

Vacuum-tube generator of undamped oscillations, especially suited to laboratory work

Commercial form of vacuum-tube generator. The tube is protected by the heavy wire guard

Simple wireless telephone outfit consisting of a vacuum-tube receiving set, telephone and oscillating-tube unit and motor-generator

Experimental Wireless Telegraphy and Telephony—XII*

How to Become an Amateur Radio Operator and Enjoy This Hobby to the Utmost

By Louis Gerard Pacent and Austin C. Lescarboursa

BUYING a piano is only half the problem of getting music into one's home; for one must still master the art of playing that piano. Buying an automobile is perhaps three-quarters or even seven-eighths of the problem of rapid and comfortable transportation; but one must learn how to drive and care for that automobile. And purchasing or building one's radio equipment is only part of the problem of radio as a hobby, albeit an important part; but there still remains the task of mastering the operation of that equipment, and training the ear and mind to respond to that musical language of dots and dashes and spaces known as telegraphy.

MASTERING THE WIRELESS CODE

There is no short cut to mastering the telegraph code. It is a matter of more or less practice, depending on one's adaptability. Some persons can become fair operators in the short space of six weeks, but it generally requires three or four months, and often six, before the average person can receive messages at commercial speeds.

There are two ways of mastering telegraphy, namely, to attend a regular telegraph school, such as may be found in almost any sizable city, or to study it at home. The main advantage of a telegraph school is that the student must put in so many days or nights a week at steady practice, and it is that steady practice that soon results in proficiency. Otherwise, one can study at home, especially if one will devote a certain part of each day to telegraphy.

The first step in a self-instruction course in telegraphy is to learn the code. Up till several years ago the Morse

code, which is the code used for our telegraph systems, was used in American wireless practice, although certain ships calling in American waters employed the Continental or European code. Today practically all radio traffic in the United States and most other countries is in Continental. The Morse code is perhaps faster than the Continental, because it has less dashes in its characters, but the use of spaces within the characters themselves, let alone the usual spaces between characters, makes it rather confusing at times and does result in errors. For example, "I" in the Morse code is made up of two dots .. while "O" is also two dots, but with a space between, thus . ., while in the Continental code "I" is two dots .. as in the Morse code and "O" consists of three dashes — — —, so that there can be no confusion. Obviously, the use of so many dashes somewhat slows up the Continental code, but this is more than compensated by its accuracy.

A code chart can be obtained from any store handling wireless equipment. With the chart in hand, the student should begin to study the various combinations for the corresponding letters, punctuation marks, figures, and so on. One method is to take say five characters or dot-and-dash combinations at a time, memorize them thoroughly, and then go on to the next five, after which the entire first ten are memorized before attempting the following five, and so on. The result is that in one or two evenings the student should memorize the entire list of letters, after which the figures can be memorized, followed by the punctuation, special devices, and so on.

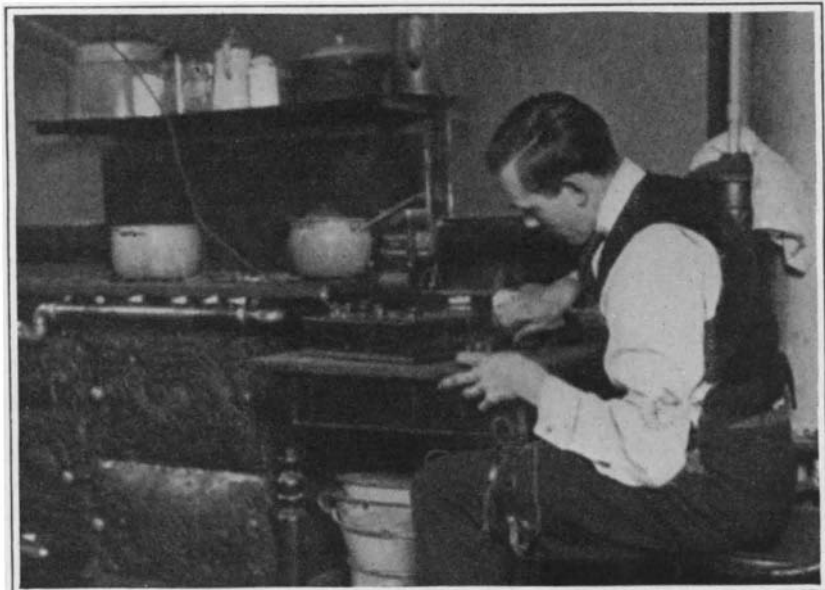
LEARNING TO SEND AND RECEIVE

With the code memorized, the next step is to practice sending messages. By means of an ordinary telegraph key, a simple buzzer and a battery, the student can simulate wireless signals with the key. The best form of practice is to take a newspaper or magazine article, and proceed to transmit the words one by one as they are read. At first the sending is slow, but with practice there

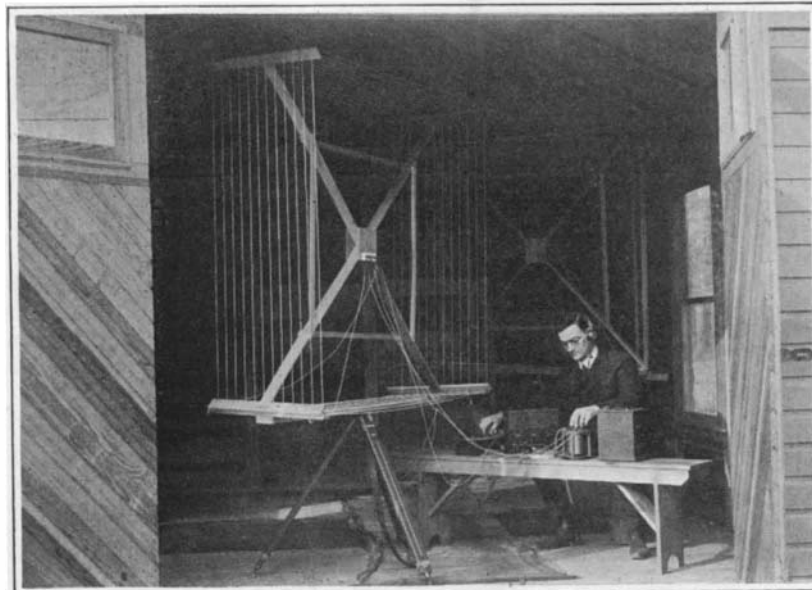
comes speed, until finally a fair rate of speed is attained. Care should be taken to form the dots and dashes carefully, interposing the proper spacing where there are spaces. If care is exercised at the beginning of such a course, the student will become a good operator instead of a slovenly one. It may be well for the student to obtain a book on telegraphy, inasmuch as many short cuts are pointed out. Indeed, some books have the most ingenious forms of code charts with various characters grouped together according to their telegraphic make-up, so as to hasten the study.

So much for sending; there still remains at least three-quarters of the work of learning to operate, namely, receiving. In the case of a self-instruction course, good results may be obtained by using any one of the several forms of automatic transmitters, which send messages at any desired speed. The messages are sent by means of toothed disks or punched paper tape, which serve to make and break a circuit containing a telegraph sounder or a buzzer, as the case may be. Certain phonographic telegraph courses are also quite satisfactory. Such devices have the much desired quality of transmitting accurate messages at slow speeds at first, and gradually speeding up until the student is proficient.

Another method is to have a friend send messages with a buzzer practice set, similar to the one employed in learning to send. Still another method is to install a wireless receiving set and listen to the commercial and amateur stations. In fact, the Navy is encouraging radio amateurs by sending out an evening code practice. Of course it is somewhat disappointing at first to listen to fast messages without being able to identify more than a letter here and there—and may be not a single letter in an entire message. But that is where the student's patience comes in; he must not be discouraged; he must realize that as in the case of learning a language, it is the constant listening to the code that gradually trains the ear and mind to identify the signals immediately. Six



In the city the amateur can receive messages by using a gas pipe as the antenna and a water pipe as the ground



A loop of wire, such as this one, used in connection with a three-stage amplifier, enables one to receive trans-Atlantic signals



In order to secure their amateur radio operator's license, these young men are undergoing the examination and test

months of constant practice should train the average person in receiving at a fair rate of speed.

THE MATTER OF RADIO LICENSE.

In the early days of amateur wireless in the United States there was no Government restriction of any kind. Anyone could purchase a complete wireless set of any power—even ten kilowatts or more if one so desired and one's pocketbook permitted—and operate it in any way whatsoever. The authors have in mind one individual who, having a particular grudge against one of the early wireless companies, proceeded to install a 20-kilowatt set in his home and then began his campaign against wireless traffic in general and his enemy in particular. When that amateur was sending with his 20-kilowatt spark, nothing could be done within a radius of 20 miles or more. His set was tuned in a very broad way, so that his waves could hardly be tuned out by nearby stations. The result was that he seriously embarrassed the company in question.

Such a case, of course, was very unusual, to say the least; yet it served along with other similar instances of radio abuse to bring about some form of radio control, which came in 1912.

The United States wireless regulations have never aimed at suppressing radio; rather, they have been formulated and applied with the object of regulating—or shall we say policing?—the ether, just as the automobile laws aim not at stopping automobiling but rather toward making it safer for pedestrians and riders alike. During our participation in the war, amateur wireless was entirely suspended and the matter placed in the hands of the Navy Department. Shortly after the signing of the armistice which brought hostilities to an end, the ban was lifted on receiving only; and last October 1st all restrictions were removed, allowing amateurs to resume transmitting, provided, as was the case before the war, that they had amateur operating and station licenses.

No license of any kind is required for the amateur who wishes to receive only. For transmitting signals, however, the amateur must apply to the Radio Inspector, Customs House, of the city at which his district office is located. The business of regulating amateur radio is in the hands of the Department of Commerce, which is represented by Radio Inspectors, each of whom is assigned to a certain district. The radio districts and the office for each are as follows:

1. BOSTON, MASS.

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

2. NEW YORK, N. Y.

New York (County of New York, Staten Island, Long Island, and counties on the Hudson River to and including Albany, Rensselaer, and Schenectady) and New Jersey (counties of Bergen, Passaic, Essex, Union, Middlesex, Monmouth, Hudson and Ocean).

3. BALTIMORE, MD.

New Jersey (all counties not included in second district), Pennsylvania (counties of Philadelphia, Delaware, all counties south of the Blue Mountains and Franklin County), Delaware, Maryland, Virginia, District of Columbia.

4. SAVANNAH, GA.

North Carolina, South Carolina, Georgia, Florida, Porto Rico.

5. NEW ORLEANS, LA.

Alabama, Mississippi, Louisiana, Texas, Tennessee, Arkansas, Oklahoma, New Mexico.

6. SAN FRANCISCO, CALIF.

California, Hawaii, Nevada, Utah, Arizona.

7. SEATTLE, WASH.

Oregon, Washington, Alaska, Idaho, Montana, Wyoming.

8. CLEVELAND, OHIO

New York (all counties not included in the second dis-

trict), Pennsylvania (all counties not included in the third district), West Virginia, Ohio, Michigan (Lower Peninsula).

9. CHICAGO, ILL.

Indiana, Illinois, Wisconsin, Michigan (upper peninsula), Minnesota, Kentucky, Missouri, Kansas, Colorado, Iowa, Nebraska, South Dakota, North Dakota.

In writing or calling on the Radio Inspector, the amateur should ask for application blanks for operator's examination, station license, or both, as the case may be. All licenses were revoked at the beginning of our war.

For operating a transmitter two licenses are required—a station license and an operator's license. The station license is issued when the station has been examined and found to conform with the rules and regulations. The matter of wave length is a most important one, and amateur transmitters must be kept below 200 meters. Then again, the emitted waves must be sharply tuned, so that they can be readily tuned out by receiving stations. The degree of this sharpness of tune is defined by the term decrement, which has a very big meaning with the Radio Inspector.

The radio amateur operator's license determines the amateur's operating ability. A transmitting and receiving speed of ten words per minute is considered ample proof that the applicant is worthy of an operator's license, provided said applicant has a good knowledge of wireless equipment, its arrangement, and manipulation. The amateur must be able immediately to recognize S. O. S. or distress calls.

Aside from being limited to 200 meters' wave length, the amateur transmitter cannot exceed 1 kilowatt input. When within five miles of a U. S. Naval or Army station, the transmitter is limited to ½ kilowatt and sharp tuning in all instances must be observed. Radio telephone experimenting also comes under the rules and regulations of the Department of Commerce, as well as any form of apparatus emitting antenna oscillations.

Only the fundamentals of the wireless regulations are given in the foregoing. The amateur is referred to the Radio Inspector in his district for full information.

What more can be said in concluding this series than that there is no hobby in the world that attracts a better class of young men and men than amateur radio. During the war the United States Army and Navy secured thousands of young men trained in radio and possessing an excellent knowledge of electricity, thanks to their years of interest in amateur radio. Many of the former radio amateurs have made their mark in the scientific world, proving that this hobby often leads to greater things.

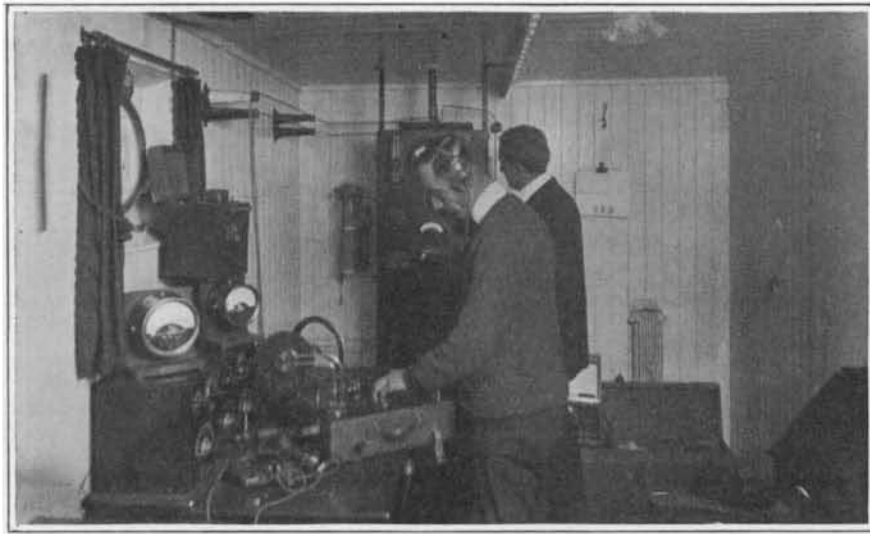
However all that may be, the fact remains that the amateur is immediately welcomed by other amateurs in his immediate vicinity. A helping hand will always be found when problems have to be solved. And with amateur stations dotting the country from one end to the other, one need never be out of touch with one or more members of the big fraternity of wireless amateurs, such as they are called, for want of a better name.

Electrons and Heat

By Fred. G. Edwards.

If the atomic ether be incompressible and therefore its atomic volume constant, as described in former papers on "Mechanical Philosophy" (CHEMICAL NEWS, 1919, cxviii., 183, 270), it follows that there can be no contraction or expansion of solids without the relative formation of mechanical electrons in the body of the metal or dielectric, and the formation of these electrons will render the adjoining atoms correspondingly positive as required for the scattering of α -rays. There would be a finite number of electrons per cc. in accordance with the temperature, and their reduction or amplification would be identical with the flow of heat.

Prof. Callendar (B. A. Dundee, 1912) asserts "that the



By means of a wave meter and other instruments the radio inspector tests the stations of amateur and commercial firm alike

corpuscles of caloric which constitute a current of heat in a metal are very closely related to the corpuscles of electricity, and have an equal right to be regarded as constituting a material fluid possessing an objective physical existence." Neglecting the entropy of the ether and assuming that the entropy of a substance is zero at zero temperature, we are also in agreement when he asserts "that entropy was simply Carnot's caloric under another name, and that the increase of entropy in any irreversible process was the most appropriate measure of the quantity of heat generated." Again, Prof. O. W. Richardson found that a platinum wire heated to between 1020° and 1200° C. gave a thermionic-current curve which allowing for difference of scale, was identical with the vapour pressure curve of water between 0° and 90° C.

By hypothesis an electron can only escape by means of an atom of free ether replacing it in the solid, and this is the reversible mechanism of radiation or absorption. Incidentally this shows that in the photo-electric effect the effective energy is the pressure of the ether at the sink, as it should be, and not at the source of light. The present theory is similar in principle to the solid space lattice of Dr. F. A. Lindemann (*Phil. Mag.*, Jan., 1915), which makes the specific heat of the electrons negligible. Admittedly, the existing electronic theory of metallic conductivity cannot meet the attacks which have been made upon it. The Lorentz atom with rotating electrons probably only survives because of its mathematical beauty in relation to the Zeeman effect. Radio-activists strongly favour this catherine-wheel firework type of atom, but Prof. Joly states:—"The halo has established the extreme rarity of radio-activity as an atomic phenomenon. One and all of the speculations as to the slow breakdown of the commoner elements may be dismissed."

If a modicum of the mathematical talent, which, since 1897, has been concentrated on the electronic theory of matter were expended upon the material theory of electricity, every known force would be directly traced to the pressure of the ether, instead of being mostly concentrated inside the atom through the naive assumption of action at a distance. The ether pressure deduced from the velocity of light is 79.6×10^{12} tons per sq. inch, or 0.5×10^{24} dynes per sq. cm. The spherical diameter corresponding to the repulsion of two electrons distant 1 cm. should be 2.33×10^{-11} cm. thus:—

$$(2.33 \times 10^{-11})^4 \times 0.7854 \times 0.5077 \times 10^{-24} = 1.17 \times 10^{-11} \text{ dynes.}$$

Although the collective motion of electrons constitutes an electric or thermal current, the truth emerges that the number of electrons per cc. in a metal is not a measure of conductivity but of the resistance in the Wiedemann-Franz inverse ratio. (From *Chemical News*.)

Improvement in the Illumination of Railway Signal Lamps.

DURING the war, owing to the blockade, there was a dearth of petroleum in Germany, and the defective cleaning of the oil obtained from Galicia caused great trouble with the railway signal lamps, which were designed for the use of the properly cleaned petroleum coming from Russia and the United States before the war. The impure petroleum gave a dim light, and produced a deposit of carbon upon the lamps themselves. The matter became serious, and might have been the cause of railway accidents. The author, Mr. Olbrich, discovered, after numerous experiments, a very simple expedient for overcoming the difficulty. He states that if the wicks be allowed to soak for five hours in a 20 per cent. solution of potassium nitrate, and then dried, the illumination given by the lamps will be wonderfully increased. He advises that the wicks in bulk should be so treated before being distributed to the various stations, as the cost will then be less than if each station has to deal with its own wicks. (*Zeitung des Vereins Deutscher Eisenbahnverwaltungen*, (abstracted by *The Technical Review*).