training, either at home or by attending classes, and will follow up favorably with advancement as the employee broadens his own knowledge of the field.

Another service offered by schools is in the form of special publications. Available to trainees, these bulletins and brochures contain information important to people in electronics. For example, the *Cleveland Institute of Radio Electronics* issues brochures on mobile radio servicing, FCC license exams, and job news. Other schools issue literature of comparable merit. Catalogs describing courses are carefully planned to provide complete course information as well as to provide intelligent aid for the newcomer in selecting a program of study.

The professional status and recognition accorded these schools are typified by the close cooperation between them and professional associations. The *Central Technical Institute* of Kansas City, Mo., is one of several schools accorded approval of the *Institute of Radio Engineers*.

There are, at present, over a score of technical schools offering a wide variety of courses. Many have provision for both home-study and residence training. Some specialize in one method or the other. All offer certificates or diplomas. And some are authorized to award engineering degrees to students who have studied the required mathematics and advanced technical courses.

(*Continued on page* 98)

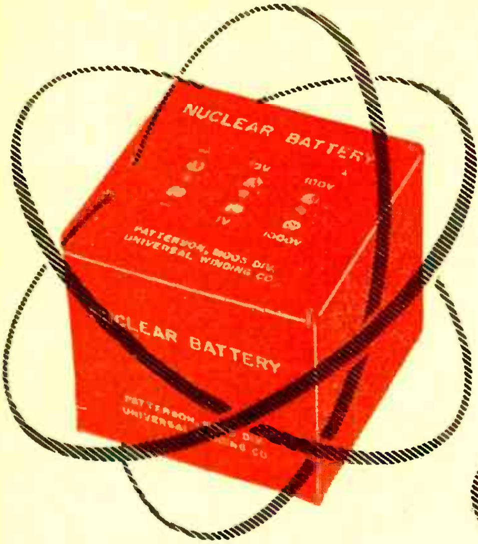


Above, students working in transmitter laboratory of Central Technical Institute, Kansas City, Mo. Overhead may be seen special dipole antenna used in experiments.

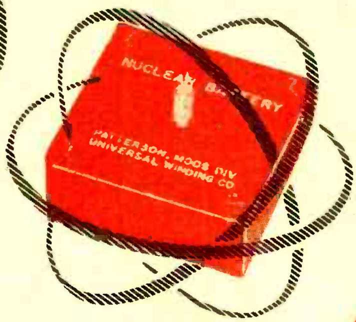
Telecasting class at National Schools, Los Angeles. Imitating exact procedures used at commercial studios, trainees operate latest video and audio equipment.

TV studio production group at Central learns telecasting techniques. Small class receives benefit of personal instruction.

Final check on home-built set is made by student taking home-study course given by International Correspondence Schools, Scranton, Pa. Previously, the trainee had constructed the multi-tester he now uses for checking resistances. Signal generator at far right was also built.



KILOVOLT NUCLEAR BATTERY



Atomic age miracle will supply a steady voltage for 25 years

Nuclear batteries compared in size with ordinary flashlight cell. Top unit has taps for 1, 10, 100, and 1000 volts. Small unit, "baby" of family, puts out steady 375 volts.

A WASTE product of nuclear fission has been converted to usable electrical energy in the "nuclear battery," newest power source of the "atomic age." Developed by the *Patterson, Moos Research Division, Universal Winding Co., Inc.,* Jamaica, N. Y., one model of the new energy source weighs only seven ounces, but can furnish a pressure of 8000 volts throughout an operating life of 25 years!

Heart of the nuclear battery is a "sandwich" of strontium-90 enclosed between two dielectrics. Strontium-90 is obtained as a by-product of nuclear fission. This "waste" liquid is treated by a process whereby the liquid is evaporated, leaving a suitable deposit for use in the battery. Beta particles emitted by strontium-90 are the source of the electrical energy. The hazard of radioactive contamination necessitates the extreme caution and specially designed equipment used in fabricating the battery. Once the sandwich is heat-sealed within its metal case, this danger no longer exists. One "hot" voltage lead extends from inside the sandwich, and the case itself is "ground."

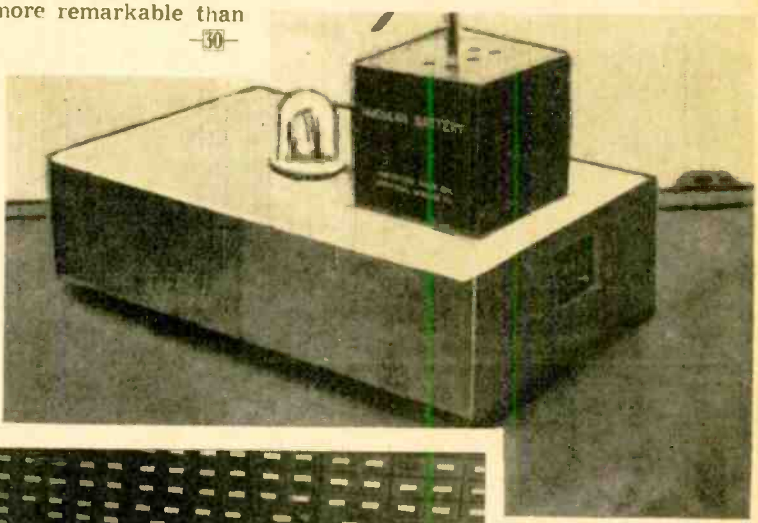
The electrical energy of the battery varies with the amount of radiation energy. Present models may use up to 500 millicuries of radiation to provide pressures as high as 10,000 volts.

In addition to its long "shelf-life," the battery has been found to function without much regard for temperature extremes, although at very high temperatures the equilibrium voltage of an 8000-volt unit may drop to 4000 volts. Since anticipated uses of such a unit will not require more than perhaps 1500 volts, this drop presents no real problem.

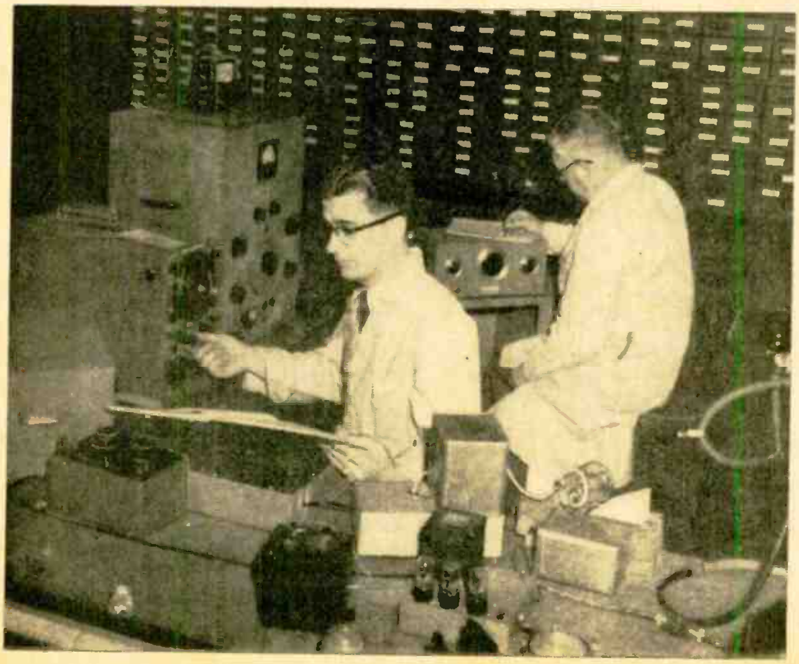
Suggested uses of the nuclear battery involve circuits which require a high-voltage, ultra-minute current source. Such applications as charging an ionization chamber, charging capacitors, and energizing radioactive instruments have been suggested. Since one of the battery's characteristics is an ability to build up a high voltage with a high degree of linearity, its use in timing circuits is foreseen. As a "trigger" to activate other circuits, it could be employed in alarm systems. Various types of control circuits, as well as transistor power supplies, could utilize the battery. It might also serve as a constant current or constant voltage reference source.

At present, three models are available: (1) Model MP-10 is a multiple voltage source, with taps for 1, 10, 100, and 1000 volts—current capacity is 2×10^{-9} amperes (2000 micromicroamperes); (2) Model P-10 is a miniature unit, measuring only 1³⁄₁₆" by ⅝"—this tiny "powerhouse" furnishes 375 volts at 50 micromicroamperes; (3) the most powerful model is the H-10, capable of supplying 10,000 volts at 500 micromicroamperes—despite its high output, this unit measures a mere 2⅜" by ⅞".

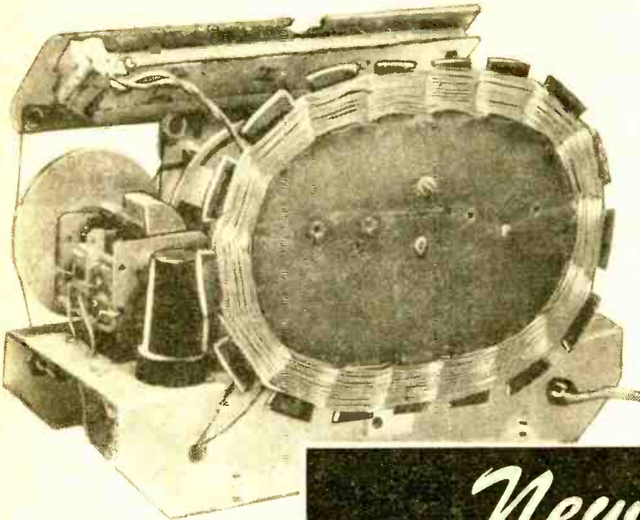
First conceived by Mr. Stanley Wallack, Director of Physical Research at *Patterson, Moos,* the nuclear battery has been under development for three and a half years. Associated with Mr. Wallack in producing the battery in its present predictable and usable form is Harry C. Lieb, Director of Chemical Research. Dr. Anthony Moos heads the organization from whose many engineering laboratories may evolve new developments even more remarkable than the nuclear battery. —30—



Above, radiation lab technicians handle radioactive isotopes in manufacture of nuclear battery. Right, the battery is used as a "trigger." Flashing of the lamp indicates that battery has activated a thyratron-controlled power supply.



Voltage and current output of the nuclear battery are measured by technicians. Oscilloscopes and various meters are used. This is only one of a series of many critical tests.

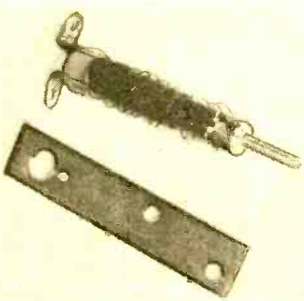


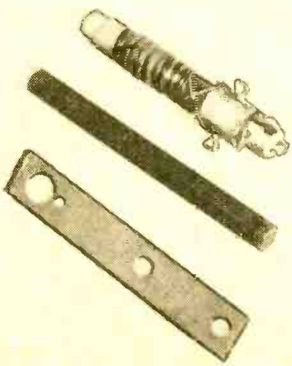
Non-directional antenna is easy to install and can revive that old set for hours of listening

By E. D. MORGAN

New Antenna Peps Up Old Radio

Most table model radios use a loop antenna similar to the one shown above. Directional characteristics can be avoided by replacing it with an antenna using a ferromagnetic core.





Two types of the new ferromagnetic non-directional antenna are shown here. The unit at the top is sold under the trade name of "Walsco-Loop"; its core is screwdriver adjusted. The unit at the bottom is the "Superex Energized Ferri-Loopstick"; its core is adjusted by hand. Despite these minor differences, both are installed and used in much the same way. Cost is less than $1.00.

MOST broadcast receivers today use built-in loop antennas. While superior to the outdoor wires of years ago, the loop has one major drawback: its sensitivity to the direction of the transmitter. Thus, when using a loop antenna, best reception is possible only by reorienting the receiver for each new station tuned in.

This difficulty is solved by a new type of antenna with no directional effects. Using a specially designed ferromagnetic core material, this antenna is extremely compact, has high sensitivity, is quite inexpensive, and is easily installed.

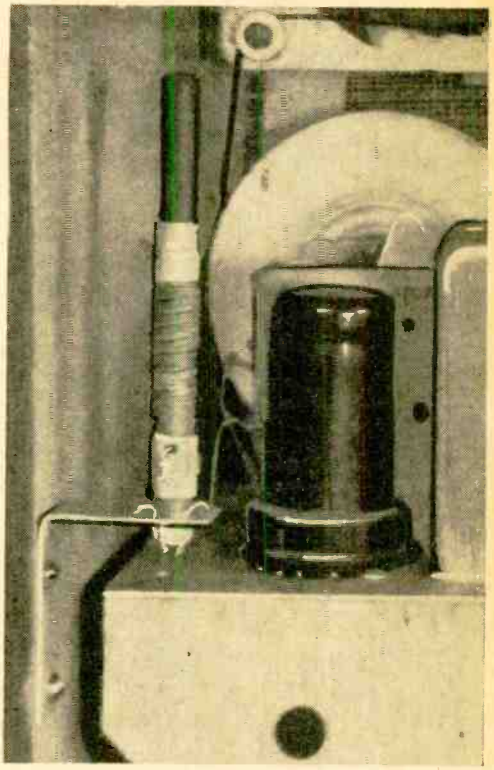
A mounting bracket, included with the antenna, enables it to be located in any position. Suggested mountings are shown in the accompanying photographs. Only a few connections and adjustments are needed.

The ground and antenna leads of the receiver are removed from the old loop and connected to the new antenna. The antenna lead should be connected with the short length of wire already fastened to the new unit. This wire must not be grounded or coiled, but extended away from the chassis. A simple solution is to tape or otherwise fasten it to the inside of the cabinet. A length of insulated "spaghetti" tubing slipped over this wire will prevent its contacting any part of the chassis.

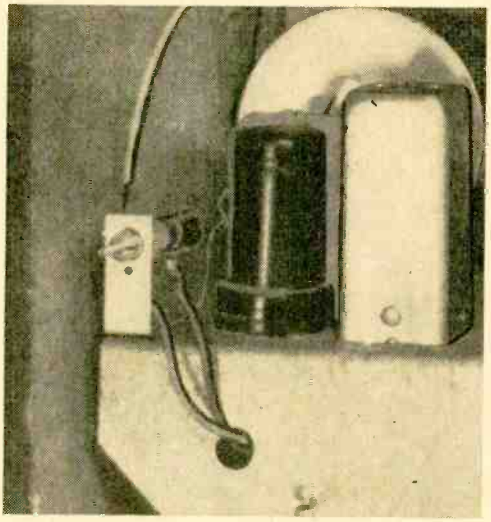
Once mounted, the antenna is easily tuned. The radio is tuned to a station near the center of the broadcast band, and the core of the antenna is then adjusted for maximum loudness. It should be adjusted gently—by hand or by a non-metallic screwdriver—depending on the type of unit used.

The set will usually track perfectly after this adjustment has been made. If it does not, tune to a high frequency station and adjust the r.f. trimmer capacitor for maximum loudness. This adjustment is made by slowly rotating the screw located on the side near the bottom of the r.f. tuning capacitor. The larger set of plates tunes the r.f. section; the smaller plates tune the local oscillator.

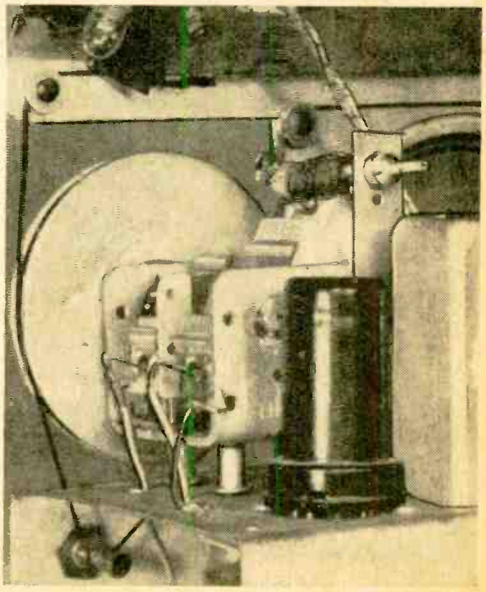
In fringe areas, the addition of an extra six feet or more of wire to the antenna lead will generally improve reception. If any extra wire is added, the core will have to be readjusted for best results. —30—



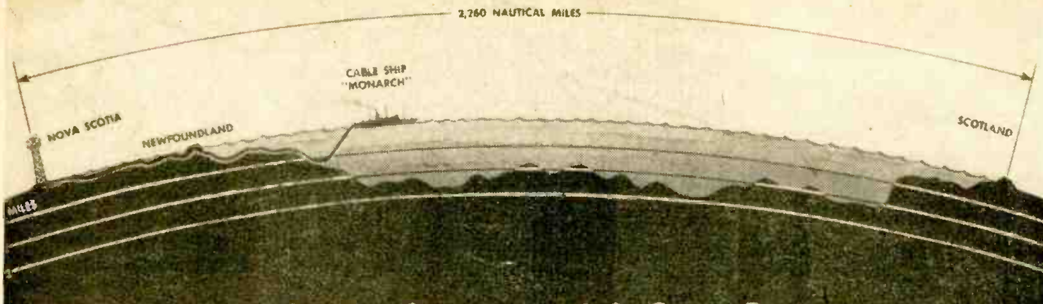
One way of mounting the ferromagnetic antenna is shown above. The metal bracket can be bent into an L-shape and mounted on the inside of the cabinet. Two small wood screws will hold it securely. The extra wire coiled around the new antenna should be unwound and extended away from chassis.



The antenna above was mounted by fastening its bracket to the chassis. Extra wire has been enclosed in spaghetti tubing, held by a tack to other side of the cabinet.



Antenna at right was mounted by fastening the bracket to the side frame of the radio's tuning capacitor. Mounting close to variable capacitor may improve reception.



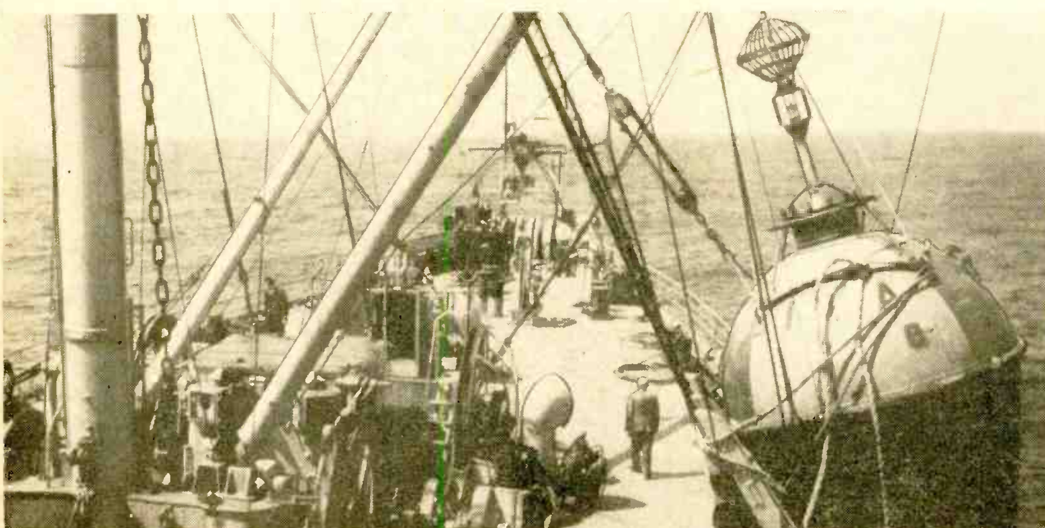
TRANSOCEANIC CABLE

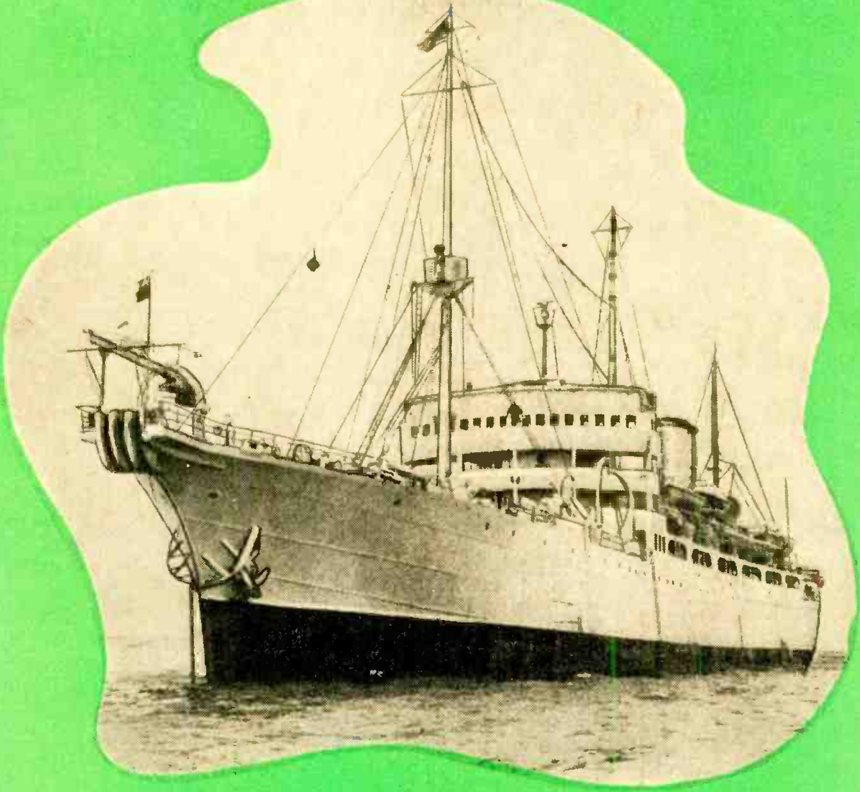
New cable includes over 100 amplifiers to carry 36 voice conversations; will assist radio circuits during storms

ONE HALF of the world's first transoceanic telephone cable, spanning the Atlantic between Newfoundland and Scotland, is expected to be laid by the end of this month. Work, which began June 22 and can proceed only during summer months, is scheduled for completion in 1956, with service established late that year. The cable is a joint undertaking of the *American Telephone and Telegraph Co.*, the British Post Office, and the *Canadian Overseas Telecommunication Corp.*

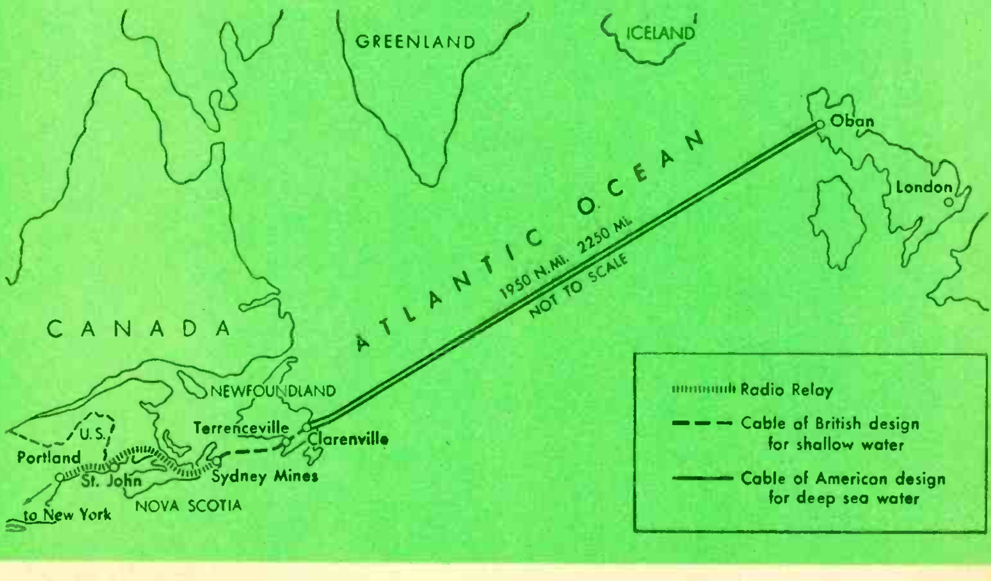
Telephone service between America and Europe will be vastly improved by the cable. Present telephone facilities, established in 1927, use radio carrier waves. Existing undersea cables, the first of which was laid in 1866, are for telegraphy only. When completed, the new cable will permit direct line voice transmission across the Atlantic. The system, whose bandwidth is wider than any yet developed for under-

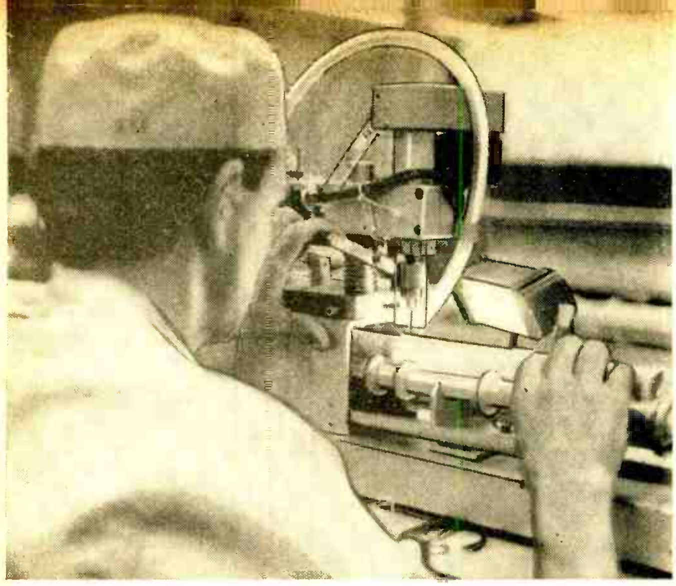
View forward of the cable-laying ship "Monarch" as it prepares to pay out the shore-end segments. The ship has similar equipment mounted on the afterdeck for paying out cable in deep water. At right is a marker buoy.





"HMTS Monarch" is world's largest cable-laying ship. Note at the bow the sheaves over which the shore-end cables will pass. Drawn below is a map of the cable route also showing the microwave relay links at the west end.





The deep sea amplifiers were assembled under exacting laboratory conditions by the Western Electric Co. In this operation, the technician is drilling precise holes to mount the 60 components.

water transmission, will handle up to 36 conversations at one time. This almost triples the present radiotelephone capacity. Two cables form the links: one carries signals eastward; the other, westward.

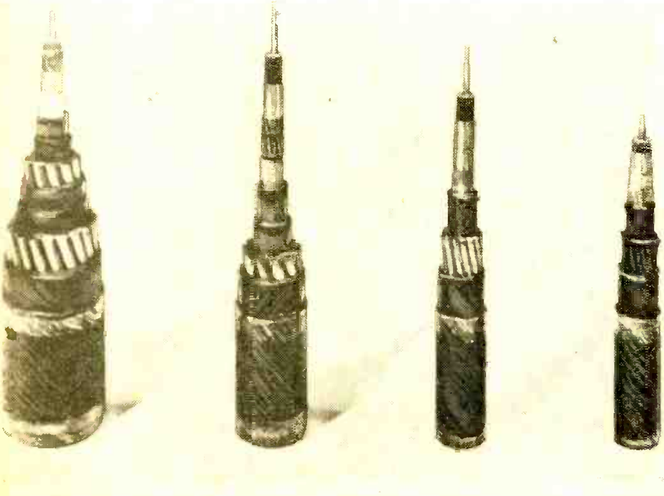
Each Amplifier Uses Three Tubes

Electronic "heart" of the system is the series of 52 amplifiers or "repeaters" built into each cable. Spaced about 40 miles apart along the ocean bottom, each amplifier uses three electron tubes of special design, powered by regulated current sent over the cable itself. Gain of each repeater is 1,000,000. Repeaters are expected to function without the need for maintenance for a period of 20 years.

Each repeater is built inside a flexible housing which is designed to approximate a piece of cable. Consequently, it can be spliced into the cable and "paid out" by the cable ship as it lays regular cable lengths. Each repeater consists of an 8' center section about 2.8" in diameter, tapering over a distance of about 20' at each end to the cable diameter. The armor of the cable itself is continued over the repeater housing.

To obtain necessary flexibility, the more than 60 components in each repeater are mounted in a series of 17 Lucite cylinders. These cylinders are surrounded by two layers of steel rings designed to withstand sea-bottom pressure of about 6000 pounds per square inch. Additional metal armoring and watertight seals at each end complete the repeater housing.

The task of laying the cable has fallen to the officers and men of the *HMTS Monarch*. Owned by the British Post Office, the *Monarch* is the world's largest cable-laying ship, with a crew of 130 and a capacity to carry 1800 nautical miles of deep-sea cable. While laying cable, the *Monarch*



Cable diameters vary according to requirements. Near the shore line, the cable needs greater protection (see cable at left). At the right is the cable used in the deep water passages. Intermediate diameters are used at other depths. The largest is about 2½", the smallest just under 1".

steams at about six knots. In other words, about six nautical miles of cable per hour will be laid. The cable is unwound and fed out by electrical winches from drums in the ship's huge storage tanks, and is lowered into the water over guiding sheaves.

The cable is laid in three segments. The shore end, which is more heavily armored than the deep-sea section, is "paid out" between Clarenville, Newfoundland, and the edge of the American continental shelf,

FACTS AND FIGURES

The total length of the new cable is 1950 nautical (or 2250 statute) miles. Having an outer diameter of about 1¼ inches, it weighs 1 pound per foot. Laying the cable will take approximately 300 men a little less than two years.

Each repeater, of which 104 will be used, requires a full year to manufacture at a cost of $70,000. Once installed, a repeater, which has a gain of 1,000,000, is expected to provide trouble-free amplification for 20 years. Should the cable be lifted and relaid (for repairs, etc.), it will cost $250,000.

Over-all cost of the entire project is $40,000,000. American Telephone and Telegraph Company *will have one-half ownership interest. Of the remaining half, the* British Post Office *retains a 41% ownership, and the* Canadian Overseas Telecommunication Corp., *9%.*

The deep-sea cable is manufactured by The Simplex Wire and Cable Co. *of Cambridge, Mass., and by* Submarine Cables, Ltd. *of Greenwich, England. Repeaters are being made by the* Western Electric Co. *in a Hillside, N. J., plant, utilizing tubes designed by the* Bell Telephone Laboratories.

a distance of about 200 miles. Of lighter design, the second segment will extend the cable to a point some 500 miles off Scotland. The third bridges the remaining distance to Oban, on the west coast of Scotland about 60 miles from Glasgow.

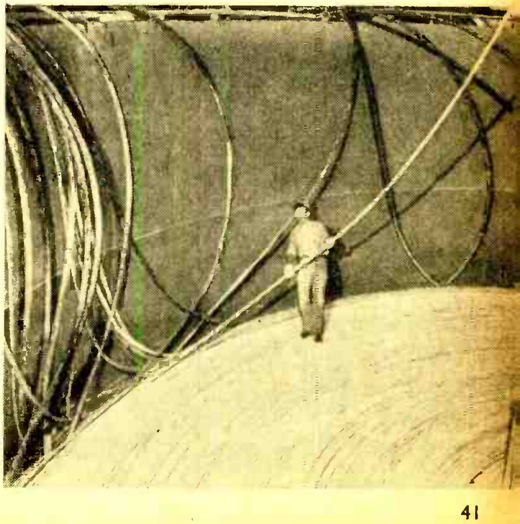
Core of the cable is a flexible copper tube about ⅝" in diameter containing a single concentric conductor surrounded by polyethelene. With the addition of protective coverings of jute and armoring wire, the over-all diameter of the cable reaches about 1¼".

The system originates with the *Bell System's* U. S. telephone network in Portland, Maine. From here, a microwave radio relay route takes over for the 575-mile stretch to Nova Scotia. From Sydney Mines, N. S., a single cable carries the circuits through the waters of Fortune Bay and across Newfoundland to Clarenville. From Clarenville, the deep-sea cable takes over.

This system will assist radio circuits in handling voice communication traffic between Europe and North America. Although subject to minor disturbances, the cable will not completely lose communication like the radio circuits during ionospheric storms. —30—

To insure that the repeaters are waterproof, technicians employ radioactive solutions and hunt for leaks with Geiger counters. Hundreds of tests were made on the repeaters since they cannot be easily replaced once the cable is at the bottom of the ocean.

Protected with layers of armor, the cable was temporarily stored in this giant tank of the Simplex Wire and Cable plant, Newington, N. H. This portion of the cable is now aboard the "HMTS Monarch" for deep-sea laying.



Kit Builds "Bubble" Lamp

AN INFLATABLE LAMP that hangs from the ceiling may be assembled from a kit distributed by *Carradan Associates,* 154 E. Erie St., Chicago 11, Ill. Made of translu-

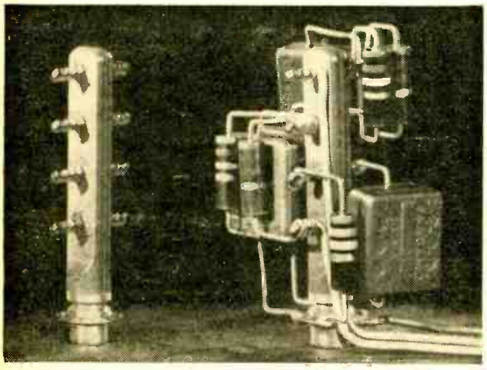
cent "Krene" plastic, the lamp can be raised or lowered to any desired position.

The assembled lamp weighs less than two pounds. Ordinary lung power, or air from a bicycle pump, inflates the plastic shade until it is about 20 inches in diameter and about 10 inches deep. A suspension cord, tied to the wire fixture frame, loops over the small hook which is screwed into the ceiling and runs back down through the center hole. The lamp cord contains a small switch. Pulling on the suspension cord raises the lamp; pulling on the lamp cord lowers it.

The complete kit, containing the inflatable shade, bulb fixture, suspension and lamp cords, hook, and instructions, retails for $14.95 at department stores and "contemporary shops." -30-

Mounting Post Aids Wiring

CALLED THE "TOTE-M-POLE," a small jig acts as a mounting support for such components as resistors, capacitors, and transistors at

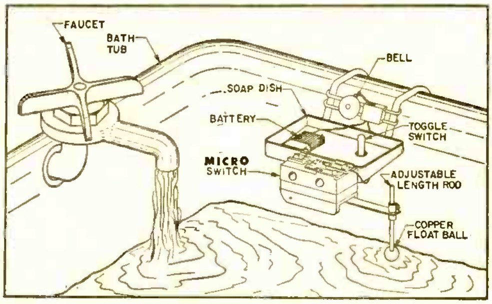


their operating point. Critical leads of grid suppressor resistors, for example, can be reduced to pigtails. Some users report as much as five feet of wire saved for each "Tote-m-pole" used in underchassis assemblies.

The "Tote-m-pole" is mounted with a single hole. It can be reused many times for model mock-up. For additional information, write to the manufacturer, *Sangamo Electric Co.,* Springfield, Ill. -30-

Device Signals Bath Is Ready

EVER WISH AN ALARM would sound before your bath water gets too high? A "Sunday inventor" has come up with an inexpensive, pint-size gadget that rings a bell when the water reaches the desired height in a bathtub. The device, still an experimental novelty, came to light in a contest held by



Minneapolis-Honeywell's Micro Switch division, and is not available on the market.

A small ball float is mounted on a rod adjustable in height. When the water gets too high, the float actuates a small switch and the switch sounds a bell. The whole gadget is attached to an old soap dish that hangs on the inside of the tub.

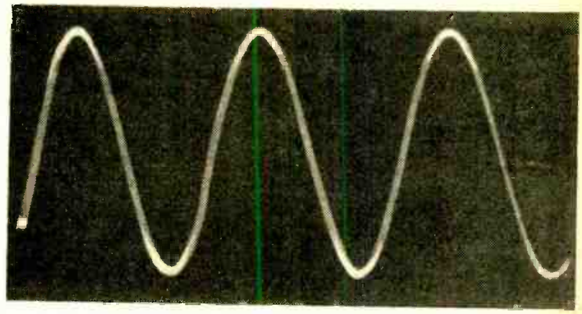
There's no electric-shock hazard either. The bell operates on a tiny battery, and has no connection with the house current. -30-

Britain's First Commercial TV

BRITAIN'S FIRST independent, commercial television station begins operation September 22. Serving the London area (in which there are about 10 million people), the station will sell advertising time—but not in the same way as U. S. stations.

A complete program will resemble the format of a magazine; it will include news and entertainment, with time available for advertisers. No advertiser, however, may sponsor an entire show. "Commercials," not to exceed six minutes an hour, may be inserted only at the beginning or end of a program.

Up to now, all television in Britain has been sponsored by the *British Broadcasting Corp.,* a government-financed, non-commercial organization. -30-



Transistorized SINE-WAVE GENERATOR

By LOUIS E. GARNER, JR.

How to build a pocket-sized test instrument which will accurately check operation of various audio devices

GENERALLY speaking, electronic test equipment intended for service and experimental work should be reliable, compact and easy to operate. *Transistors* are ideally suited to the design of this type of test equipment.

One item of transistorized test equipment is the pocket-sized a.f. signal generator shown in Fig. 1. Such a generator can be a valuable test instrument in the hands of the experimenter or technician. With it, he can service and check the operation of p.a. systems, phonograph amplifiers, intercom systems, and the audio sections of auto sets, home radios, and portables.

Nor has performance been sacrificed in obtaining the small size shown. The instrument not only gives an almost perfect sine wave (an actual photograph of the output signal is shown above), but delivers a signal of sufficient amplitude for virtually all normal work.

Circuit Description

The basic circuit consists of a single CK722 transistor used as an oscillator followed by another transistor as a buffer amplifier. Use of a "buffer" stage minimizes the effect of external loads on the output frequency, amplitude or waveform. "Grounded-emitter" circuits are used in both stages to permit the use of a single battery in the power supply.

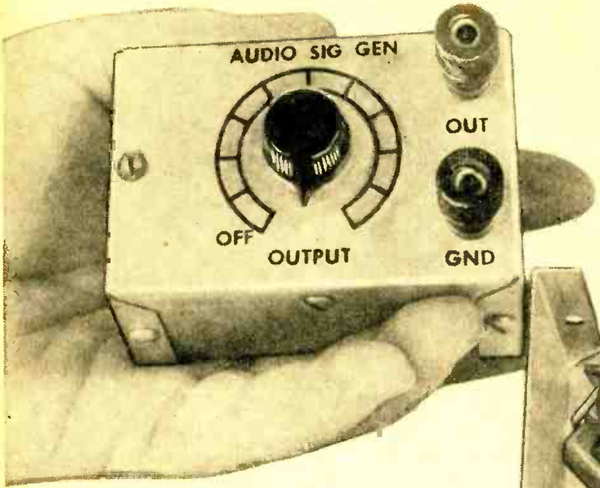
Audio operating frequency is determined by the sizes of *CH1, C1* and *C2*. The ratio of *C1* to *C2* is chosen to permit matching the high collector-emitter impedance to the low base-emitter impedance. Hence, *C2* is approximately ten times larger than *C1*. The emitter is connected to the juncture of these two capacitors.

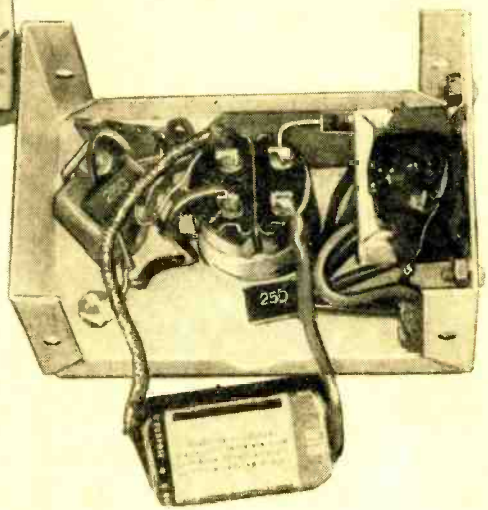
Resistors *R2* and *R3* serve to prevent shorting the "base" side of the tuned circuit through the low impedance of the power supply. These two resistors also form a voltage divider to provide a low-impedance output signal tap. The audio signal appearing across *R3* is applied to the base of the second CK722 through coupling capacitor *C3*.

Power for the entire circuit is supplied by a single 15-volt hearing-aid type battery, *B1*, controlled by s.p.s.t. switch *S1*. In order to save space, the power switch is mounted on the output control.

In the author's model, a d.p.s.t. switch, rather than a s.p.s.t. unit, is used so that the extra terminals may be employed as "tie points." The entire circuit has been assembled inside a small *Bud* Minibox, which serves both as "chassis" and "cabinet."

Choke *CH1* is a small output transformer salvaged from a "personal portable" receiver; only the primary (high-impedance)





Above-chassis and under-chassis views of the transistorized audio signal generator. This unit gives an almost perfect sine wave of sufficient amplitude for virtually all normal work. It may be used for nearly every application in which a conventional vacuum tube generator might be employed.

winding is used. Almost any small iron-core choke will operate in this circuit. The author has tried units from broadcast receivers and various replacement filter chokes or output transformers. In most cases, the only change in operation was in the output frequency. In a few rare cases, it was found necessary to change either the ratio of *C1-C2* or to adjust the size of *R1* in order to obtain a good quality sine wave.

If the transistors are to be soldered in place, special care must be exercised to avoid heat damage. The leads should be left at least 1" long and the soldering should be completed as quickly as possible. Use a hot and well-tinned iron.

Adjustment and Operation

Once the wiring is completed, the instrument should be checked for operation by using an oscilloscope to observe the output signal. If no signal can be obtained, it probably means that the oscillator stage is not functioning properly.

In such a case, carefully recheck all wiring. Look out especially for "cold" soldered joints, defective parts, and actual wiring errors. If oscillation still cannot be obtained, try interchanging the "oscillator" and "buffer amplifier" transistors. In extreme cases, it may be necessary to change the ratio of *C1-C2*.

On the other hand, if a signal is obtained which is not a sine wave, try adjusting the value of *R1*. Again in extreme cases it may be necessary to vary the ratio of *C1-C2*.

As mentioned previously, the frequency of operation depends on the values of *CH1*, *C1* and *C2*. For most test work, the exact frequency of operation is not too important so long as it falls within the middle audio range—from about 300 to about 3000 cps. In the author's model, the operating frequency was approximately 1250 cps.

Should the builder wish a lower frequency, the size of *C1* and *C2* may be increased, maintaining approximately the same ratio. For a higher frequency, reduce the values of *C1* and *C2*, again maintaining the proper ratio.

The transistorized audio signal generator may be used in almost every application where a conventional (vacuum tube) generator might be employed. A few typical applications are listed below. In each case, the techniques described may be applied equally well to p.a. amplifiers, intercom circuits, phonograph amplifiers, or the audio section of a broadcast or short-wave receiver.

Signal Injection Tests: Where an amplifier is "dead" or "very weak," the transistor audio signal generator is used to inject a signal at the input of each stage, starting with the output stages and working back, stage-by-stage, towards the preamplifier. The output signal may be heard in the loudspeaker, observed on an oscilloscope screen, or measured using an a.c. v.t.v.m. or output meter. The point at which the output signal first disappears indicates the defective stage. Routine voltage and resistance tests in that stage will generally permit the trouble to be isolated to a specific part.

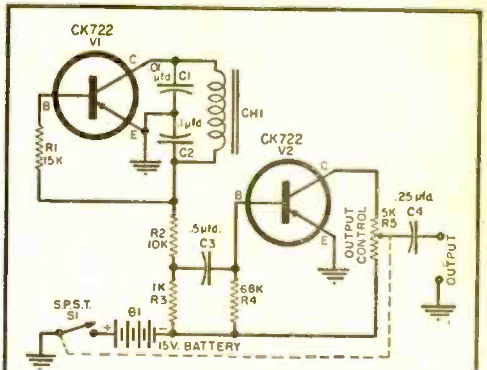
A coupling capacitor may be easily

checked for an "open" using this technique. Simply "inject" the audio signal on each side of the capacitor and note the results obtained. If the signal dissappears on the "input" side of the capacitor, a replacement is indicated.

Gain Tests: Where an amplifier is "weak" rather than "dead," the transistor audio signal generator may still be used to isolate the defect to a specific stage (or stages). The audio signal is applied to each stage of the amplifier, in order, and the output and input signals to the stage measured, using an oscilloscope or a.c. v.t.v.m. By comparing the two signal levels, the gain of the stage is immediately determined, and "weak" stages are effectively isolated.

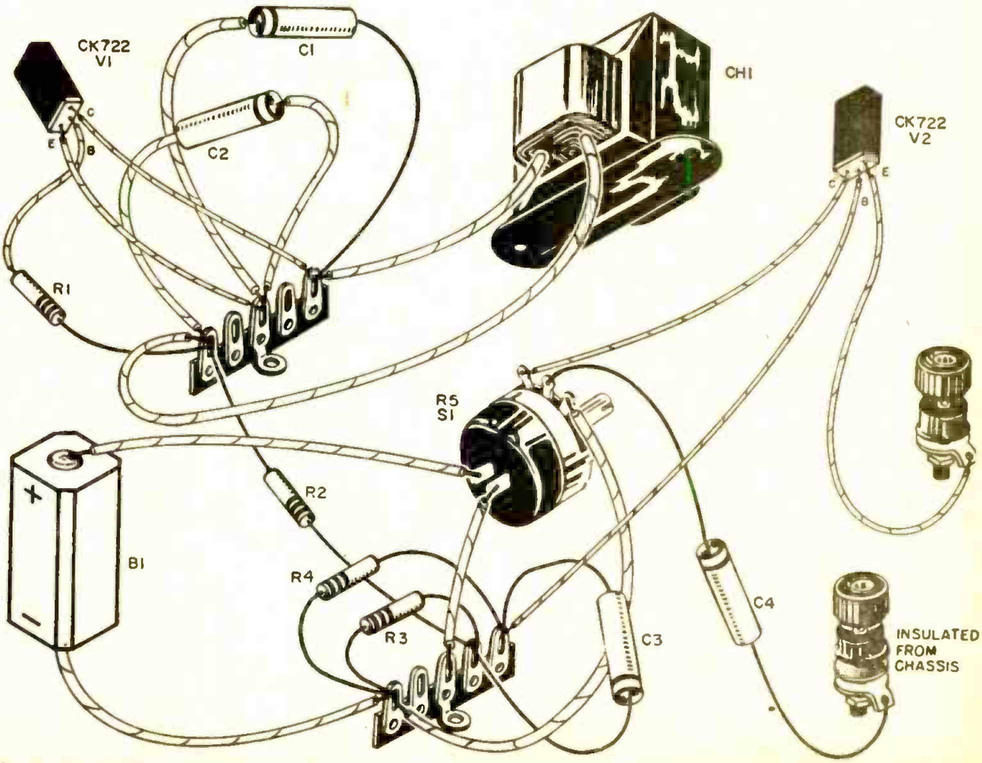
Distortion Tests: Since the transistorized audio signal generator supplies a good quality sine wave, the instrument may be used for general distortion tests. The audio signal is applied to the suspected stage and the appearance of the output observed on the screen of an oscilloscope. If the positive half-cycle of the applied sine wave has been flattened, it generally indicates either insufficient bias, a weak tube, or low screen or plate voltages. If the negative half-cycle of the applied signal has been flattened, it generally indicates excessive bias.

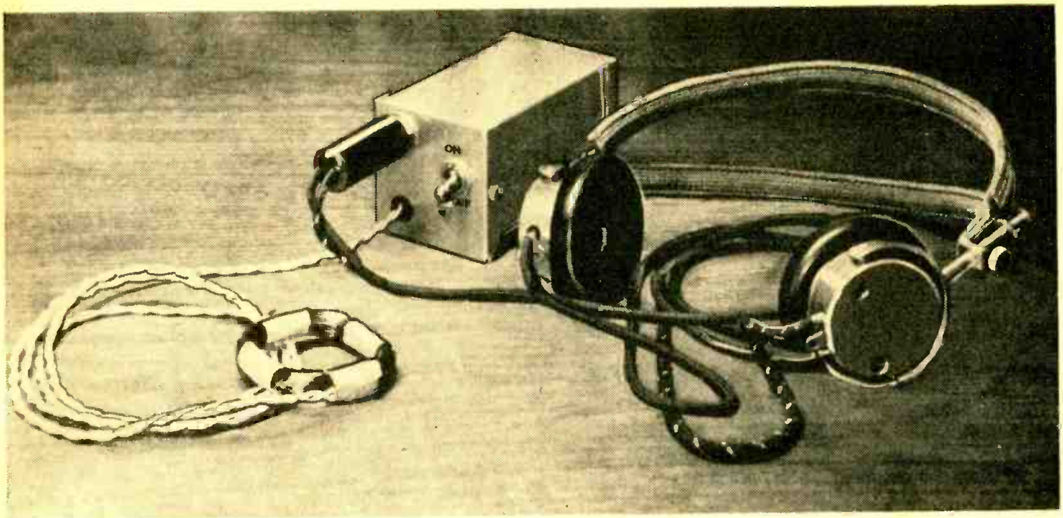
—30—



B1—15 v. hearing-aid battery (Burgess U-10)
C1—.01 µfd. paper capacitor
C2—.1 µfd. paper capacitor
C3—.5 µfd. "metalized" paper capacitor
C4—.25 µfd. "metalized" paper capacitor
CH1—Small choke or output transformer (see text)
R1—15,000 ohm, ½ w. carbon resistor
R2—10,000 ohm, ½ w. carbon resistor
R3—1000 ohm, ½ w. carbon resistor
R4—68,000 ohm, ½ w. carbon resistor
R5—5000-ohm carbon potentiometer
S1—S.p.s.t. switch (on R5)
V1, V2—P-n-p junction transistor (Raytheon CK722)
1—Cabinet (Bud CU-3001 Minibox)
Misc.—Binding posts, hardware, small knob, solder, wire

Fig. 1 (above) is a wiring schematic of the signal generator. A pictorial diagram showing the various components is given below.





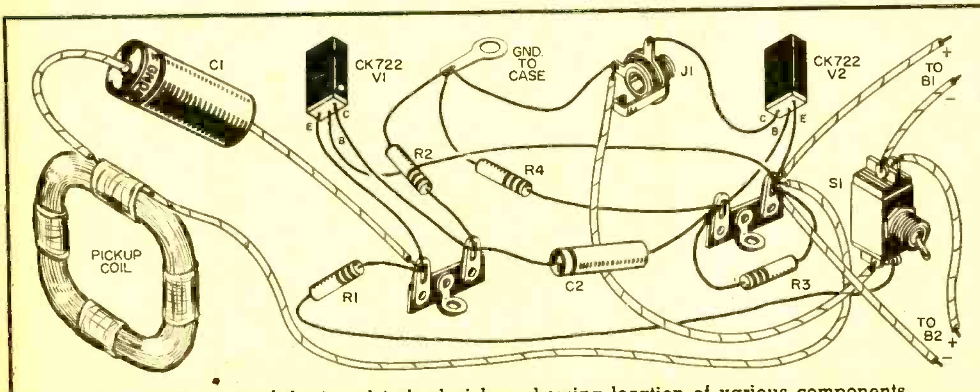
TRANSISTORIZED TELEPHONE PICKUP

By GEORGE BERRY

AN "AUDIENCE" at one end of a telephone conversation is often desirable. However, telephone company rules forbid connecting external devices to their lines since such devices can impair line balance and ringer operation. The solution to this problem is to use an induction pickup.

The little gadget to be described here consists of a home-made pickup coil, taped to the outside of the telephone wall box, plus a small transistor amplifier and a pair of headphones. Headphones enable a third person to hear both ends of the conversation.

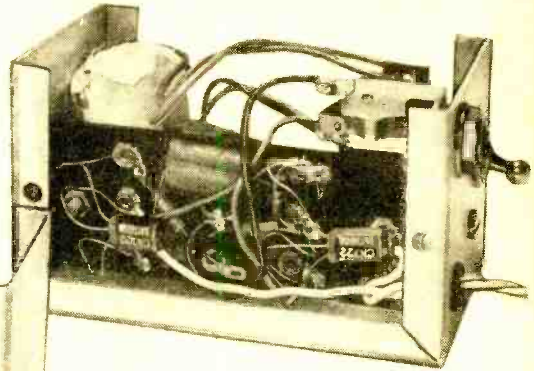
The transistor circuit is conventional and requires no hard-to-get parts. The amplifier was built in a standard 2¼" x 2¼ x 4" "Flexi-Mount" aluminum box. As shown in

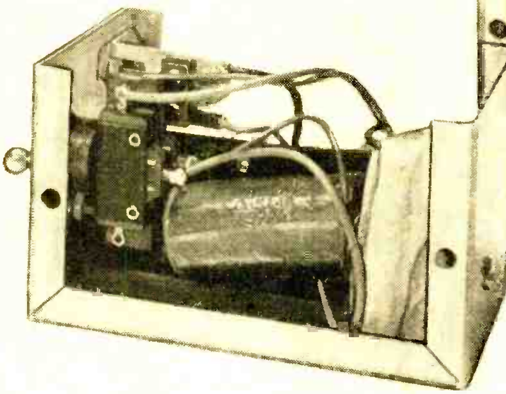


Pictorial diagram of the transistorized pickup showing location of various components.

←

Completed telephone pickup consists of a home-made pickup coil, small transistor amplifier and headphones. Pickup coil is taped to outside of a telephone wall box.





Side views of amplifier with cover removed. Layout is not critical, and shielding is unnecessary. The conventional transistor circuit requires no hard-to-get parts. This pickup can be duplicated by the constructor for about $10.00. Experimenters may use the coil and amplifier for audio induction tests.

the photographs, the circuitry is mounted on a card of 1/16" Bakelite with nine eyelet lugs riveted in for the tie points. Any handy type of construction will work. Layout is not critical and shielding is not necessary. The power supply consists of four "Penlite" batteries, wrapped with tape and placed in the right-hand corner of the case.

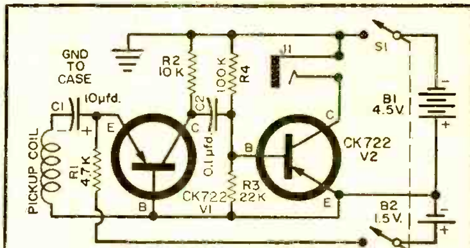
Solder the transistor leads only after all other connections have been soldered to their terminals. Leave the leads full length, hold them an inch back from the end, and solder quickly with a hot clean iron. If soldering is done properly, the fingers won't feel the heat. Excess heat will ruin transistors.

On desk-type phones without a wall box, signal pickup is not as good but still usable. A thin, flat, doughnut-shaped coil of about 360 turns of No. 30 "Formex" or similar wire—four inches in diameter—is better here, placed flat against the bottom of the phone base.

In place of the transistor amplifier, any audio amplifier having a mike input will work with these pickup coils. Use a 200-ohm line-to-grid transformer between coil and amplifier input. In fact, a high-impedance pickup coil can be made by removing the core from an old interstage audio transformer and connecting the secondary terminals of the winding directly to the mike input. Shunt the coil with a 270,000-ohm resistor for better frequency response. The magnetic field that such coils pick up comes from a small transformer inside the phone box.

Monitors of this sort are fun as well as being useful; but don't abuse other peoples privacy, and don't record a conversation without permission, or without using equipment that puts the "beep" signal on the line as required by law. —30—

Readers who do not care to wind their own coils may find it worthwhile to experiment with the "telephone pickup coil" (Catalog No. 99S478) advertised by the *Allied Radio Corp.* This coil would appear to be a manufactured duplicate of the unit described in the text. It is currently sold for about $4.00.



B1—Three "Penlite" cells (Type K) in series
B2—One "Penlite" cell (Type K)
C1—10 μfd. electrolytic capacitor, 6-volt or any higher rating
C2—0.1 μfd. paper capacitor, 100-volt or any higher rating
J1—Phone jack, open-circuit type
R1—4700 ohm, ½-watt resistor
R2—10,000 ohm, ½-watt resistor
R3—22,000 ohm, ½-watt resistor
R4—100,000 ohm, ½-watt resistor
S1—D.p.s.t. toggle switch
V1, V2—Type CK722 transistor
1—Pickup coil, 650 turns No. 30 enamel wire bunch-wound on 1½" dia. form
1—Pair of magnetic headphones, high-impedance type (2000 to 8000 ohms)

Wiring schematic of unit with parts list.

The "Radio Add-On" Unit

By HOMER L. DAVIDSON

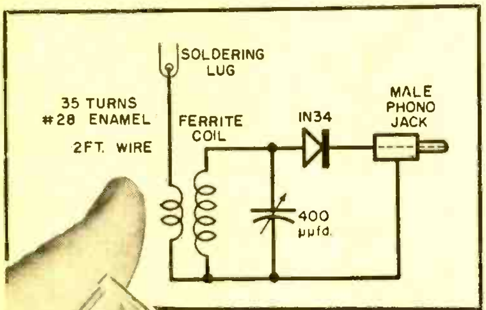
A simple, easy-to-build radio attachment for your TV set

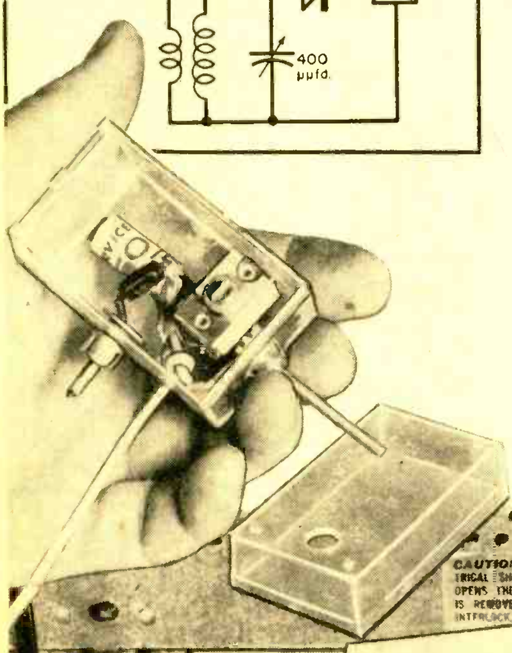
ATTACH this little gadget to your TV set and make your wife or mother happy. It will enable her to listen to a favorite radio program or news broadcast while she is ironing, cleaning, or just getting the meals ready for the table. The "Radio Add-On" can be especially valuable to those families who threw away the console broadcast receiver when they initially purchased a TV, or who have let the small radio gradually deteriorate until it is now not worth fixing.

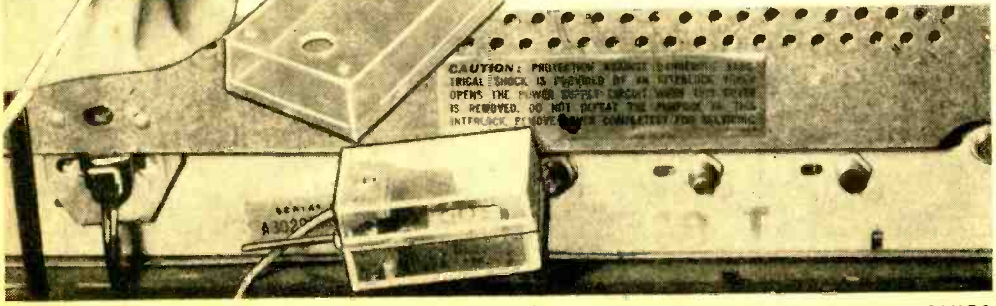
The "Radio Add-On" consists simply of a fixed crystal detector, antenna coil, variable capacitor, and a male phono plug. Use a commercial adjustable antenna coil similar to the *Miller* Type 6300. Wind a layer of Scotch cellophane tape around the coil, and over this wind about 35 turns of No. 28 enamel wire. Then place another layer of tape over this winding so that it will not unravel. One of the new coil wires goes to the bottom of the ferrite antenna coil and the other should be soldered to a long lead which serves as the antenna. This lead can sometimes be fastened to the antenna lead on the TV set for additional signal strength.

The author built his "Add-On" units in small plastic cases. The 400-μμfd. padding capacitor was soldered across the ferrite coil. Holes were drilled in the side and end of the plastic box for the tuning slug of the coil and the outside connection to the phono plug. Another small hole permits the "antenna" lead wire to exit from the case.

Tuning the "Add-On" is simplicity in itself. Obviously the unit will only bring in one broadcast station after it has been preset. Thus, the constructor should select the desired station using both tuning adjustments, the slug of the ferrite coil, and the 400-μμfd. padding capacitor. Any station in the standard broadcast band can be tuned in using these two controls. Once the "Add-On" has been preset, flipping the switch on the front of the TV receiver from "TV" to "Phono" will immediately bring in the station. —30—

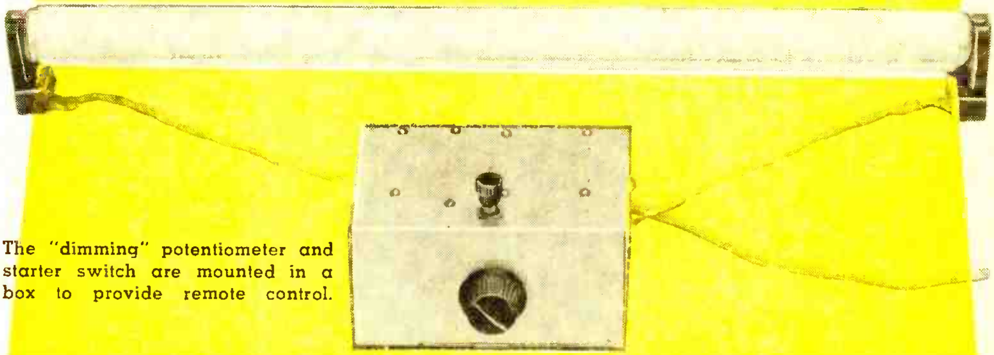






Schematic diagram (top) and photographic view showing assembly of the gadget (left) which is plugged into a TV set (below).

Dimming Fluorescent Lamps



The "dimming" potentiometer and starter switch are mounted in a box to provide remote control.

By H. J. CARTER

Filament transformers control brilliance of fluorescent tubes

THE IDEA of dimming is not usually associated with fluorescent lighting, yet there are many applications for dimmed fluorescent light. Background lighting for portrait photography, room decoration, and display lighting with mixed color lamps are typical examples. A fluorescent lamp in the living room should be dimmed when watching TV.

To dim a large number of lamps to extinction without perceptible steps in intensity, it is necessary to use a commercial circuit with a saturable reactor or thyratron control. When the number of lamps to be controlled is less than ten, use one of the inexpensive circuits described in this article; they will vary the light intensity from maximum down to 10% of maximum.

Commercial fluorescent lamp units use either a manual starter switch or a glow starter, and a special transformer or ballast coil. The dimmer circuits do not use these components; to convert a lamp fixture for dimming, use the manual switch and ballast in one of the circuit variations to be described later.

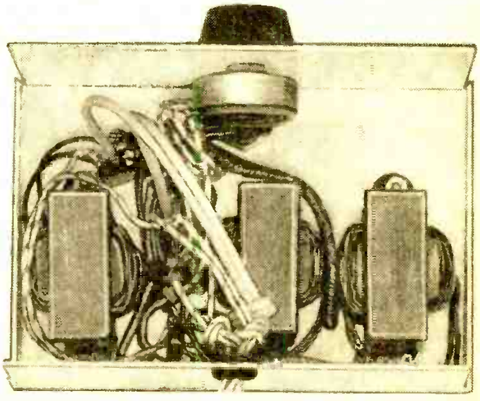
Circuit Operation

Fluorescent lamps are similar to neon bulbs in their characteristics; both fire at at a voltage considerably higher than their sustaining voltage; and both are voltage regulators, i.e., the the sustaining voltage is nearly constant for a wide variation in current. Because of its size, a fluorescent lamp would seem to require a very much larger firing voltage than a neon bulb except that a filament is provided at each end of the lamp.

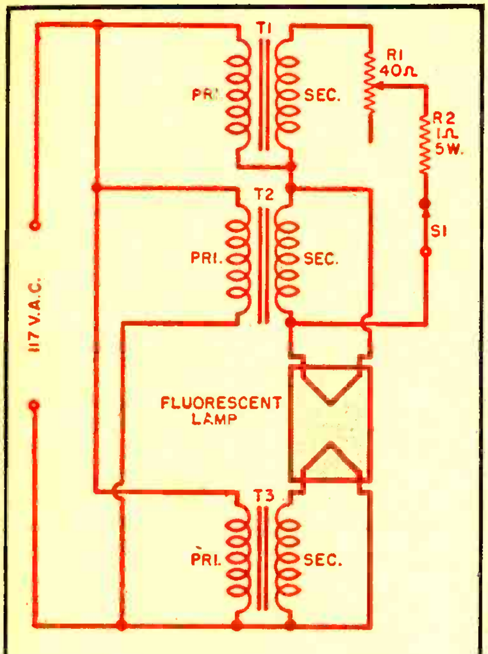
In normal lamp operation, the filaments are heated by applying about ten volts from a transformer built into the ballast coil. When the lamp conducts, gas ions bombard the filaments to maintain their temperature; the starter automatically disconnects the transformer power.

A dimmed fluorescent lamp operates with reduced current flow. If the current is too small, the filament temperature will drop to the point where the applied voltage is insufficient to sustain the arc, causing the lamp to extinguish. The lamp also has a tendency to flicker as this point is approached. To avoid these effects, the dimmer circuits provide a continuous flow of filament current to help maintain filament temperature. Filament voltage is not critical.

In the basic dimmer circuit of Fig. 1, transformers *T2* and *T3* supply filament



Under-chassis view of the remote control unit.



R1—40 ohm, 4 watt potentiometer similar to Mallory M40RK
R2—1 ohm, 5 watt resistor
S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed
T1, T2, T3—Filament transformer, 6.3 volts at 1.5 amp. secondaries, similar to Triad F14-X

Fig. 1. Wiring schematic of basic circuit with pictorial shown below.

power continuously at about half normal voltage. Power from *T2* also energizes the secondary of transformer *T1* under control of the potentiometer *R1*.

The primary of *T1*, the ballast, is connected so that the voltage induced by the *T2* secondary is added to the line voltage. This added voltage is regulated by varying the resistance of *R1*; at maximum resistance, the induced voltage is a minimum, while at minimum resistance set by the fixed current limiting resistor *R2*, the induced voltage is maximum.

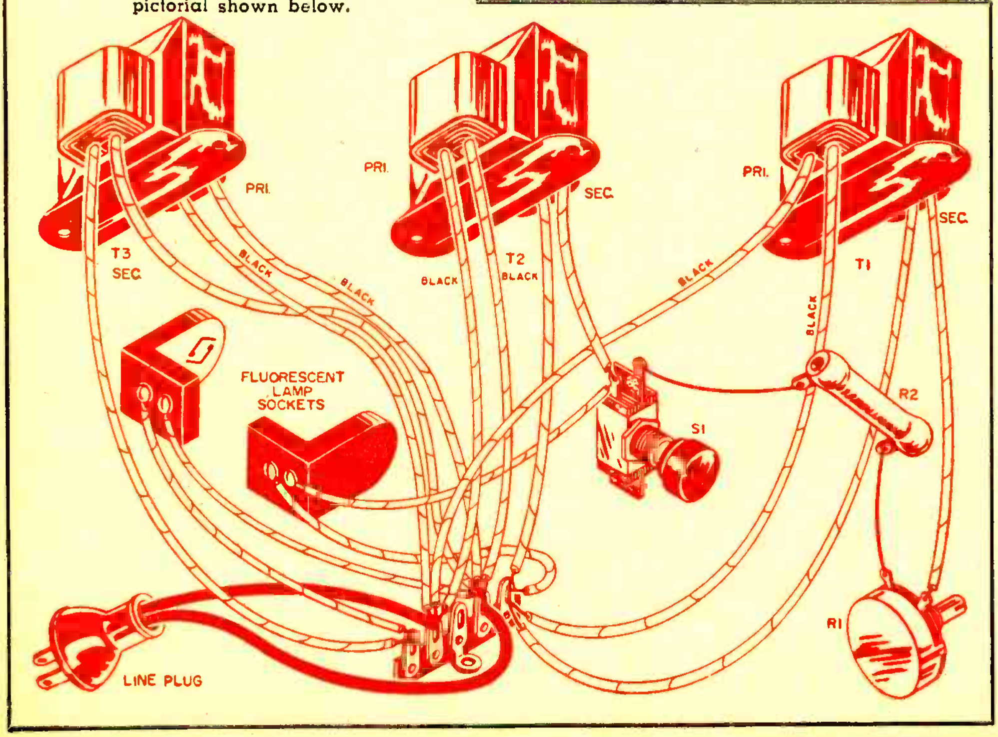
Potentiometer resistance is also *reflected* into the primary as a much higher resistance, so the ballast coil (primary) appears to have a variable reactance as *R1* is varied. The combined effect of voltage and reactance change is to vary the lamp current, thus varying the light intensity.

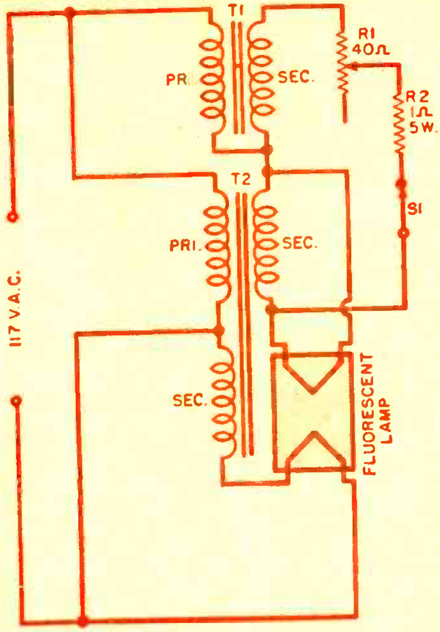
A normally closed switch, *S1*, is used for starting. Momentarily opening *S1* will produce a surge of about 700 volts across the primary of *T1*, enough to initiate the arc current.

Circuit Modifications

The dimmer circuit of Fig. 2 is the same basic circuit of Fig. 1 except that *T2* and *T3* are combined into one transformer. Choice of circuit depends upon the cost and availability of the transformers.

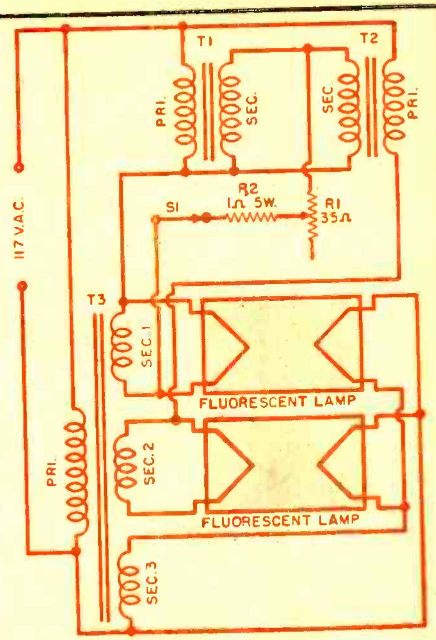
Multiple secondary transformer *T3*, used in the circuit of Fig. 3, could be replaced





R1—40 ohm, 4 watt potentiometer similar to the Mallory M40RK
R2—1 ohm, 5 watt resistor
S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed
T1—Filament transformer, 6.3 volts at 1.5 amp. secondary
T2—Filament transformer, two secondaries 5 to 10 volts at 1.5 amp. each

Fig. 2.



R1—35 ohm, 25 watt potentiometer similar to Mallory 25K35P
R2—1 ohm, 5 watt resistor
S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed
T1, T2—Filament transformer, 6.3 volts at 1.5 amp. secondaries (see text)
T3—Filament transformer with three secondaries 5 to 10 volts, similar to UTC S-72 or Triad F-36A (also see text)

Fig. 3.

with two or three separate transformers if they happened to be available, using the connections of **Fig. 1.** Do not combine the ballast transformers *T1* and *T2,* however, because each lamp must be controlled from a separate source. No two lamps are identical in their firing voltages, so if two were connected directly in parallel one would conduct first and lower the voltage available to the other to prevent it from ever firing. *Secondaries 1* and *2* of *T3* must be connected to separate lamps.

Instead of using *secondary 3,* it is possible to employ a separate transformer. If a commercial lamp were to be converted for dimming, the filament connections on the ballast that comes with the lamp could supply power to the two filaments shown connected to the third secondary of *T3.* Consult the diagram pasted to the lamp ballast before connecting the lamps.

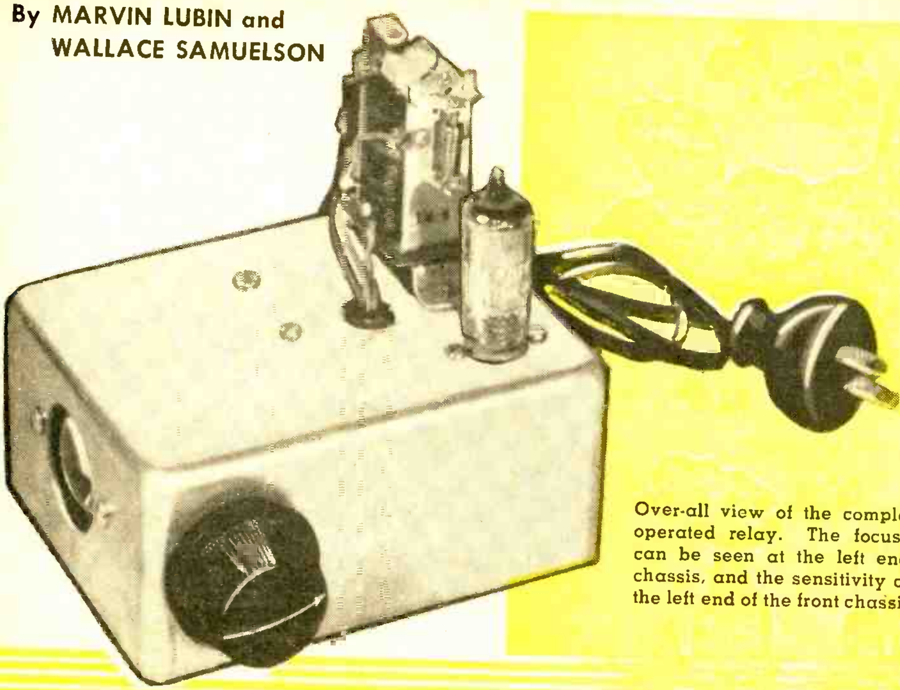
If the lamp to be converted had manual switches for starting and stopping, one could be used in place of the switch *S1;* usually the black button is normally closed, so the red button is not used.

Mount the potentiometer and starter switch in a box for remote control. A 3" x 4" x 6" aluminum box was used here, but if the experimenter builds any of the other circuits with alternate transformer combinations, he should measure the components to be sure they will fit the box.

All three transformers shown are rated at 1.5 amp., 6.3 volts on the secondary, sufficient to power up to one 40-watt lamp or its equivalent. In the circuit of Fig. 3, the ratings should be the same for *T1, T2,* and *secondaries 1* and *2* of *T3,* but the third secondary of *T3* should have at least a 2.5-amp. rating. Voltage ratings of the secondaries of *T3* can be anywhere from 5 to 10 volts. Voltage ratings for the secondaries of *T1* and *T2* should be the same as the secondary of *T3* to which they are connected, in order that each lamp will dim to the same intensity.

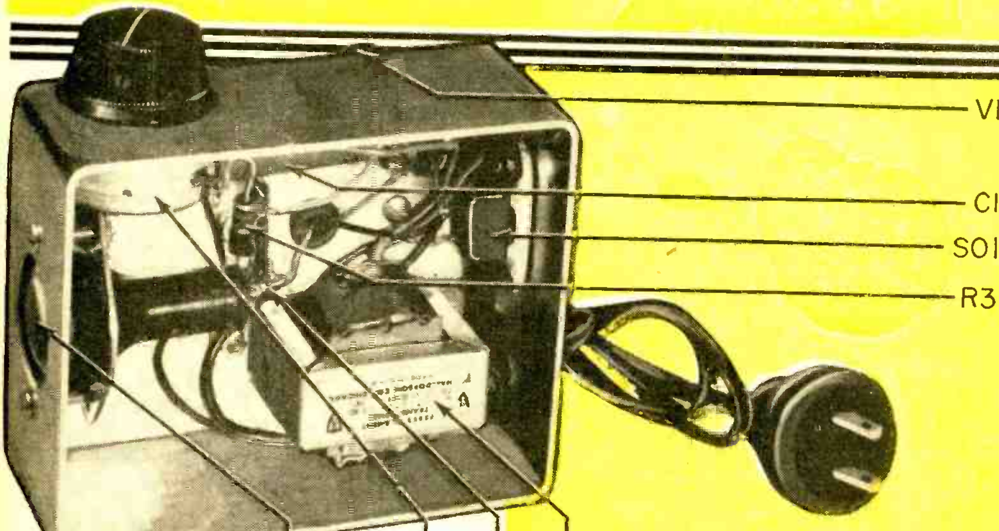
In all the circuits, the connections to the ballast transformer must be properly phased. If the lamp flickers and goes out when the rheostat is varied, reverse the primary connections. —30—

By MARVIN LUBIN and
WALLACE SAMUELSON



Over-all view of the complete light-operated relay. The focusing lens can be seen at the left end of the chassis, and the sensitivity control at the left end of the front chassis flange.

Light-Operated Relay Using a CdS Photocell



Under-chassis view of unit.

Sensitivity of this unit, which employs a thyratron triggered by a CdS photocell, can be adjusted over a very wide range

CADMIUM sulfide photocells have won wide acceptance in the relatively short time since they were introduced. Their high sensitivity and ruggedness make them ideal for many applications requiring a light-sensitive device. However, manufacturers are not resting on their laurels, but are continually striving to improve these cells.

The most recent advance is the development of a low-impedance cell which will provide a current of 8 to 10 milliamperes under illumination compared with 1 to 2 ma. from previous units. This new cell has a dark resistance on the order of a few megohms, compared with thousands of megohms for previous units, but in the large majority of applications this reduced dark resistance is of no consequence, while the increased current under illumination permits direct operation of cheaper, more rugged relays.

Cadmium sulfide crystals are grown from CdS powder in special furnaces. They are then mounted on electrodes and sealed in glass tubes or are potted in transparent plastic. Their resistance decreases in proportion to the applied illumination up to between 1 and 10 foot-candles. At higher light levels, the resistance continues to fall, but no longer in direct proportion to the illumination.

Presently available cells will operate up to a maximum of 400 volts with a maximum rated dissipation of 150 milliwatts. Change of resistance with temperature for a fixed illumination is about 2:1 in the range from $-50°C$ to $+70°C$.

One limiting factor of photoconductive materials is their response time. As a result of painstaking work with CdS crystals, the response time has been improved to the point that, for relay applications, switching times on the order of 1 millisecond can be obtained.

Last month a very simple light-operated relay was described in which the current through the photocell was used to operate a relay directly, without any amplification. In many applications, the available light is inadequate for such operation, or perhaps a more rugged relay is desirable. In such instances, a simple thyratron "trigger" tube can be employed to improve the sensitivity tremendously. The schematic diagram of such a unit is given in Fig. 1.

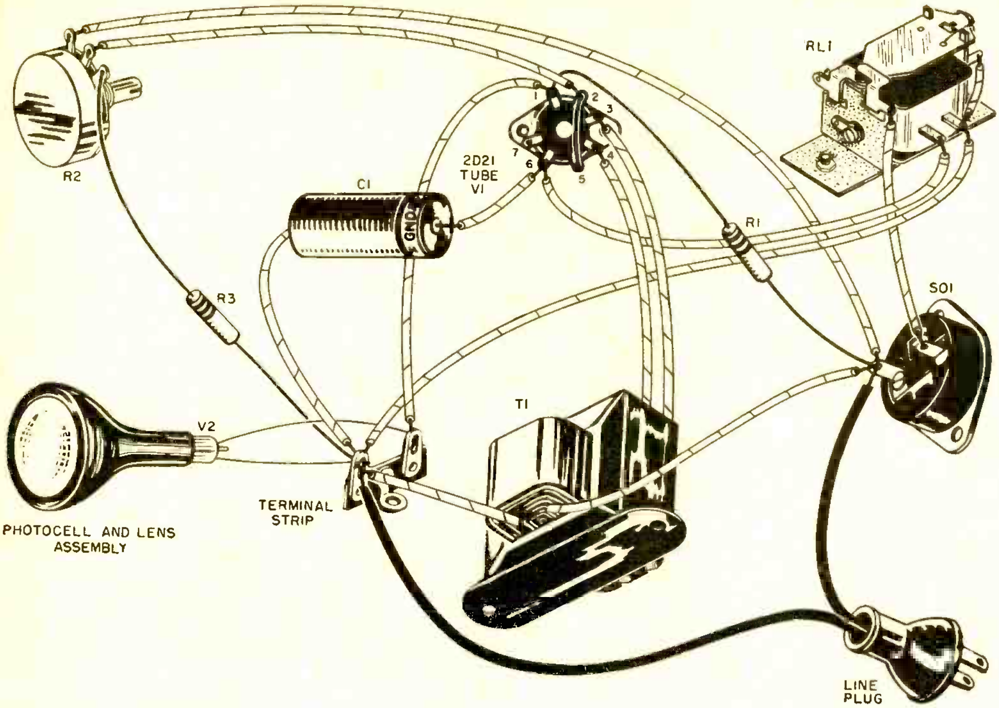
The control tube, *V1*, is a grid-controlled thyratron type 2D21, capable of passing up to 50 ma. of current. No rectifier is required since this tube is operated with a.c. on its plate and is self-rectifying. Pulsating d.c. flows through the relay coil, and is smoothed out to a certain extent by capacitor *C1*. This minimizes hum and vibration in the relay.

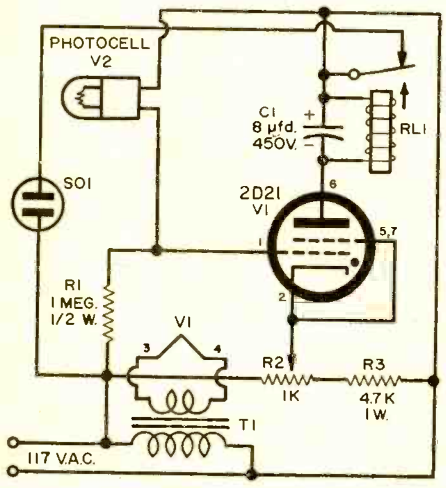
Sensitivity is controlled by the 1000-ohm potentiometer, *R2*, which serves to establish the cathode potential of the 2D21 thyratron. The potential on the control grid is determined by the current flowing through the photocell and resistor *R1*. This current increases as the result of illumination, increasing the grid potential and causing the tube to fire (conduct).

For a step-by-step analysis of this operation, assume momentarily that the right-hand side of the a.c. line is positive. The cathode of the 2D21 will then be at a slightly positive potential with respect to the other side of the line. With the photocell dark, no current will flow through *R1*, and the grid will be approximately at the same potential as the other side of the line. Thus, the grid will be negative with respect to the cathode, and the tube will not fire.

Under illumination, current through *R1* increases, making the grid more positive. When the grid becomes sufficiently positive, the thyratron will fire, closing the relay. It is not necessary to analyze operation during the other half of the a.c. cycle, as the plate of the thyratron will be negative with respect to the cathode, and no current will flow through the tube regardless of the grid potential.

Construction of the light-operated relay shown in Fig. 1 is similar to that described in the August issue. Reference to the photographs and pictorial diagram will make the construction clear. A small filament transformer *T1* provides power for the 2D21 heater. Any convenient chassis is satisfactory—a commercial 4" x 6" x 2" unit is ideal. Light is concentrated on the photocell by means of a small lens mounted at the large end of a rubber attachment plug cap from which the prongs





C1—8 µfd., 450 v. elec. capacitor
R1—1 megohm, ½ w. resistor
R2—1000 ohm wirewound potentiometer, linear taper
R3—4700 ohm, ½ w. resistor
RL1—Plate circuit relay, 2500 ohm coil, s.p.d.t. contacts (Potter & Brumfield LM5, LS5)
SO1—Chassis type a.c. socket (Cinch-Jones 2R2)
T1—Filament transformer, 6.3 v. @ 1.2 amp.
V1—2D21 thyratron tube
*V2—Cadmium sulfide photocell (Standard Electronics CdS-3 Type BX-2 or CY-2)**
1—Rubber handle plug
1—Line cord and plug
1—Lens, 1¼" diam., 1" focal length
1—2-lug tie point
1—4" x 6" x 2" chassis base
1—7-pin miniature tube socket
1—Molded knob for sensitivity control
Misc. machine screws, wire, solder, etc.

**Available from Standard Electronics Div. of Hupp Corporation, P.O. Box 513, Carlisle, Pa., at $3.55*

Total cost of parts, approx. $14.50

Fig. 1. Schematic diagram and parts list for relay. Pictorial diagram is at top of page.

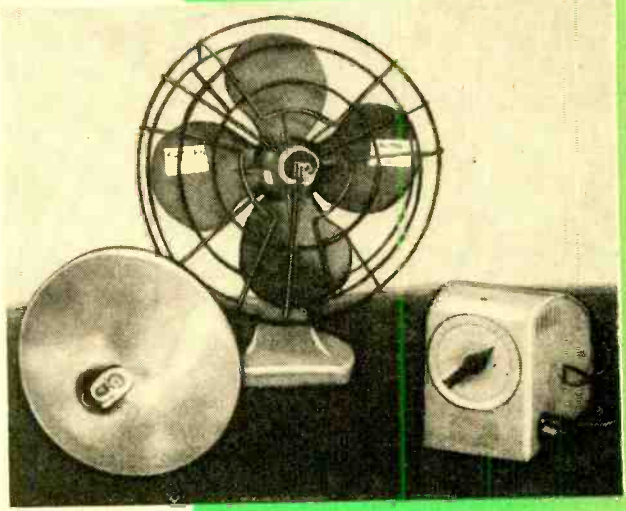
have been removed. Tape is wrapped around the photocell so that it fits snugly in the other end of the cap.

After the unit is completely wired and carefully checked, it should be plugged into the 117-volt a.c. line and allowed to warm up for a minute or so. The sensitivity control can then be set so that the relay will operate with the available amount of light.

A s.p.d.t. relay is employed, so that the external circuit can be either opened or closed as a result of light striking the photocell. In Fig. 1, the connections are such that the external circuit is normally closed, and will be opened whenever light of sufficient intensity strikes the cell. Such an arrangement can be used for turning on lights as darkness approaches, and then turning them off when daylight returns.

This device can easily be assembled in one or two evenings, and should provide endless hours of enjoyment. —30—

Flash lamp (left), control unit (right), and electric fan for checking operation of strobe.



Stroboscope

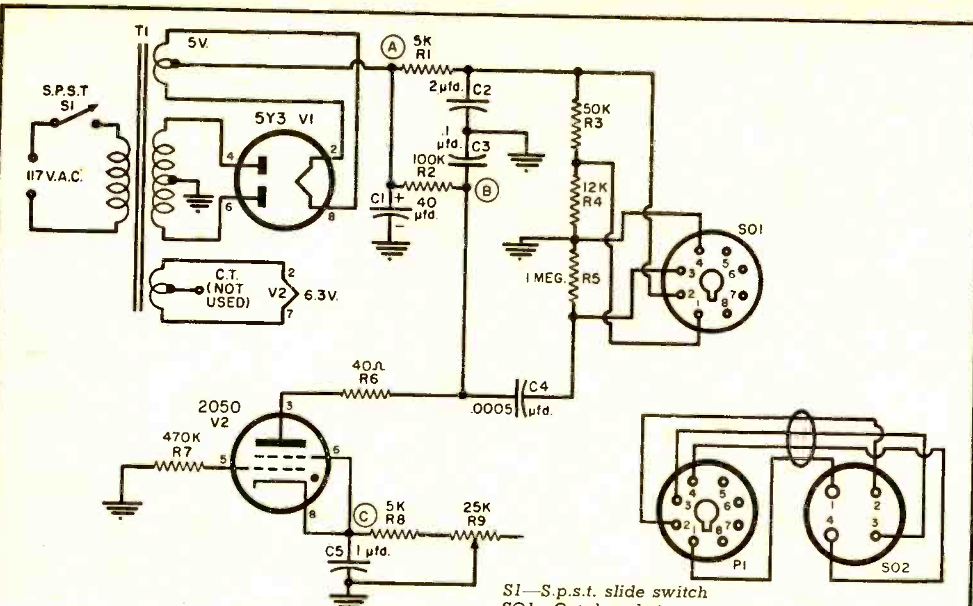
FOR THE ELECTRONIC WORKSHOP

By HARVEY POLLACK

This device is a valuable tool for freezing rapidly vibrating or rotating objects for close study, and for checking rpm and vibrational frequencies

A CALIBRATED STROBOSCOPE is one of those extra devices one finds in a well-equipped shop for which new uses are constantly arising. Whenever it is necessary to measure the speed of an electric fan, a circular saw, a grindstone, or other rotary machines in the shop, the "strobe" steps into the role of a safe and accurate tachometer; when bends and strains in vibrating machinery are to be pin-pointed, the stroboscope "freezes" the motion, permitting visual inspection of the high-speed machine and easy location of the fault; when a loudspeaker rattles and groans, viewing it under the slow-motion illumination provided by the adjustable strobe light makes the loose or worn portion stand out clearly.

The stroboscope is an essentially simple device. A special lamp—in this case, a neon-filled 1D21/SN-4 (or 631-P1) strobotron tube—having a flash duration of less than 5 microseconds is caused to emit short bursts of light at accurately timed



C1—40 µfd., 450 v. elec. capacitor
C2—2µfd., 600 v. tubular capacitor in can (Aerovox Type 610 or equivalent)
C3—.1 µfd., 600 v. tubular capacitor
C4—.0005 µfd., 600 v. mica capacitor
C5—1 µfd., 400 v. tubular capacitor
P1—Octal plug
R1, R8—5000 ohm, 10 w. wirewound resistor
R2—100,000 ohm, 1 w. resistor
R3—50,000 ohm, 1 w. resistor
R4—12,000 ohm, 1 w. resistor
R5—1 megohm, ½ w. resistor
R6—40 ohm, 1 w. resistor (author used two 80 ohm, ½ w. units in parallel—See pictorial)
R7—470,000 ohm, ½ w. resistor
R9—25,000 ohm, wirewound potentiometer
S1—S.p.s.t. slide switch
SO1—Octal socket
SO2—4-prong standard Bakelite socket
T1—Power transformer, 240-0-240 v. @ 55 ma.; 5 v. @ 2 amperes; 6.3 v. @ 2 amperes (Stancor PM-8402 or equivalent)
V1—5Y3 tube
V2—2050 thyratron tube
1—4' length of 4-wire cable, color-coded
1—Chassis and cabinet (see text)
1—A.c. line cord and plug
1—Pointer knob to fit 25,000 ohm pot. shaft
2—Octal sockets
1—1D21/SN-4 or 631-P1 strobotron
1—Standard pull-chain receptacle shell
1—Standard threaded reflector to fit shell
Misc. machine screws, nuts, solder, etc.
Total cost of parts, approx. $14.50

Fig. 1. Schematic diagram and parts list for the versatile electronic stroboscope.

intervals. When the flash repetition rate is correctly adjusted, any rotary or vibratory motion may be apparently stopped so that the device appears stationary. By varying the speed of the flashing light, the motion may be seen proceeding slowly in a forward or reverse direction at will.

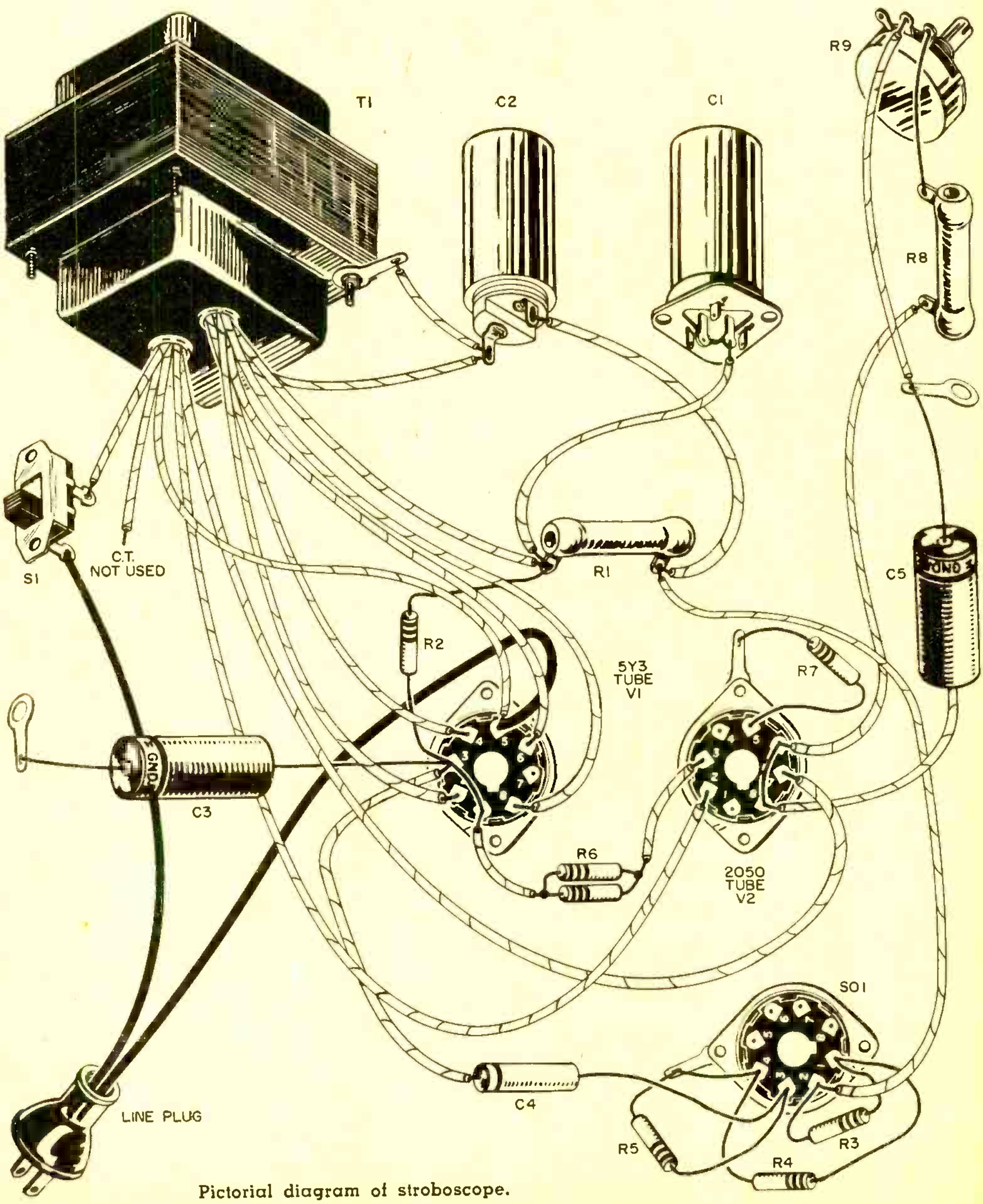
For example, suppose that an electric fan is rotating at 1800 rpm or 30 revolutions per second. At this speed, one complete revolution occurs in 1/30 of a second. If the blades are viewed under a light which flashes briefly every 1/30 of a second, they will be seen at exactly the same position at the peak of each flash. Since the remainder of the revolution takes place in darkness, the blades will appear to stand still. As previously mentioned, if the synchronization between the moving object and the flash rate is permitted to be somewhat imperfect, the former will appear to move very slowly and may be examined for faults, undesirable vibration, and origin of unusual noise. "Freezing" of motion also takes place when the blades turn through two complete revolutions between flashes (15 flashes per second for this example), three revolutions between flashes (10 flashes per second), and so on. As the strobe speed is reduced, however, flicker becomes annoying, so that the speed is usually adjusted for a 1:1 ratio.

The repetition rate of the stroboscope to be described in this article is continuously variable over a range which is more than adequate for home workshop applications. A 2050 thyratron tube is set up as a variable frequency relaxation oscillator which pulses the strobotron at a speed determined by the setting of a single knob, the "timing control."

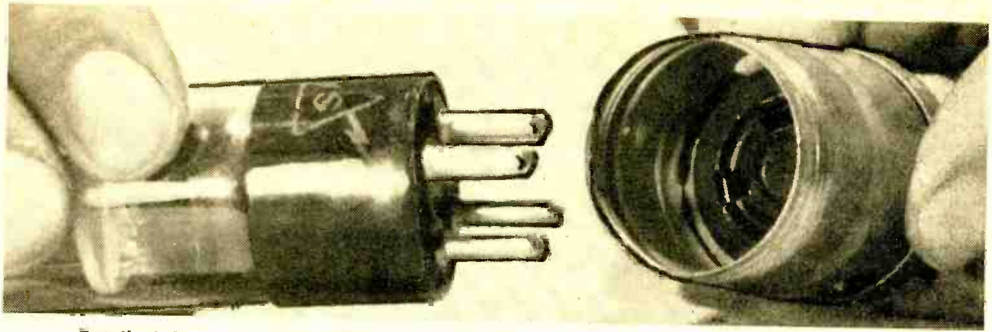
Construction

A discarded case and chassis originally belonging to a radio babytender were used in the author's instrument. Better, more commercial appearance can be achieved by designing the unit to fit into one of the handsome utility cabinets now available at most electronic distributors. (As a suggestion, either the *Bud Manufacturing Co.* C-973 case with matching chassis or the *Insuline Co.* Model 3801 would do the job admirably.) The component parts may be laid out in any fashion that suits the builder because the wire lengths and routing are not critical in any way. Chassis grounds are used throughout to facilitate the wiring; so in buying the tube sockets, try to get the types that have four grounding lugs arranged about the retaining ring.

To add to the convenience of the device during use, the strobotron and its reflector were mounted at the end of a 4', 4-wire cable. This allows the operator to move the light source around freely while the activating equipment "stays put" on the bench. The reflector end was fabricated by fitting a standard 4-prong Bakelite tube socket as required by the pins of the strobotron into the brass shell of an ordinary 120-volt a.c. electrical receptacle. Such receptacles have standard photographic reflector threading at their ends, as shown



Pictorial diagram of stroboscope.



Detail of the brass socket with a 4-prong socket installed for the 1D21 strobotron tube.

Measure From	Measure To	Resistance Expected (approx.)
A	chassis	over 65,000 ohms
B	chassis	over 165,000 ohms
C	chassis	over 10,000 ohms with wiper of R9 set at about half scale
strobe pin 2	strobe pin 3	over 1 megohm

Table 1. Resistance measurements in circuit.

Table 2. Data for calibrating stroboscope.

Stoppage Number	Frequency of Flash (cps)	Frequency of Flash (rpm)
1	60	3600
2	40	2400
3	30	1800
4	24	1440
5	20	1200
6	(do not calibrate)	
7	15	900
8	(do not calibrate)	
9	12	720
10	(do not calibrate)	
11	10	600

in photograph above. At the opposite end of the 4-wire cable is an octal plug which matches the socket at the side of the chassis. The "on-off" switch and the exit hole for the 120-volt line cord are both at the rear of the cabinet.

Wire the stroboscope like any other electronic device: mount the heavy parts first, then the light ones; wire the heater circuits for both the rectifier and the thyratron, and tuck these leads out of the way; then complete the chassis wiring and make up the cable. After the wiring has been completed, *and before power is applied*, the builder must test for short circuits and incorrect connections by means of an ohmmeter, as shown in Table 1. This will avoid damaging the transformer and other power components.

When it has been determined that the minimum resistances shown are present, power may be applied. The strobotron will probably begin to flash at a slow speed but as the thyratron warms up and assumes control, the flash rate should stabilize. Then, adjustment of the timing control will vary the repetition rate between five or six flashes per second to well over 65 per second.

Calibration Procedure

The easiest way to calibrate the stroboscope involves the use of a 10-cent cardboard stroboscope disc—many radio distributors give these away free-of-charge—and a phonograph turntable. Set the disc on the turntable under a 60-cps light source such as an incandescent lamp operated on standard a.c. or preferably under a fluorescent light. Find the ring labeled "78 rpm" on the disc. Then start the turntable and watch the 78-rpm ring; if the black and white areas remain stationary, everything is ready for calibration. If they move slowly, adjust the speed of the turntable (if there is a speed control) or load enough records on it under the strobe disc to get the speed just right. Remove the light.

Start the stroboscope light and let it warm up for a few minutes. Rotate the timing knob fully clockwise, then back it off while directing the neon light on the strobe disc until the 78-rpm ring becomes stationary. Mark the scale either 60 cps or 3600 rpm at this point, whichever is preferred. Now, going counterclockwise very, very slowly, a point will again be reached where the 78-rpm ring stands still; the frequency of flash is now 40 cps or 2400 rpm. Calling each of the points where the 78 rpm becomes static a "stoppage," Table 2 may be followed to calibrate the entire scale.

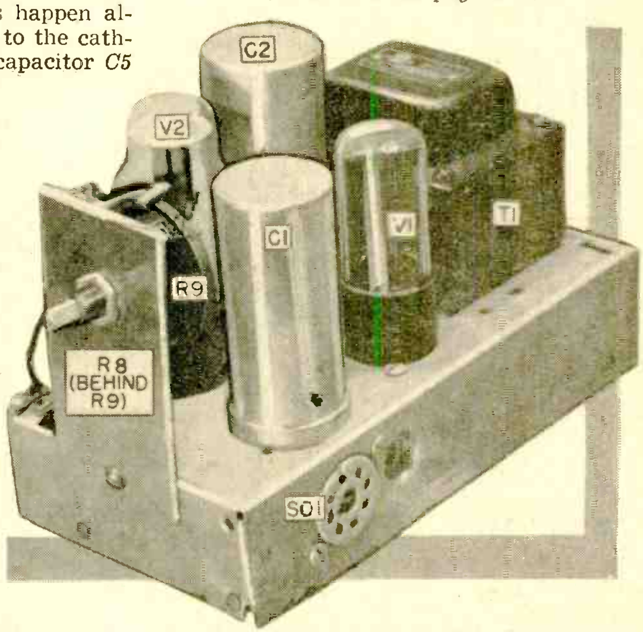
When using the calibrated scale for

tachometer purposes, always find the *highest* flash rate at which perfect "freezing" of the moving object is obtained. This is the correct value of the number of revolutions or vibrations per second (or minute) according to the scale.

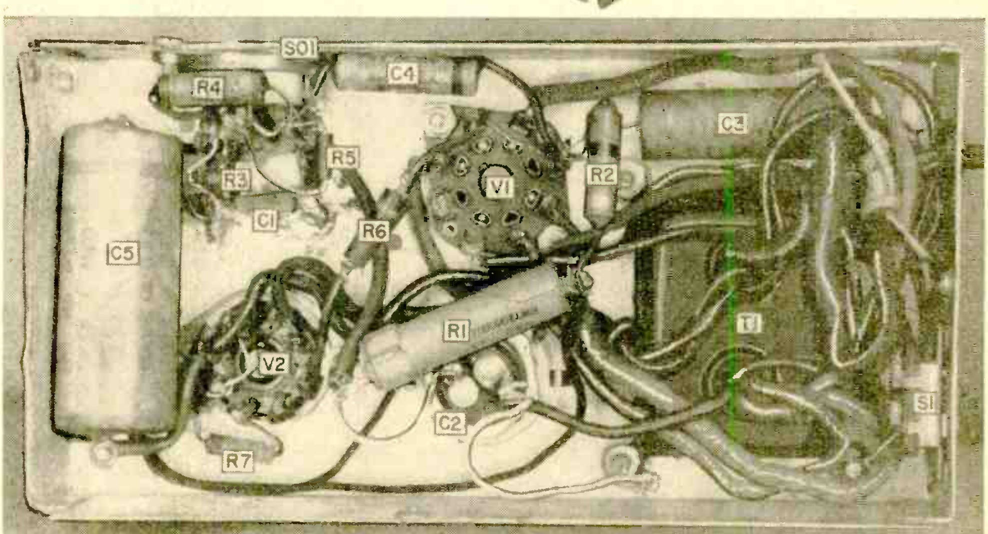
The strobotron is a cold-cathode gas-filled tube which fires only if its anode (pin No. 2, Fig. 1) is highly positive and if its control grid (pin No. 3) is made about 100 volts more negative than its screen grid (pin No. 1). The tube deionizes only if its anode potential is made to dip below about 60 volts.

When the equipment is turned on, the thyratron cathode soon heats sufficiently to emit electrons, and the tube ionizes and starts to conduct. Two things happen almost instantaneously: (1) due to the cathode current of the thyratron, capacitor *C5* charges positively at point C with respect to ground, its potential being equal to the voltage drop across *R8* and that part of *R9* in the circuit—thus establishing sufficient bias to tend to cut off the plate current; (2) the anode voltage of the thyratron drops practically to zero as its plate current discharges capacitor *C3* almost instantaneously. The presence of the bias and the simultaneous loss of anode voltage deionizes the thyratron. *C5* then begins to discharge through *R8* and *R9* at a rate determined by the setting of *R9*, continuing to do so until the bias is sufficiently reduced to permit the thyratron to fire again. (During this discharge time, *C3*

(*Continued on page* 109)



Top view of chassis, showing location of the major components. Stroboscope cable plugs into SO1.



Under-chassis view of the complete unit, with the various component parts identified. For proper orientation, compare location of SO1 with the location of this same socket in top view of chassis.

CARL & JERRY

By

JOHN T. FRYE

Smart technicians take every precaution against electrical shock; Jerry finds out the hard way

AUGUST had been a pretty hot month and now September was starting out the same way. Even down in Jerry Bishop's basement laboratory it was warm, and the youth puttering at his workbench was barefooted and wearing only a shirt and shorts. His pal, Carl Anderson, was seated on the bench swinging his long legs idly back and forth as he watched his chubby friend working on a radio receiver.

"The shielded loop antenna fastened to the back of this set is really directional," Jerry remarked, as he picked up the chassis and stepped away from the bench so that he could turn the playing receiver about. "Wups!" he said, as the tangle-shortened line cord pulled from the wall socket. He set the receiver down on the bench, untangled the cord, replaced the plug in the wall socket, picked up the set, and once more stepped away from the bench.

Suddenly his body gave a convulsive jerk and then became rigid. A low moan

forced its way between his clenched teeth. The cords in his neck and in his quivering wrists stood out tautly beneath the skin. His staring eyes looked agonizingly at his friend and then shifted imploringly over to the receiver a.c. plug in the wall socket.

Carl, whose widening eyes had been staring through his horn-rimmed glasses at the strange behavior of his companion, finally realized what was wrong; and in a single motion he leaped from the bench and tore the receiver line cord from the wall socket. In that same instant, Jerry dropped the chassis to the concrete floor with a resounding crash, tottered backward and collapsed on the leather-covered couch along the wall.

"Hey, Jer, are you all right?" Carl asked anxiously, as he bent over his friend. "What was wrong? Were you getting a shock from that set? Want me to get your folks or call a doctor? Hey, why don't you answer me?"

"Gimme a chance!" Jerry gasped, as he panted for breath through a wide-open mouth. "I'll be all right, I think, but that was mighty close."

For a few minutes he continued to gasp for breath, but gradually he began to breathe more easily and color started to return to his dead-white face. Carl, who had been watching him narrowly all the while, relaxed a little and returned to the chaffing way of talking that normally prevailed between the two fast friends.

"Heck!" he drawled, "I was hoping I might get a chance to use that new method of artificial respiration I've been practicing down at CD headquarters. Maybe," he said hopefully, "I ought to give you a little of it anyway. It won't hurt. I just sort of play you gently like an accordion."

"Keep your greasy paws off me!" Jerry warned, as he struggled to a sitting position and ruefully examined the seared white welts burned across the inside of his fingers where they had been in contact with the edges of the charged chassis. "Man, do those fingers feel hot! They must have a real fever in them. There's a nasty odor of burned flesh about 'em, too," he remarked, wrinkling his nose in distaste.

"Just wait a couple of hours until they begin to get sore," Carl encouraged.

"Well," Jerry said as he stood up rather shakily, "let's see if we can find out where I goofed. This whole thing was a shocking surprise to me, if you will allow a poor sick man a pun. I thought I was taking every precaution."

Carl set the receiver back on the bench, and the boys looked it over. Fortunately, it had landed on a corner that had doubled under and absorbed most of the shock. When a couple of tubes that had been jarred from their sockets were replaced, and the set was gingerly plugged in, it played normally.

"Pull the plug and let's see if we can reconstruct the accident," Jerry suggested. "Until we find out what went wrong, I'll be afraid to touch another electrical device of any kind. In some way the 117-volt line current must be reaching the chassis; although, in a transformer set like this, it shouldn't. Some a.c.-d.c. receivers have one side of the line connected directly to the chassis; but this is never done with transformer sets. Hm-m-m," he broke off as he reached for the ohmmeter probes, "I'll bet that's it."

"What's it?" Carl demanded. "Stop trying to sound like a pill-pusher with those knowing 'hm-m-m's' of yours."

"Each side of the line is bypassed to the chassis through a .05-μfd. capacitor," Jerry explained. "I'm thinking that one of them may be short-circuited."

Sure enough, as the probes were touched to the leads of one of the capacitors, the meter pointer indicated zero resistance. "That explains everything," Jerry said contentedly, as he tossed the probes back on the bench.

"To you, maybe; but not to me," Carl denied. "Only *one* side of the line was shorted to the chassis that both of your hands were holding. I thought you had to have a complete circuit path before electrical current would flow. Just touching one wire doesn't complete a circuit. You can't fool me. I've seen a bird roosting on a high-tension wire carrying thousands of volts."

"You're forgetting something. One side of the line coming into the house is grounded right out at the transformer. This is true of all two-wire services. For that matter, one wire of a three-wire service is grounded, too. The current was going from the ungrounded or 'hot' wire through the shorted capacitor to the chassis, then through my body and bare feet in contact with the damp cement floor, and finally back through the earth to the pole transformer out in the alley."

"You mean all you need to get a strong current flow is one wire and a good ground?"

"Sure; I'll show you." As he said this, Jerry picked up a short extension cord with a light bulb in its socket and removed the plug from the end of the twisted leads. Separating these leads, he connected a battery clamp to the end of each one. Then one clamp was clipped to the brass valve handle of a water faucet at one side of the basement, and the other was fastened to the end of a test lead. Jerry thrust the probe end of the test lead into one of the openings in the wall receptacle. Nothing happened. "That's the grounded side," Jerry remarked as he removed the test prod and thrust it into the other side of

the receptacle. Instantly, the lamp in the socket glowed with normal brilliance.

"Convinced?" Jerry asked.

"Of that part," Carl admitted cautiously, "but there're still some things I don't understand. Why didn't you get a shock as soon as you touched the chassis?"

"I was standing on this long strip of rubber carpet I put in front of the bench just to avoid having contact with the earth while handling electrical equipment; but you'll recall that I stepped backward off the rubber mat just before the jolt hit me."

"But you were off the mat the first time before the plug pulled out. Why didn't you get a shock then?"

"Because the plug happened to be in the socket in such a manner that the side of the line shorted to the chassis through the capacitor was the grounded side. When I straightened out the cord and replaced the plug, I must have reversed the position of the plug prongs so that the hot side of the line was the one shorted to the chassis. Then all that protected me from shock was the rubber mat, and when I stepped off that—"

"You began to shake, rattle, and roll," Carl finished.

"You can say that again. I felt just as though my whole body was clamped in a

(*Continued on page* 123)

THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

IT USED TO BE that every successful applicant for an amateur radio license had to pass a 13 word-per-minute code test. On the average, it takes at least 100 hours of practice to be sure of passing such a test. Today, the availability of the Novice Class license, with its five word-per-minute code test, has eased the situation considerably.

Most of the time expended in learning the code is required to increase one's ability to copy about eight words a minute. Fifteen to thirty minutes of practice a day for a few weeks will bring your speed up to this level, which will enable you to pass the Novice code test easily. Then, you can get most of the time-consuming practice necessary to pass the 13 word-per-minute General Class test while making actual two-way contacts over the air. Passing the Novice Class written examination is quite easy after a little study. (See last month's column.)

Contrary to what some of you may think, learning the code will not be a useless accomplishment after you obtain your license. Over half of all amateurs use it regularly—even though they could use phone if they wished—for three important reasons: (1) they like it, (2) a code transmitter is much simpler and less expensive than a phone transmitter of equal power, and (3) one watt of power in a code transmitter will give the same reliable range as four watts in a phone transmitter.

THE RADIOTELEGRAPH CODE

A	· —	U	· · —
B	— · · ·	V	· · · —
C	— · — ·	W	· — —
D	— · ·	X	— · · —
E	·	Y	— · — —
F	· · — ·	Z	— — · ·
G	— — ·	1	· — — — —
H	· · · ·	2	· · — — —
I	· ·	3	· · · — —
J	· — — —	4	· · · · —
K	— · —	5	· · · · ·
L	· — · ·	6	— · · · ·
M	— —	7	— — · · ·
N	— ·	8	— — — · ·
O	— — —	9	— — — — ·
P	· — — ·	0	— — — — —
Q	— — · —	.	· — · — · —
R	· — ·	,	— — · · — —
S	· · ·	?	· · — — · ·
T	—	/	— · · — ·
DOUBLE DASH	— · · · —	END OF MESSAGE	· — · — ·
ERROR	· · · · · · · ·	INVITATION TO TRANSMIT	— · —
WAIT	· — · · ·	END OF WORK	· · · — · —

Read the accompanying text before studying this chart. Don't think of the code as dots and dashes but as the sounds they symbolize.

Learning the Code

"Well begun; half done" describes learning the code exactly. The obvious way to begin is to sit down with a printed code chart and memorize it, "E—dot, T—dash," etc. It is also a very poor way. The code is not a visual language. It is sound language, consisting of two sounds most nearly described as *"dit"* and *"dah."*

Learning to copy it well is a matter of training yourself so that, as your ears hear these sounds in certain combinations, your hand will automatically write or print the proper letter. When the code is learned visually, at least one extra step is introduced into the process. This is not important at very low speeds, but at higher speeds there simply is not time between letters for any unnecessary steps.

The best way to learn the code is in a code class presided over by a good teacher, or with the aid of a patient tutor. In either event, to teach you the letter "E," the instructor will say "E" once and send *dit* on his key, while you write or print "E" on your paper. After repeating "E" several times, he will introduce another letter in the same manner and then alternately send the two letters, while you write them down every time he sends them.

Additional letters will be introduced in

George A. Hooper, Jr., Oreland, Pa., proudly examines his Novice license, which arrived on his 12th birthday. His call letters are WN3AML. George's father and mother, shown with him, are both licensed amateurs—W3BYB and W3SBE, respectively. (Photo by W3ARG.)

the same manner. Each time you have another one to contend with, you will have a tendency to forget some of those you have already learned. When this happens, the teacher will say the correct letter once and send it on the key a few times for you to write down.

Instead of sending each letter slowly, the instructor will send them at a speed equivalent to between 10 and 15 words per minute. He will slow down the over-all speed by increasing the spacing between letters. In this way, you will be forced to learn the letters by sound, because you will not have time to analyze them *dit* by *dah*. Yet, the comparatively long spaces between them will give you time to recognize the letters.

At first, you may find it fairly difficult to copy these rapidly sent letters, but stick with it, because this method of learning them will save you considerable time before you are finished.

Do not attempt to learn additional letters before you have thoroughly mastered those you have already studied. Also, do not make each practice session too long. After about 30 minutes of concentrated study, your brain will go on strike, and further study without a break will be largely wasted. However, if your tutor is also helping you to prepare for the written examination, you can transfer your attention to your books for a while and come back to the code later for another short session.

There is no best order in which to learn the code. A good one is to learn the vowels first and then work through the consonants and numbers in a random manner. In this way, you can start copying actual words for practice, almost from the start. In addition, it will reduce the possibility of associating one letter with another, as happens when they are learned in special "memory" groups.

By the time you have memorized the alphabet and the numerals, your copying speed will already be very close to five words a minute. A few more hours of practice, divided into short sessions, will raise your speed to seven or eight words per minute. This is adequate to pass the Novice Class code examination.

Recorded Code Courses

Lacking an experienced instructor, or to supplement his help, a phonograph-record or tape-machine code course is very helpful. Several of them are available through amateur supply houses. Some of the record courses are recorded at 33⅓ rpm, and others are recorded at 78 rpm; therefore, be sure to select one that will fit your player.

If a record player is not available, you may prefer to buy or rent a tape machine. Although the first cost of a good one is fairly high, a large number of reasonably priced practice tapes are available for them.

An advantage of recorded code courses is that they are always available for practice, and to repeat and repeat, as often as desired. A disadvantage is that, after several playings, they become partially memorized and give the student an exaggerated idea of his copying ability. As a result, additional practice material is required with them.

The two methods of learning the code to be described next are slower than those already described and are only recommended to those who must work without skilled help of any kind. Under the circumstances, you must memorize it the best way you can and depend upon your short-

(*Continued on page* 114)

The best way to place the hand and fingers on a telegraph key is the way that feels most comfortable to the individual operator. The position shown in this picture is typical.

Tuning the Short-Wave Bands

By HANK BENNETT

EVERY few days when we sit down to review the latest batch of tips and reports, we often find letters from the regular "stand-by" reporters who never let a month pass without sending in a report. We find letters and reports from newcomers. We find many reports that appear to have been written with a good deal of thought and others that were written in haste. The majority of the reports include listings of various stations that have been heard with the exact (or nearly exact) frequencies. Now and then, a report comes to us with the frequencies all approximated, some of them being as much as 200 kc. off. This type of report is actually of little value to us, or, for that matter, to any s.w. editor. It is not my intention to criticize this latter type of report, but rather to attempt to help those who are unable to have an accurately calibrated receiver or frequency standard.

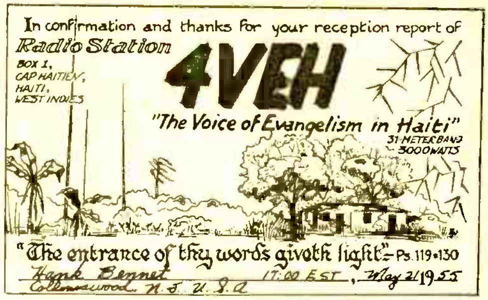
The ideal piece of equipment for any SWL's shack is, of course, a frequency meter. With one, you can determine the exact frequency of the station being received. But many DX'ers (including your Editor) are not fortunate enough—for various reasons—to claim ownership of a frequency meter. As a result, they are forced to make do with what they have.

One of PE's steady reporters, Floyd Backus of Richmond, Va., uses an HQ140X receiver. His antenna is 102' long, 30' high. Since this photograph was taken, he has added an RME 22A preselector and a 24-hour clock.

Again, another good way of determining frequencies is with a high-priced commercial receiver that does everything but turn itself on and off. The majority of our friends have low- or average-priced commercially made receivers, and practically all of these have a "logging scale" or the equivalent on the bandspread dial. In reality, this is nothing more than an extra scale with divisions from 0-100 or 0-200. And that is where we come in. With this logging scale and a piece of graph paper, you can make for yourself a tuning chart that will often be as correct as almost anything except first-line frequency measuring equipment.

On some receivers, the high end of a certain band will be at zero on the logging scale. On others, zero may be the low end. You'll have to determine that on your own particular receiver. We'll assume that zero is at the high edge for this discussion. Set the logging scale to zero. Tune in a known station that rarely—if ever—changes frequency. WWV on 10 mc. is a good one. Now, with the logging scale, slowly tune from 0 to 100, and record all the known s.w. stations that you can find. Knowing their frequencies will help.

The next step calls for a piece of graph paper. Or make a graph—it'll take but a few minutes. The one we drew has 14 horizontal lines and 21 vertical lines. Across the bottom of the vertical lines, we placed the numbers 0 to 100, each line being 5 more than the previous one. Coming down the left side, we began with the frequency of 10,000 kc. The next lower line was 9950 and so on, each lower line being 50 kc. less. At the zero vertical line, exactly where it intersected the horizontal 10,000-kc. line, we placed a large dot and the notation "WWV—10,000 kc." Coming down a bit, we located TIFC, Costa Rica, on 9647 kc. Others noted were GRH on 9825, ORU on 9767, Havana on 9026, Madrid on 9363; all of these were noted at their respective places on the chart. We drew a heavy line from the WWV dot down to the dot for Madrid, and the other dots fell into line. It's just a matter of time until you load up that line with dots. When an unknown station pops up, it's a fairly easy job to determine the exact frequency by going down the logging scale line to the point where it intersects the frequency line.



This QSL card was received from Station 4VEH, Cap Haitien, Haiti, often heard on 9639 kc.

SEVERAL READERS have commented on the lack of acknowledgments for certain items. By way of a brief explanation, we offer the following. Due to the large number of reports received, we try to condense items. Reports may come from several readers, and if we were to acknowledge each individual report or portion thereof, we'd have less room for items. Please bear with us; we're trying to give you as much information as possible. Tnx!

Now for this month's reports, with all times shown being Eastern Standard, based on the 24-hour system.

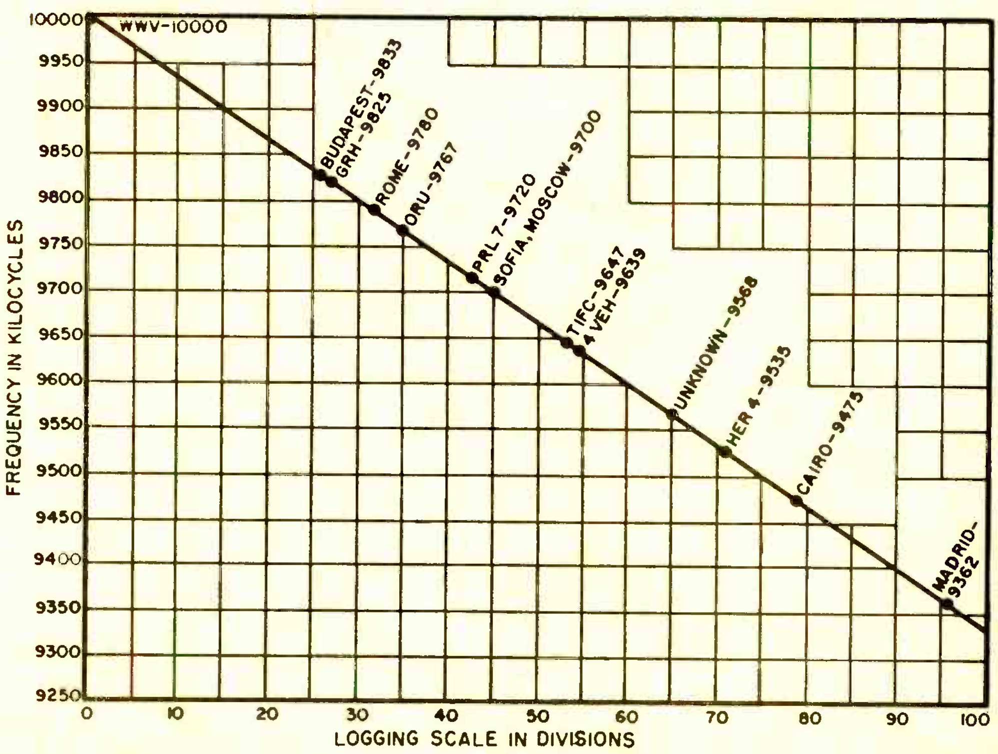
AUSTRALIA—VLB15, on 15320, has an English news period at 1745-1800. Perth (VLW9—one of the harder ones) has English news around 0608-0615, with a standard ABC program following the news. The latter is best in the early morning hours around sunrise.

BULGARIA—Sofia, 9700 kc., is noted operating at 1930-2030 and 2300-2330.

BRAZIL—A new station is *Radio Emissora Paranaence de Curitiba,* at Parana, Brazil. This one has been heard testing around 1600 and reports are requested. It definitely is *not* "Radio Club de Paranaence." The frequency is 9545 kc. Another new one is *Radio Globo,* Rio de Janeiro. No details are available at the moment except that it also operates on 254 meters in the broadcast band.

COLOMBIA—Of interest to pennant collectors is the offer of HJBB, *La Voz de Cu-*

(*Continued on page* 118)



Sample tuning chart for 9-mc. band, made with receiver logging scale and graph paper.

R/C NOTES

As the leaves turn red, yellow, and brown, somewhere in the calm, still autumn twilight an R/C flying fan lies on a pile of dead leaves with his back against a tree trunk, watching a fallen leaf lazily sideslip into a turn on its way down to earth. The frantic anxiety and bustle of an R/C flying meet is as far from his mind as anything can be. But the rest of us "normal" R/C'ers will remember that if autumn's here winter can't be far behind; so we'll get out to the meets scheduled for September. There are some interesting ones.

The *Seventh Upper Midwest PAA Load Meet,* a regional contest including R/C, will be held in Monticello, Minn., on September 4 and 5; contact Walt Billett, 2541 Nicollet Ave., Minneapolis, for further details. *The New York Aeronuts* are sponsoring a model airplane meet, including R/C events, to be held in Plainview, L.I., N.Y., on September 11; Murray Quitko of 410 E. 57th St., Brooklyn 3, N.Y., is contest director.

The popular family flying meet sponsored by the *Flying Bisons* of Buffalo, N.Y., will be held this year on September 18. At this writing, the contest director has not yet been chosen, but additional information may be obtained by getting in touch with Howard Thomas at 47 Stenzil Street, North Tonawanda, N.Y.

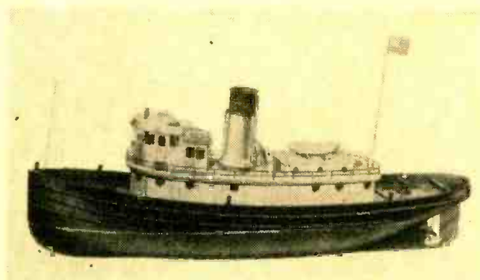
An unusual event which should be of interest not only to R/C'ers but to other hobbyists as well, is the *Third Annual Long Island Sound Hydro Championships* which will be held in Bayville, L.I., N.Y., on September 24. This meet, which is sponsored by the *Screamin Demons,* includes R/C events in the twin pontoon and flying boat classes of seaplane models. Donald J. McGovern is contest director and resides at 81-53 242nd St., Bellerose, N.Y.

If you live near Wichita, Kansas, you can take in the *"Y" Wichihawks Third Annual Contest,* which includes R/C. This will be held on September 25. Contact Jean P. Valle at 3891 E. Bruce St., Wichita 10, for further information.

Bell Telephone Laboratories recently announced that it has been able to produce an efficient solar battery which may conceivably be used someday soon to power some of the pole-mounted telephone equipment requiring relatively low voltages and current. Since this unit is still undergoing development, it will probably be some time before it is far enough reduced in size (and in price—the units now available from *National Fabricated Products, Inc.* sell for about $25) for practical applications around the home and in modeling.

However, the *International Rectifier Corporation* of El Segundo, Calif., is currently merchandising a line of small "sun batteries" retailing for around $2 which may be of interest to our R/C fans. Of course, at the present time, the power output of such units is extremely small, but the output of a sun battery may be amplified by a transistor amplifier so that the resultant voltage can be used to key a switching circuit. Such applications as timing controls, garage door openers, and battery chargers are "naturals" for this type of gadget.

Of interest to R/C model boat fans is the new model tugboat kit made available by the *Henry Engineering Co.,* of Burbank, Calif. It contains a scale model of an



ocean-going tugboat called the "Veco Tugboat 35," being 35" in length. Beam of the model is 8". This model is designed to operate at maximum efficiency with a three-channel radio control installation.

Whether you build your own R/C equipment or use ready-built gear, you'll need a battery box to house the various batteries and cells needed. From *Ectron Products Co.,* Box 393, Smyrna, Ga., comes the latest "triple threat" battery box. Measuring 1 1/8"x2 9/16"x2 7/8", this new container will hold either two 22½-volt batteries and six pen cells or three 22½-volt batteries and four pen cells. One of the best features of the case is the fact that it has individual spring terminals which give strong, even pressure at each contact point.

Selling for $1.65, this battery container may be obtained through your local hobby shop or direct from the manufacturer.

—30—

AMA-TOURING

with Roger Legge

THE 21-mc. band may become the best band for amateur DX within the next several years. It is a relatively new band for amateur operation, being allocated to amateurs by the 1948 International Radio Conference to compensate for reductions in the size of several of the lower frequency amateur bands. Authorization by individual countries for their amateurs to operate in this band was started in 1952. C.w. operation by U. S. amateurs was authorized in May, 1952. However, the band was not used much until it was opened for U. S. phone operation in March, 1953. This was just too late in the recently completed sunspot cycle for good DX conditions from Europe and Asia, as the 1952-53 winter season was the last one when the maximum usable frequencies were as high as 21 mc. on these paths with any degree of regularity.

Propagation conditions favorable for DX on the 21-mc. band are best from October through March, with intermediate conditions in September and April. Conditions have been better than expected during the summer months this year, with fair reception from Latin America and New Zealand.

With the sunspot numbers on the way up, September will be the beginning of improved DX conditions on the 21-mc. band. Eastern and Central USA listeners should particularly watch for Africans at 1200-1700 EST. Western listeners should find improved reception from the Pacific Area at 1200-2100 PST.

The 21-mc. band covers 21.00 to 21.45 mc. Usual distribution of stations is as follows: 21.00 to 21.05 mc.—c.w. stations, both U.S. and foreign, although there is only a small amount of c.w. operation on this band; 21.05 to 21.25 mc.—foreign phone stations; 21.25 to 21.45 mc.—phone stations in USA and U.S. territories.

Here are some of the stations to watch for on the 21-mc. band:

Africa—CN8CS, CR6AG, CT3AN, EA8AI, EAØAC, EL2X, FB8BC, FR7ZA, OQ5BI, VQ5BI, VQ2DT, VQ4EU, ZD1SW, ZD3BFC, ZD4BK, ZD6BX, ZE2KR, ZS3G

Americas—CE2AY, CE6AB, CP5EK, CX5AF, FM7WQ, FP8AP, FY7YE, HR1LW, PJ2CD, PZ1RM, YS1RA, VP1GG, VP2KM, ZB5GM

DX FORECAST FOR SEPTEMBER

From	In Eastern & Central USA (EST)		In Western USA (PST)	
	14 mc.	*21 mc.*	*14 mc.*	*21 mc.*
Central & South America	0600-2100	0900-1900	0500-1200	1000-1800
Europe & North Africa	0600-0800 1400-1800	——	1200-1400	——
Central & South Africa	1500-1900	1100-1800	1400-1900	0800-1600
Far East	0700-0900	——	0700-0900 2100-2400	1300-2200
Australia & New Zealand	0700-0900	1700-2000	0700-0900 1900-2300	1100-2100

The 24-hour clock system is used for these forecasts. Hours from midnight until noon are shown as 0000 to 1200, hours from 1 p.m. to midnight as 1300 to 2400. EST represents Eastern Standard Time; PST is Pacific Standard Time, three hours later than EST.

Pacific—KC6AA, KH6AHQ, KW6BB, VK2AQF, VR2CG, ZL2AJB, ZL4BO

HKØAI, SAN ANDRES ISLAND—Victor Abrahams, HKØAI, the only amateur on San Andres Island, writes as follows:

"I am located in the Caribbean, 120 miles east of Nicaragua, 400 miles from continental Colombia, though the islands belong to Colombia. San Andres is 9½ miles long and 4½ miles wide, with 4000 inhabitants. Main product is coconuts; we export 15 million yearly. We have air service to Colombia weekly.

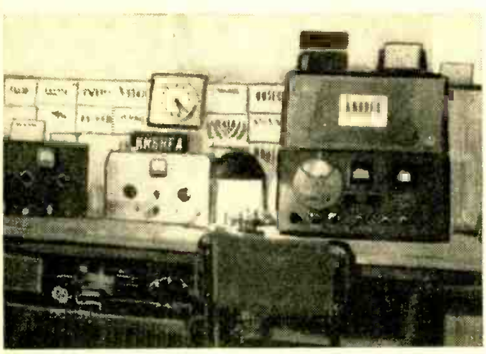
"I am the only amateur station here. The rig is home-made, 100 watts, with 3-element beam antenna. Receiver is a *Hallicrafters* S-40-B. My job is to take care of the signal station and beam for incoming planes, and I also operate a movie theater. I have a family of nine children and live on one of the most beautiful islands in the Caribbean."

Here are the month's reports on 14-mc. phone DX. All times are 24-hour EST:

Asia & Oceania

Australia—The VK's are coming through well on the West Coast at 0100-0300 and 0800-1100, and on the East Coast at 0530-0730, including the following: VK2SA 14.18; VK3AMH, 14.15; VK4MS, 14.11; VK5CE, 14.135; VK6KJ, 14.165; VK7AZ, 14.155. (*Moore, Mann, Kenney*)

Caroline Islands—KC6CG, 14.20 mc., on Ulithi Atoll, is putting a signal through to



Listening post and novice station of Hugh Clark, KN6HFA, Fresno, Calif. In three years Hugh has heard hams in 90 countries.

the Midwest and East Coast around 0700. (*Terry, Mann*)

French Frigate Shoals—KH6ABH, heard on 14.205 at 0630, is located at the U.S. Coast Guard Loran Station, Tern Island, French Frigate Shoals, 400 miles west of Hawaii.

Hongkong—VS6CL has been heard on 14.19 at 0900. (*Jim Moore, Calif.*)

Iwo Jima—KAØIJ, on 14.20 mc., is heard at 0600 (*Mann, Kenney*). The Volcano Islands are administered from the U.S. Hq. in Japan, hence the KAØ call; while the

This card is from one of rare South Pacific Islands to be heard on the amateur bands.

Bonins are administered from the U.S. Naval Headquarters in Guam, hence the KG6I prefix for Chichi Jima as separate from Iwo Jima (*Terry*).

Japan—The KA stations, operated by U.S. personnel in Japan, are heard well at 2330-0300 and at 0800-1000 on the West Coast and at 0530-0800 on the East Coast, including the following: KA2JW, 14.12; KA3EB, 14.15; KA4DR, 14.22; KA5WW, 14.12; KA7JS, 14.16; KA8AB, 14.19; KA9MF, 14.155 (*Moore, Hogan*); JAØAA, 14.155 mc., has been heard at 0915 (*Moore*).

Johnston Island—KJ6BG was heard on 14.25 mc. at 1000. (*Kenney*)

Marianas Islands—KG6SB, 14.185 mc., on Saipan, has been heard at 0150. Guam stations heard are: KG6AFX, 14.22, and KG6FAA, 14. 297. (*Moore, Mann*)

Marshall Islands—KX6BU, 14.22 mc., was contacted at 0630. His address is Navy Radio Club, FPO 824, San Francisco, Calif. (*Steve Mann*, K2CJN)

New Guinea—The VK9 prefix is used for New Guinea, Papua and Norfolk Island. New Guinea stations heard are: VK9AU, 14.17; VK9BS, 14.19; VK9RM, 14.14. (*Moore, Mann*)

New Zealand—ZL1BY, 14.15, continues to put through the best signals from ZL. He uses a V beam, 710 feet long. Other ZL's heard at 2200-0200 and 0530-0730 are: ZL1GX, 14.18; ZL1KN, 14.18; ZL2AAZ, 14.165; ZL2BE, 14.18; and ZL3AP, 14.14.

Norfolk Island—VK9OK, 14.11, and VK9RH, 14.09, are active from the island, located 900 miles northeast of Sydney. Listen for them around 0030-0200.

Papua—The most active station in Papua is VK9DB, heard on 14.105 at 1000; also on 14.16 at 0900. (*Moore, Kenny*)

(*Continued on page* 121)

POPULAR ELECTRONICS

Audio and Hi-Fi Section

Disc and Tape Review

By BERT WHYTE

BY THE TIME you read this, we will all be suffering from the heat of the September "dog days." If you are not entirely preoccupied with keeping cool, you might find the energy to listen to a little music. Keeping in mind the enervating qualities of the heat, it might be better to jump around the catalog this month and choose some material in a light vein, leaving the more ponderous heavyweight stuff for a cooler time. Perhaps what we had better do is to get together a "pop" program such as can be heard in almost any outdoor stadium or park at this time of year.

"Pop" Program

One of the perennial favorites of these "pop" concerts is the *Carmen* Suite from Bizet's great opera of the same name. As with any work enjoying such popularity, there is a more than plenteous supply of recordings from which to choose. At last look, there were ten versions available. Of these, an unusually large number can qualify as hi-fi in sound quality. No less than five are running in this sweepstakes—six really, if you count the Kostelanetz version which is titled an "orchestral scenario" rather than a "suite."

The Kostelanetz disc is one of the top contenders. Its advantage is that more of the Carmen material is presented here than on the other discs, arranged in the sequence in which it would appear in the opera. The sound on this version is one of the best of *Columbia's* recent efforts, although it must be pointed out that there is a tendency to emphasize the overlush orchestration of Kostelanetz, especially in the strings. These are typical of any Kostelanetz disc, very sharply defined with perhaps too much of an edge for some people. The brass is very bright and clean; and when you hear the woodwinds, you'll realize that not only are they sweet-sounding with very live intonation, but that some pretty fine players are with the Kostelanetz orchestra. Percussion is good on the disc, but a little more definition in the extreme bass would have been preferable.

The suite, as it is usually presented, has good recordings from Sir Thomas Beecham on *Columbia,* Anthony Collins on *London,* Stokowski on *Victor,* Golschmann on *Capitol* and Mario Rossi on *Vanguard.* This is really quite a mixed bag because best performances do not coincide with best sound.

The Beecham performance is perhaps the best of the lot, with Stokowski running a very close second. This kind of music is peculiarly suited to the talents of these two old hands. They know how to maintain a brisk tempo that doesn't drag, yet they avoid the trap of riding the horse too fast as do some of their contemporaries. The lyrical sections are lovely in the careful modeling by these two master craftsmen . . . no tendency to slush and schmaltz here! Stokowski has a slight edge in rhythmic purity, while Sir Thomas has the most expressive dynamics. Soundwise, the Beecham disc is the winner with a good clean recording featuring excellent percussion of great weight and rousing brass. A few seasons back, this recording was good enough to be used quite frequently as a demonstration disc. The Stokowski sound is quite old, which is all the more remarkable for the values contained therein. Generally clean and little distorted, it lacks the dynamic range and the better acoustics of later versions, this "dryness" of sound being the one major drawback.

Of the other versions, Collins on *London* has a fairly modern hi-fi sound, but suffers in several departments; the performance is good but not outstanding. The Golschmann/*Capitol* effort is very recent and has beautiful wide range in frequency and dynamics. String tone is brilliant, a mite edgy . . . brass really sounds out here, percussion is sharply etched, acoustics are suitable. The performance is well handled, but it doesn't generate the excitement of the Beecham or Stokowski versions.

The Rossi recording on *Vanguard* is the best-sounding of all the existing versions. Here is superbly clean, well-defined string tone, brass sonorities that you can "feel," brilliant soaring woodwinds and percussion of great impact and articulation. The acoustic perspective is ideal, not too dry, nor too reverberant. Rossi conducts at a pretty fast clip, and on a few occasions the ball gets away from him. The dynamics in this recording are quite spectacular, both soundwise and in the Rossi treatment of the score. You might say that Rossi is guilty of a number of musical faults, but it cannot be denied that he is a thorough craftsman; and for all its pace, his reading does not lack cohesion. This *Vanguard* disc has the equally popular and familiar *L'Arlesienne* Suite of Bizet on the flip side, as do several of the other discs, making a very appropriate coupling. The sound of the *L'Arlesienne* is best on the *Vanguard* disc, and it also receives a most commendable performance from Rossi.

Summing up . . . the sound on all the discs reviewed is compatible with good hi-fi sound systems; but the most spectacular sonics will be heard from the *Vanguard* recording, with the *Capitol* disc in place, and the Kostelanetz in show. Performance plum must go to Sir Thomas with Stokowski hard on the baronet's heels.

⊙ ⊙ ⊙

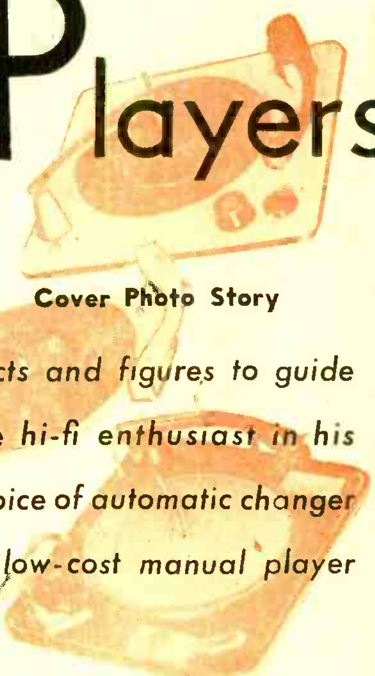
Another oft-played piece of music at pop concerts is Richard Russell Bennett's symphonic picture of *Porgy and Bess* from the opera by the immortal George Gershwin. There are four versions in the LP catalog, only one of which is hi-fi in sound. This is the Antal Dorati/Minneapolis Symphony reading on *Mercury,* an outstanding example of modern recording. No matter what the section of the work . . . be it the soft lyricism of *Summertime* or the spritely *I Got Plenty o' Nothin',* or the crashing sonorities of the fight scene . . . the music is flawlessly reproduced. Sweet soaring strings are an edgeless delight, the brass is superbright (just listen to the staccato figure a few bars before the beginning of *I Got Plenty . . .*), percussion is fabulous . . . huge blasts of tympani and bass drum, ultrasharp snare drums, the weighty clash of cymbals, the brazen clangor of the gongs in the fight scene . . . all are reproduced with perfect definition, with no distortion and with dynamics almost perfectly preserved. Add the spacious acoustics and Dorati's brilliant handling of the score, and you have a recording of extraordinary realism.

The flip side of the disc is a work that may be unknown to a great many of you, but it is one of the most outstanding demonstration pieces in the LP catalog. It is Morton Gould's *Spirituals for Or-*

(*Continued on page* 110)

By HANS FANTEL

What You Should Know About Record Players



Cover Photo Story

Facts and figures to guide the hi-fi enthusiast in his choice of automatic changer or low-cost manual player

AMONG the parts of a hi-fi system, the turntable and the tone arm have a unique distinction: they are the only "silent" parts. They should produce no sound and no electrical signal. Yet, paradoxically, these "mute" components vitally affect the quality of record reproduction as well as the life span of the records.

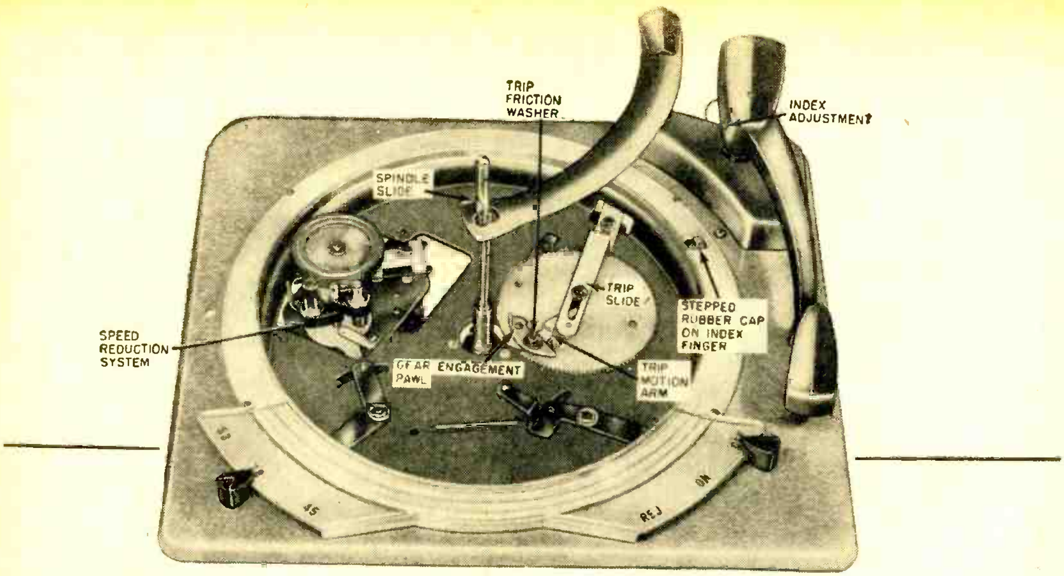
Electronics men sometimes snub the turntable and the tone arm as "merely mechanical." For such neglect, the carousel at the front end of a phonograph often gets its revenge by mixing distortion into the signal at the very source (where no signal analyzer can catch it) and by gradually chewing up the records. On the other hand, a properly selected turntable and arm or changer can be an immense help in preserving records and in coaxing all sonic detail from their grooves.

The turntable and the tone arm have two basic functions: (1) to rotate the record steadily at a preselected speed, and (2) to guide the pickup across the record in such a way that the stylus can track the signal in the groove with complete freedom from disturbing outside forces. Neither of these tasks are as simple as they might seem.

Turntable Requirements

First, consider the turntable. The motor must rotate it evenly at constant speed. Both motor and turntable must be free of hum radiation that might be picked up by magnetic cartridges. Motor vibration must be isolated by shock mounts and carefully designed torque transmission from the turntable and from the base or platform on which the tone arm is mounted. Otherwise, the vibration would become audible as a low "rumble" in the loudspeaker, especially at high volume. (This is a common defect of cheap equipment.)

The speed of rotation must be constant within a fraction of 1% to avoid changes of pitch, known as "wow," or a rapid chugging called "flutter." Either of these defects gives the music a weak, tremulous quality. It is especially noticeable and annoying when the pitch of the recorded



This view of a typical record changer, with turntable removed, reveals the complexity of design. Operation of changing mechanism depends on precise movements of tone arm.

musical instrument is absolutely constant —for instance, in long, sustained piano or organ tones. Slow piano or organ music, therefore, represents a good way to check a turntable.

To attain smooth rotation, hi-fi turntables should be dynamically balanced (something like balancing car wheels), and should have an even flywheel effect.

Tone Arm Requirements

The tone arm must meet three requirements: (1) correct stylus pressure, (2) tangential tracking, and (3) non-resonance. An arm deficient in any one of these may seriously distort the signal, jump grooves, hasten stylus wear, and literally turn records to dust long before their time. Let's examine these requirements in detail.

Stylus Pressure: Some arms use counterbalancing weights to attain proper stylus pressure. Others use spring tension. Weight or spring should be adjustable. Since the spring gradually weakens, the stylus pressure in spring-balanced arms should be occasionally checked and readjusted. Inexpensive stylus pressure gages are available for this purpose. Proper stylus pressure depends on the pickup used. This information is included in the pickup specifications. (See POPULAR ELECTRONICS, June, 1955, page 76.)

Tangential Tracking: A traditional headache of tone arm designers is the "tracking error," i.e., the deviation from a true tangent as the arm travels across the face of the record. Obviously, the arm can be at true tangent to the record groove at only one diameter, usually about half way through the recorded band. But proper tone arm design reduces the "tracking error" at the beginning and end of the record. Approximate tangentiality of the arm is necessary to allow the modulation from both sides of the record groove to act equally against the stylus. Otherwise, the signal becomes "unsymmetrical" and sounds distorted.

Non-Resonance: The arm must be non-resonant over the whole range of recorded frequencies. Otherwise, the arm itself would vibrate in rhythm with the signal in the groove. The stylus would then combine the arm vibration with the actual signal vibrations, producing a kind of ambient harmonic distortion. Besides, the sensitive groove walls of the record, with their delicate modulations, would literally take a beating from the vibrating arm.

These requirements apply equally to manually operated record players and automatic changers. The average buyer, without a complete testing lab in his home, cannot check all these factors himself. But knowing the requirements will help him select suitable equipment from the specifications published by reliable manufacturers. Of course, even the best equipment can produce nothing but mayhem unless the turntable is absolutely level. Checking every turntable installation with a spirit level, and making any necessary adjustments, is an excellent idea.

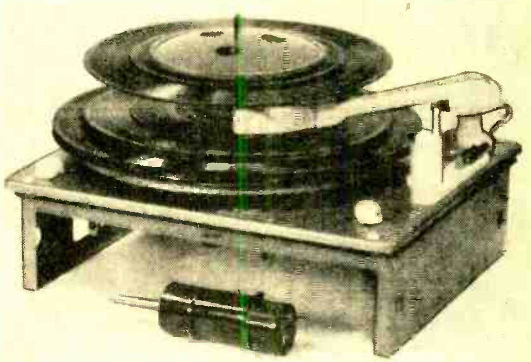
Automatic Changers

The choice between a manual player and an automatic changer depends largely on listening habits. LP records have made automatic changers unnecessary for anyone who doesn't mind getting up every 25

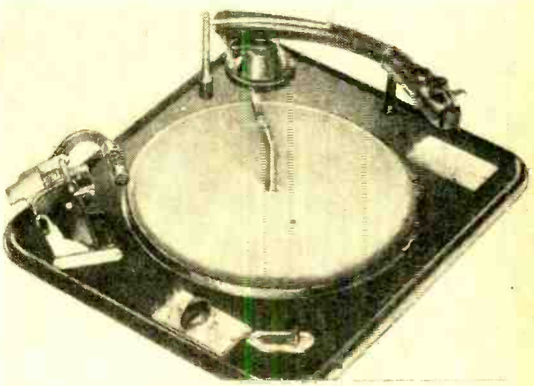
Collaro RC-54 plays all sizes of records. Rubber mat on turntable reduces chance of hum pickup, is dust-proof. Automatic idler disengagement prevents flat spots from forming on rubber idler wheel when changer is "off." Plug-in cartridge heads and adjustable stylus pressure are featured. Net, $48.75. (Rockbar Corp., 215 E. 37th St., New York 16, N. Y.).

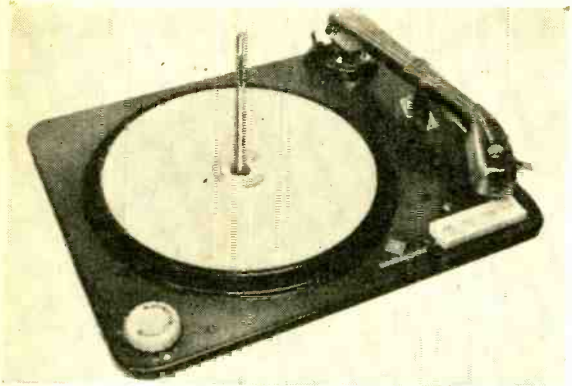
Dekamix, a recent import, features a motor of special design said to compare favorably with higher priced units. Tone arm is balanced by adjustable weights rather than spring. Turntable is rubber-faced. Plug-in head accommodates standard pickups. Net, $44.95. (Ercona Corp., Electronics Div., 551 Fifth Ave., New York, N. Y.).

Fentone Rex AA features a long, non-resonant tone arm for improved tracking of records. Knurled knob adjusts weight and thus stylus pressure. Rubber mat covers turntable. Short spindle may be inserted to deactivate the changing mechanism. Arm may be lifted during change cycle without damage to equipment. Supplied with base. Net, $59.50. (Fenton Co., 15 Moore St., New York 4, N. Y.)

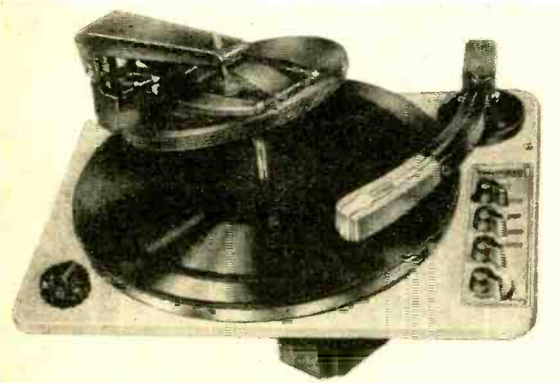


Garrard "Triumph" RC-80 has weighted turntable. Plug-in heads accommodate all pickups. Pull-out spindle permits quick record removal and turn-over. Easily replaced belt drive separates motor vibration from turntable. The "Crown" Model RC-90 features variable speed adjustment and heavier motor. RC-80 net, $48.51; RC-90 net, $68.11. (British Industries, 164 Duane St., New York 13, N. Y.).



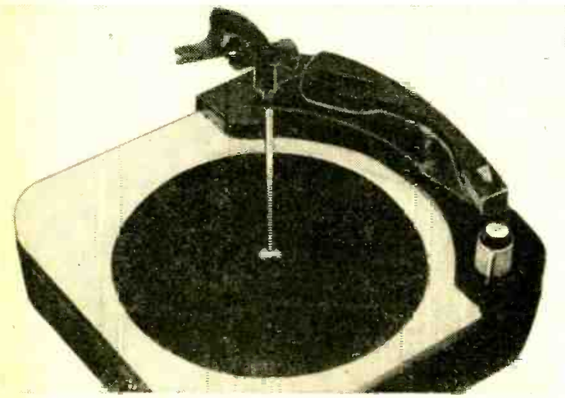


Miracord XA-100 boasts fine workmanship and ingenious design. Changing mechanism is housed in long center spindle, called "magic wand." Alternate short spindle permits manual operation. Built-in filter eliminates surface noise of old records. Plug-in heads accept standard cartridges. Unit has heavy-duty motor and well-mounted arm. Net, $67.50. (Audiogersh Corp., 23 Park Pl., New York 7, N. Y.).



Thorens CD-43 is generally rated as top quality changer in the field. Sturdy construction and precision manufacture characterize this unit. Direct gear drive from electronically balanced motor shaft eliminates all friction elements. Cast iron frame and flyball speed governor assure vibration-free and stable operation. Control permits variable speed adjustment. Net $93.75. (Thorens Co., New Hyde Park, New York).

V-M 935HF is an adaptation of a well-known inexpensive changer to hi-fi requirements. Four-pole motor assures smooth, hum-free operation. Laminated turntable is weighted and balanced. Muting switch assures silence during change cycle. Plug-in heads accept standard cartridges. This unit may also be used as manual player. Net, $38.20. (V-M Corp., Benton Harbor, Mich.)



Webcor G-1127-270 comes complete with metal base and G-E magnetic pickup. Four-pole motor is said to keep wow and flutter below 0.5%, hum below 40 microvolts. Arm can be adjusted for 6 or 8 grams stylus pressure. Turntable is covered with electrostatic flocking. Pickups other than G-E may be used. Net, $49.00. (Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago 39, Ill.)

minutes or so to turn or change the record. But listeners who like to stack up hours of music at a time, or who play mostly 78- or 45-rpm records, still have good reason for buying a changer.

Yet even for marathon listeners, the automatic changer is not an unmixed blessing. The following drawbacks should be considered:

1. Loading records on a changer is often quite a chore of fumbling with levers, supports, pusher platforms, etc. This is especially annoying when playing a single LP record, which could more easily be handled on a manual player. Of course, some changers are less cumbersome than others.

2. As the records pile up on the changer turntable after playing, the stylus comes down on each succeeding record at a different angle of incidence. This may hasten the wear of both stylus and record.

3. In most changers, the center spindle stands still while the turntable rotates, causing friction at the center hole of the record. Along with the action of the drop mechanism, this tends to ream out the center hole, so that after many playings the record may run off-center.

4. Most changers (except a few high-priced "Rube Goldberg" designs) do not turn over records. Hence, they cannot play with continuity a complete work recorded on both sides of the same record. After finishing the first side, the changer will simply go on to the next record. This is perhaps the most serious drawback, and, in the case of LP records, makes the practicality of an automatic changer rather questionable. It would actually be simpler to flip over an LP record by hand, using a manual turntable.

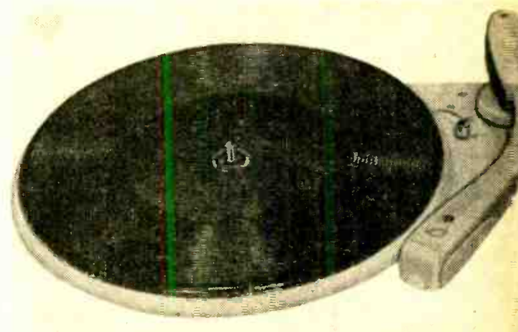
Each buyer must decide for himself whether for his particular type of listening the advantage of an automatic changer outweighs these drawbacks.

Manual Players

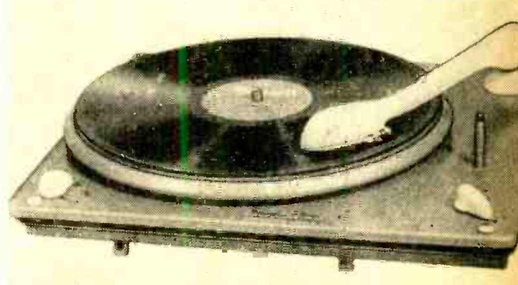
Manual players can be bought as fully assembled units that are very simple to install—just "plug in and play." Turntables and arms can also be bought separately and then mounted together on a board. This requires precision carpentry, but gives the buyer greater freedom in combining components of his choice. Because of the special design features of separate turntables and tone arms, they will be discussed in a separate article in the near future. For many audiophiles, the pre-assembled manual unit has proved quite satisfactory.

The absence of a complex changer mechanism saves both space and money. A pre-assembled manual player usually costs about $20-$30 less than a record changer

Bogen B-50's heavy construction, precision workmanship, and 11¾" weighted and balanced rubber-covered turntable give it professional transcription quality. A special feature is its continuously variable speed from 29 to 86 rpm, with notched settings at 78, 45, and 33⅓ rpm. This feature assures true pitch regardless of a.c. line variations. Long, well-mounted tone-arm is adjustable for stylus pressure and accepts standard cartridges. Net, $42.00, base extra. (David Bogen Co., Inc., 29 Ninth Ave., New York 14, N. Y.)



Collaro AC-3/554 (above) is a sturdily constructed, smooth-running manual player with features similar to its automatic counterpart, the RC-54. Turntable is rubber-covered to keep records dust-free. Plug-in cartridge heads accept standard pickups. Unit has automatic start and stop. Net, $25.20. Fentone Rex 3310-PE (below) is a 3-speed manual player with built-in spring suspension to eliminate acoustic feedback. Fentone Model 3332-PE (not shown) includes a variable speed regulator (± 3 rpm) and built-in preamplifier with tone controls. 3310-PE net, $36.75; 3332-PE net, $76.75.



Garrard "Model T", like the famous Model T of another line of goods, offers dependable service at low cost. Despite its name, there is nothing obsolete about it. Highly compact, it features plug-in cartridge heads, adjustable stylus pressure, automatic start and stop. Net, $31.75 (45-rpm spindle adapter included, base extra).

Miraphon XM-110 showed no trace of rumble or wow in stringent tests. Tone arm, featuring automatic shut-off and return, is made of special non-resonant material. It accepts standard pickups. Motor operates quietly. Stylus pressure is adjustable. Turntable is rubber-covered. Net, $37.50.

Thorens CBA-83 automatically places arm at start of record and returns it to rest when disc is finished. Turntable is weighted and balanced. Stylus pressure is adjustable. Arm accepts standard cartridges. Net, $67.50. Model CB-33 is similar but without automatic arm setdown. Net, $52.50.

of corresponding quality. Since no vertical space is needed for stacking records, manual players fit more easily into sliding drawers and other types of cabinetry. Or, with their walnut or metal bases, they can simply be put on a table or desk without any special installation. (Again, make sure they are level!)

Although these players do not change records, they have various degrees of "automation" built into them. Most have automatic switches that start the turnable when the arm is lifted and stop automatically after the record is finished. The *Miraphon,* for instance, automatically picks up the arm at the end of the record, returns it to the normal rest position, and then shuts itself off. The *Thorens* Model CBA 83 actually sets the stylus down at the beginning of each record, regardless of size. This feature is definitely worthwhile for people with unsteady hands. For others, it is convenience at a price.

All the players shown here meet hi-fi requirements for home music with respect to 4-pole motor, weighted and balanced turntable, and tone arm design. Capable of fitting into any system, these preassembled units offer a welcome combination of quality, simplicity, and economy. —30—

THE MEANING OF

FREQUENCY RESPONSE

(PART 1)

BY NORMAN H. CROWHURST

First of a series explaining a very important hi-fi term on the basis of components that influence performance

PROMINENT in the specifications of any amplifier is a statement of its frequency response. This is because frequency response is probably the most easily recognized and understood of all the possible specifications in audio equipment. Frequency response is called "flat" when the equipment responds uniformly to all frequencies throughout the audio spectrum, which is generally specified as covering from 20 to 20,000 cycles.

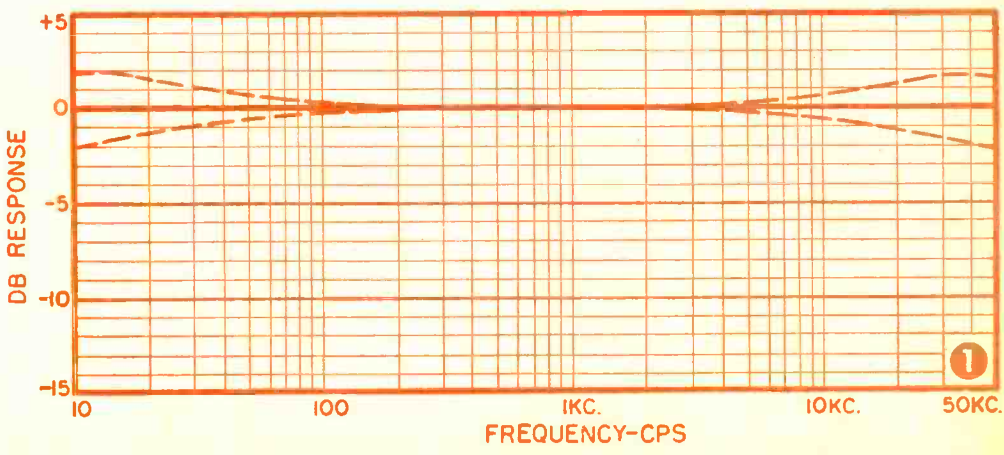
The term "flat" derives from the method usually adopted of plotting frequency response graphically. Ordinary squared ruled paper used for plotting graphs is not used to plot frequency response. Slightly different rulings are employed for the graph paper. The reason for this change arises from the relationship between frequency and the apparent pitch, and between the intensity and the apparent loudness of sound.

Plotting Frequency Response

A change of pitch of one octave corresponds to doubling the frequency. Thus, graph paper should be used on which 130 cycles, 260 cycles, 520 cycles and 1040 cycles are spaced apart uniformly. A logarithmic frequency scale achieves this uniform spacing. Each octave of frequency change corresponds to the same distance in a horizontal direction along the graph. Multiplying the frequency by successive factors of 10 also gives a uniform distance horizontally.

In the vertical direction, the intensity is also plotted to a logarithmic scale, which for convenience is labeled in decibels—called db for short. To produce a required

Fig. 1. Ideal flat response (solid line) with usual deviations (dashed lines).



change in loudness, the intensity of sound —or the signal voltage—has to be *multiplied* by a figure corresponding to the required *difference* in loudness. For example, changing the voltage successively from 1 to 2 to 4 to 8 to 16, etc., will sound like equal loudness steps. To plot response so that the curve looks as the loudness sounds, a logarithmic voltage scale should be used as well as a logarithmic frequency scale.

To save having to make constant reference to logarithm tables and convert voltages in the audio circuits into logarithms of these voltages, and so on, in order to find out the effect of a given response on the quality of reproduced sound, a decibel scale is used. Instead of plotting voltage vertically, the usual practice is to convert the voltages by some convenient means into decibel readings, which give a better picture of the apparent loudness corresponding to frequency. Under this arrangement, multiplying the intensity of sound by successive factors of, say 10, will correspond to uniform distances measured vertically up the graph paper.

Multiplying the intensity by a *power* ratio of 10 corresponds to 10 decibels. This is quite convenient. Notice, however, due to the fact that the relationship is logarithmic, that multiplying the power by 2 does not correspond to 2 db but rather to 3 db. (Actually, the logarithm of 2 is .301, so it should be 3.01 db, but the small decimal is usually overlooked.) Multiplying by successive factors of 2, three times, results in adding 3 db to the intensity level three times, making a total increase of 9 db, which corresponds to an increase of intensity of $2 \times 2 \times 2 = 8$ times.

Deviations from "Flat" Response

Plotting a graph of the response of an amplifier gives a response curve as shown in Fig. 1. If the response is exactly the same at all frequencies, then the output will be represented by a straight horizontal line. As has already been mentioned, this response is called flat. In practice it is never possible to achieve complete uniformity, and hence the response will deviate from flat as represented by the "dashed" lines shown in Fig. 1.

From the electronics aspect, the first question is, "What can be the cause of such deviations from flat frequency response?" There are three basic contributing components. Two of these are called reactances, because they behave somewhat differently from a resistance in an electric circuit. The third contributing component is somewhat beyond the scope of the present article and will be discussed more fully in a later article: it is the effect of positive and negative feedback, either intentional or accidental.

Effect of Capacitance

The two kinds of reactance mentioned are due to inductance and capacitance. Taking the second one first: if a capacitor is charged through a series resistance, a voltage applied to the input end of the resistance will take a certain amount of time to charge the capacitor to the same voltage. Fluctuation of voltage at low frequencies at the input end of the resistance, shown in Fig. 2, will produce a corresponding fluctuation of voltage on the capacitor, but with a small delay due to the fact that time is taken for the charge to leak through the resistor to the capacitor. At higher frequencies of fluctuation, the time taken for the charge to leak through the resistor is so long that the full charge does not reach the capacitor before the voltage is alternating in the opposite direction; hence, the voltage fluctuations appearing across the capacitor are considerably smaller than the voltage fluctuations applied to the input end of the resistor.

It is evident from this brief consideration that the effect of charging a capacitor through a resistance is twofold: (a) there is a time delay due to the charging effect of the capacitor, and (b) there is a loss of amplitude in the fluctuation of voltage when the frequency rises. This is illustrated by the graphs in Fig. 3, which represent the waveform at the input end of the resistance and the waveform on the capacitor for two different frequencies. It will be seen how the waveform is delayed and reduced in amplitude in each case, but in somewhat different proportions due to the difference in frequency.

Now suppose that instead of measuring the voltage across the capacitor the voltage across the resistance is measured, still applying the same fluctuating voltage to the combination. This voltage will appear due to the charging current flowing to the capacitor. If the voltage applied at the input end is steady, there will be no voltage across the resistance because there will be a steady charge in the capacitor; but as the voltage at the input end changes, some of the change of voltage will appear across the resistance, due to the fact that the charge on the capacitor takes time to follow the change in input voltage. Finally, if the change in voltage at the input end is so rapid that the charge on the capacitor does not have time to change appreciably during the cycle of fluctuation, then the voltage across the resistance will be almost the same as the applied input voltage.

The condition last described is essentially that which exists in using a coupling capacitor in an amplifier: a fluctuating voltage is developed at the plate of a tube which has to be coupled to the grid of the following tube through the coupling capacitor, as shown in Fig. 4. At high frequencies the coupling capacitor is sufficiently large, so the charge in it remains steady because it does not have time to change at the frequency being used. Consequently, the voltage across the grid resistor *R2* is almost identical with the voltage change across the plate resistor *R1*.

At low frequencies, however, the capacitor absorbs a charge corresponding to a certain amount of the voltage fluctuation appearing at the plate, and only some of the fluctuation is able to appear across resistor *R2* in the grid circuit. This results in a loss of low frequencies. Of course, with a steady voltage, which corresponds to zero frequency, a coupling capacitor assumes a steady state and there is no voltage across the grid resistor at all.

To summarize the effect of capacitance in a circuit: if the capacitance is across the voltage to be used, as for example the stray capacitance between the grid and cathode terminal of a tube or any other small capacitances of this nature, the result is a loss of the extremely high frequencies—because the capacitance does not have time to charge to the fluctuations at these frequencies.

Stray capacitances are not usually shown on a printed schematic, and they are not recognized as physical components. Such a capacitance is made up of the inevitable capacity that everything possesses for storing a few electrons as its electrical potential changes. Figure 5 shows how it may be imagined. On the other hand, where the capacitance takes the form of a series feed to the resistor, as in the case of a coupling capacitor, the result is a loss of low frequencies.

(To be continued)

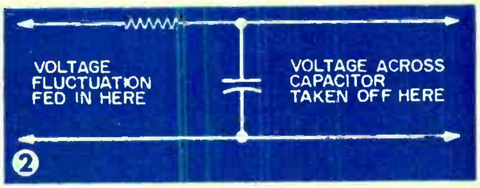


Fig. 2. Relation between resistance and capacitance in this common arrangement will give rise to phase delay and other losses.

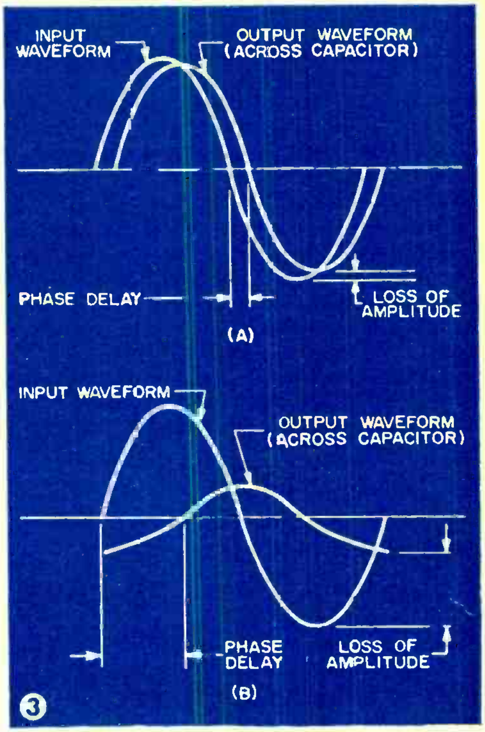


Fig. 3. Input and output waveforms of Fig. 2 at (A) low and (B) high frequencies, showing the increase in phase delay and loss of amplitude as the frequency is increased.

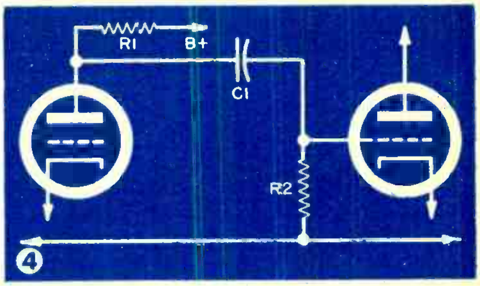


Fig. 4. Proper capacitance values are required between stages in the amplifier. Too low a value results in high-frequency loss.

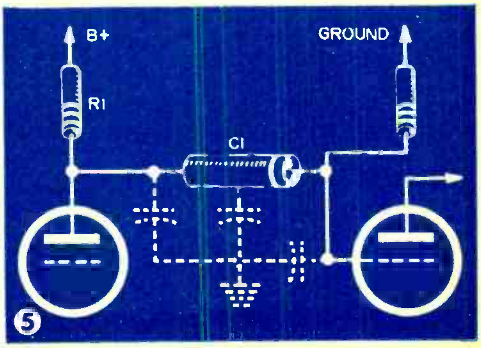


Fig. 5. Stray capacitance effects (dashed lines) cause small high-frequency losses.

Build Your Own HI-FI TUNER

TO THOSE accustomed to the type of music obtainable with low-cost table-model radio receivers, listening to a high-quality audio system connected to a high-fidelity tuner will reveal a tonal quality never thought possible. Take a good-quality phonograph amplifier with matched speaker system, add the simple hi-fi tuner shown in the photographs, connect an antenna and ground . . . and prepare for real listening enjoyment.

Hi-fi fans (frequently called "audiophiles") will be familiar with the expression "tuner." For the uninitiated, a tuner is a basic radio receiver, but without an audio power amplifier or loudspeaker. It is designed to be used with a separate audio system to form a complete receiver. Tuners may be used with both commercial and home-built audio amplifiers, including public address systems, but they give best results when used with a high-fidelity installation.

Although this simple hi-fi tuner will meet the requirements of a discriminating audiophile, the circuit used is not at all complicated. Even a beginner should have little or no trouble assembling the tuner in two or three evenings or on a week-end.

Assembling the Tuner

Either one of two versions of the tuner may be assembled, depending on the requirements of the individual builder. The schematic wiring diagram for a *powered* version is given in Fig. 1, while the circuit changes necessary for a *non-powered* version are shown in Fig. 2. The photographs show the powered version.

Operation of both versions is similar, except that the powered version requires a source of line voltage (117 volts, a.c.) and has somewhat greater sensitivity, permitting its use with most audio amplifiers without a preamplifier. On the other hand, if an audio system has a good preamplifier, the non-powered version may be preferred—the circuit is simpler, requires fewer parts, wiring is easier, and no power source is necessary.

Components needed for both versions of the tuner are specified in the parts list. Those parts used only in the powered version are identified. All parts are standard and should be available at local radio parts distributors. If there is no distributor near at hand, the items needed can be purchased through one of the large mail order supply houses advertising in this magazine.

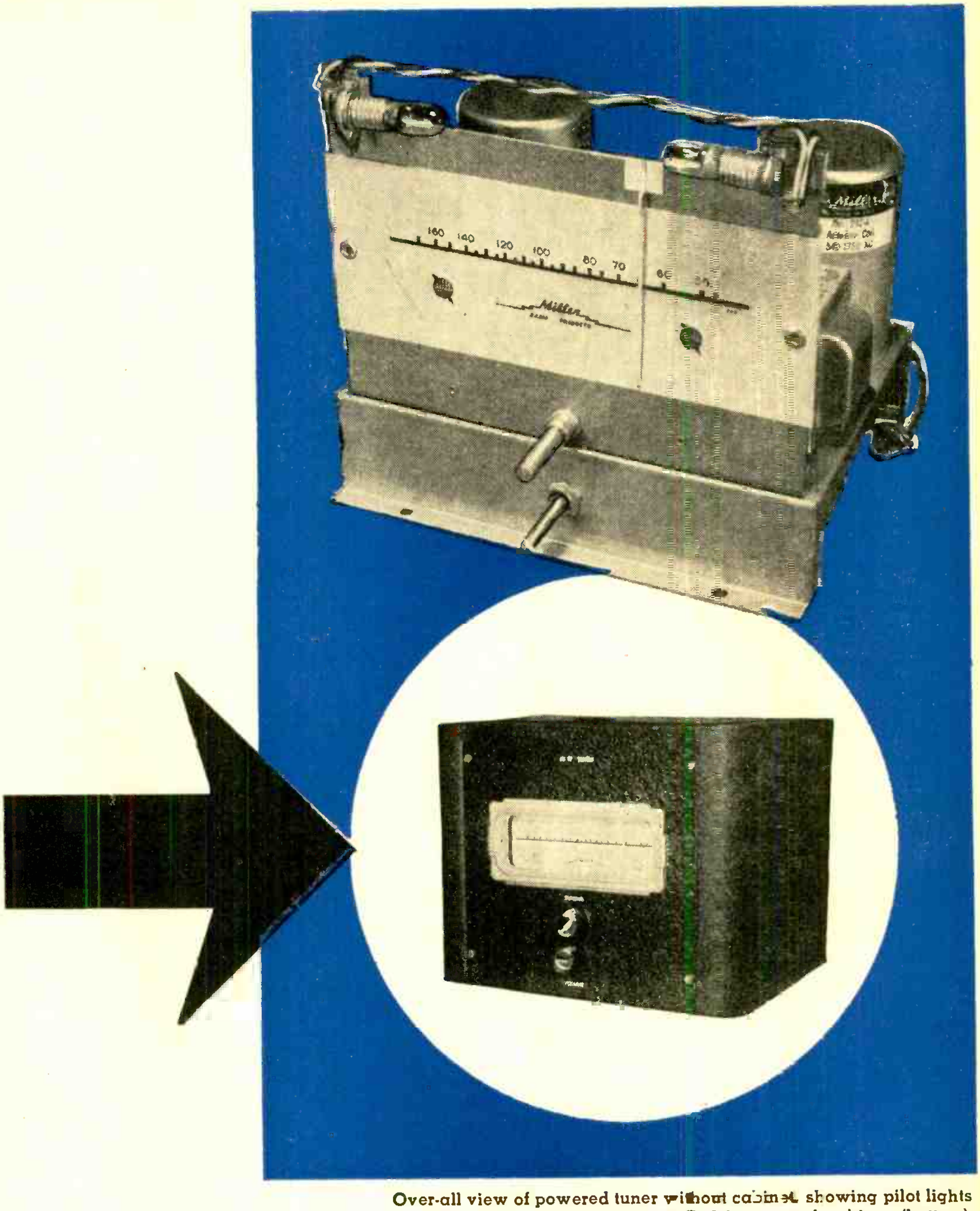
Construction Hints: A commercially available prepunched metal chassis base was used in the model. With this chassis, no chassis machine work will be required to assemble the non-powered version. To assemble the powered version of the tuner, it will be necessary to drill and punch a few additional holes.

To bend the chassis base from sheet metal, use the layout shown in the photographs as a general guide. Except for the mounting holes, exact dimensions are not critical. Locate mounting holes exactly by holding the part to be mounted on the chassis and marking hole locations with a scribe.

With the chassis machine work completed, mount the major components, using small machine screws, nuts and lock washers. The photographs of the model will serve as a guide in determining parts location. Above chassis parts are identified in Fig. 4, below chassis parts in Fig. 3.

Wiring is comparatively easy and straightforward. There is plenty of room below the chassis, so don't worry about working in tight corners. Coil lug connections are identified in Fig. 1. Only a few general precautions should be observed in wiring the unit.

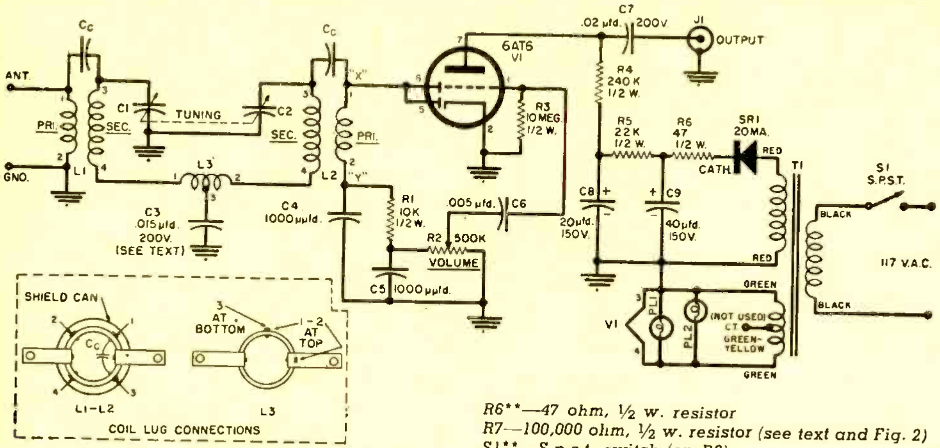
In assembling the powered version, take care when soldering leads to the selenium rectifier, *SR1*. Complete this soldering as quickly as practicable to avoid overheating the terminals. Be sure to observe cor-



Over-all view of powered tuner without cabinet showing pilot lights and dial (top), and the unit installed in a metal cabinet (bottom).

By LOUIS E. GARNER, Jr.

Here is an AM tuner which will reproduce the full range of audio frequencies transmitted by local broadcast stations



C1*, C2*—2-gang tuning capacitor, approx. 365 µµfd. per gang
C3*—0.015 µfd., 200 v. tubular capacitor
C4**, C5**—1000 µµfd. disc ceramic capacitor
C6**—0.005 µµfd. disc ceramic capacitor
C7**—0.02 µfd., 200 v. tubular capacitor
C8**, C9**—20/40 µfd., 150 v. dual elec. capacitor
C10—0.00025 µfd., 200 v. tubular capacitor (see text and Fig. 2)
C11—0.05 µfd., 200 v. tubular capacitor (see text and Fig. 2)
J1*—Phono jack
L1*, L2*—T.r.f. antenna coils (Miller No. 242-A, including Cc)
L3*—Mutual coupling coil (Miller No. EL-55)
PL1**, PL2**—6.3 v. pilot lamp bulb and socket
R1**—10,000 ohm, ½ w. resistor
R2—500,000 ohm carbon potentiometer, audio taper
R3**—10 megohm, ½ w. resistor
R4**—240,000 ohm, ½ w. resistor
R5**—22,000 ohm, ½ w. resistor
R6**—47 ohm, ½ w. resistor
R7—100,000 ohm, ½ w. resistor (see text and Fig. 2)
S1**—S.p.s.t. switch (on R2)
SR1**—20 ma. selenium rectifier
T1**—Power transformer, 150 v. @ 25 ma., 6.3 v. @ .5 amp.
1—7-pin miniature tube socket**
1—Line cord and plug**
1—1N34 crystal diode (see text and Fig. 2)
1—Chassis,* approx. 7" x 5" x 1½" (Miller No. 585-1)
1—Slide rule dial* (Miller No. 152-H)
1—Cabinet (optional, Bud C-1789)
1—2-position screw-type terminal strip*
1—2-lug terminal strip
1—3-lug terminal strip
Misc. wire, solder, etc.

* These items are included in the basic Miller kit, No. 585. If unavailable elsewhere, contact J. W. Miller Company, 5917 S. Main St., Los Angeles 3, Calif.

** These components are not required for the non-powered version (Fig. 2).

Total cost of parts, approx. $21.50

Fig. 1. Schematic diagram and parts list for the powered version of the AM tuner.

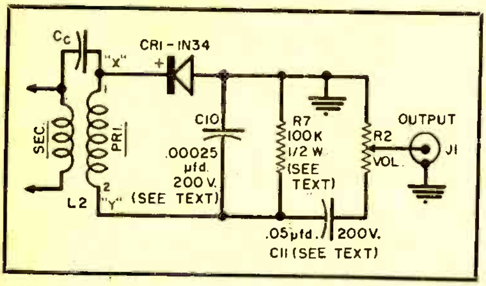


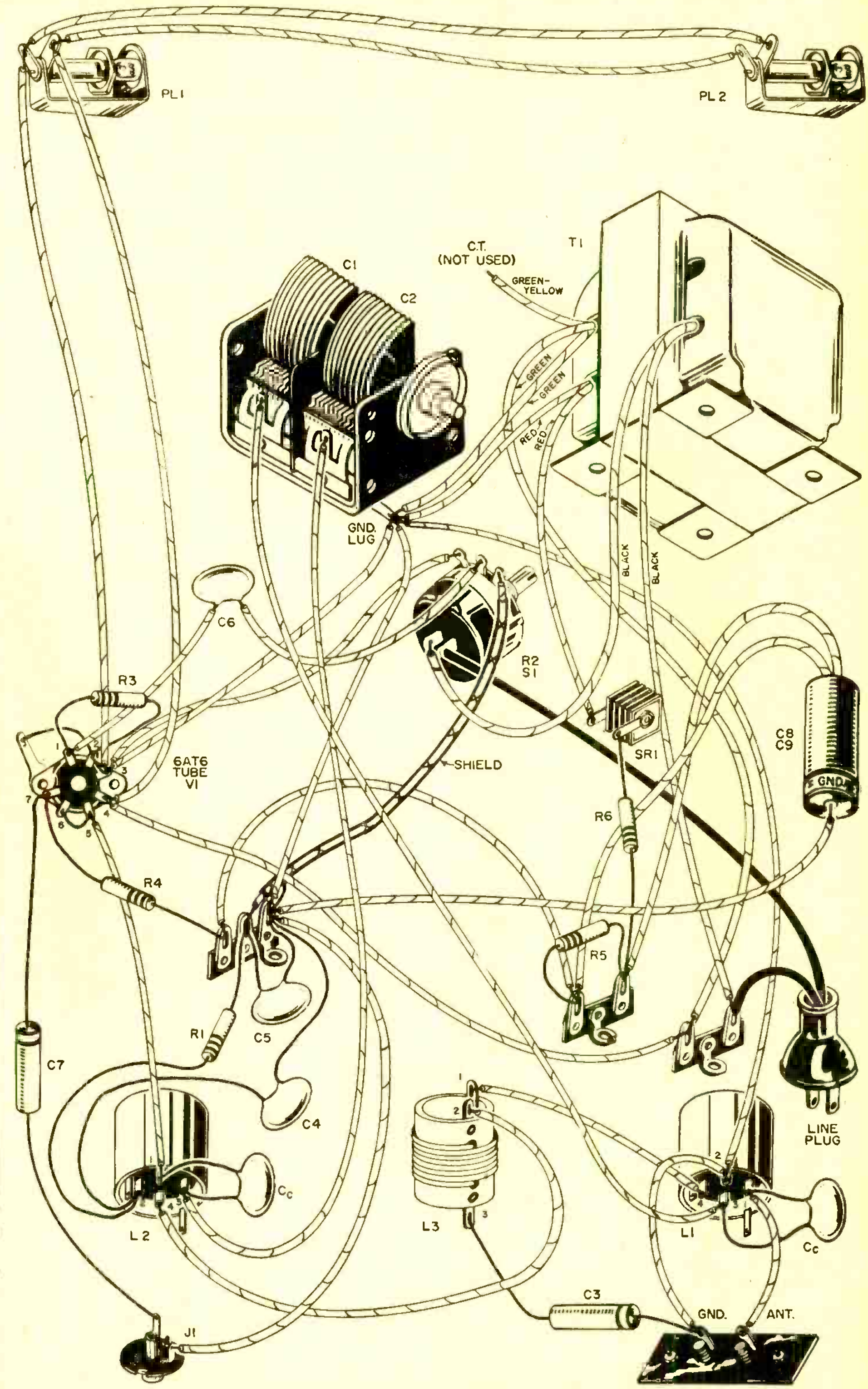
Fig. 2. Partial schematic of non-powered unit.

rect lead polarity when connecting the electrolytic filter capacitor (*C8, C9*). Shield any long leads carrying audio signals to avoid hum pickup.

Parts *C10, C11, R7* and the 1N34 crystal diode are used only in the non-powered version of the tuner. In building this version, wire the r.f. circuit as shown in Fig. 1 up to points "X" and "Y." From these two points, follow the circuit in Fig. 2. When installing the 1N34 diode, take special pains to avoid heat damage. Use reasonably long leads and hold each lead with a pair of long-nosed pliers while soldering the diode in place. The pliers tend to absorb heat, keeping it away from the sensitive part of the diode.

When the wiring is completed, double check for possible errors. Install the 6AT6 vacuum tube (if the powered version has been assembled) and mount the control knobs. Prepare a length of shielded single-conductor cable for connecting the tuner to an audio amplifier. At one end, use a connector to fit the output jack, *J1*, of the tuner. At the other end, use a connector to match input jack of audio amplifier.

Alignment: Alignment of the completed tuner is quite simple and requires no expensive test equipment. All that is necessary is a standard insulated alignment tool for adjusting the small mica trimmer capacitors. One is mounted on each section of the main tuning capacitor and is connected in parallel with it.



Pictorial diagram indicates how the various components are connected into the circuit.

Connect a *good* antenna and ground to the proper terminals of the tuner. Using the shielded connecting cable, connect the tuner to the audio amplifier and turn both units on. Turn up the gain or volume controls on both the tuner and the audio amplifier.

Adjust the tuning dial so that the pointer is at the extreme low frequency end of the dial when the tuning capacitor (*C1, C2*) plates are fully meshed. Next, tune in a strong local broadcast station whose operating frequency is near the higher frequency end of the dial (from 1200 to 1600 kc.). Check to see if the dial reading corresponds to the station's operating frequency. If it does, no further adjustment is necessary.

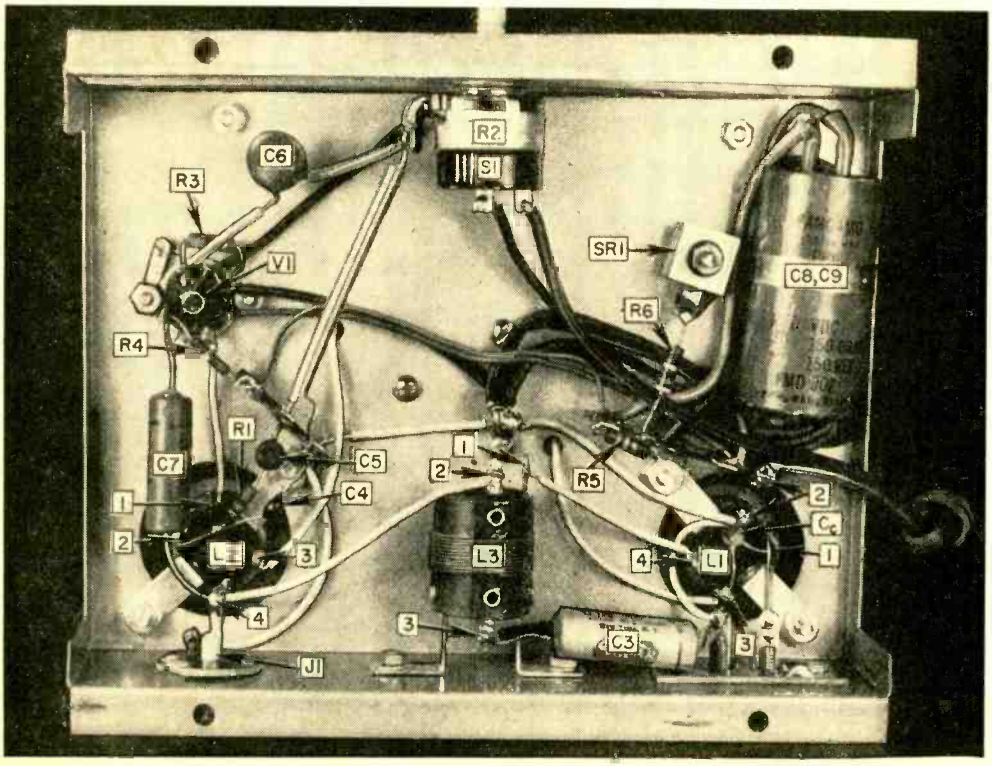
If the dial reading does not correspond to station frequency, use the insulated alignment tool to adjust the small trimmer capacitors mounted on the sides of *C1* and *C2*, shifting the point at which the station is picked up in the proper direction. . . . i.e., towards the correct station frequency. Continue to adjust the trimmers, retuning the dial each time, until the dial reading corresponds exactly to station frequency when best reception is obtained. Be sure to *adjust both trimmers each time.* When dial and station frequency correspond, the alignment is complete.

How It Works

In operation, r.f. signals picked up by the antenna-ground system are coupled into the primary of r.f. transformer *L1* in the powered version (Fig. 1). *L1, L2, L3,* and *C3,* together with tuning capacitors *C1* and *C2* and coupling capacitors *Cc* form a band-pass tuner circuit which selects the desired station frequency as the values of *C1* and *C2* are changed. This double-tuned circuit has a bandwidth of 25 kc. at the 2-db points, yet—because of the high *Q* of the coils used—is able to separate local stations without difficulty.

The selected r.f. signal, appearing at points "X" and "Y," is applied to the diode section of the 6AT6 dual-purpose tube, where detection occurs. *R1,* together with volume control *R2,* acts as the diode load resistor, and the detected audio signal appears across these components. Since the resistance of *R2* is large compared to that of *R1,* most of the audio signal appears across the volume control. However, *R1,* acting with capacitors *C4* and *C5,* serves as an r.f. filter network to remove any r.f. signal that might remain.

Fig. 3. Under-chassis view of powered version of the AM tuner, showing location of selenium rectifier, electrolytic capacitor, and socket for audio amplifier tube V1.



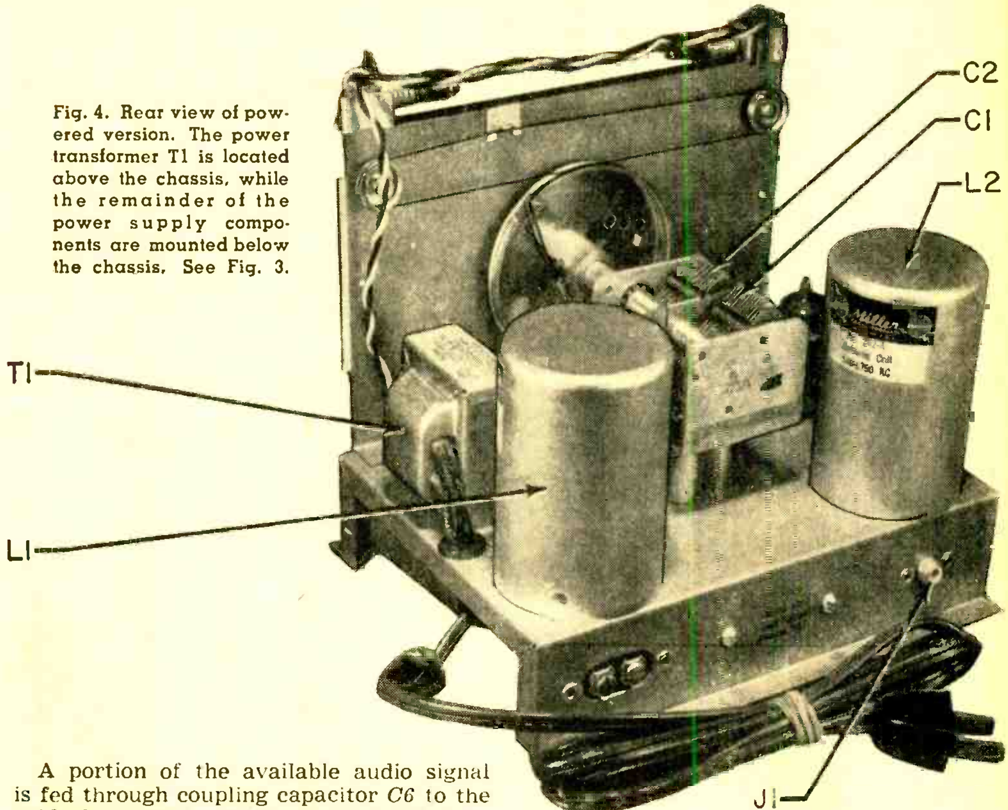


Fig. 4. Rear view of powered version. The power transformer T1 is located above the chassis, while the remainder of the power supply components are mounted below the chassis. See Fig. 3.

A portion of the available audio signal is fed through coupling capacitor *C6* to the grid of the triode section of the 6AT6 tube. The amount of signal applied to the grid of the tube depends on the setting of *R2*. Grid return resistor *R3* has a high value and serves to establish contact bias for the triode tube. An amplified audio signal appears across the tube's plate load resistor *R4*, and is coupled through d.c. blocking capacitor *C7* to the output jack *J1*, where it can be picked up and fed to an audio amplifier.

D.c. operating voltages for the amplifier are obtained from a conventional half-wave rectifier circuit employing the selenium rectifier *SR1*. *R5*, together with electrolytic filter capacitors *C8* and *C9*, forms a standard *RC* "brute force" filter circuit to remove ripple. A small resistor, *R6*, prevents the current surge into *C9* (when the unit is first turned on) from damaging the rectifier.

A.c. voltages for the rectifier circuit, as well as filament voltages for the vacuum tube and pilot lamps, are obtained from transformer *T1*. A s.p.s.t. switch, *S1*, serves as a power switch and is mounted on the rear of the volume control *R2*, as shown in the pictorial diagram.

In the non-powered version of the tuner, the pickup and selection of the r.f. signal is the same as in the powered version. However, the diode tube section is replaced by a crystal diode detector (1N34 diode), and no amplification of the audio signal is obtained. Thus, when the non-powered version is assembled, it should be used with an amplifier having a good pre-amplifier section.

Installation and Use

The completed hi-fi tuner may either be used "as is" or it may be mounted in a cabinet. It fits well into a commercial metal cabinet (specified in the parts list and shown in the lead photograph) but may also be mounted in a home-built or wooden cabinet.

In order to keep the circuit simple, a straight t.r.f. (tuned radio frequency) circuit has been used, with no r.f. amplification. Therefore, the tuner requires a *good antenna and ground* for proper operation and is designed to be used primarily with local AM broadcast stations. In rural areas having only a few local stations, the sensitivity of the tuner may be greatly increased at a slight loss in selectivity (ability to separate stations) by adding two 15-$\mu\mu$fd. fixed ceramic capacitors across terminals 1 and 3 of coils *L1* and *L2*. These capacitors are in addition to capacitors *Cc* already mounted in the coils. —30—

What

From business to pleasure—Ken Had, pictured above, is dictating a sales report to his home office. It will be mailed and will provide a detailed day-by-day summary of his activities. At the right, Milton Hedin listens to one of many tapes collected throughout the past five years. These tapes are an important part of a hi-fi setup.

By LEON WORTMAN

Don't miss half the fun of the electronics hobby —own and enjoy a magnetic tape recorder

IN ADDITION to providing loads of fun, magnetic tape recorders perform many functions. They act as business machines, teaching tools, scientific devices, law enforcement instruments and aids to the church.

Just what is a tape recorder? After all the time, intelligence, and effort that have gone into making tape recorders practicable, it would be futile to attempt to answer that question in one or two sentences. Generally speaking, a "tape recorder" is a device which mechanically records or impresses sound, data, or intelligence onto a flat ribbon. The material the ribbon is made of is unimportant for the moment.

A *"magnetic* tape recorder" is a device which does the same thing *electronically* to a flat ribbon coated with a thin layer of magnetizable material. The magnetized tape ribbon will retain the recorded information indefinitely and will play it back at any time. Therefore, it is sometimes referred to as a "magnetic memory." And like the mind's memory, the tape can be made to "forget" . . . by a simple process known as "erasing."

Early Recorders

In the early years of recording, magnetic recorders used fine magnetizable steel wire wound on a spool. Years later, steel ribbons—or tapes—were employed. Whether magnetic wire or tape is used, the electronic processes of recording are identical.

The concept of a magnetic tape recorder dates back to 1888, when an article in *Electric World*—written by one Oberlin

About Tape Recorders?

Smith—proposed that a cord or silk thread be impregnated with steel dust or short clippings of fine steel wire. Smith also suggested that a length of fine steel wire be utilized. But, he confessed, he really considered that idea impractical. Smith never did build a magnetic recording machine. He was content to think and write and leave the construction work to other brilliant men of that era.

It was in the year 1898 that a patent application was finally made for a practical magnetic recorder. The application was filed by a young man, Valdemar Poulsen, who called the device a "Telegraphone." Poulsen's claim to be the first inventor of a practical magnetic recorder has never been challenged. He showed the machine to the public for the first time at the Paris Exposition in the year 1900; for his invention, he won the *Grand Prix*. That same year, he acquired a U. S. patent for his "Telegraphone."

This is the first of a new series of articles on tape recorders. Something of the historical background is given, as well as many of the uses of modern recorders. Future articles will explain exactly how tape recorders work, and how they may be used to enhance various aspects of modern living. Of particular interest will be an article containing valuable hints on what to look for when shopping for one's own recorder.

Poulsen provided frequent demonstrations that his magnetic wire recorder really worked. It was a great attention-getter and a considerable curiosity wherever it was shown. But no one knew exactly what to do with it, how to put it to some useful work. As magnetic wire recorders, ver-

At the left, a group of scientists is listening to heart beats previously recorded for medical study. Such units capture valuable data that often can not be observed except under unusual conditions. Below, Russell Lund and his family relive their two-week European vacation which they completely tape-recorded.

Joseph Lang, at station WJR, Detroit, Mich., prepares a tape for use as a transcribed radio program. Tapes can be accurately timed to within a small fraction of a second.

sions of the original "Telegraphone" were offered for sale in competition with the wax cylinder dictation machines. The cylinders had it all over the wire spools for simplicity. Moreover, the cylinders in the machines did not snarl as the wire from the spools so often did.

Magnetic wire recorders were also set up to compete with cylinders as home entertainment machines. But they offered no advantages either in economy or quality to offset their unwieldy operation. As a result, magnetic recorders made very slow progress during the first few decades of the 20th century.

Today's magnetic recorders, using flat wound tapes, offer many advantages over other types of recording machines. They range in price from under $100 to many thousands of dollars. The price a user pays is determined largely by what he expects to get in performance, and what he can afford. At all price levels, most magnetic recorders boast reliable performance, long life, and simple operation.

Uses of Tape Recorders

The many different ways that tape recorders are used indicates the extent to which they have caught on in modern life. It may well be that before long the recorder will become as widely used as the camera.

Actors rehearse dialogue; develop style and delivery; improve diction; even use magnetic tape recordings for auditions and audience reactions to routines.

Advertising Agencies prepare and present to their clients taped ideas for radio and TV shows, commercials, talent auditions; make recorded surveys — house-to-house and man-on-the-street interviews for market research.

Auctioneers record inventory, bidding procedures, purchases and their own selling techniques.

Broadcasters in AM and FM radio and TV make on-the-spot recordings of interviews, news events, and sports for playback later. They also use tape for off-the-air checks on talent and programs. Often, out-of-town programs coming in over the "lines" are recorded. These are played back and broadcast at a convenient local time.

Business Offices tape-record conferences, especially when complex technical problems are discussed. Recordings are made of interviews with prospective key employees. Sales meetings are taped, and sales training sessions with "how-to-sell" demonstrations are presented from tape. Telephoned orders are recorded, as are reports and messages sent to and from branch offices. Traveling salesmen make "call" reports on tape. And the devices are used widely for office dictation.

Churches play tape-recorded chimes and music, and record sermons of visiting dignitaries. Clergymen use tape to prepare and rehearse sermons. Tape libraries, available on loan to clergymen, contain many famous sermons as well as complete church services. These are made available to groups and communities which are too small or isolated to have a church of their own. Tape also brings church services to shut-ins. Choir groups learn new and complex hymns and harmonies quickly with tape recorders.

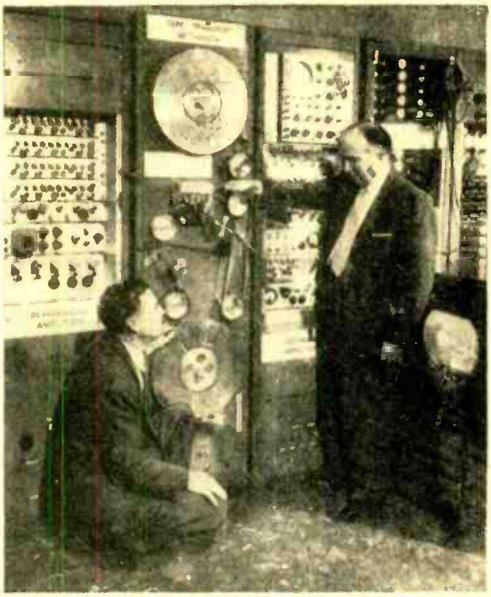
Department Stores and Supermarkets play taped music; make special sale announcements and talking displays with magnetic tape recorders.

Factories broadcast tape-recorded music all day or at "break" and lunch times, as well as safety and general interest announcements.

Fire Department Dispatchers keep recordings of telephoned alarms to verify the address of a fire.

Funeral Parlors use appropriate prerecorded tape music.

Home Recording is a fascinating form of entertainment, especially because comparatively few people have ever heard their own voices. Recording party fun and listening to the playback is always good for a "howl"! Sound albums of family birth-



Tape recording appears to solve the problem of storing television program material easily. The equipment shown above was used by RCA for the first public demonstration of black-and-white and color TV tape recording. Checking equipment are Dr. Harry F. Olson (standing) and W. D. Houghton of the RCA acoustical research laboratory.

day parties, get-togethers and the baby's voice are as exciting as photo scrapbooks. The home user can easily build a private library of favorite music, radio shows, famous voices and news events. Magnetic tape recorders are a wonderful aid to private music and voice lessons. Many families separated by military service or jobs maintain contact by "corresponding" on tape.

Lawyers frequently tape conversations with clients, rehearse courtroom pleas and proceedings.

Lecturers make tape-recorded narrations for slide and silent films; also for rehearsal and self-improvement.

Medical Men tape office and clinic consultations for case history study. The sounds of good and bad hearts, sick and well lungs, etc., are taught to doctors and students by means of magnetic tape.

Music Publishers employ magnetic tape to "spot" check commercial radio and TV use of copyrighted music and jingles; also for song auditions.

Musicians rehearse and practice solo or in combinations to check arrangements and make job auditions.

Nature Study Groups make good use of portable tape recorders to keep the sounds of nature, birds, wildlife, and even to record the sounds of life under the sea.

Police use tape recorders for taking down confessions, testimony, and other important evidence.

Aids to Science and Industry

Schools employ magnetic recorders quite extensively in all areas, but especially in the departments of music, drama, speech and language. Student self-evaluation, study of dramatic interpretations, oral development and the mastering of new and unfamiliar sounds are all aided by tape recordings.

Scientific Groups utilize all kinds of magnetic tape recorders—big and small, fixed and portable—in the lab and in the field. An interesting application is the recording of technical data in situations where the hands are not free or cannot be used (such as in the very cold Arctic regions). Special recorders are employed in advanced research work where data must be taken down at very high speeds, stored and played back later for analysis. Tapes are also used in computers and short- and long-term memory devices.

Restaurants, Hotels, and Cocktail Lounges provide incidental and mood music on prerecorded tapes as a background to relaxation.

Telephone Companies use tape-recorded messages for automatically announcing weather and time signals.

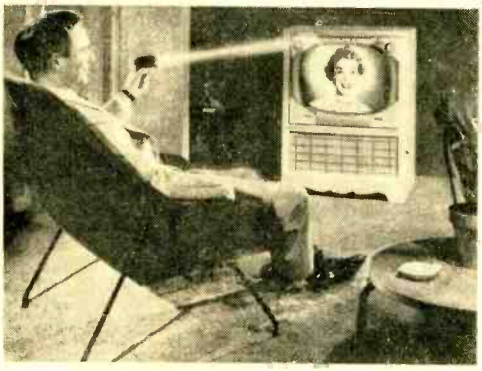
"Datacord," made by Brush Electronics Co., Cleveland, Ohio, is a tape transport mechanism used for high-speed data recording. Tape, loosely stored at bottom, is pulled up by reel. As it passes recording head, data from computers is impressed on it.

The phenomenon of storing sound on tape and playing it back as desired will be explored in future articles. Hints on what to look for when shopping for a magnetic tape recorder will also be given. —30—

"Gun" Tunes TV Set

A TELEVISION RECEIVER that is turned on or off by a flash beam from a small pistol-shaped gadget held in the viewer's hand has been announced by the *Zenith Radio Corp.,* 6001 Dickens Ave., Chicago 39, Ill. The beam of light also changes channels and can cut out the sound on long-winded commercials.

Known as "Flash-Matic," this device permits the user to beam the ray of light from



across the room at sensitive "windows" on the corners of the TV set. A flash beam shining in the lower left-hand corner will turn the set on or off. Channels are switched by flashing the light through the upper two windows: a beam in the upper left corner changes channels counterclockwise; one in the upper right corner changes channels clockwise. A beam striking the lower right-hand window effectively tunes out commercials. When desired, another touch of the flash gun will bring the sound on again.

No connecting wires are needed between the set and the "Flash-Matic" control gun. "Flash-Matic" sets can also be operated manually. Nine new receivers using this device have been placed on the market, ranging in price from $400 upward. —30—

Recorded "Course In Audio"

DESIGNED TO FASCINATE and edify is the LP record "This Is High Fidelity," issued by *Vox Productions,* 236 West 55th St., New York, N. Y. This disc is essentially a beginner's course in audio, with music and other aural effects illustrating important points.

The listener can actually hear what happens when frequency response is limited or expanded; how a "floating ground" effects reproduction; what influence room acoustics have on sound. The different choirs of the orchestra are explored, as are the basic elements of music—such as rhythm, pitch, and harmony.

One section of the record contains a step-by-step frequency run from 15,000 cps to 30 cps. This is useful in testing the response of a sound system. Outer edges of the label on each side contain a stroboscopic imprint for checking turntable speed.

The record is accompanied by an attractive brochure that discusses hi-fi, components selection, technical data, and construction kinks. It is a package to delight any music lover or audio enthusiast. —30—

TV Sets Use 119 Tube Types

ONE HUNDRED AND NINETEEN different receiving tube types are used in 150 different 1954 and 1955 television receivers surveyed, according to the *General Electric Company's* receiving tube subdepartment in Owensboro, Ky. Of various makes and models, the 150 sets had a total of 2950 sockets. This survey was one of a series made to insure availability of replacement tubes in the *G-E* line. —30—

Novel Portable Radio

STYLED TO MATCH a "Skotch Kooler" is the new "Bagpiper" portable radio. The 4-tube, battery-operated broadcast receiver is completely enclosed in a waterproof, insulated case. Controls, speaker, and whip antenna are mounted on the lid. The insulated construction protects the set from hard knocks and provides a baffle to improve tonal quality. As the chassis is mounted beneath the lid, removal for battery replacement or servicing is simple and easy. The "Bagpiper" is 7½" in diameter, 9¾" high, and weighs 5½ pounds. It retails for $29.95 and is made by Radio Division, *Lawrence Co., Ltd.,* 2330 Victory Pkwy., Cincinnati 6, Ohio. —30—

Build YOUR OWN HEATHKITS

INTERESTING—EDUCATIONAL

Heathkits are fun to build with the simplified easy-to-follow Construction Manual furnished with every kit. Only basic tools are required, such as soldering iron, long-nosed pliers, diagonal cutting pliers, and screwdriver. All sheet metal work has already been done for you. No cutting, drilling, or painting required. All parts furnished including tubes. Knowledge of electronics, circuits, etc.. not required to successfully build Heathkits.

New charcoal gray baked enamel panel with highly readable white lettering.

New PRINTED CIRCUIT VACUUM TUBE VOLTMETER KIT

New meter Peak-to-peak scale—new color harmony—new control knobs.

The VTVM is the standard basic voltage measuring instrument for radio and TV servicemen, engineers, laboratory technicians, experimenters, and hobbyists. Because of its extremely high input resistance (11 megohms) the loading effect on the circuit being measured, is virtually negligible. The entire instrument is easy to build from a complete kit, with a detailed step-by-step Construction Manual. Featured in this instrument is an easy-to-wire foolproof printed circuit board which cuts assembly time in half.

New printed circuit board for faster, easier construction—exact duplication of Laboratory development model.

CIRCUIT AND RANGES: Full wave AC input rectifier permits 7 peak-to-peak voltage ranges with upper limits of 4000 volts peak-to-peak. Just the ticket for you TV servicemen. Seven voltage ranges, 1.5, 5, 15, 50, 150, 500 and 1500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, and 4000 volts. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, center scale zero position, and a polarity reversal switch.

Model V-7

$24.50

Shpg. Wt. 7 lbs.

New easy-to-read open panel layout. Off-on switch incorporated in selector switch

IMPORTANT DESIGN FEATURES: Transformer operated—1% precision resistors—6AL5 and 12AU7 tubes—selenium power rectifier—individual AC and DC calibrations smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting—new knobs—test leads included. Easily the best buy in kit instruments.

Heathkit HANDITESTER KIT

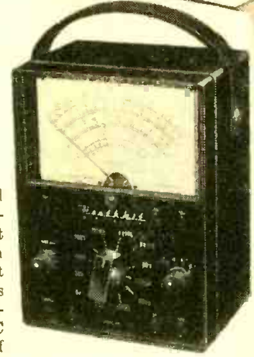
The Heathkit Model M-1 Handitester readily fulfills all requirements for a compact, portable volt-ohm-milliammeter. Its small size permits the instrument to be tucked into your coat pocket, tool box or glove compartment of your car. Always the "handitester" for those simple repair jobs. Packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges, full scale 10, 30, 300, 1000 and 5000 volts. Ohmmeter ranges 0–3000 ohms and 0–300,000 ohms. DC milliammeter ranges 0–10 milliamperes and 0–100 milliamperes. Uses 400 microampere meter—1% precision resistors—hearing aid type ohms adjust control—high quality Bradley rectifier. Test leads are included.

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

Heathkit MULTIMETER KIT



Here is an instrument packed with every desirable service feature and all of the measurement ranges you need or want. High sensitivity 20,000 ohms per volt DC, 5000 ohms per volt AC. Has the advantage of complete portability through freedom from AC line—provides service ranges of direct current measurements from 150 microamperes up to 15 amperes—can be safely operated in RF fields without impairing accuracy of measurement.

MODEL MM-1

$29.50 Shpg. Wt. 6 lbs.

Full scale AC and DC voltage ranges of 1.5, 5, 50, 150, 500, 1500, and 5000 volts. Direct current ranges are 150 microamperes, 15, 150, and 500 milliamperes and 15 amperes. Resistances are measured from .2 ohms to 20 megohms in three ranges and db range from −10 to +65 db. Ohmmeter batteries and necessary test leads are furnished with the kit.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 10, MICHIGAN

Model OL-1

$29.50 Shpg. Wt. 15 lbs.

New PRINTED CIRCUIT *Heathkit* 3" OSCILLOSCOPE KIT

Ideal for individual home work shop, ham shack, or as extra instrument for outside servicing.

Compact size, light weight, portable — perfect for service work or field operation.

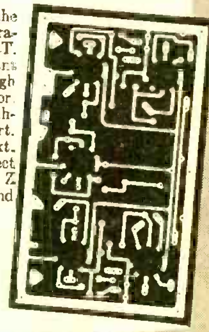
New, modern styling, gray panel with white lettering, light gray knobs and case — contrasting red and black terminal posts.

New printed circuit for constant circuit performance, rugged component mounting — assembly time cut in half!

Measures only 11¾" x 6¾" x 19½" and weighs only 11 pounds.

USE: This brand new Utility Scope was designed especially for servicemen and radio amateurs, and is adaptable for use in all general Scope applications. Perfect for modulation monitoring, etc. Use it to tackle alignment or adjustment problems. Equally valuable in breadboard work. A must for ham shack or for outside servicing.

DESCRIPTION: Front panel controls of the Model OL-1 are "bench tested" for ease of operation and convenience. Sharp focusing 3" CRT. Printed circuit for ease of assembly and constant performance. Assembly time cut in half! High quality electronic components used. Sensitive hor. and vert. amplifiers with broad freq. response; cathode follower for isolation. Push-pull hor. and vert. output to deflection plates. Int., 60 cycle, or ext. sync. Sweep freq. range 10–100,000 cycles. Direct connection to deflection plates. Provision for Z axis input. Uses 3GP1 CRT, 4-12AU7 hor. and vert. amplifiers, 1-12AX7 sweep gen., 1-6X4 LV rect., and 1-1V2 HV rect. The Heathkit Model OL-1 is a real standout value at only $29.50, and is another example of the famous Heathkit combination; quality plus economy.



Heathkit SIGNAL GENERATOR KIT

New, modern panel and knob styling — professional appearance and professional performance.

Broad frequency coverage — fundamentals from 160 KC to 110 MC in 5 bands — up to 220 MC on calibrated harmonics.

Cathode follower output for good isolation — fixed step and continuously variable attenuation.

USE: This instrument is "serviceman engineered" to fill the requirement for a reliable basic service instrument at moderate cost. Frequency coverage extends in five bands from 160 Kc to 110 Mc on fundamentals, and dial is calibrated to 220 Mc for harmonics. Pre-wound and pre-aligned coils make calibration unnecessary for service applications.

DESCRIPTION: The Heathkit Model SG-8 Signal Generator provides a stable modulated or unmodulated RF output of at least 100,000 microvolts which can be controlled by both a continuously variable and a fixed step attenuator. Internal modulation is at 400 cycles, or can be externally modulated. AF output of 2-3 volts is also available for audio testing. Uses dual purpose 12AU7 as Colpitts RF oscillator and cathode follower for stable, isolated, low impedance output, and type 6C4 tube for 400 cycle oscillator. Operation of the SG-8 is well within the frequency limits normally required for service work. Modern styling features high definition white letters on charcoal gray panel with re-designed control knobs. Modern professional appearance and Heathkit engineering know-how combine to place this instrument in the "best buy" category. Only $19.50 complete.

Output selection — internal modulation, pure r.f., or audio output.

MODEL SG-8 $19.50 Shpg. Wt. 3 lbs.

Heathkit ANTENNA IMPEDANCE METER KIT

MODEL AM-1

$14.50 Shpg. Wt. 2 lbs.

The Model AM-1 Antenna Impedance Meter makes an ideal companion unit for the GD-1B Grid Dip Meter or a valuable instrument in its own right. Perfect for checking antenna and receiver impedance and match for optimum system operation. Use on transmission lines, halfwave, folded dipole, or beam antennas. Will double as monitor or relative field strength meter. Covers freq. range of 0–150 Mc and impedance range of 0–600 ohms. Uses 100 microampere meter and special calibrated potentiometer. A real buy at only $14.50 complete.

Heathkit GRID DIP METER KIT

MODEL GD-1B

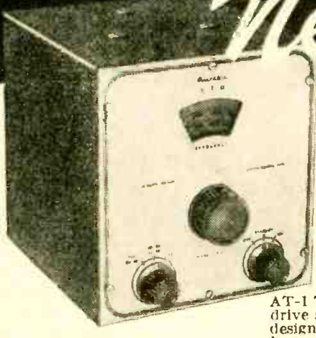
$19.50 Shpg. Wt. 4 lbs.

Amateurs and servicemen have proven the value of this grid dip meter many times over. Indispensable for locating parasitics, neutralizing, and aligning filters and traps in TV or Radio and for interference problems. The Model GD-1B covers from 2 Mc to 250 Mc with 5 pre-wound coils. Featuring a sensitive 500 microampere meter and phone jack, the GD-1B uses a 6AF4 or 6T4 tube. An essential tool for the ham or serviceman.

ACCESSORIES: Low freq. coverage to 355 KC with two extra coils and calibration curve. Set No. 341A for GD-1B and set No. 341 for GD-1A. Shipping weight 1 lb. Only $3.00.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 10, MICHIGAN

New *Heathkit* VFO KIT



- Smooth acting illuminated and precalibrated dial.
- 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.
- 7 Band coverage, 160 through 10 meters—10 Volt RF output.
- Copper plated chassis—aluminum cabinet—easy to build—direct keying.

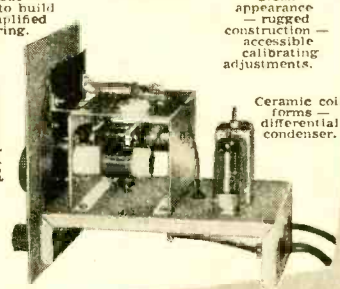
MODEL VF-1

$19.50

Ship. Wt. 7 lbs.

Here is the new Heathkit VFO you have been waiting for. The perfect companion to the Heathkit Model AT-1 Transmitter. It has sufficient output to drive any multi-stage transmitter of modern design. A terrific combination of outstanding features at a low kit price. Good mechanical and electrical design insures operating stability. Coils are wound on heavy duty ceramic forms, using Litz or double cellulose wire coated with polystyrene cement. Variable capacitor is of differential type construction, especially designed for maximum bandspread and features ceramic insulation and double bearings.

This kit is furnished with a carefully precalibrated dial which provides well over two feet of calibrated dial scale. Smooth acting vernier reduction drive insures easy tuning and zero beating. Power requirements 6.3 volts AC at .45 amperes and 250 volts DC at 15 mills. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter Kit. The VFO coaxial output cable terminates in plastic plug to fit standard ½" crystal holder. Construction is simple and wiring is easy.



Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

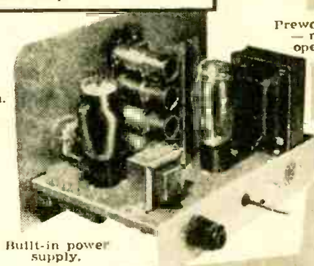
$29.50

Ship. Wt. 16 lbs.

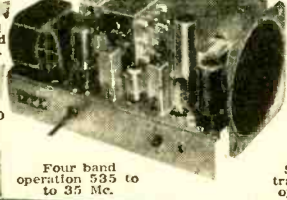
SPECIFICATIONS:

Range 80, 40, 20, 15, 11, 10 meters.
6AG7 ....Oscillator-multiplier.
6L6 ....Amplifier-doubler
5U4G .... Rectifier.
105-125 Volt A.C. 50-60 cycles 100 watts. Size: 8⅛ inch high x 13⅛ inch wide x 7 inch deep.

Here is a major Heathkit addition to the Ham radio field, the AT-1 Transmitter Kit, incorporaring many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, A. C. line filtering, good shielding, etc. VFO or crystal excitation—up to 35 watts input. Built-in power supply provides 425 volts at 100 MA. Amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual.



Heathkit COMMUNICATIONS RECEIVER KIT



SPECIFICATIONS:

Range.........535 Kc to 35 Mc
12BE6 ....Mixer-oscillator
12BA6 ....I. F. Amplifier
12AV6 Detector—AVC—audio
12BA6 ....B. F. O. oscillator
12A6........Beam power output
5Y3GT ....Rectifier
105-125 volts A.C. 50-60 cycles, 45 watts.

A new Heathkit AR-2 communications receiver. The ideal companion piece for the AT-1 Transmitter. Electrical bandspread scale for tuning and logging convenience. High gain miniature tubes and IF transformers for high sensitivity and good signal to noise ratio. Construct your own Communications Receiver at a very substantial saving. Supplied with all tubes, punched and formed sheet metal parts, speaker, circuit components, and detailed step-by-step construction manual.

MODEL AR-2

$25.50

Ship. Wt. 12 lbs.

CABINET:

Proxylin impregnated fabric covered plywood cabinet. Shipg. weight 5 lbs. Number 91-10, $4.50.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 10, MICHIGAN

Heathkit ECONOMY SIX-WATT AMPLIFIER KIT

MODEL A-7B

$15.50 Shpg. Wt. 10 lbs.

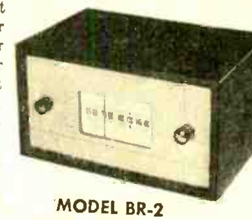
Here is an outstanding amplifier value. This economically priced amplifier is capable of performance usually associated only with far more expensive units. Can be nicely used as the heart of an inexpensive high quality home music system. Features inputs for tuner and phono (Model A-7C accommodates a microphone by using an additional preamplifier stage). Separate bass and treble boost and cut tone controls for just the degree of tonal balance you want. The entire kit can be built in a few pleasant hours for years of enjoyment.

Technical features, frequency response ± 1½ db 20–20,000 cycles. Full 6 watts output. Push-pull beam power output stage. Output transformer impedances 4, 8, and 15 ohms. Tube lineup, 12J5GT, 12SL7, 2—12A6, 5Y3GT, and 12SJ7 (A-7C only).

All parts including tubes are supplied along with a prefabricated and painted chassis. Detailed step-by-step Construction Manual eliminates necessity for specialized knowledge.

MODEL A-7C incorporates a preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance cartridge or microphone. $17.50

BROADCAST BAND NEW *Heathkit* RECEIVER KIT



MODEL BR-2

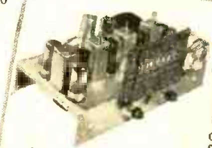
$17.50 Shpg. Wt. 10 lbs.

less Cabinet

Here is the ideal radio kit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit deserves your attention. Circuit is transformer operated, eliminating shock hazard usually associated with "economy" AC-DC circuits. New high gain miniature tubes and IF transformers—powerful ferrite core built-in rod type antenna—chassis mounted 5½" PM speaker—optional operation either as receiver or tuner and phono input. Covers broadcast band 550—1600 Kc. Uses 12BE6, 12BA6, 12AV6, 12A6, and 5Y3 tubes.

CABINET: Proxylin impregnated fabric covered plywood cabinet available. Includes aluminum panel, flocked re-inforced speaker grill and protective rubber feet. 91-9, Shpg. Wt. 5 lbs. $4.50

Heathkit FM TUNER KIT



MODEL FM-2

$22.50 Shpg. Wt. 8 lbs.

Here is an FM tuner kit designed for simplified construction to operate either through the "phono" section of your radio or with a separate amplifier. AC transformer operated—8 tube circuit—slide rule type tuning dial—88–108 megacycle coverage—three double tuned IF stages—factory adjusted front end. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

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ON PARCEL POST ORDERS insure postage for weight shown.

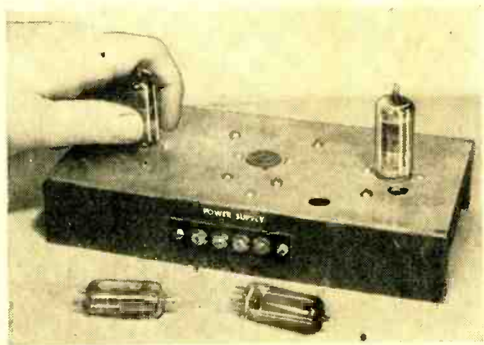
ORDERS FROM CANADA and APO's must include full remittance.

SAVE YOUR OLD TUBES

EVEN if your old vacuum tubes have low emission and register in the "bad" portion of your tube checker, or even if they have internal shorts, don't throw them away as long as the heaters are in good condition. These tube filaments may be used as inexpensive "ballast" resistors in experimental circuits. Here is the way it is done.

To determine the "hot" resistance of the heater, refer to a tube manual for the rated voltage and heater current and then apply Ohm's law. For example, a type 12SQ7 tube has a heater rated at 12.6 volts and .15 amp. Applying Ohm's law, we find that the hot resistance is 84 ohms. The "cold" resistance may be determined by an ohmmeter. Actual resistance in the circuit will be somewhere in between the "hot" and "cold" values, depending on how much current flows through the heater. If desired, this value may be determined experimentally.

You'll find that old tubes are especially valuable for "filling out" series heater strings. As an example, suppose that you are assembling a simple audio amplifier using a 12SL7, a 35Z5, and a 50L6. If the tube heaters are connected in series, the total drop is only around 97 volts. You can fill out the string to bring it up to line voltage by connecting the heaters of two old 12-volt tubes in series with the amplifier tubes.



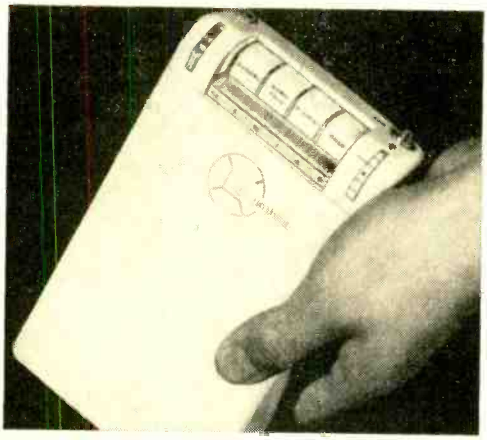
A tube whose performance is not suitable in regular circuits can be salvaged for other uses.

Choose tubes with the same heater current ratings as the other tubes in the particular string (.15 amp for the tubes cited in the example) and connect leads only to the heater pins.

It is as simple as all that. So the next time you are tempted to toss a radio tube in the wastebasket, run through the uses to which it might be put, stay your hand, and save money! —30—

Pocket-Size Wire Recorder

WIRE RECORDINGS can be made under any conditions—indoors or out—with the new "Minifon P55." This pocket-size recorder uses what is said to be the world's tiniest



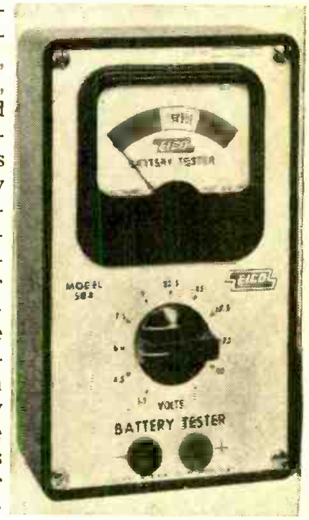
electric motor. Though small enough to fit into a man's pocket, the P55 will make recordings up to five hours on a single reel of wire thinner than a human hair.

Push-button control provides instantaneous action for recording, stopping, rewinding, playback, and erasing. Recordings can be played through earphones, speaker-microphone, any radio, TV set, or external amplifier. Accessories include a combination speaker-microphone for recording and playback, a wrist watch microphone, and a dictation foot-switch.

Price is $289.50, complete with crystal microphone, earphones, ½-hour reel of wire, and the batteries to power the unit. Made in Western Germany by *Protona, GMBH*, Hanover, the "Minifon P55" is marketed in America by *Geiss-America*, Chicago 45, Ill. —30—

Low-Cost Battery Tester

AVAILABLE IN EITHER KIT or wired form is the new *EICO* Model 584 battery tester. This device will test A or B batteries for portable radios, hearing-aid, lantern, and radiation counter batteries, as well as many other types. Because it provides a simulated load for the battery being checked, the battery's terminal voltage can be effectively brought to the same level as occurs under actual operating conditions.



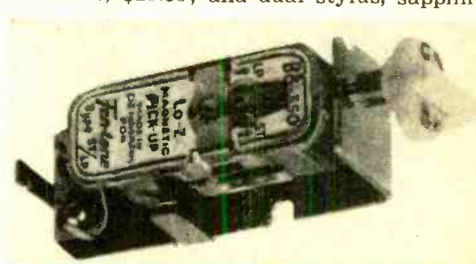
The resultant measurement is said to be more accurate than is possible with the use of a conventional voltmeter. The kit sells for $9.98; the wired model is priced at $12.95. For additional information, write to *Electronic Instruments Co., Inc.*, 84 Withers St., Brooklyn 11, N. Y. —30—

8-Pole Magnetic Hi-Fi Pickup

A MAGNETIC COIL surrounded by eight poles is the heart of a novel phono pickup introduced recently by the *Fenton Co.*, 15 Moore St., New York 4, N. Y. Known as the "B & O Lo-Z," the magnetic cartridge is a Danish contribution to the American hi-fi market.

Frequency response is said to be flat from 20 to 16,000 cycles ±2 db, then gradually rising as it approaches 20,000 cps. Other reported features include very small mass and negligible inertia, freedom from resonance over the whole audible range, high compliance, and very low record wear. Cartridge snaps into mounting hardware to fit most phono arms.

The following models are available at the net prices indicated: single stylus, sapphire tip, for standard (78-rpm) discs, $7.50; single stylus, sapphire tip, for microgroove (LP) records, $7.50; dual stylus, sapphire tip, for both standard and LP records, $7.95; single stylus, diamond tip for LP's, $18.95; and dual stylus, sapphire



tip for standard discs and diamond tip for LP's, $19.95. For additional information, write to the *Fenton Co.* —30—

Career in Electronics

(*Continued from page* 32)

The foremost question in many readers' minds will be: which is best—correspondence or resident training? The decision must be based on the prospective trainee's own needs. Deciding factors might be: (1) intended specialty of the student and course offered by the school; (2) time available for study vs. length of course; (3) location of resident school with its opportunities vs. increased living costs and convenience of the home-study program; and (4) the character of the school itself as determined by comparative examination of the literature of several schools. Incidentally, free literature describing each school is available to all interested parties. Write directly to the institution concerned.

In subsequent articles, both home-study and resident training will be explored in greater detail, with examples and photos of representative schools to highlight important points. —30—

AFTER CLASS

METER CONVERSION

FINE, jeweled-bearing meter movements may be obtained at surplus stores at surprisingly low prices—often substantially below the cost of manufacture. For most experimental uses, their scale ranges are inconvenient, sometimes even useless, but with a little effort almost any one of these may be converted into an instrument having exactly the range desired for a given job.

A moving coil meter of the d.c. variety is either a current-measuring instrument or a voltage-measuring device. If its range

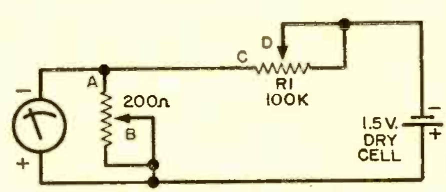


Fig. 1. Circuit for measuring Rm and Ic.

is too limited, i.e., if it doesn't read sufficiently high for a specific application, it may be converted into a higher range instrument by taking the procedural steps

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✔ Omar Bibbs, 1320 E. 27th St., Kansas City, Mo.	1st Class	34 weeks
✔ Kenneth Rue, Dresser, Wisconsin	2nd Class	20 weeks
✔ B. L. Jordan, Seattle, Washington	1st Class	20 weeks

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outlined below. As a start, the following meter characteristics must be determined:

Rm—the internal resistance of the instrument (ohms).

Ic —the coil current required to produce full-scale deflection (amperes).

Efs—the applied voltage that is to cause full-scale deflection in the final instrument, applicable if you are making a voltmeter from a milliammeter or microammeter or if you are converting an existing voltmeter to read higher voltages (volts).

Ifs—the current expected to produce full-scale deflection in the finished, converted instrument if you are simply increasing the range of a milliammeter or microammeter (amperes).

Measurement of *Rm*: The internal resistance of a voltmeter may be measured directly with any good ohmmeter. *Caution:* an ohmmeter *must not be used* to measure the internal resistance of a microammeter or milliammeter as it may burn out the coil. When dealing with these sensitive instruments, the procedure given in the following paragraph must be followed.

Set up the circuit of Fig. 1, leaving the 200-ohm potentiometer disconnected. *Before connecting to the 1.5-volt battery, set the resistance between points C and D on R1 at maximum.* Complete the connections and slowly adjust *R1* until the meter reads full scale; leave *R1* at this setting, connect the 200-ohm pot as shown and rotate its shaft until the meter deflection is reduced to exactly half-scale. Disconnect the meter movement from the circuit and measure the resistance between points A and B on the 200-ohm pot. This is the internal resistance, *Rm,* of the meter. Make a note of its value.

Measurement of *Ic*: The full-scale deflection current of an existing voltmeter may be computed using the following equation in which *E* is the full-scale voltage printed on the meter face:

$$Ic = E/Rm \quad (Ic \text{ in amperes})$$

To measure the full-scale deflection current of a microammeter or a milliammeter, disconnect the 200-ohm pot from the circuit of Fig. 1. Measure the resistance between points C and D on *R1* for the setting which produced a full-scale deflection. The full-scale coil current may now be calculated by means of the equation below:

$$Ic = \frac{1.5}{Rm + R(C\ to\ D)} \quad (Ic \text{ in amperes})$$

Note the value of *Ic* thus determined in writing, then decide on the full-scale range

of the converted instrument, *Efs* or *Ifs* as the case may be. These figures should be jotted down so that you have the written values for *Rm, Ic,* and either *Efs* or *Ifs* all together for use in the steps that follow.

Conversion to Voltmeter: A voltmeter is a moving-coil movement to which a resistance, generally quite high, has been added in *series* (Fig. 2A). This series resistor is called a multiplier (*M*). If the meter movement is already a microammeter or milliammeter, the value of *M* may be determined by applying the following equation using the values for *Rm, Ic,* and *Efs* determined previously:

$$M = \frac{Efs}{Ic} - Rm$$

Example: A 0-500 microammeter ($Ic =$ 500 microamperes) is to be converted into a 0-100 voltmeter ($Efs = 100$ volts). If the internal resistance of the meter is 100 ohms, what is the required multiplier? Since 500 microamperes = .0005 amp., then:

$$M = 100/.0005 - 100 = 200{,}000 - 100 = 199{,}900 \text{ ohms}$$

In this example, the internal resistance is so small compared to the multiplier that it might be ignored with no serious consequences. Thus, a resistor of 200,000 ohms might be used for *M*.

Increasing Voltmeter Range: Here again a multiplier is required, the same equation being used. The only difference between this and the previous case is that the internal resistance is usually much higher and cannot be ignored.

Example: A 0-10 voltmeter is to be converted for use as a 0-1000 voltmeter. Its

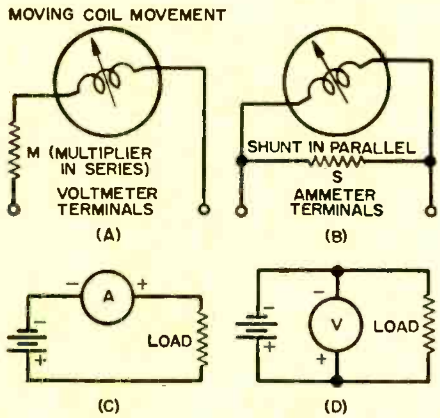


Fig. 2. Circuits for (A) voltmeter, (B) ammeter, (C) series ammeter, and (D) shunt voltmeter.

internal resistance, Rm, is 10,000 ohms; $Ic = 10/10{,}000$ or .001 amperes for full-scale deflection. Thus:

$$M = 1000/.001 - 10{,}000; \text{ so that}$$
$$M = 990{,}000 \text{ ohms}$$

Increasing Current Meter Range: Unlike a voltmeter, a current-measuring instrument is equipped with a *shunt* (S in Fig. 2B) to divert some of the circuit current away from the meter coil. The resistance of the required shunt may be found from:

$$S = \frac{Ic}{Ifs - Ic} \times Rm$$

Example: A 0-1 milliammeter ($Ic = .001$ amp.) is to be used for measuring currents up to 0.1 amperes ($Ifs = 0.1$ amp.) Its internal resistance is 50 ohms ($Rm = 50$ ohms). What is the value of the shunt needed?

$$S = \frac{.001}{.1 - .001} \times 50 = .0101 \times 50$$
$$= .505 \text{ ohms}$$

Small resistances like this are practically impossible to buy, but may be made up quite easily from standard enamel-covered copper wire. Wire tables in any handbook provide the information needed to determine the length of a given gage wire for a specific resistance. Shunts are generally wound as small-diameter coils on ceramic or wood forms.

Before using your newly converted instrument, you are reminded that miliammeters and microammeters are used in *series* with the load while voltmeters are always connected in *parallel* with either the voltage source or the load (Fig. 2C and 2D).

The following quiz is intended as a self check. You should be able to answer all of the questions correctly if you have mastered the text. Answers are on page 128.

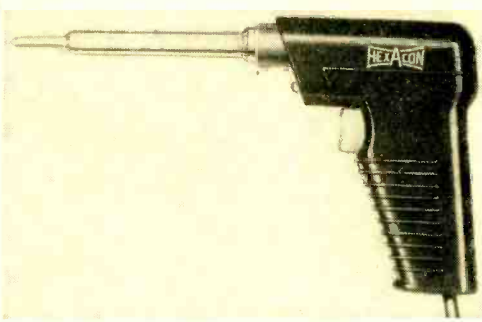
QUIZ

1. A 0-1 milliammeter is to be converted into a 0-100 voltmeter. The internal resistance of the movement is 20 ohms. Compute the value of the multiplier required.
1. A 0-2 voltmeter is to be used on a circuit where the anticipated voltage peak is to be 50 volts. The internal resistance is 1000 ohms. Find the multiplier.
3. The range of a 0-1 ampere meter is to be extended to 0-10 amperes. Measured internal resistance (circuit of Fig. 1) is .01 ohms. Find the shunt needed for this conversion.
4. What would happen if a voltmeter were connected in series with the source of voltage and the load instead of in parallel with either one?
5. What would happen if a milliammeter or ammeter were to be connected in parallel rather than in series with the load? —30—

TOOLS & GADGETS

FEATHERWEIGHT SOLDER GUN

A new "instant" solder gun which becomes soldering-hot in a few seconds, without the use of heavy transformer or fragile thermostats, has been announced by *Hexa-*



con Electric Co., 569 W. Clay Ave., Roselle Park, N. J. It weighs but 8 oz.

The special alloy tip is said to resist corrosion and bending, thus eliminating tip maintenance. Trigger control gives any degree of heat required without danger of overheating. Recommended for radio-TV

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1B3GT	.79	6AS7G	2.25	6SG7	.43	12SN7GT	.60
1L4	.56	6AT6	.40	6SH7	.45	12SQ7GT	.44
1L6	.60	6AU5GT	.70	6SJ7GT	.45	14A5	.59
1LA4	.66	6AU6	.46	6SK7	.50	14A7	.45
1LB4	.66	6AV5GT	.85	6SL7GT	.70	14B6	.40
1LC6	.66	6AX5GT	.59	6SN7GT	.60	14Q7	.52
1LD5	.66	6B4G	.90	6SQ7GT	.44	19BG6G	1.18
1LE3	.66	6BA6	.49	6V6GT	.48	19J6	.66
1LG5	.66	6BC5	.55	6W4GT	.40	19T8	.70
1LH4	.66	6BE6	.50	6W6	.60	25A7GT	1.50
1LN5	.49	6BG6G	1.18	6W6GT	.56	25AV5GT	.80
1N5GT	.55	6BH6	.61	6X4	.35	25BQ6	.98
1R4	.66	6BJ6	.49	6X5	.39	25BQ6GT	.90
1R5	.67	6BK5	.70	6X5GT	.35	25Y5	.45
1S4	.65	6BK7A	.78	6X8	.75	25Z5	.38
1S5	.65	6BN6	.59	6Y6G	.63	25Z6GT	.42
1T4	.65	6BL7GT	.77	7A4-XXL	.47	35A5	.48
1U5	.50	6BQ6GT	.88	7A5	.55	35B5	.52
1V	.57	6BQ7A	.80	7A6	.47	35C5	.51
1X2A	.79	6BZ7	.90	7A7	.45	35L6GT	.48
2D21	1.00	6BY5G	.60	7A8	.46	35W4	.39
2V3G	.80	6C4	.39	7B5	.41	35Y4	.40
2X2A	1.00	6C5	.36	7B7	.43	35Z3	.41
3D6	.45	6C6	.50	7B8	.47	35Z5GT	.39
3LF4	.80	6CB6	.55	7C4	.40	50B5	.52
3Q4	.62	6CD6G	1.18	7C5	.44	50C5	.51
3Q5GT	.63	6D6	.50	7C6	.45	50L6	.48
3V4	.65	6E5	.46	7F8	.70	50L6GT	.45
5T4	.70	6F6	.40	7Y4	.35	75	.44
5U4G	.49	6H6GT	.40	12AT6	.46	77	.39
5V4G	.71	6J4	2.00	12AT7	.68	78	.39
5Y3GT	.39	6J5GT	.40	12AU6	.46	80	.35
5Y4G	.43	6J6	.49	12AU7	.60	83V	.60
5Z3	.47	6J7	.45	12AV6	.46	117L7GT	2.00
5Z4	.54	6K7	.40	12AX7	.70	117N7GT	2.00
6A7	.59	6K6GT	.39	12AY7	.90	117P7GT	2.00
6A8	.59	6L7	.44	12BA6	.48	117Z3	.37
6AB4	.48	6N7	.61	12B4	.70	117Z6GT	.65
6AF4	.80	6Q7	.45	12BE6	.50		
6AG5	.56	6S4	.48	12BH7	.70		
6AH6	.80	6S7G	.47	12BY7	.68		
6AK5	.80	6SA7GT	.50	12SA7	.52		
6AL5	.44			12SH7	.47		
6AL7GT	.70			12SJ7GT	.50		
6AS5	.50			12SK7	.50		

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Do We Have To Die?

Forty-three years ago in forbidden Tibet, behind the highest mountains in the world, a young journalist named Edwin J. Dingle found the answer to this question. A great mystic opened his eyes. A great change came over him. He realized the strange power that knowledge gives.

That Power, he says, can transform the life of anyone. Questions, whatever they are, can be answered. The problems of health, death, poverty and wrong can be solved.

In his own case, he was brought back to splendid health. He acquired wealth, too, as well as world-wide professional recognition. Forty-three years ago, he was sick as a man could be and live. Once his coffin was bought. Years of almost continuous tropical fevers, broken bones, near blindness, privation and danger had made a human wreck of him, physically and mentally.

He was about to be sent back home to die, when a strange message came— "They are waiting for you in Tibet." He wants to tell the whole world what he learned there, under the guidance of the greatest mystic he ever encountered during his lifetime of travel throughout the world. He wants everyone to experience the greater health and the Power, which there came to him.

Within ten years, he was able to retire to this country with a fortune. He had been honored by fellowships in the world's leading geographical societies, for his work as a geographer. And today, 43 years later, he is still so athletic, capable of so much work, so young in appearance, it is hard to believe he has lived so long.

As a first step in their progress toward the Power that Knowledge gives, Mr. Dingle wants to send to readers of this magazine a 9,000-word treatise. He says the time is here for it to be released to the Western World, and offers to send it, free of cost or obligation to sincere readers of this notice. In addition he will give to each of them a 64-page book showing the astonishing events the world may soon expect, according to great prophecies.

For your free copy of both works, simply send a postcard or letter to The Institute of Mentalphysics, 213 South Hobart Blvd. Dept. R-296, Los Angeles 4, Calif.

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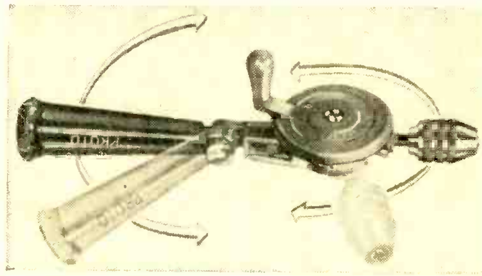
labs, electric motors, electrical maintenance, farms, schools, hobbyist and home use, the gun is rated at 150 watts and is available for 120 volts, d.c. or a.c. List price is $7.95.

ALL-ANGLE DRILL

Both the chuck and handle of the "Proto" No. 370 drill are adjustable to several positions. This feature enables the drill to

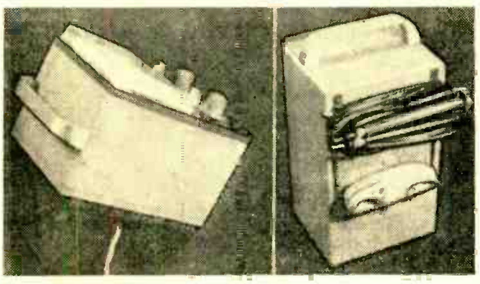


reach around obstructions and to be used in close quarters. The ¼" chuck swings in a 270° arc, and a spring lock enables the user to change angles with a flip of the thumb. The handle turns in a 180° arc at right angles to the chuck movement path. It is held in its several positions by an adjusting screw. Additional data may be obtained from the *Plomb Tool Company,* 2209 Santa Fe, Los Angeles, Calif. —30—

TIPS and TECHNIQUES

METER STAND HOLDS LEADS

A simple accessory that provides prongs for coiling line cord and test leads, and also serves as a stand for supporting a meter at



an angle, may be fashioned from a piece of coat-hanger wire. As shown in the photo, the stand is held to the back of the meter by two simple clips made from scrap copper. The clips are attached to the meter case with 6-32 x ¼" machine screws. The long test prods fit through one side of the top holder with their tips snugly secured through the other end. Shown here is a *Heathkit* Model V-7 vacuum-tube voltmeter, although the idea can be adapted for use on any meter.

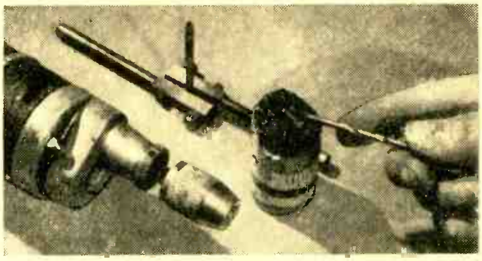
EASY-TO-MAKE LABELS

Easy-to-make and long-lasting are "typed-tape" labels. Ordinary adhesive tape is

pasted onto used photo film or cellophane, which may then be placed in a typewriter for labeling. Pen and India ink will also do. Each name plate can be cut out as needed with a scissors or razor blade. When backing is removed, the labeled tape may be applied to a panel, plug, etc. A thin coat of clear lacquer will increase the label's durability.

ADHESIVE SECURES DRILL BITS

Slipping of drill bits in the chuck of a small electric drill can be overcome by applying a little sandpaper disc adhesive as



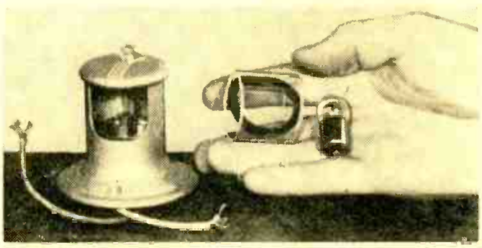
shown in the photo. Available in stick form, the adhesive contains rosin which provides a non-slip grip. This adhesive may also be used in the jaws of a tap-wrench (shown in photo), if the wrench is the type that loosens easily. When applied, the adhesive will prevent the tool from falling from the bench to the floor where it may be damaged.

COLORS IDENTIFY TOOLS

For quick visual identification of small tools on a cluttered workbench, paint the handles with a bright enamel, using different colors to designate different tools. Colored masking tape can also be used although the colors may not be as vivid as enamel paint. Tools whose handles are color-coded in this manner will be less apt to "disappear" at the moment when they are needed most.

SURPLUS LAMP AIDS EXPERIMENTS

Lamps similar to the one illustrated are often available as surplus items. This one, about 3″ in diameter at its metal base and



2½″ high, will operate on six volts. The base has protruding leads and a glass protector fits over the assembly. It may be employed as a pilot lamp on a test table with a suitable transformer, or on a car battery. Other uses will suggest themselves to the experimenter. —30—

Stroboscope

(*Continued from page* 59)

has had ample time to recharge and re-establish anode potential on the thyratron.) When the thyratron fires, the same events occur, establishing relaxation oscillation at a frequency governed largely by the size of *C5* and the setting of *R9*.

Attention should now be given to capacitor *C4*. The left side of this capacitor is connected to the anode of the 2050 through a very small protective resistor, *R6*. Hence, the charge on *C4* depends upon the anode voltage of the thyratron. During the time that the thyratron is not firing, *C4* takes on a potential equal to that of the anode of the 2050 with its left side positive and its right side at ground potential. During this period, the control grid of the strobotron (pin No. 3) is at ground potential; such a potential is not negative enough to fire the strobotron.

At the instant that the thyratron fires, the anode voltage drops practically to zero, as previously explained, so that *C4* can now discharge through the thyratron and through *R5* to ground. Direction of electron flow during the discharge is upward through *R5*, making the lower end of it very negative with respect to ground. The control grid (pin No. 3) of the strobotron thus becomes highly negative and the strobotron fires.

When the strobotron ionizes, its resistance drops practically to zero, so that the current through it is extremely high. This high current "empties" capacitor *C2* in less than 5 microseconds and, since the anode potential of the strobotron is being taken from capacitor *C2*, the strobe's anode voltage instantaneously drops below 60 volts, causing it to deionize and extinguish.

Thus, the emitted light from the strobotron is very intense and of very short duration. The value of *C2* was carefully chosen to give sufficient intensity and sufficiently short discharge time. Higher values delay extinguishing of the strobe (blurred motion of high-speed objects) and smaller values cause a reduction of intensity. –30–

Disc and Tape Review

(*Continued from page* 70)

chestra. A veritable tour-de-force of orchestration, this has some of the most spectacular effects—especially in the percussion—ever recorded! There is tympani that will blow your speaker cone right out of the window if you are not careful! This tremendous "liveness" is probably due to the dynamic range, which on this disc is as great as you'll ever encounter. In fact, the range probably is close to the limit of what can practicably be cut on a disc. If you can't track certain sections of this disc, don't blame the record; look instead for deficiencies in your arm or cartridge.

Music of Ravel is always strongly represented on all pop concert programs. The *Bolero* is of a certainty the odds-on favorite, but we will not review it here since I have already done so in an earlier column in POPULAR ELECTRONICS. Next in order of popularity is the *Rhapsodie Espagnol*. At the present time, there are 11 versions on LP, only one of which can really be classed as modern hi-fi in quality—the Von Karajan reading on *Angel* 35081.

One of the most successful of all *Angel* recordings, and with a splendidly recorded and performed *La Mer* on the reverse side, the Von Karajan disc is an exceptional buy. Von Karajan, not generally noted for his facility with this kind of music, turns in a most satisfying performance. He indulges in a few of his famous mannerisms and has some highly individual ideas on tempi; but this is minor in the over-all picture. The sound is a very smooth, luminous sort of thing, almost transparent in the texture of its strings and the lovely woodwinds. Yet, in the lustier sections of the work, the brass is clean and bright, the percussion sharply defined, and dynamic range is not inhibited. Perhaps the outstanding feature is the meticulous balance maintained by Von Karajan and the *Angel* engineers. The balance and the superb acoustics make for a very live sound. There are other more spectacular-sounding versions of this work, but I think this one is the truest representation of the score.

The only other versions which can be considered as having fairly decent sound are the Ormandy/*Columbia* (some brilliant hi-fi pyrotechnics in this one, but also some sonic sins), the Munch/Boston Symphony on *Victor*, and the Ansermet/*London* reading. Any of these discs will sound pretty fair on the average hi-fi setup, but their faults will be as easily apparent to owners of top quality "big systems." If, however, we were to pin the question down as to the very best performance, the palm would have to go to Ormandy, who with his incomparable Philadelphians does a marvelous job in capturing the Spanish essence of this work.

There you have it! Best sound with excellent performance is . . . the *Angel;* best performance with reasonably hi-fi sound . . . the *Columbia* disc.

⊙ ⊙ ⊙

Another of Ravel's most popular scores is his ballet *Daphnis et Chloe*. This work is usually played at concerts in the form of two suites, with Suite No. 2 performed far more often than the first. The work is well represented in the catalog in all its forms . . . as a complete ballet by Ansermet on the *London* label, as Suites Nos. 1 and 2 on a Cluytens/*Angel* disc and an Ormandy/*Columbia* disc, and as Suite No. 2 on eight other LP's.

On the matter of the ballet in its complete form, the Ansermet reading is superbly done and the sound is one of *London's* best jobs. However, I have just heard some advance pressing of the new Dorati/Minneapolis Symphony reading on *Mercury*, and what I have heard so far is highly impressive, especially in the sound department where there is no question that this is the best hi-fi version yet to appear. I will reserve judgment on the performance until I have a chance to hear the work in its entirety. Suffice it to say that, so far as I could tell, the job is well done. If there are some of you who just can't wait for this to be released, you need not have any qualms about the Ansermet reading, as it has withstood the test of time quite well.

Between the Cluytens/*Angel* version and the Ormandy/*Columbia* version of the two suites, there is little to choose. The *Angel* has the more natural, more impressively musical sound, with the beautifully clean strings and the superior French woodwinds virtually distortionless. *Columbia* has the fabulous strings of the Philadelphia orchestra, but they have a slight edge to them; brass and percussion is more spectacular than the *Angel* disc. Ormandy does an eminently satisfying job of conducting this work, but Cluytens outguns him with his tempi and phrasing, his orchestral contrasts that clearly show a deeper insight of the score and a more loving approach.

Of the discs containing Suite No. 2 only, the Toscanini is far and away the best. The Maestro has a way with this kind of music that is irresistible. As usual, the pace may be considered by some to be a mite fast, but he gets away with it because of his ability to elicit a fabulous amount of inner detail that gives the work its strong textures. Unfortunately, this is not the best sound by any means. The acoustics are cramped, the frequency and dynamic range somewhat restricted.

Until I have a chance to evaluate the new *Mercury*, the score on this work would be: best sound and best performance . . . the *London* complete ballet; best sound and performance on the two suites . . . the *Angel* disc.

o o o

Unfortunately, space does not permit a thorough review of some of the other staples of the pop concert repertoire, but here are a few recommendations which in every case are considered the best sounding but not necessarily the best-performed versions of a particular work: Ravel's *Alborada del Gracioso . . . Angel* and *Mercury;* Ravel's *Mother Goose Suite . . . London* and *Columbia;* Ravel's *La Valse . . . Mercury, Columbia, London;* Saint Saen's *Dance Macabre . . . London, Columbia;* Sibelius *Finlandia . . . Columbia, Angel;* Tchaikovsky's *Nutcracker Suite . . . Mercury, Columbia* 4729, *Victor* LM9023, *Angel* 35004; Tchaikovsky's *Romeo and Juliet . . . Mercury, Westminster, London, Capitol;* Mussorgsky's *Night on Bald Mountain . . . Victor, London.*

Jazz Corner

There are some very good jazz items this month. Those of you who are old enough will remember rather fondly the great swinging band of saxophonist Charlie Barnet, and will be pleased to learn that Charlie recently got together a bunch of his old sidemen and other "hotshots" and has turned out an album for *RCA Victor* called *Redskin Rhumba*. This, of course, was the title of one of the numbers in Barnet's famous Indian sketches, and included the ever popular *Cherokee, Iroquois,* etc.

The years have treated Mr. Barnet and his saxophone kindly, and the aggregation behind him has not forgotten how to swing! Charlie really blows up a storm with all his saxophones, including his famous soprano, and the result is some of the best "big band" jazz I have heard in a long time. In fact, there seems to be a trend forming that could lead us back to the era of the "big swingin' bands." I think this is largely due to the magnificence of sound that these big bands make when recorded with modern techniques and reproduced through good hi-fi systems.

This recording is a brand new *Victor* orthophonic, and if you think you know how the Barnet saxophone sounds, you haven't really heard it until you hear it on this disc. Many of Charlie's subtler intonations, and other details which just couldn't be captured on the 78 rpm's, are heard here with startling clarity and are really quite revelatory. The sound itself is very wide range in frequency and dynamics, the trombones and trumpets are bright and punchy, the traps have a clean, solid sound.

It is a record which should appeal to a large public, and the teensters who don't know Mr. Barnet should listen to him and hear some real music and real musicianship instead of some of the watered-down pablum they are fed these days!

⊙ ⊙ ⊙

Another all-time favorite comes into his share of hi-fi attention on *Capitol* disc called *B.G. in Hi-Fi*. It takes no musical Sherlock Holmes to figure out that those initials stand for the immortal Benny Goodman, a name even the teensters are familiar with.

Yessir, the old "King of Swing" gets together with a few of his old boys and a lot of new "sit-ins," and he too gets a chance to have his fabulous clarinet heard with hi-fi sound. Playing a potpourri of old favorites, including such gems as *Airmail Special,* Benny gives ample evidence of his ability to keep it swingin'! If he hasn't quite the freshness and improvisation that characterized his earlier playing, nevertheless he still has that big solid tone and the accurate intonation. The band behind him could have had a few more hours together to improve their ensemble work, but the spirit is there and they do quite well.

Capitol produces some of the best big band records made these days. Their acoustic treatment is ideal, and the mixing engineer does a terrific job of maintaining balance. Add to this the wonderfully wide dynamic and frequency range, the almost total lack of distortion and—as a bonus—really dead quiet surfaces, and this record makes a legendary Benny Goodman take on new life. It is highly recommended to you.

Tape Tips

As promised, here is one of the new *AV/-Vanguard* Jazz Showcase releases: *Jimmy*

Rushing Sings the Blues—AV7015 inch reel, 7½ i.p.s., 30 min., $7.95.

The name Jimmy Rushing will be familiar to those who remember his work with the late Jimmy Lanceford's band and other groups. As a proponent of blues singing, Jimmy is unique. His voice is not what anybody could ever call beautiful, his range is quite restricted, he strains at times. But neither could anybody deny the earthiness, the "rightness" of his rather gravelly voice for singing the moanin' low blues!

Jimmy is backed up on his numbers by a group of well-known sidemen including Jo Jones on the skins, Sam Price on piano and Buddy Tate on the tenor sax. When Jimmy rears back his head and gives forth with an old favorite like *Chicago,* man . . . you know you're getting the real deal . . . the gen-u-wine blues.

Soundwise, this is another example of the excellent recording done by *Vanguard* and expertly dubbed by *AV*. All elements vocal and orchestral are very smooth, yet clearly delineated; frequency and dynamic range are, of course, far better than on the disc originally issued; the piano in particular has that beautiful, clean sound and wonderful transients peculiar to its reproduction on tape.

Good acoustics and a signal-to-noise ratio good enough to make tape hiss minimal add up to the fact that prerecorded tapes are getting better and better all the time. Now if the tape companies can only figure out how to furnish the raw tape at a realistic price, we'll really get prerecorded tape off the ground!

Record of the Month

This month a *Westminster Lab* Series disc gets the nod. It has a familiar item like Chabrier's *Espana,* coupled with two numbers by Revueltas, and the fantastic *Iron Foundry* of Mossolov. The first *Westminster Lab* series that justifies its advertising adjectives, the balance is kept reasonable here and is not subverted for the sake of hi-fi effects.

The *Iron Foundry* and the Revueltas works are sensational enough in themselves without further enhancement by trickery. Sound is very wide range, dynamics startling in their contrasts, and some of the bass drum blasts will lift you out of your seat! Don't fail to hear this one! —30—

Transmitting Tower

(*Continued from page* 63)

wave receiver or practice with another beginner to build up your speed.

In order to avoid memorizing the code visually, if at all possible to do so, ask someone who is not interested in learning the code himself to help you and your partner. After reading this article to learn what is required, he can take the code chart and act as your instructor. Instead of using a key, he can say the *dits* and *dahs* composing each letter as a single staccato group. Many a patient parent, brother, sister, or girl friend has helped a new ham get started in this manner.

Getting down to bedrock, teaching yourself the code from a chart is the least desirable of all methods, because of its slowness. Nevertheless, probably most amateurs on the air today started in that manner and used signals picked up on their receivers for copying practice.

At first, it will be difficult to find any signals going slow enough to permit copying even an occasional letter. But write down every one you do recognize. Eventually, you will be able to copy more and more of them, and you will be over the "hump."

No matter how you learn the code, you should start over-the-air copying as soon as you can, to accustom yourself to copying all sorts of signals through noise and interference. Learn to copy through headphones, too, because you will have to wear them when you take the FCC examination. Your family will probably insist on it, anyway.

Copying Practice

One excellent source of over-the-air practice is W1AW, Newington, Conn. Every night of the year starting at 9:30 p.m., Eastern Time (Standard Time in the winter and Daylight Time in the summer), it sends an hour of code practice on eight different frequencies in the amateur bands. On Sunday, Tuesday, Thursday, and Saturday, the transmission speeds are 5, 7½, 10 and 13 wpm. On Monday, Wednesday, and Friday, they start at 15 wpm and increase in 5-wpm steps to 35 wpm.

The most useful of the W1AW frequencies are 1885, 3555, 7125, and 14,100 kilocycles. The first two will be heard best from within several hundred miles of the station, and the other two will be more useful over greater distances. These code-practice sessions may be identified by the preliminary call on code of "QST DE W1AW" repeated for several minutes, starting promptly at 9.30 p.m., Eastern Time.

However you learn the code, you will eventually reach a speed beyond which you cannot seem to copy, in spite of your best efforts. Many students attempt to get past this very frustrating period by beating themselves over the head with the code for hours at a time. Unfortunately, this does not do the trick.

The only thing that does work is regular, short practice periods, in which you try to copy signals going slightly faster than the speed at which you can write down every letter. Sooner or later, you will start making progress again.

Learning to Send

Learning to send before you have memorized the code and have acquired some copying skill will retard your progress. This is because in learning to send you must think in terms of individual *dits* and *dahs*. As we have seen, this is the thing we try to avoid in copying. Fortunately, the only time it is necessary to learn to send immediately is when two beginners are studying together and must copy each other's sending.

Your key should be mounted on a fairly large base so that it will not flop around in use. Its contact spacing should be about 1/16", and its spring tension should be sufficient so that the contacts will open immediately upon the release of pressure, but not so great that heavy pressure is required to close them.

Best placement of the key varies with individuals. In general, place it in line with the shoulder of your keying arm, so that when your fingers are on its knob, your entire forearm is on the table. Lightly place your first two fingers on top of the knob near its back, with your thumb along the side, and your other fingers curved naturally toward the palm of your hand. All keying should be done with your flexing wrist, not with your fingers nor with your whole arm.

The *dit* is the basis of all sending rules. The *dah* is three times its length, and the spacing between *dits* and *dahs* within a letter is equal in length to one *dit*. Spacing between letters is three *dits*, and the spacing between words is equal to five *dits*.

Make a series of about ten *dits*, keeping them and the spaces between them short and uniform. Next, make a series of about eight *dahs*. Then, alternately send various combinations of *dits* and *dahs*. Use the same flexing wrist motion for all these exercises, and strive to make every *dit* sound like every other *dit*, every *dah* like every other *dah*, and every space exactly the same length.

In sending actual letters, do not worry about speed. Strive for accuracy. Watch especially the spacing, both within letters and between letters. Space poorly, and your sending will be difficult or impossible to read. Any time you have the least doubt about your sending, go back to the fundamental exercises again.

If you make a mistake in sending, send the error sign—eight *dits*—or the question mark, then go back to the last correctly sent word and start over from there. Most experienced operators use the question mark for this purpose.

Code Practice Oscillators

The simplest signal source for practicing sending is a high-frequency buzzer, a couple of dry cells, and the telegraph key all connected in series. More satisfactory because they are usually more reliable in operation and produce a more natural-sounding signal in your phones, are vacuum-tube or neon-bulb oscillators. Instructions for building several of them have appeared in past issues of POPULAR ELECTRONICS and in the *Radio Amateur's Handbook*. They also can be obtained commercially, already wired or in kit form, at prices from about $8.00 to $20.00. The more expensive of them can usually be used in conjunction with your transmitter as a keying monitor, after you obtain your license.

The Novice Code Test

The Novice Class code test consists of 25 five-letter words sent at a speed of five words per minute. You must copy a minimum of 25 consecutive letters to pass it. To be certain that you will be able to do so, you should be able to copy well at a speed of seven to eight words a minute. The extra speed will overcome the effects of the nervousness all

applicants suffer when they take the test.

No numbers or punctuation marks are included in the receiving test, but they may be called for in the sending test. In addition, you will not get very far in making contacts over the air unless you know them; therefore, do not neglect any of the symbols included in the code chart. Besides, you will have to know them later when you pass the 13-wpm General Class code test.

News and Views

Good news for Novices and prospective amateurs in the Albany, N. Y., area is that *The Fort Orange Radio Distributing Co., Inc.* will sponsor another amateur radio course this fall. Their spring course was an overwhelming success. Of the 51 who enrolled, 40 qualified for their Novice licenses, and "Uncle Dave" Marks, W2APF, president of the company, presented to each graduate a one-year membership in the *Albany Amateur Radio Club.*

Encouraged by the success of this first course and profiting by the few minor mistakes that were made, the fall course will be expanded in scope and should be even more successful than the first one. To register for the course and to get details as to starting date and similar information, contact *Uncle Dave's Radio Shack, Fort Orange Radio Distributing Co., Inc.*, 904-916 Broadway, Albany, N. Y.

In Chicago, free code classes for prospective amateurs will be held Monday evenings between 7:00 and 9:00 p.m., starting September 12 and continuing to November 28. The place is *Allied Radio Corporation,* 100 N. Western Ave., Chicago 80, Ill.

Helen Kennedy, WN9MXI, 5056 North Winchester St., Chicago 40, Ill., suggests that, to make it easier to change crystals in close quarters, a length of "Scotch" tape be placed on each side of the crystal holder and the ends stuck together at the top to form a handle. The crystal frequency can be typed on a small label, which is placed between the two lengths of tape at the top, for easy identification.

Helen uses this idea successfully with her *Johnson* Ranger transmitter. At the time she wrote, she had worked 25 states in about six weeks of limited operating time.

Let us hear from you. What type of a transmitter and a receiver do you use? How many states and countries have you worked?

Until next month, 73.

Herb, W9EGQ.

Short-Wave Bands

(*Continued from page* 65)

cuta in Cucuta. In exchange for a correct report, they will send a pennant in white, red, and brown. On 4815 kc., the address for HJBB is *La Voz de Cucuta,* Apartado Aereo 5-19, Cucuta, Colombia.

CURACAO—There are no s.w. xmsns from Curacao at present. The outlet on 5010 was for tests only and has been discontinued.

DENMARK—OZF, 9520 kc., Copenhagen, opens at 2030 in language. The session with Marianne usually runs from 2100 to 2128 and consists of talks and musical numbers. English programs are heard at 2200 and 2245, news at 2200.

ECUADOR—HCJB, Quito, 11915 kc., has an easily heard English program from 2100-2345. It usually is of a religious type, with a bit of Spanish now and then. They have an attractive QSL card.

EGYPT—If you can read foreign languages, try Cairo on 9790. They have an Arabic program at 1920-2000 with the sign off at 2000 after time pips. Identity is *Huna El Kahera*.

FRENCH EQUATORIAL AFRICA—Brazzaville, on 11970 kc., is another fairly easy one to find; around 1500 with English and French program; at 1850-1855 with news; at 1915-1940 with French music and English news; and around 2045 in a French session.

FIJI ISLANDS—VRH4, Suva, 3980 kc., with 500 watts, is owned by the *Fiji Broadcasting Commission* and transmits in English, Fijian, and Hindustani for the Pacific Islands at 1330-0530 weekdays and 1500-0500 on Saturdays. Broadcasts are relays of medium wave VRH and VRH2. A new vertical antenna will probably restrict radiation to the colony. Reports have been received from as far away as Japan, Norway, and USA. It is being heard on the West Coast around 0500-0600 and identifies as "This is Suva Calling." The s/off theme is "God Save the Queen."

FINLAND—OIX5, Pori, on 17800, opens at 2300 with time report and news in English. OIX4, 15190, opens Sunday at 0430 with a "Home Service" program. It fades in in the West around 0630 with pop music; news can be heard at 0600. A new English period opens at 1430.

FORMOSA—BED3, 15235, the *Voice of Free China* in Taipeh, opens at 0000 with English news; also noted at 1800-1900 and 0000-0200 to North America, at 0230 to the Middle East; English news at 0000, 0130, 0230.

GERMANY—NWDR, Cologne, on 11945, is a new channel with German news after English announcement at 1215. English session to North America is at 2115 with news at 2130-2140, German at 2200, pop music at 2300, German program at 2315-2330, French announcement and s/off at 2330. A new station is DGE24, 5135, operated by the editors of "Sportwelt Koln" for test purposes over a xmtr of the German "Bundespost." It is being noted around 0815.

GREECE—Athens, on 15345, has French at 1315, followed by English and a weekly review. Native songs are presented at 1330.

HUNGARY—An easy xmsn to hear is *Radio Budapest* on 9833 with an English session to North America at 2300-2330; news at 2330.

INDO-CHINA—One that isn't too easily logged is the *Voice of Vietnam* in Hanoi on 11998. Their English xmsn can be tuned at 0800-0830 and is mostly news. Dual with 9925 kc., they identify as "This is the *Voice of Vietnam* broadcasting from Hanoi, the capital of the Vietnamese People's Republic. . . ." Oriental follows the announcement.

IRAN—Another one that is not too easy to locate is *Radio Teheran*, EPB, on 15100. It can be tuned around 1510 with music; clock chimes at 1515, followed by English news to 1523. The 1530 s/off is with their national anthem, after more clock chimes.

JAPAN—*Radio Japan* began a new service to North America (Eastern portion) at 1930-2000 and 2130-2200 (not a repeat of the earlier xmsn), in English for the first 20 minutes and then in Japanese over 11705 kc. (JOA4) and 15235 (JOB5). Reports from Eastern North America will be answered with a special QSL card. *Radio Japan* will add Italian to its European service soon. Additional English news periods on 11705 can be heard at 0710 and 0745.

LIBERIA—ELWA, Monrovia, is back on 11800 after a short stay on 15200. They are currently using a sloping "V" antenna beamed in an easterly direction, and they will welcome any reception reports.

MAURITIUS—Here's a fairly tough one. V3USE, Forest Side, on 15085V, at times fades in around 2240 in language; music to 2300; *BBC* news at 2300-2315, followed by s/off with "God Save the Queen."

MOZAMBIQUE—CR7BF, Lourenco Marques, 11742 (parallel with 9762 kc.), presents the "Lucky Disc Show" late evenings around 2300-0000. "Uncle Barry's" show for the kids starts up around 0017V.

NETHERLANDS—PCJ, 9590 kc., Hilversum, features the Eddie Startz "Happy Station Program" in English around 2130, usually preceded by talks and news.

NETHERLANDS NEW GUINEA—The complete xmsn for *Radio Omroep Nieuw Guinea*, Hollandia, N.N.G., is as follows according to an airmail letter from the director: Sunday-Thursday at 1930-2030 on 7126 kc.; daily at 0400-0700 on 3345 and 5045 kc.; on Friday at 2200-0030 on 7126 kc.; on Sunday at 1830-2330 on 7126 kc. The xmtr is a 250-watt job made by *Philips*, with 200 watts fed into the antenna. All programs are in Dutch except 0900-0930 (daily except Sunday) when Malay is used. A new xmtr of 5 kw. for s.w. service is expected to be in operation as of October 1, 1955, from the Island of Biak.

SPANISH GUINEA—*Emisora de Radiodifusora de Santa Isabel* (Apartado Postal 195, Santa Isabel) is operating on 7160 kc., with 750 w. as follows: Wednesday—0130-0230, 0700-0900, 1300-1600; Sunday—0700-0930, 1330-1530; in Portuguese at 1300-1330 (Wed.), French at 1345-1415 (Wed.), English at 1430-1500 (Wed.); all other programs are in Spanish. A new station identifying as *Radio Equatorial Bata da Voz de Espana en Guinea* is being heard around 1615; s/off at 1700. Frequency is 8805 kc.

SWEDEN—SBP, Stockholm, 11705 kc., has English news periods at 2100, 2200, 2300, and 0000. Effective last month (August), a regular 15-minute DX program in English will be broadcast by *Radio Sweden* as follows: the first Monday of the month at 0815 to the Far East on 11705; at 0945 to South Asia on 11705 kc.; at 1315 to Africa on 15155 kc.; at 1545 to Europe on 6095; and at 2030 to Eastern North America on 9620. The frequencies are subject to seasonal changes according to the printed schedule.

TURKEY—TAU, Ankara, on 15160 kc., has English news and classical music to Western Europe at 1600; usually easily heard on the East Coast.

UNITED STATES—The mysterious KK2XEZ, operating on 17850V at 1400-1600 in English, is located in Dallas, Texas. Power is said to be 500 kw., both on 17850 and 940 kc. in the broadcast band. It is operated by the *Voice of America* and verifications are obtained from *VOA* Headquarters in Washington, D. C. Although primarily an experimental station, it often relays the *VOA* jazz program at 1530.

RUSSIA — The latest schedule from *Radio Moscow* is as follows: at 1800-1820 and 2030-2130 on 7230, 9480, 9550, 9570, 9590, 9610, 9660, 9680, 9700, 9710, 9730, 9760, 9830, and 11910; at 1820-1930 on the same channels but adding 11750 and 15110 kc.; at 1930-2030 on the same channels, but dropping 9700 and 9830 kc.; at 2130-2300 (same as 2030-2130) but 9570 is dropped at 2200; at 2300-0030 on 7230, 9480, 9590, 9610, 9680, 9730, 9760, 11750, 15110 kc.; at 0030-0100 (same as 2300-0030) but dropping 11750 and 15110; at 0100-0200, the West Coast listeners can hear in the 11- and 9-mc. bands.

CLASSICAL MUSIC LOVERS can often hear their favorites on VLA15, Shepparton, Australia, on 15200 kc. at 2315; on *Radio Nacional de Peru*, 6082 kc. at 2250; or on HJFC, Colombia, 6010A at 2345.

That's it for this month. Please keep your reports coming—the more reports we receive, the better your s.w. will become. —30—

Ama-Touring

(*Continued from page* 68)

Philippines—DU stations heard recently are DU1AP, 14.195; DU6RG, 14.18; and DU7SV, 14.175; heard best at 0600-0900.

Pitcairn Island—VR6AC is back on the air, using 25 watts. He was heard on 14.15 at 1900; is usually heard at 2230-2330 on Tuesdays and Saturdays. (*Moore*)

Saudi Arabia—HZ1AB, 14.13, was contacted at 1900. The Near East stations are coming through around 1900-2100, on occasions when the boys in that area are on at that time. (K2CJN)

Singapore—VS1's heard at 0900-1200 are: VS1FO, 14.18; VS1FS, 14.12; and VS1GT, 14.19. (*Moore, Kenny*)

Sumatra—JZ4JD was heard on 14.12 mc. at 0930. He is believed to be the former PK4JD. (*Moore*)

Tahiti—FO8AD on 14.19 was heard at 0100 (*Moore*); FO8AK was heard on 14.14 at 2250 (*Steve Terry, Ill.*)

Europe

Channel Islands — GC6FQ, 14.14, has been heard on the West Coast at 0100 (*Moore*); GC6FQ was heard on 14.16 at 1700 (*Gallagher, Florida*).

Greece—SVØWK, 14.15, and SVØWM, 14.195, seem to be the most active Greek stations. Both are operated by Americans stationed in Greece. Reports may be sent to APO 206, New York, N. Y. It is reported that amateur operation by Greek nationals may be resumed soon, using SV1 calls.

Rumania—YO3GM was heard on 14.12 mc. at 2040. **(Steve Terry)**

Americas

Alaska—KL7BIQ, 14.23, has been heard at 0800, giving location as the north coast of Alaska.

Bahamas—Amateur operation in the Bahama Islands has been infrequent during recent years, but VP7 is now being represented by an increased number of stations including: VP7AI, 14.19; VP7NG, 14.15; VP7NK, 14.165; VP7NN, 14.155; and VP7NS, 14.175. Reception is best around 2000.

Canadian Arctic—Amateurs at weather stations in the Far North continue to be very active. The following are heard: VE8MA, 14.17, at Eureka Sound; VE8MC, 14.17, on Prince Patrick Island; VE8PF, 14.15, Padloping Island; VE8SF, 14.16, Nottingham Island; W1DNF/VE8, 14.19, Baffin Island; W1KGH/-VE8, Baffin Island; W9RJV/VE8, 14.185, Resolution Island.

Dominican Republic—HI6EC appears to be the only amateur active in the Dominican Republic. He is heard quite often on about 14.18 mc.

El Salvador—YS1MS, the most active ham in this country, is heard well on 14.19 around 2000.

French Guiana—FY7YE, operating on 14.12 around 1600, provides an opportunity for hearing the rarest of the countries on the South American continent.

Greenland—KG1AA, 14.20, and KG1FR, 14.22, are the currently active Greenland stations. The address for KG1AA is 931st Sqdn., APO 23, New York, N. Y.

Haiti—HH7RM, 14.15 mc., has been operating mobile from his auto, one of the few mobile transmitters heard from Latin America. He gives his address as Box 146, Port-au-Prince.

Panama—HO1EH is heard on 14.19 at 0630. This is a new prefix for Panama hams, as others heard so far use HP calls.

Peru—OA5G, 14.195, a previously infrequently heard district in Peru, is very active, heard best around 2030. He is an American located at an isolated mine 250 miles from Lima.

Puerto Rico—The best time to hear KP4's is at 0600-0700, before the U. S. phone band fills up with W's. Puerto Ricans heard then are: KP4ABD, 14.21; KP4EE, 14.29; KP4FAC, 14.24; KP4WD, 14.25; KP4ZK, 14.24.

Turks & Caicos Islands—VP5BM, 14.165, is a new station located on Grand Turk Island. He uses 50 watts and is heard around 0630 and 1430. He states that QSL's should be sent via W4NMO, Lorne Creech, P. O. Box 463, Wauchula, Florida.

Venezuela—YV9AP verified reception of this station, which was operated by the Expedition to the Amazonas Territory of Venezuela. The expedition may be repeated at a later date. The operator is Gustavo Nouel, YV5AP, Apartado del Este 4762, Caracas. *(Steve Terry)*

Virgin Islands—KV4BB, 14.20, has a schedule with W2CAA around 1800 and is also on around 0700 *(Ted Hogan, North Carolina)*; KP4WN/KV4, heard on 14.21 at 0630, is another Virgin Island stations. —30—

Carl & Jerry

(*Continued from page* 61)

huge vise that was squeezing tighter and tighter. You'll never know how desperately I was trying to yell at you to jerk that cord, but I couldn't get out a mumbling word."

"Have you figured out what you did wrong?"

"There's quite a list. First, standing barefooted on a damp cement floor while handling electrical equipment of any kind is just asking for trouble. Second, I should have realized that only the capacitor stood between me and a possible fatal shock; and I've replaced enough shorted capacitors to know how easily they can fail. My basic error was in not using my imagination to picture what *could* happen and then taking precautions to see that it didn't."

"Such as wearing shoes, Nature Boy?"

"Ordinary shoes would not insure safety. What I should have done, and will do immediately, is buy an isolation transformer that we'll use consistently. This is basically a simple two-winding transformer. The primary winding goes to the line, and the secondary winding feeds the device being tested. Since the secondary has no connection to the ground, there is no danger of being shocked through contact with the ground. The only way you can get shocked while using such a transformer is to contact both secondary leads simultaneously. In addition to providing this safety, the ordinary isolation transformer has tapped windings so that secondary voltages slightly above, equal to, and slightly below the line voltage can be had from the isolated secondary."

"I didn't realize you could get such a jolt from 117 volts. I always knew such a voltage would make you jump, but I didn't realize it was really dangerous."

"Don't you believe it! I'll bet more people are electrocuted with the 117-volt line current than with any other potential, simply because it's so easy to contact and because it is treated with so little respect. A scientist once told me that if the skin resistance were reduced to zero a person could be killed by only six volts. Ordinarily, the oily skin provides ample protection against such low potentials, but when the skin is wet with salty perspiration as mine was, the skin resistance drops sharply; and once the current starts to burn, it quickly drops the skin resistance still more."

"Then you think those smart alecks who stick their fingers into light sockets to show how much juice they can take are not being very bright."

"That's putting it mildly! Only a jerk or a real square would do a stupid thing like that. Electricity makes a wonderful friend and servant, but it can become a vicious, lightning-fast killer if you treat it carelessly. A smart technician takes every possible precaution against getting even mild shocks, for under the right circumstances they can be fatal."

(*Continued on page* 126)

GLOSSARY OF ELECTRONIC TERMS

This glossary, which is being published in serial form, started in August. It consists of a selected group of definitions taken from the booklet "A Dictionary of Electronic Terms," published by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. The complete dictionary, containing over 3500 terms, is available from Allied at 25 cents a copy.

carbon microphone—A type of microphone in which the pressure of sound waves against a diaphragm is transmitted mechanically to a number of carbon granules within a container, causing the resistance of the carbon granules to vary in step with the sound impressed on the diaphragm.

cascode amplifier—A grounded-cathode input stage feeding a grounded-grid second stage. Used mainly in TV front-end tuners to provide good gain and low noise.

cathode—Negative or electron-emitting electrode of a radio tube. Thermionic vacuum tubes employ heated cathodes; the heat is either supplied indirectly by a filament located inside the cathode, or is supplied by current flowing through the cathode itself. In this latter case, the cathode is also the filament. Gas tubes often employ cold cathodes.

cathode follower—A degenerative voltage feedback circuit wherein the output is taken between cathode and ground, providing high impedance input with low impedance output.

cathode-ray oscilloscope—A test instrument using a cathode-ray tube to make visible the waveform of a varying current or voltage.

cathode-ray tube—A type of tube, funnel-shaped in general appearance, in which a beam of electrons generated in a gun structure at the apex of the tube impinges onto a fluorescent coating on the face of the tube, causing a spot of light to be emitted. Voltages applied to vertical and horizontal pairs of electrodes in the gun structure bend the electron stream, resulting in a visible pattern trace on the face of the tube. Used in oscilloscopes and television receivers.

ceramic capacitor—A capacitor whose dielectric is ceramic.

ceramic cartridge—A small piezoelectric device containing a ceramic element used on phonographs and microphones to convert recorded material and sound to electrical energy. The operation of a ceramic cartridge is the same as that of a crystal cartridge, but a ceramic element rather than a Rochelle salt crystal is employed. Ceramic cartridges deliver somewhat lower output voltage than crystal cartridges. However, ceramic cartridges, unlike crystal cartridges, will not deteriorate when exposed to extremes of heat and humidity. See **crystal cartridge.**

channel—(1) A narrow band of frequencies including the assigned carrier frequency, within which a radio or television station is required to keep its signal in order to prevent interference with stations on adjacent channels. (2) A branch or path over which signals may travel; thus, an amplifier may have several input channels, such as microphone, tuner, or phonograph.

characteristic impedance—Pertaining to transmission lines. For a uniform and infinitely long line, it is the ratio of applied voltage to steady state current at a given frequency. It is measured in ohms and usually designated as Zo. For maximum power transfer, the Zo of a line should equal the Zo of a source and load.

choke coil—An inductor used to limit the flow of alternating current while allowing direct current to pass. R.f. choke coils have air or pulverized iron cores, while a.f. and filter chokes have iron cores.

choke input filter—Network of capacitors and inductances, the first member being a choke. See **capacitor-input filter.**

circular mil—Unit of area equal to the area of a circle whose diameter is 0.001" or 1 mil. The area in circular mils is the square of the diameter in mils. Used chiefly in specifying cross sections of round conductors.

class A amplifier—A vacuum tube amplifier in which the grid bias value is chosen for plate current operation in the center of the linear portion of the tube characteristic curve. Amplification is essentially linear, the output signal being an amplified duplicate of the input signal. Plate current flows at all times. To denote that grid current does not flow during any part of the input cycle, the suffix "1" may be added to the letter or letters of the class identification. The suffix "2" may be used to denote that grid current flows during some part of the cycle.

class AB amplifier—A vacuum tube amplifier in which the grid bias value is slightly higher than for class A operation. Plate current flows more than half a cycle, but less than a full cycle. The higher bias also reduces static plate current, permitting the use of higher plate voltage and resulting in higher efficiency. Class AB amplifiers are further designated as Class AB1—in which the input signal never drives the grids positive, and class AB2—in which the grids are driven slightly positive on signal peaks.

class B amplifier—A vacuum tube amplifier, generally using two tubes in push-pull, in which the grid bias equals approximately the cutoff value of the tube so that plate current at no signal input is practically zero. Current flows during approximately half of the cycle. A class B amplifier is used both in radio and audio frequency work. As an audio amplifier, its comparative efficiency is very high.

class C amplifier—A vacuum tube amplifier in which the grid bias exceeds the cutoff bias value, so that at no signal input the plate current is zero and current flows during appreciably less than half of the cycle. The grid is always driven slightly positive on peaks. Used chiefly for r.f. amplifiers of transmitters. Most efficient type of operation.

coil—A number of turns of wire wound on an iron core, on a coil form made of insulating material, or so as to be self-supporting. A coil offers considerable opposition to the passage of alternating current but very little opposition to direct current.

coil form—The tubing or solid object on which a coil is wound. It can have any shape and can be made from any insulating material, such as paper, cardboard, fiber, Bakelite, a plastic or ceramic material, or wood.

computer—An electronic instrument for rapidly solving extremely complex and involved mathematical problems.

condenser—(See **capacitor**).

condenser microphone—A microphone operating by the change in capacitance between two plates separated by a dielectric.

cone (speaker)—The conical-shaped paper or fiber diaphragm of a loudspeaker.

contact resistance—The ohmic resistance between the contacts on a switch or relay. It is in fractions of an ohm.

control grid—That electrode in a vacuum tube which has the most effective control over the plate current passed by the tube. The control grid is usually the electrode nearest to the cathode. Usually grid to which signal is applied.

converter—That section of a superheterodyne radio receiver which changes incoming modulated r.f. signals to a lower frequency known as the intermediate frequency; the converter section includes the oscillator and the first detector. Also, a device, usually rotary, which changes electrical energy from one form to another, as a.c. to d.c., etc.

counter—A circuit whose output frequency is a submultiple of the input frequency.

coupling—The means by which signals are transferred from one radio circuit to another. Coupling can be direct through a conductor, electrostatic through a capacitor, or inductive through a transformer. Also, a connecting device.

crystal—(1) A piece of natural quartz or similar piezoelectric material which has been ground to the proper size to produce natural vibrations at a desired radio frequency and to generate that frequency when set into vibration. A quartz crystal is used in radio transmitters to generate with a high degree of accuracy the assigned carrier frequency of a station, and is used in crystal filters of radio receivers to improve the selectivity of the i.f. amplifier. (2) The mineral used in a crystal detector is known as a crystal.

crystal cartridge—A small piezoelectric device containing a Rochelle salt crystal. Used in phonographs and microphones to convert recorded material and sound to electrical energy. A crystal phonograph cartridge mounts at the end of a phonograph pickup arm and includes a stylus (needle) which rides in the grooves of a record disc. Thus, the stylus vibrates in a pattern coinciding with the pattern of the recorded grooves. These vibrations of the stylus cause varying stress on the crystal, which in turn converts this stress to electrical energy. This energy is conducted to an amplifier for amplification and transformation to audible sound. A similar crystal cartridge is used in a crystal microphone, but in this case a diaphragm is used rather than a stylus. This diaphragm vibrates in accordance with the sound picked up by the microphone and causes voltage-producing stress in the cartridge. The crystal cartridge in either phonograph or microphone is a constant-amplitude device, i.e., the greater the amount of stylus or diaphragm movement (not rate of movement), the greater is the output.

crystal control—Use of a quartz crystal to maintain operation of a radio station at its assigned frequency, within the limits prescribed by law.

crystal set—A radio receiver which uses a crystal detector for signal rectification, and has no vacuum tubes.

current—The movement of electrons through a conductor. Current is measured in amperes, in milliamperes and microamperes.

cycle—One complete reversal of an alternating current, including a rise to a maximum in one direction, a return to zero, a rise to a maximum in the other direction, and another return to zero. The number of cycles occurring in one second is the frequency of an alternating current. The word cycle is commonly interpreted to mean cycles per second, in which case it is a measure of frequency.

damping factor—The ratio at the nominal impedance of an amplifier, measured at a given speaker output tap, to the actual impedance at the same output tap, e.g., if the output winding tap on a speaker output transformer is designed to match a speaker having an impedance of 16 ohms, and if the actual impedance of the amplifier—when measured at the same tap—is two ohms, the damping factor is expressed as 8:1. High damping assists a speaker in cleanly reproducing transients and permits independence of the voltage output of the amplifier from the varying load impedance of the speaker.

db meter—A meter having a scale calibrated to read directly in decibel values at a predetermined level and used to indicate volume levels.

decibel—Unit of relative power, voltage or current. In electroacoustics, since the response of the ear is logarithmic (detectable change increases with level), the bel is defined as the logarithm of the ratio of the power level in question to that of the reference value. Since perhaps a tenth of this difference could be detected by the ear, a unit one-tenth as large is used: the decibel. The number of decibels is 10 log P2/P1 or 20 log E2/E1 or 20 log I2/I1. The over-all gain of a system is the sum of the decibel gains of the stages. Gains may be positive or negative. There is often a need for a unit of absolute power. The decibel is used in this sense by choosing a fixed reference value for P. In radio work, this is taken as 6 mw., chosen as the power needed to produce a barely audible 60-cycle note. One mw. is generally used in broadcast station practice. When 1 mw. is used, the gain is expressed in volume units instead of decibels to avoid confusion. In sound measurement, a zero level of 10^{-16} watts per square centimeter is chosen; the threshold of audibility at 1000 cycles.

decoupling—A method of isolating individual stages of an amplifier to prevent interstage feedback through common power supply circuit.

de-emphasis circuit—In FM receivers, an RC filter following the discriminator that decreases to normal proportions those high audio frequencies which, at the transmitter, have been emphasized to obtain a better signal-to-noise ratio. Also used in amplifiers used for playing records, as some records (Columbia LP type, for instance) are pre-emphasized at the time of recording, for the same reason given above.

degenerative feedback—Provision in a vacuum-tube circuit for a signal to be fed back from the plate to the grid circuit to decrease the amplification. It is used in r.f. circuits to improve stability, and in a.f. circuits to reduce distortion and noise. Also called **inverse feedback, negative feedback** and **stabilized feedback.**

demodulation—The reverse of modulation. The process of extracting the audio or video frequency component from the modulated r.f. signal. Commonly called **detection** (for example, the function of the second detector in a superheterodyne radio receiver).

detector—Commonly, the stage or circuit in a radio set that demodulates the r.f. signal into its audio or video component. Generally, a device or circuit that changes the form of a received radiation into a more usable form for the purpose desired (such as visual or aural indication, frequency conversion, demodulation, etc.).

dielectric—The insulating material between the plates of a capacitor or adjacent wires in a cable, or between any two parts of an electronic circuit; generally air, mica, paper, oil, cloth, ceramic, or glass.

(To be continued next month)

Carl & Jerry

(*Continued from page* 123)

"How's that?"

"Doctors say that occasionally a comparatively mild shock can trigger the heart into quivering in a manner that interferes with its normal functioning. They believe this accounts for the deaths that sometimes occur from low-current shocks."

"Maybe that's why it's a good idea always to use only one hand when working on equipment where there's a possibility of shock."

"Check. Keeping one hand in your pocket under such circumstances is a strictly professional procedure. It avoids the possibility that a dangerous current can enter one hand and go out the other, and pass through the vulnerable chest cavity on the way across."

For a little while, there was a silence, while both boys thought about the near tragedy that had just taken place; then Jerry spoke up:

"Carl, I want you to show me how to do that new artificial respiration business you were talking about. In case of shock, artificial respiration immediately applied is the best possible first-aid treatment to use until a doctor can be reached. Getting started with the treatment just as soon as the body is freed from the current is the important factor. A delay of only a few seconds in beginning artificial respiration may spell the difference between life and death."

"Fine!" Carl agreed; "and that gives me an idea. Let's hold regular surprise drills right here in the basement. After I've shown you how the artificial respiration is done, every few days one of us will fake being shocked. All he will have to do is touch a piece of electrical equipment that is plugged in and become rigid, just as you did. Then the other fellow will free the 'actor' from the 'hot' object, taking care not to be shocked himself. This will be done either by pulling the plug as I did or by opening that master switch that cuts off the whole bench and all its outlets. Then, the guy doing the acting will collapse on the floor, making himself as limp as possible. The other fellow will straighten him out and start artificial respiration just as quickly as he can, and keep it up for at least a couple of minutes. If we keep doing this, we'll soon be prepared to handle a real case of shock almost automatically. Constant drilling is the best insurance against getting rattled in an emergency."

"Truer words were never spoken!" Jerry applauded. "If we use our heads and take the precautions we should, the chances are that neither of us will ever have to use first aid here in the basement; but it will be mighty comforting to know both of us can, and you never know when we may have a chance to save a life somewhere else. Working with electricity and not knowing how to apply artificial respiration is about as foolish as it would be for an explorer to start into the South American jungle without a snakebite kit."

—30—

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METER CONVERSION QUIZ

(Questions on page 104)

1. 99,980 ohms. 2. 24,000 ohms. 3. .0011 ohms. A shunt like this might be made from 8.5 inches of No. 12 copper wire. 4. The circuit would not operate but the meter would not be damaged. 5. The instrument coil would almost certainly burn out instantly!

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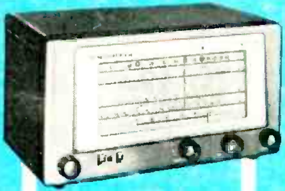

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