February, 1919 20 Cents

The WIRELESS AGE

Volume 6 Number 5

An Aviator's Wireless Telephone Equipment Showing the Transmitter and the Receiving Helmet

Amateur Attacks on Government Ownership

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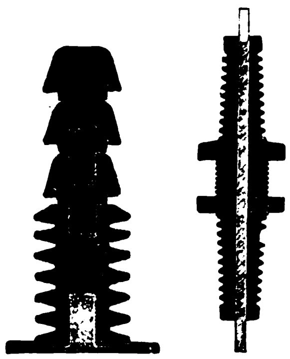

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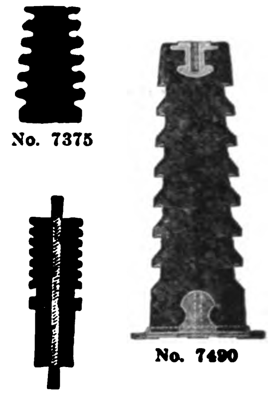

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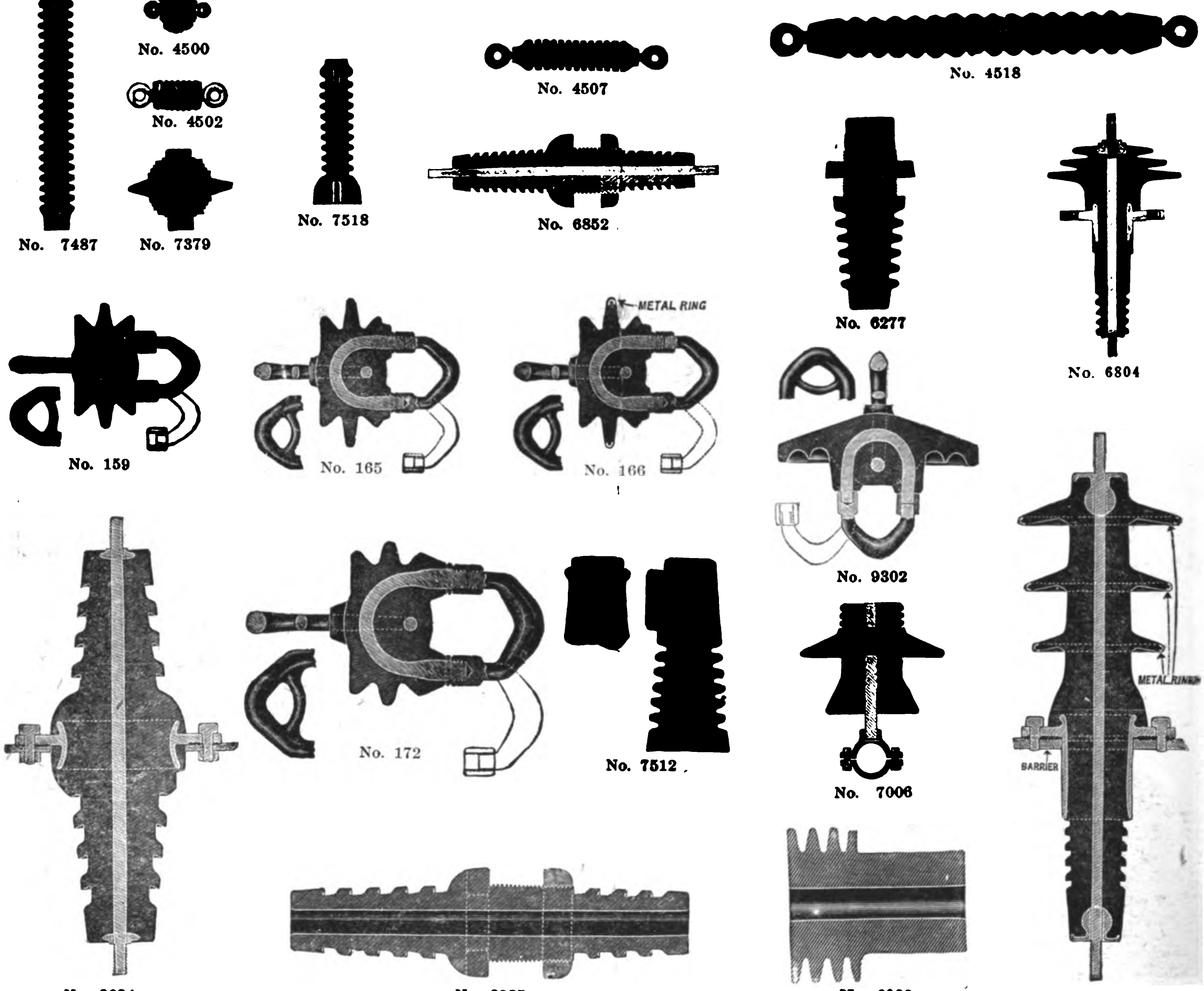

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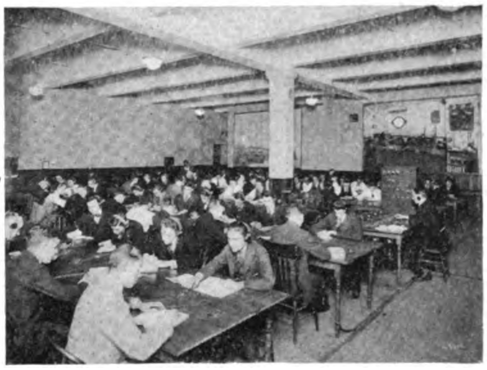
POSTAL AIRCRAFT will require radio apparatus for communication with principal cities situated along the proposed routes.

Where do you stand in the post-war expansion of Wireless Telegraphy?



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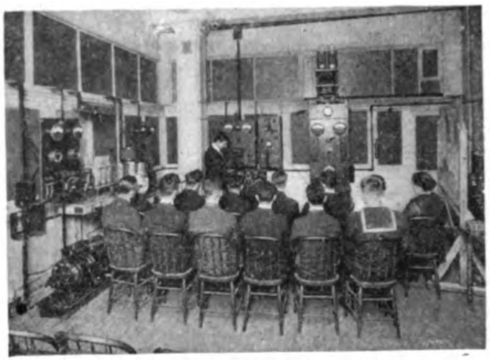

A lecture on radio theory

You will then be prepared to pass the Government license examination and to operate all types of wireless equipment. Before making a decision in this matter you are urged to make a thorough inspection of our school. ASSURE YOURSELF that the organization which you sign up with possesses a laboratory with MODERN WIRELESS TELEGRAPH EQUIPMENT.

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WIRELESS TELEGRAPHY

The Wireless Age

Edited by J. ANDREW WHITE
E. E. BUCHER, Technical Editor

Vol. 6 — Contents for February, 1919 — No. 5

Index of Equipment

RENEWALS—When subscription expires, find a renewal blank enclosed. Return with remittance promptly.

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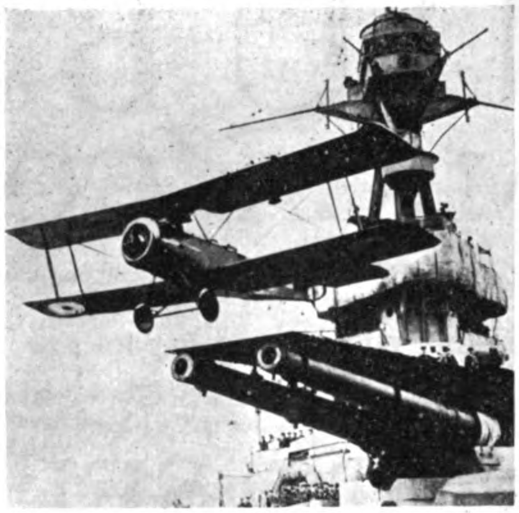
GREAT BRITAIN
Marconi House, Strand, London

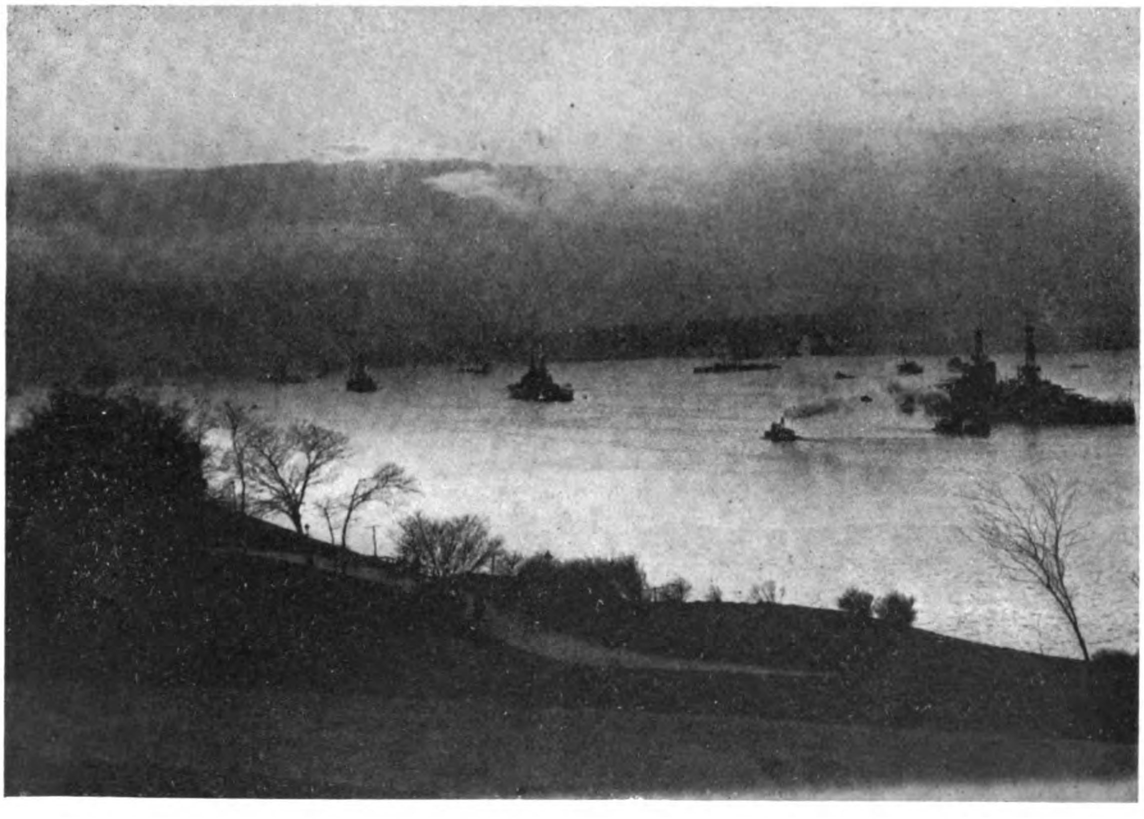
AUSTRALIA
97 Clarence St., Sydney, N. S. W.

New Uses of the Air



Above: How the naval air scouts were launched on their daily patrol missions in overseas waters

To the left: Colonel Culver directing by wireless telephone four army airplanes flying in formation over Washington. The planes were at a height of 2,000 feet. With Col. Culver is Senator Warren; General Kenly is at the right of the picture



Photos by Int'l.

When the battle fleet arrived in New York the first greeting was given by wireless telephone

VOL. 6. No. 5. FEBRUARY, 1919

THE WIRELESS AGE

WORLD WIDE WIRELESS

Another Five Per Cent Dividend for American Marconi

AT a meeting of the Directors of the Marconi Wireless Telegraph Company of America held at the offices of the company on January 14, 1919, a dividend was declared out of surplus profits at the rate of 5 per cent on outstanding stock. This return on the common stock is payable July 1, 1919, to stockholders of record at the close of business June 2, 1919.

The dividend is the third declared by the American Marconi Company, the first, 2 per cent, being in August, 1913, and the second, 5 per cent, paid six months ago, August 1, 1918.

Navy Announces Underground and Water Wireless

HOW underground and through-water wireless, or induction telegraphy, was put into practical use during the war was disclosed on January 11 by Navy Department officials, giving to the public another of its secrets carefully guarded so long as it might be of value to the enemy. This development originated in private research by James H. Rogers, a scientist of Hyattsville, Md.

In practical use the new system so far is employed only for receiving radio messages sent out from powerful stations in Europe. These are now being read at underground receiving stations in the United States.

In addition, it was revealed at the department, through an adaptation of the Rogers theory, submarines under water are intercepting radio signals sent from shore. With crude apparatus the scientist has succeeded in transmitting signals two miles from a submerged wire simulating a submersible.

Officials say it is possible, although not yet an accomplished fact, that ground or water sending can be developed to a considerable extent. They do not anticipate, however, that the present method of sending from high towers will be superseded, except for special purposes.

The theory most generally held until Rogers demonstrated the correctness of his views was that impulses hurled into the air from a radio transmitting station and deflected earthward became dissipated, as does lightning, when they struck the ground or water. The Maryland scientist, however, believed that the impulses flowed through the earth as through the air and that it was only necessary to trap and measure them in the ground.

Mr. Rogers had been at work on this theory before the United States entered the war and already had interested naval experts. He offered the results of his work to the navy without restriction, and when they were accepted after some demonstrations at Hyattsville, officials say, he was with difficulty persuaded to accept even remuneration for actual time given to co-operation with the government.

One of the first steps taken was the request of the Navy Department, under war legislation, that his application for patents be expedited. This was done.

Some of the main advantages of the Rogers system as developed so far, according to the experts, are almost negligible cost of construction, the intensifying of signals by pointing the sending apparatus toward the receiving station and reduction of static interference. Because of the latter advance the navy's receiving station at New Orleans, where communication with ships in southern waters swept by frequent electrical storms is maintained, uses the underground apparatus with marked success.

James H. Rogers and his new underground and undersea wireless used by the Navy during the war

In war a great advantage is that submarines receive messages while submerged. This is being done by wires trailing in the water.

Trans-Atlantic Radiophone When Peace Treaty Is Signed

WE will be talking across the Atlantic ocean by wireless telephone by the time the peace treaty is signed, according to Godfrey Isaacs, managing director of the Marconi's Wireless Telegraph Company of England. In a press interview he is credited with saying that as soon as war restrictions are removed, the development of wireless telephony will go ahead at a surprising rate.

"One day in the not distant future," he said, "we will walk about with wireless telephones attached to our bodies, and will be able to call up a friend, say from Picadilly Circus, who is flying somewhere. Or one may have a wireless telephone invitation from a friend flying in France to join him at dinner.

"It will not be very long before one will be able to sit at one's desk in London and speak to New York practically instantaneously. It will be quite as easy to speak with Paris, Rome, Amsterdam, Moscow, Sydney, Melbourne or New Zealand.

"We are arranging for large organizations whereby we shall always be in wireless telephonic communication with airships, to keep them informed concerning meteorological conditions."

Cheapening and quickening of news transit and expediting of trade and industry are among the immediate results predicted by Mr. Isaacs.

The Bump of Repentance
—*Nelson Harding in the Brooklyn Eagle*

War Ban on Wireless Messages Lifted

THE War Trade Board has lifted the ban on the use of the radio by commercial vessels in the Pacific and Atlantic oceans west of the fortieth meridian. This restores the use of the radio to conditions existing before the war.

The only restriction against its use now is in connection with the blockade, no communication with the Central Powers being permitted. The War Trade Board previously had rescinded its restrictions on use of the cables.

Relatives and friends of soldiers returning on transports from overseas may communicate with them by wireless and receive answers.

Messages may be filed at any telegraph office and will be relayed to a naval radio base.

Charges via New York are sixteen cents a word, including telegraph tolls. Persons so desiring may pay in advance for answers.

No message will be accepted until the ship for which it is destined has passed half way across the Atlantic.

Salary Increases for American Wireless Operators

THE special wage commission authorized by United States Shipping Board unanimously reached the decision that salaries to be paid wireless operators on vessels operated from Atlantic and Gulf ports, effective January 1, 1919, to be as follows: All chief operators, $110; all assistant operators, $85. There are to be no trans-Atlantic or coastwise bonuses, and no sliding scales.

Wireless Phone Commercially Practicable

JOHN C. PARKER, professor of electrical engineering of the University of Michigan, believes that it will be commercially practical to use the wireless telephone for long distance and middle distance calls.

"While a sending apparatus is expensive, and the cost of operation is greater than by wire, the total initial cost without wires will be so much less than that with hundreds of miles of wires that the wireless, as now developed, will be more economical," Prof. Parker says.

"It will be more dependable. Static disturbances have been practically eliminated, so storms will not interrupt service, whereas heavy storms put many wires out of business.

"For regular standard wire business, the radio or wireless telephone should supersede the telegraph and the wire telephone. It would be possible for one newspaper service, for example, speaking through one transmitter, to give news to thousands of different papers at the same time. It is impossible to compute the load this would take off the telegraph wires. The man talking through the wireless transmitter could be heard by as many persons as had receivers tuned up to the wave length the transmitter was sending."

Joseph H. Cannon, associate professor, said it would be entirely possible for the President of the United States to speak from the White House into a radio telephone and be heard by everybody in the United States who could get a receiver tuned up to his.

"On ocean and lake ships it would be entirely practical to install radio telephones, connected with wire telephones on the shore that would give direct, verbal communication between persons on shore and ship," Prof. Cannon says. "When we have airplanes carrying passengers between Chicago and New York the passengers could keep in touch with developments on the stock market minute by minute. The baseball or football enthusiast could follow his game play by play, as if he were in a club and the returns were coming by ticker."

Marconi Service for Passenger and Mail 'Planes

GODFREY ISAACS announced on December 18 that Marconi's Wireless Telegraph Company, of London, would outfit airplanes employed in air passenger and mail service with wireless and would supply operators in the same way as it now serves ships. It also is intended to receive regular reports of air conditions in different localities and to circulate these for the information of the pilots. As every airplane will have either a name or distinguishing number, it will be possible to send telegrams from any part of the world or from any ship to an airplane. It is intended that this organization will be ready by the time the peace treaty is signed.

Arrangements recently have been made for the erection of wireless stations in the extreme parts of China, one on the frontier of Cashmere and another on the Chinese side of Siberia. Mr. Isaacs has arranged with Handley-Page for the transport of the necessary machinery by one or more of his big machines. The journey inland will take two or three days instead of months.

War Radio Hero Found a Job Waiting

WEARING the Croix de Guerre with a palm, which had been pinned upon him by Premier Clemenceau of France, Sergeant Elias A. Kimball of Co. E, Second Telegraph Battalion, applied recently for a job at the Labor Bureau in the Hall of Records, New York.

"I've had enough of war; what I want now is work," Kimball said.

At Belleau Wood, he and eight comrades were operating a radio outfit when the Germans opened a barrage and the aerial was blown into No Man's Land. Six men tried to bring them back. They were killed. The Major in charge of the party crawled out, but was hit and incapacitated. Then Kimball wriggled his way forward and brought back the wires and the injured Major. For that he got the French War Cross.

Later, at Soissons, he won the palm by sticking to his radio apparatus during a heavy fire and a terrific electric storm. Lightning finally struck his mechanism and knocked him unconscious. When he recovered he was in a Paris hospital.

Sergeant Kimball got his job from the Labor Bureau.

Radio Essential Equipment on Modern Aircraft

SOME details of the development of the airplane radio telephone set which is featured on the cover of this issue were given by Major General George O. Squier, Chief Signal Officer of the Army, in a paper recently read before the American Institute of Electrical Engineers.

On May 29, 1917, the Chief Signal Officer called a conference in his office to set in motion the project of evolving a "voice command" equipment for airplanes which should meet all the severe requirements of the military service and which should be thoroughly standardized for quantity production. Speech was exchanged between airplanes twenty-five miles apart in October, 1917, and sample sets were sent at once to the army in France, for trial. Several thousand sets were ordered and have been completed and distributed to flying-fields here and to the Air Service in France.

The radio equipment consists of the vacuum tube transmitting and receiving set, and the special telephone transmitters and receivers. General Squier, referring to the latter, said: "Those of you who have heard the terrific roar of a Liberty engine will realize the difficulty of talking in an airplane in flight. The development of a transmitter which is affected by the human voice, and not by the enormously greater engine and wind noises, is one of the principal features of this set. Similarly, to shield the ears of the aviator from the same noises required a special combination of sound-insulating materials surrounding the telephone receivers and suitable for use within an aviator's helmet."

The antenna originally consisted of a flexible copper wire several hundred feet long, unreeled by the aviator and trailing almost horizontally behind the airplane. Modified antenna using much shorter wires fixed to the framework are now used.

The operation of the sets is extremely simple, all adjustments being made before leaving the ground. The only manipulation required of the aviator is that of the changeover switch to change from talking to listening.

Valuing the remarkable advances recently made in radio, General Squier said: "Commercial and military possibilities have, however, hardly been touched as yet. It is believed that radio apparatus soon will be as essential on aircraft as it now is on ocean-going steamships, and that its use will enormously increase the effectiveness of aircraft for all purposes."

Royal Society Chairman Recognizes Future of Wireless Press

IN a recent address on "Science and the Future," delivered before the Royal Society of Arts, in London, by its chairman, A. A. Campbell Swinton, interesting comments were made on the recent achievements and new possibilities of wireless communication.

"One matter, however, is within public knowledge," he said, "and that is the increased and still increasing amount of news that we get in the papers that appears under the heading of 'Per Wireless Press.' Indeed, wireless telegraphy appears to be developing at last in what has always appeared to me to be its proper field, which is not so much to communicate between one individual and another, but rather for the communication of intelligence broadcast over the earth. No doubt maritime wireless communication between ships, and between ship and shore, hitherto its most useful application, is another case altogether, and supplies a want that telegraphy by wire cannot meet at all. With this we are already familiar, while the use of wireless as a voice that can speak simultaneously to points on every portion of the earth is in some ways a more novel proposition.

"No doubt some persons who had private wireless stations of their own before the war, were used to getting time signals from Paris from the Eiffel Tower, and from Nauen in Germany while a few of those who had mastered the difficulties of reading the Morse alphabet by ear, were able to decipher weather reports from these places as well as from our own Admiralty, in addition to general news from Poldhu in Cornwall, and from one or two other large stations.

The girl he left behind him
—*Thomas in the Detroit News*

"What I have in my mind, however, goes much farther than this. In London tape and column-printing telegraph instruments operated by wire, that record sporting, parliamentary and general news, have long been familiar objects in clubs and hotels, and have become a portion of our daily life. Now there is no reason at all why similar printing instruments, which he who runs can read, should not be operated by wireless means, not only in London and other large cities, but throughout the country, or even throughout the world. Special transmitting stations using different wave-lengths could send out the messages, while separate printing machines, tuned each to respond to the wave-length of a particular transmitter, at each required point, would receive and record them. No connecting wires, costly both as regards first expense or as regards upkeep, would be required, but only suitable aerials at each transmitting and receiving station.

"Some regulations would be necessary to prevent interference, and as wireless waves, traveling as they do through the ether of space at the enormous speed of 186,000 miles per second, recognize no international boundaries, they would have to be universal. Thus arises a fitting opportunity for the league of nations. For the distribution of news to the press nothing could be better or more economical, while there is no reason why clubs, hotels and private houses everywhere should not also be thus supplied with the latest intelligence. For in wireless telegraphy it costs no more to send signals to a thousand receiving stations than to a single one, and there is practically no limit to the number of stations that can simultaneously receive signals from a single transmitting station.

"To some, this sketch of the universal distribution of news to all and sundry may appear fantastic, but it is not really so at all; for at any rate as concerns an area no larger than Western Europe and the British Islands, it is well within the range of practicability at the present time, and only requires a little working to arrive at the best arrangements."

Radio Service to South America an Imperative Need

IMPERATIVE need of direct cable connections, supplemented by radio service, between the United States and South America as the first and most important step in the development of relations between the American continents, is emphasized in a report made to Secretary Daniels by Captain C. T. Vogelgesang, just returned from Brazil as chief of a naval mission.

"The field is at this time open to energy and enterprise," the report says, "and if United States capital, backed by a strong and enduring policy of Government support, does not avail itself of the golden opportunity that is now presented, foreign capital will control and we will not have established that community of interest that Brazil looks for in her relations with us."

Wireless to Relieve European Cables

ORDERS were issued by Postmaster General Burleson on January 4 for routing by wireless all Government cable messages addressed to Europe unless specifically stamped "not to be sent by radio." The order does not apply to private cable messages, those sent by individuals or business firms, and does not apply to confidential Government messages.

Routing of Government messages by radio wherever possible was determined upon because of congestion of the cable lines.

Both the War and Navy departments have been asked to co-operate in radio use and to instruct officers in Europe to use radio for official messages wherever possible.

Fiji Islands Connected with New Zealand

A WIRELESS station has been established at Avarua, the principal town and port of Rarotonga, that now practically connects up a chain of wireless stations between the Fiji Islands, Tahiti and Rarotonga with New Zealand.

Service to Hawaii and Japan Resumed

AFTER suspending ten months, commercial radio communication between San Francisco, Hawaiian Islands and Japan was resumed December 19 at midnight.

Lieutenant-Commander C. R. Clark, Pacific Coast communication superintendent, stated Government stations will handle the traffic. The San Francisco station is at South San Francisco and the Hawaiian station at Pearl Harbor. The Japanese station at Funibashi is controlled by the Japanese Government.

Under the Government plan, messages for Japan will be received only from San Francisco and bay cities. Messages may be filed in any part of the United States for the Hawaiian Islands. Western Union offices will receive messages for delivery to naval stations. Due to congestion and the limited service, only full-rate messages will be accepted. All messages will be subject to censorship. Information concerning the certain codes which may be used may be had from the office of the Chief Cable Censor.

Before the war the Marconi Company handled commercial radio traffic to Japan. This service was suspended February 21, this year.

France to Get American Overseas Station

THE French government is expected soon to take over from the American Navy what will ultimately be the most powerful wireless station in the world. It is located at Croix d'Hins, near Bordeaux, and will consist of eight towers, each more than 800 feet high. It will be able to transmit messages not only to all parts of the United States, but perhaps even to Honolulu. Construction was begun a few months ago by the American Navy for the American Expeditionary Forces, with the understanding that ultimately it should be ceded to France.

Naval War-time Radio Included 4,000 Stations

"NAVY NIGHT" in the thirty-ninth annual meeting of the American Society of Mechanical Engineers was signalized by two events of more than usual timeliness and popular news interest. Before an audience which filled the auditorium of the Engineering Societies Building, in New York, Lieutenant Commander William L. Cathcart, U. S. N. R. F., lectured on "The Achievements of Naval Engineering in the War," with special reference to the Bureau of Steam Engineering of the Navy

Recounting the achievements of the electrical division, Commander Cathcart said:

"Under the supervision of the radio division there are now more than four thousand radio installations on board vessels flying the American flag. The bureau's direction," said Commander Cathcart, "extends similarly to fifty naval radio coastal stations and seventy-five commercial coastal stations in this country; to others in the West Indies and the Canal Zone, in our island possessions, and Alaska and Vladivostok in the Pacific, and finally to one now building for us at Bordeaux, in France, which will be the most powerful wireless station in the world.

"Communication between Washington and Russia will be made through the establishment of the Vladivostok station, now nearing completion. Our communications with China are through Cavite, and our Asiatic fleet to the United States Naval Radio Station at Peking."

Amateur Radiotelegraphy of the Future*

By Alfred N. Goldsmith, Ph.D.

Director of the Radiotelegraphic and Telephonic Laboratory, College of the City of New York

EDITOR'S NOTE—The author advocates operating all amateur radio stations of the future on sustained waves between 100 and 300 meters. He points out the desirable results of such a change, including a forty-fold increase in the number of stations operating within a given zone without interference, together with the immediate possibility of radio telephony.

I AM compelled by circumstances not to describe the actual construction of any particularly desirable transmitter and receiver. So detailed a prophecy as to the future of amateur radio communication seems to me ill-advised and calculated to do more harm than good. I prefer to indicate a line of future development, of a radical but practicable type. In so doing, it is my hope that an impetus will be given toward the development of the necessary equipment, so that those parts thereof which are now existent will be supplemented by the remaining new portions of the apparatus.

It is evident to even the most casual observer of radio telegraphy on a commercial scale during the last fifteen years that the tendency has always been strongly toward the use of sustained or "undamped" waves. Starting with the old-fashioned "spark-in-antenna" type of set, with its almost incredibly high damping and equally incredible capacity for the creation of intolerable interference with the work of other stations, the art progressed first to the inductively coupled stationary spark set of the old "United Wireless" type. Later came the modern quenched spark sets, these radiating waves of a damping of the order of 0.1. Were it not for the absurd regulation which practically places all ship and shore stations on a single wave length of 600 meters, these quenched spark sets would probably give a good account of themselves in the way of reducing interference. As it is, however, the full use of the available wave lengths is much restricted. Certainly it is to be hoped that in this, as in many other particulars, the present unwise radio regulations will be drastically amended.

The Sustained Wave and the Beat Receiver

But the evolution of the commercial transmitter has gone even further. There exist to-day at least three different types of fairly high-power sustained wave generators, namely the Poulsen arc, the vacuum tube oscillator, and the radio frequency alternator. All of these are in actual use, the first and third preponderating at present. With the advent of sustained waves, the receivers employed had to undergo fundamental changes. A whole series of new devices were evolved for sustained wave reception, notably the tikker, the tone wheel, and the beat method of reception. It is on this last method that I would center the attention of the reader. For it is my belief and hope that the amateur of the future will work with short sustained wave transmitters and beat receivers. In that direction I see really unusual opportunities for the earnest and ambitious worker.

*Abstracted from a paper prepared for the Radio Club of America, 1916.

Of course, the tendency toward low damping in amateur transmitters and receivers is very marked, quite apart from the 0.2 decrement regulation of the Government. Many amateurs are using quenched, or rotary synchronous, or non-synchronous gaps, and are doing work on low damping. The attempt to reduce the decrement of the receiving set is equally well marked. It only remains to carry this tendency to its ultimate, desirable, and logical conclusion.

The evils of high damping are very obvious, yet a brief calculation may not be amiss. Suppose that the decrement of the spark transmitter is 0.2 and that the decrement of the receiving set is also 0.2. Suppose further that the wave length is 150 meters. The question is: how far must the receiving set be detuned so that the signal strength is reduced to one-half? A simple calculation will show that a change in wave length of 10 meters is sufficient. That is, if we assume that we can read a message through interference of half its strength, a receiving operator could read at will any one of three stations at 140, 150, or 160 meters respectively. This is also on the assumption that the three stations come in equally loudly at resonance. Unfortunately these conditions are not always realized in practice, and if one of the three interfering stations should happen to be exceptionally near or exceptionally powerful, its interference would be difficult if not impossible to overcome.

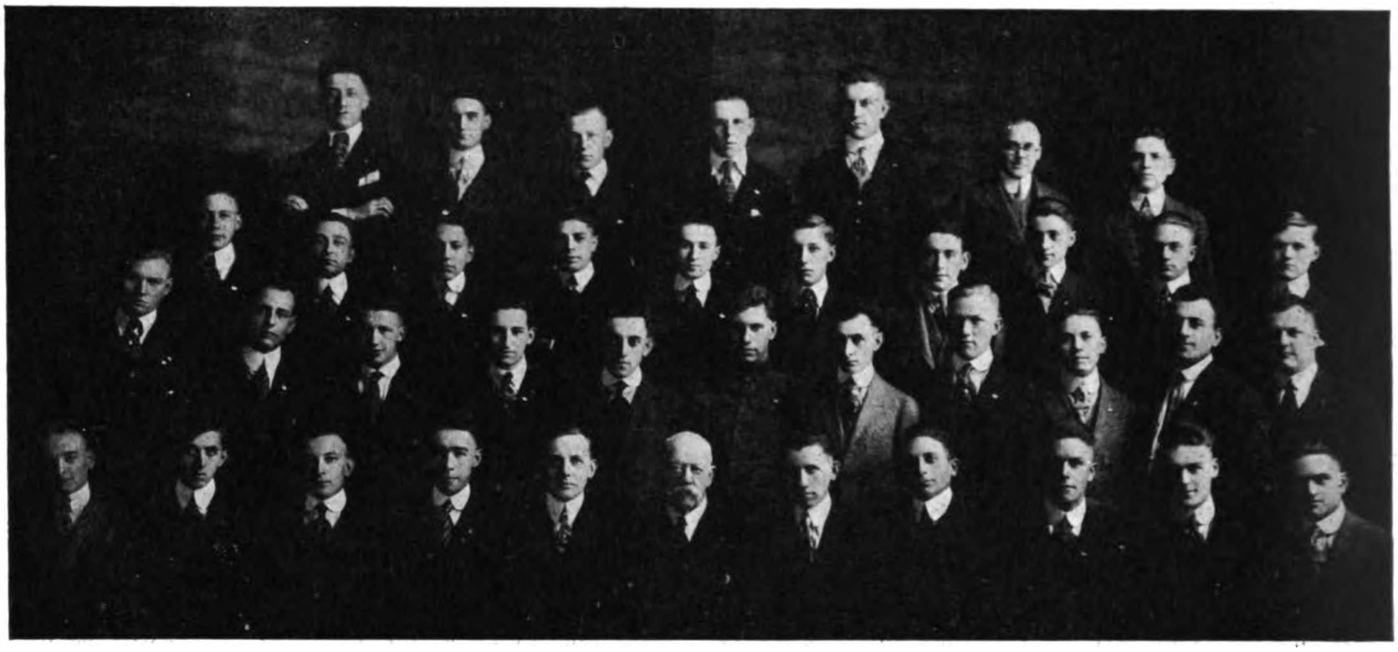
Operating 400 Stations Without Interference

I believe that the basis of decrement and ratio of desired-to-undesired signal given above is a fair one for comparative purposes. If so, we could not have more than about 10 stations working between 100 and 200 meters without causing serious interference. And this, too, under the most favorable conditions of equal-powered stations at equal distances from each other. The present-day excessively difficult conditions in thickly amateur-populated districts become immediately explicable on the above basis. It is clear that a radical change is needed so that every amateur can be reasonably secure from interference. It is for this reason that the sustained or "undamped" wave transmitter and beat receiver are advocated.

Fortunately enough, the beat receiver is particularly well suited to use at the short waves which are favored by the amateur. Interference is much less with beat receivers on short waves than at the long waves used by commercial stations. The following calculations will show this point clearly: Let us consider a large commercial station working, say, at 10,000 meters. This corresponds to a frequency of oscillation in the antenna of 30,000 cycles per second. If we receive this on a beat receiver, e.g., the ultraudion or one of the well-known Armstrong circuits, the receiving audion must be producing oscillations about 500 cycles more or less than those of the incoming wave. In this case, that frequency would be either 29,500 or 30,500 cycles per second for the local vacuum tube. It is found that the beats become quite faint and practically inaudible when we get more than 3,000 per second of them. That is, the range between 27,000 and 33,000 cycles per second must not be encroached on by an interfering wave. If it is, we shall get audible beats and interference between the desired and the undesired waves. Consequently we tie up the entire range of wave lengths between about 9,100 meters (corresponding to 33,000 cycles) and 11,100 meters (corresponding to 27,000 cycles). Stations must lie about 9 per cent apart in wave length at 10,000 meters for perfect beat reception. Thus, between 10,000 and 20,000 meters, only about 6 or 7 stations could work successfully on this basis. When we go down to 200 meters wave length (corresponding to 1,500,000 cycles), we find a much more favorable state of things. The limits of interference now lie between frequencies of 1,503,000 cycles and 1,497,000 cycles. These correspond respectivly to 199.6 meters and 200.4 meters, and are only 0.3 per cent apart. We will tabulate these and a few other results for comparison.

Wave Length	Nearest Usable Wave Length	Per Cent Change
10,000 m.	9,100 m.	9.0
300	299.1	0.3
200	199.6	0.2
100	99.9	0.1

Consequently we reach the astonishing conclusion that under conditions comparable to those mentioned previously, *amateur stations (using sustained wave transmitters and beat receivers) might be as many as* 400 *in number between* 100 *and* 300 *meters without interference!* It will be noticed that I have stretched the amateur wave length range to 300 meters, which is a change that I favor under the conditions mentioned, since interference would then be so markedly reduced.



Hundreds of students similar to this radio and buzzer class at the St. Louis University are being prepared, at the various schools throughout the country, to operate the new devices in wireless telegraphy and telephony developed during the period of the war

Arc and Vacuum Tube Transmitters

I need hardly point out at length the desirability of having 400 stations in the same amateur zone working without interference as compared to a possible 10 under present conditions. The improvement speaks for itself.

It is necessary to go further, and point out the actual methods which will probably enable the amateur to carry out so admirable an improvement. To begin with, he will need for his transmitter a sustained wave generator of extremely constant frequency or wave length. Also, it should be steady and silent in operation. Although I have repeatedly drawn 10 or 20 watts at 200 meters from small Poulsen arcs on 220 volts direct current by a simple enough method, I cannot recommend the arc for the desired purpose. It is not sufficiently constant in either wave length or current output for the purpose. It may be possible to improve it eventually, but, so far as I know, it is not a very satisfactory device at 100 or 200 meters.

It is probable that Chaffee arc sets somewhat like those described by Mr. Bowden Washington in the August, 1916, issue of the Proceedings of the Institute of Radio Engineers would be satisfactory for the purpose if the "inverse spark frequency" were painstakingly and accurately adjusted. I regard this as a highly profitable direction for investigation since the Chaffee arc is a simple and reliable device, and is well suited to amateur purposes. In its most recent forms, with the hydrogen tanks eliminated and alcohol vapor substituted, it seems to be remarkably well adapted to work from 100 to 300 meters with a steady sustained wave, suited to beat reception. I recommend experimentation and perservering tests with this most promising device. In working with it, attempts should be made to keep the running voltage as low as possible.

If one is content with low power and somewhat unusual equipment, the large vacuum tubes form an alternative source of steady oscillations of constant wave length. It is not excessively difficult to cause such bulbs to produce oscillations corresponding to 200 meter waves, particularly if high vacuum bulbs are used. It is to be hoped that these bulbs will be produced for the amateur market in form suited for both filament lighting and electron current supply from ordinary 110 volt D.C. power lines. That is, either a long 110 volt filament or a low voltage filament with series resistance should be used. Furthermore, the 110 volt supply should be also used in the plate circuit either directly or with a potentiometer. This double use of the 110 volt supply is quite possible, and has indeed been already accomplished by one of the best versed experimenters with such bulbs. The simplicity of such an arrangement is considerable, since one needs merely plug into any 110 volt socket to start the outfit operating. If alternating current only is available, rectifiers of some sort (e.g., hot filament vacuum rectifiers of the Fleming valve or kenotron types) become necessary.

Avoiding Capacity Changes in Tubes

At least one advantage in the use of the vacuum tube for transmitter is that the same bulb with a slight change can be used for the receiver. There should be simultaneous power reduction and wave length change by means of quick-acting switches. In this connection, an increasingly well-known difficulty with very short wave beat receivers may be mentioned. Particularly, when using the vacuum tube in beat receivers, the capacity in the various circuits at 200 meters is extremely small, and may be only the internal capacity of the tube itself. Consequently bringing the hand near any unshielded condenser causes a huge percentage change in capacity because of the capacity of the body, and the tuning (which is extremely close and delicate at best) is completely thrown out. It will almost certainly be necessary for really reliable operation to enclose the entire receiver, and for that matter the transmitter also, in a grounded wire netting screen. Any handles for adjustment must come through small holes in this screen or else be operated by means of soft iron attachments on the handle and small permanent magnets outside the screen.

There is a curious type of interference which will arise when two sustained wave amateur stations get too close together in wave length. It is familiar to those who have occasionally heard Nauen on 12,800 meters interfere with South San Francisco, the latter being also a sustained wave station. This is "beat interference," and results in the clear beat tone being heard whenever the waves from both the interfering stations come in. It is an annoying form of interference but can be avoided among amateurs with very slight trouble.

The Field for the Amateur Radiophone

Another great advantage of the sustained wave transmitters which I have been advocating for all amateurs is that their long-desired goal of radio telephony becomes immediately accessible. All that is necessary is an ordinary telephone transmitter placed in the antenna, for example, with Chaffee arc sets or vacuum tubes; or used as a trigger control in any one of a number of interesting ways with the tube oscillator. I need not dwell on the additional value to the amateur of a combined radiophone and radio telegraph set, which is exactly what these sustained wave transmitters practically are. When used for radio telephony ordinary detector reception is possible, and in some ways preferable, to beat reception. Even supposing that these stations are received on ordinary crystal or vacuum tube detectors, there can be as many as 40 operating simultaneously without interference between 100 and 300 meters. Furthermore, they will not interfere at all with the hundreds of other sustained wave, beat received radio telegraph stations in the same zone.

How Spark Sets Handicap Sustained Waves

There is one matter of the utmost gravity in connection with the suggested proposal of sustained wave telephone or telegraph transmitters combined with beat receivers for amateurs. And that is the absolute necessity, if the desired results are fully to be achieved, of having *all* amateurs working in this fashion. Every old-fashioned spark transmitter in a given zone will render its 20 meter range of wave lengths practically unusable by the more modern and highly efficient sets. So that only a few amateurs of the older type in any given zone would practically wreck all good work, even if they had the best intentions, which latter might not even be the case. It would be the intrinsic clumsiness of their apparatus which would be to blame, exactly as would be the case in a musical competition between a violin and an automatic rivetter.

Removing the "Jamming" Bugbear

Since this is therefore a great advance, calling for the simultaneous co-operation of *all* amateurs, I suggest most earnestly that leading and influential amateur organizations, begin an educational and legislative campaign in this direction. It would be well to appoint a *Committee on Amateur Stations,* the duty of which Committee should be the spreading of the most modern and advanced ideas as to station construction and operation. Needless to say, the paramount function of this Committee would be to prepare the way for the great forward step to sustained wave transmitters and beat receivers. The publishing of suitable literature explaining simple, practical ways of getting the desired results can be to great advantage left to such a Committee. Furthermore, the drawing up of a program for suggested legislation along these directions and the enlisting of amateur and public support for such measures would also be a function of the Committee.

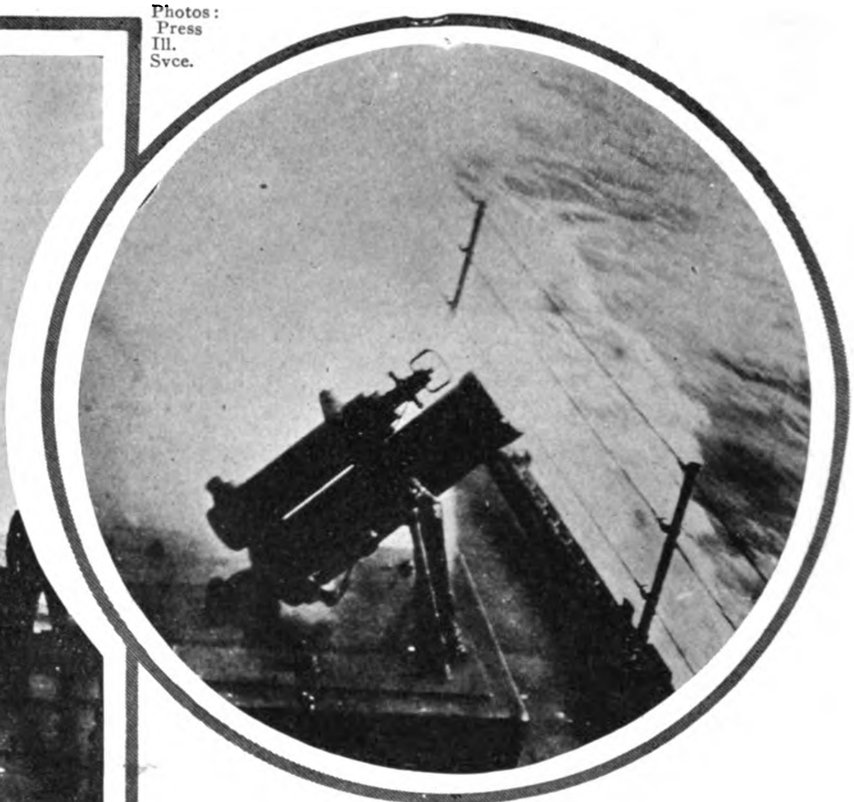
In this way, every amateur would be given much widened opportunities, and the advanced worker would be protected. Furthermore, even the beginner would be much assisted by the removal of the bugbear of everlasting "jamming." A campaign for the new type of amateur sets would therefore be a direct contribution to the spread of scientific knowledge over the entire country and an increase in public interest in the radio field. I need hardly say that this is the most basic and fundamental type of real national preparedness, and that no greater stimulus to national progress exists than awakened interest in science and scientific methods.

Suggestion for Prize Contest April Wireless Age

We will pay the usual prizes of $10, $5 and $3, in addition to our regular space rates, to the three contributors who send us the best manuscripts on the following subject:

What, in your opinion, is the most efficient receiving set for amateur wave lengths, and what should be the dimensions of the antenna and the tuning coils for best results?

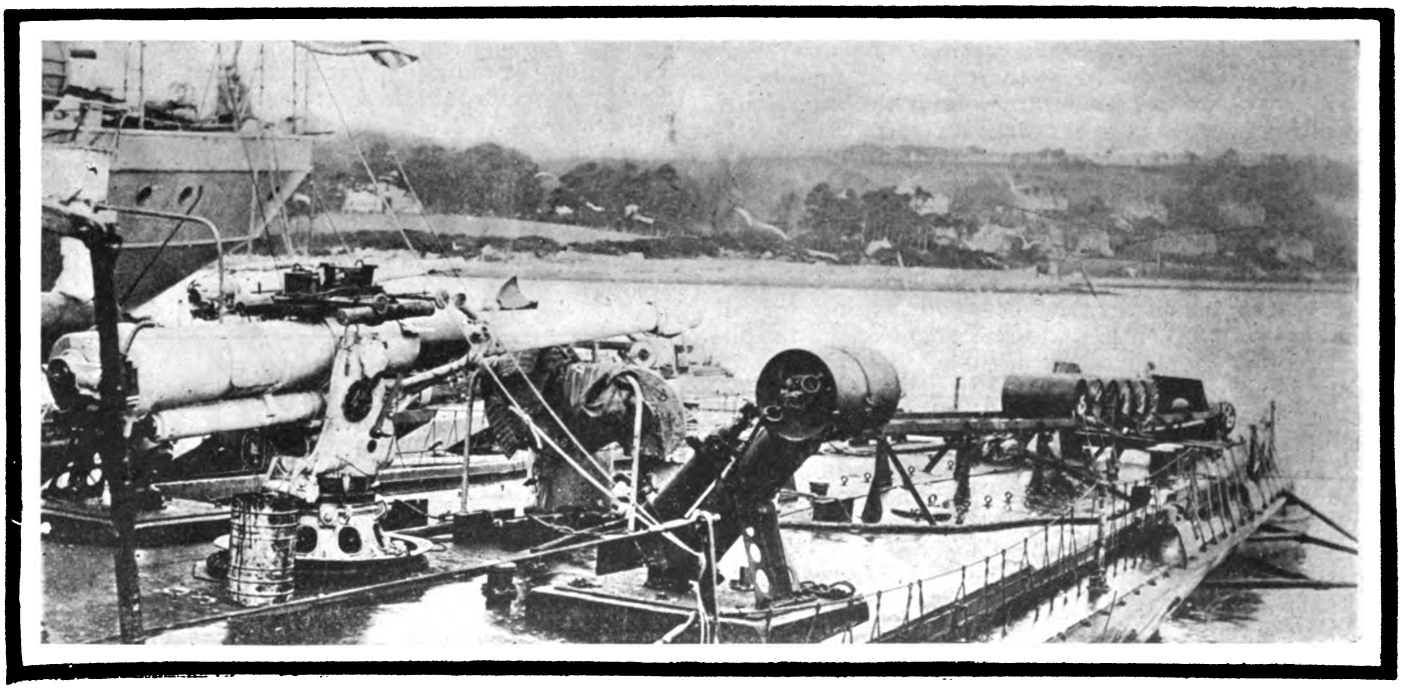
Photos: Press Ill. Svce.



"Ash Cans!"

The Depth Bombs Which Beat the Submarine

These photographs are the first which the Navy has released for publication showing the depth bombs which American gobs insistently termed "ash cans"—for the duration of the war. The view in the upper circle shows the depth mine gun in action; the surface view of the finish of a Hun submersible shortly afterward, appears on the left



Tranquillity graces this deck scene of an American fantail lying alongside the mother ship Melville, her mission accomplished. A depth charge is here resting on its gun; nearby is a rack capable of holding 44 additional "cans"

My Experiences in the War

First Installment of the Personal Narrative of a Pioneer in Aircraft Wireless Who Was Wounded and Captured In the Attempt to Stop the Hun Invasion

By Captain Gordon Adams

South Lancashire Regiment

DURING the first year after I had passed through the Royal Military College at Sandhurst, and obtained my commission as a Second Lieutenant in the English Royal Army, I found that the whole of my spare time was engaged in learning actual military work; but at the end of that period, in 1908, my regiment moved to a small village in Ireland, and having successfully passed my examinations for promotion to the rank of Lieutenant, I had a considerable amount of time at my disposal for working at subjects other than of a pure military nature. From this time on, I devoted every possible moment that I could spare from my military duties to the study and application of mathematical science.

Capt. Gordon Adams

Starting off with astronomy, I went all through the subject of navigation, both theoretical and, as far as possible, practicable. This led on to surveying, and so on to optics and mathematical physics in general. Every new field that opened up demanded an increased knowledge of mathematics and I, therefore, had to work away solidly at that which is the absolutely indispensable tool in the tackling of any branch of science.

In 1910, I was made musket instructor to my regiment. Then I found numerous opportunities for applying the knowledge which I was gaining in addition to my professional duties. During my annual leave I made up the practical part which I was unable to work at while with my regiment through lack of instruments and other facilities. On these occasions I generally managed to get what I wanted in London or Cambridge Universities.

In May, 1912, the British Government decided to create the Royal Flying Corps, consisting of a Naval and a Military wing; in the autumn of that year the Central Flying School was inaugurated for the training of Naval and Military airplane pilots. Early in 1913 I sent in an application to join the R. F. C. and was very fortunate in having my application accepted within a very short time.

In those days the government required all officers to take their Royal Aero Club certificate at their own expense at a civilian flying school before proceeding to the Central Flying School. Once accepted as a Military Pilot, however, expenses were refunded. There were four flying instruction grounds then in existence. I selected Hendon (Brooklands, Eastbourne and Salisbury Plain being the other three). At Hendon there were four main schools, the Graham-White, the Bleriot, the Caudron and the Deperdussin. I chose the Caudron. The Caudron machine was a single seater tractor, with a 35 h.p., Y-type Anzani engine. It had no ailerons, the lateral control being effected by wing warping. It was unique in its construction; for though a tractor machine it was built with tail booms exactly like a machine of the pusher type. The pilot sat in what looked like a small cockle shell.

In the Caudron School, as in all other schools using single seater machines, the instruction was of the "Fly or Die" type. You were given a machine, and after a few explanations as to what to do, you were told to "push off" and taxi the machine about the ground, but after acquiring more confidence the throttle was opened until flying speed was reached; then a small drop was executed which usually terminated in a somewhat abrupt "alterissage." These hops were gradually lengthened until the pupil was able to make an ordinary straight flight.

When I did my first drop, I had never been up as a passenger, so that it was the first time I had ever lost touch with the earth. There is no question that the sensation embraced, for me, more than mere novelty. From straight flights the pupils went on to turns, until eventually the standard required for the R. Ae. Club's certificate was reached. The test for this certificate was to fly 5 figures of eight at a height of not less than 150 feet, and then to land. After touching the ground, with the engine switched off, the machine had to come to a standstill at a distance not greater than 50 yards from a given point. This performance had to be gone through twice.

Owing to the instability of machines in those days, no instructional flying was carried out except when the weather was absolutely dead calm. This entailed getting up in the morning at dawn, the hour when the air is usually calmest.

On the morning I was going to take my Aero Club certificate I started off full of confidence, but after doing a half-circuit of the Aerodrome, and when I was only about 15 feet off the ground, my engine began to miss badly. I found myself up against the proposition of either charging straight into a shed or attempting to turn. I tried the latter, sideslipped and crashed. . . .

No other machine being available for me to have another try on, I had to wait until my arrival at the Central Flying School to take my "ticket."

Just as the training methods were widely different from those of the present day, so did the early aeroplanes reflect the inefficiency of aeronautics five years ago. The equipment available for flying instruction was uncertain and diversified. In addition to the schools at Hendon there were several manufacturing firms experimenting with different types of machines. One of these was the Breguet. This machine was peculiar in many ways. In the first place, most of the spars were steel instead of wood. It had only one row of interplane struts, and when stationary the trailing edges of the wings were very flexible and hung down in festoons. The wings were warped for lateral control by the feet, the steering being done by a wheel. The tail and rudder were two flat planes fixed at right angles to each other, the whole being attached to the end of the fuselage by a universal joint. The result was that the tail or elevator and the rudder could not be

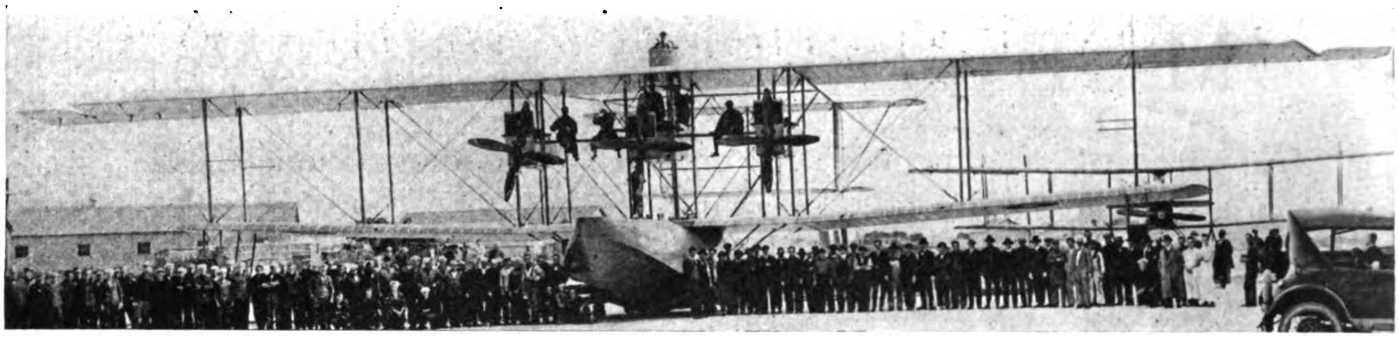


Photo by Int'l

This giant American hydroplane, which carried fifty passengers in a flight at Rockaway Beach, N. Y., offers a striking contrast to the early machines which Capt. Adams describes. It is propelled by three Liberty motors developing twelve hundred horsepower and producing a speed of eighty miles per hour

moved independently of one another. On one occasion when a Frenchman named Collardeau was flying the machine, the universal joint gave way and the whole contraption fell off in the air.

But even then, a lively discussion was being carried on about attempts to fly the Atlantic. Lieutenant Porte, I recall, was at Hendon at that time flying a 100 h.p. Anzani-motored Deperdussin, which was expected to casually cross the Pond most any day.

Another company at Hendon was the Handley-Page. They had one shed and were experimenting with a monoplane, with indifferent success. The future could not then be foretold, but I was certainly very pleased when Mr. Handley-Page made good on his bombing machines, for he persisted through many years of bad luck.

Gustav Hamel was another generally to be seen performing what then appeared to be the most astounding aerobatics. He generally flew a Bleriot monoplane with

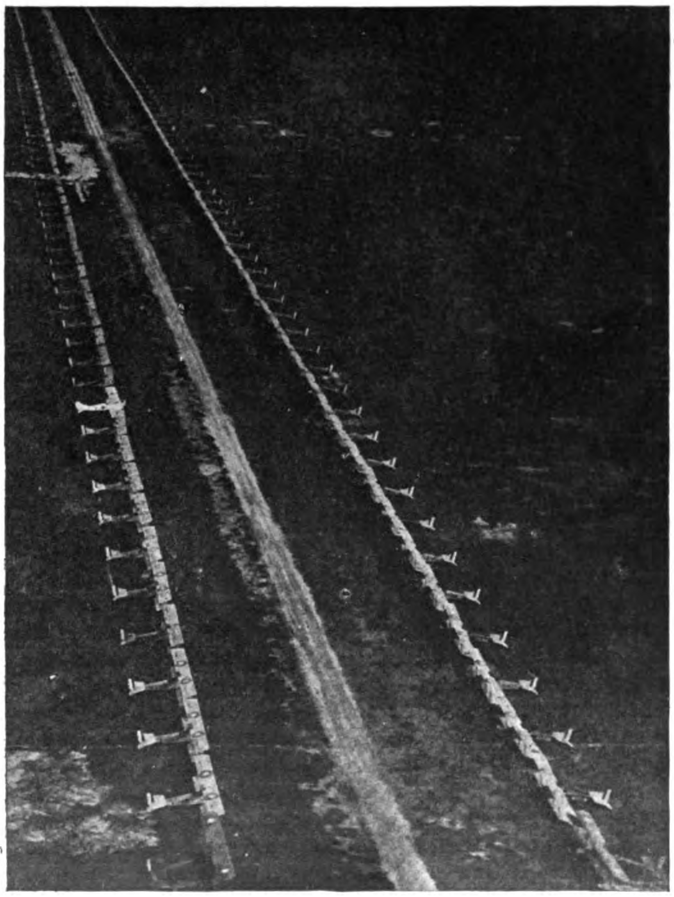


Photo by Int'l.

View of the flying field and its equipment of over 100 airplanes at Ellington Field, Houston, Texas. Contrasted with the flying fields described by Capt. Adams, some impression is gained of the rapid development of the airplane in the last five years

a Gnome engine, but later took to a Morane-Saulnier monoplane with a Le Rhone engine. Beatty was also frequently in evidence on an odd twin-propeller Wright machine.

When I arrived at the Central Flying School, I was given a Short biplane with a 70 h.p. Gnome engine. It was one of the old box-kite types in which pilot and passenger sat side by side. The ailerons were of the non-balanced type; that is, owing to the absence of a balancing wire they hung straight down when the machine was stationary. The speed of the machine was somewhere about 40 miles an hour. I took my ticket on this machine about a week after I arived at the C. F. S.

The school was organized into 4 flights, A, B, C and D, and the pupils, who were both naval and military officers, were divided up amongst them. About half way through the three months course, the pupils were changed to other flights, so that on graduation each officer had flown at least two types of machine, generally one tractor and one pusher. A flight was equipped with Avros; B, with Maurice Farmans; C, with B.E. 2's; and D, with Henri Farmans and Shorts. In addition to actual flying the course entailed searching examinations on theory of flight, construction, rigging, engines, theoretical and practical meteorology, formation of troops, cross-country navigation, use of maps, and types of British and foreign war vessels.

Much of the engine instruction was devoted to the Gnome, which was the original rotary engine. It had seven cylinders. The exhaust valves were in the cylinder heads and opened direct into the air and the inlet valves were in the piston heads, the gas coming in through the crank case. There were, therefore, neither intake nor exhaust pipes.

I took my civilian pilot's certificate in May, 1913, and graduated at the Central Flying School as a military pilot in August. From then I joined No. 5 Squadron, R. F. C., at Farnborough.

The establishment of the military wing of the R. F. C. in those days was one squadron of airships and seven squadrons of airplanes. The whole was commanded by Lt. Col. F. H. Sykes. Each squadron of airplanes consisted of three flights. Each flight consisted of one Flight Commander, ranking as a Captain, and three flying officers ranking as Lieutenants or Second Lieutenants, and was equipped with 4 machines. The total officer personnel of a squadron was, 1 Major in command, 3 Captains and 15 Lieutenants or Second Lieutenants, six of whom acted as observers. All officers had to be pilots; equipment officers had not then come into being. The technical and routine work which nowadays is done by equipment officers was then carried out by the pilots themselves. The larger units such as wings, brigades and divisions were non-existent.

This establishment was only partially completed when I joined the corps, in fact there were only four airplane squadrons in existence and they were not completely equipped. The whole corps at that time was naturally in a very embryonic stage. My squadron had in it no fewer than seven different types of machines. These were:

The Maurice Farman "Longhorn," with 70 h.p. Renault V-type engine.

The Henri Farman with 80 h.p. Gnome engine. (These were both of the pusher type, the main difference being that the M. F. had a front elevator, whereas the H. F. had not.)

The single seater Avro, with 50 h.p. Gnome engine.

The Sopwith, with 80 h.p. Gnome engine.

The Caudron, with 45 h.p. Anzani engine.

The B.E. 2a, with 70 h.p. Renault engine.

The Graham-White, with 45 h.p. Anzani engine.

This last named machine was a quaint looking device and was popularly known as the "Pterodactyl." The fuselage projected some distance in front of the main planes and it was there that the observer sat with the engine immediately in front of him.

My flight was equipped with Avros. They were sporting machines to fly as they had, virtually speaking, no lateral control at all. The wings were supposed to warp, but as the warping cables were led up from the base of the first struts to the top of the second pair, very little bending of the wing tip could be obtained. In fact it had absolutely no effect at all! All lateral control had to be done with the rudder.

The B.E. 2 was another wing-warping machine, but in this case the warping cables were led straight from the fuselage to the top of the outer rear struts. This gave it twice the warping effect of the Avro. It was a very uncomfortable machine to fly on a rough day, as the wings were very flexible and frequently a gust under one wing would cause the wing to warp suddenly, which, acting through the control cables, would in many cases jerk the joystick out of the pilot's hands and give him a sharp blow on the inside of his knees. This machine was the forerunner of the numerous B.E. types.

Photo: Int'l

The world's fastest airplane, built by Curtiss. Carrying a full military load it attained a speed of 160 miles per hour and climbed 13,000 feet in ten minutes. The 'bus in which the author learned to fly five years ago had less than one-fifth its power and one-quarter its speed. The triplane illustrated has a new 400 horsepower K-12 engine, which is lighter by 25 per cent than any other aeronautical engine

The corps at that time only consisted of about 60 officers, of whom 90 per cent were regulars, seconded or loaned to the R. F. C. from their respective regiments. It was a great life in those days, flying machines which viewed from the present day standpoint appear absolutely prehistoric.

I spent about four pleasant months doing practically nothing but flying. Then I began to feel that I wanted to progress. So I obtained leave and went up to London University and, metaphorically taking my coat off, got down to real hard work on theory and practice of wireless telegraphy with a view to applying it to aviation.

On the termination of this period of leave I returned to my squadron, and within a week an experimental flight was started consisting of eight officers. Great assistance was given by the Royal Engineers at Aldershot; they loaned the observatory and wireless station to the corps for experimental purposes. The particular job that I was detailed to was the theory and design of wireless installation on airplanes. The first installation was a Rouzet set, and it was upon this crude equipment as a start that the present day airplane wireless was built.

It would give great amusement to pilots of today could they see those old B.E.2 machines which we used for wireless experimental work. The fabric in many cases had to be removed from the wings in order that yards of wiring might be run round the edges of the planes to supply additional capacity.

As a start, the only thing attempted was to transmit messages from the machine at a low altitude to a station on the ground, but before the war broke out two machines had actually got into communication with each other in the air at a distance apart of about ten miles. In addition to myself, there were three other officers engaged on wireless work. All three are dead now, two were killed in the air, and the other died from illness. These three officers did all the practical flying work while I was mainly concerned with the solution of any mathematical problems which they presented to me, such as calculating the curve which a trailing wire aerial would take up at a given speed in order to see if it would clear the undercarriage while being unreeled, and similar problems. The trailing wire was the only type of aerial used, though suggestions were frequently forthcoming for draping aerials between the wing struts regardless of the additional wind resistance which they would cause.

Photo: Central News

The ease with which wireless communication is held with aircraft records some rapid progress since the writer of this article began to apply wireless to the airplanes of the British Royal Flying Corps

(To be continued)

Progress In Radio Science

The Production of Tone Frequencies

METHODS of operating a wireless system over a wide range of tone frequencies devised by Oscar Roos are shown in the diagrams, figures 1 to 6.

The fundamental circuit is shown in figure 1. A condenser C-2 is connected in series with an inductance L-2 and a radio frequency alternator A-2, for which may be substituted, if desired, an arc generator of the Poulsen type. A spark gap S is included in the circuit, which may be placed in the field of a magnet M or in a vessel containing a compressed gas. Two trigger valves or arresters V and V-1 are connected on either side of the spark gap. These arresters may be an ordinary spark gap, a quenched spark gap, or two oppositely arranged rectifiers such as a point and plate

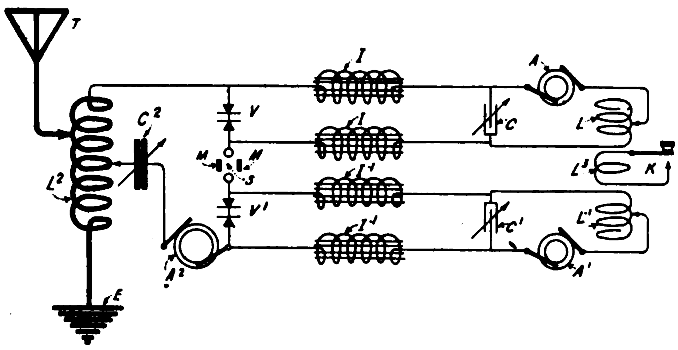


Figure 1—The fundamental circuit of the Roos wireless system for wide range of tone frequencies

rectifier, a hot and cold electrode rectifier, a mercury vapor rectifier or an aluminum or other film arrester. These arresters normally prevent the condenser C from discharging across the spark gap, but they are rendered ineffective through being broken down momentarily by an impulse from an auxiliary source, which in this case consists of two low voltage alternating current generators A and A-1 of different frequencies. Generator A is connected in series with inductance L and condenser C and generator A′ in series with inductance L′ and condenser C-1.

Coils L and L-1 are placed in inductive relation by means of the linking system L-3 which includes the key K. By closing key K the circuits L, C and L-1, C-1 are thrown into resonance and the potential resulting therefrom breaks down the arresters V and V-1, thereby rendering the spark gap operative. If the frequency of the alternators A and A-1 are within the range of audio tones, the amplitude of the antenna oscillations will vary periodically accordingly.

A modification is shown in figures 2 and 3 where the condenser is charged by a direct current generator G, which is protected by the choke coils I and I-1. It is connected in series with the quenched spark gap S′.

In operation neither the high frequency generators A-1 or A-2 or the dynamo G can break down a larger gap than S-1 and S-2 and the arresters, therefore, prevent the discharge of the condenser C-2 across the gap unless they are simultaneously broken down. If n represents the frequency of generator and m the frequency of generator A-1, the arresters will be simul-

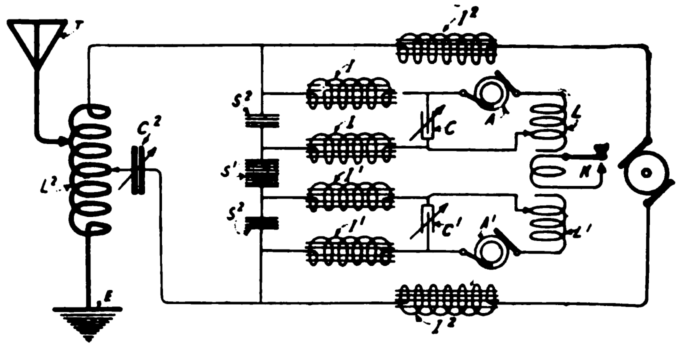


Figure 2—Modified circuit with a direct current generator, protected by choke coils, charging the condenser

taneously broken down 2 (n—m) times per second and the tone produced in the receiving system will be the beat frequency of the generators. It is obvious that this tone may be varied over a great range by slightly altering the speed of one or both of the generators. The design of the dynamo G is such that it will have a falling voltage characteristic in order to prevent arcing in the spark gap. Figure 3 differs from 2 in that rectifiers are employed as arresters in place of the quench gaps S-2 shown in figure 2.

The modified circuit in figure 4 has the auxiliary source of energy for discharging the main circuit, coupled to two alternators A and A-1 connected in series. By means of the valve connection V-2 both halves of the wave are rectified. By means of the transformers M and M-1 the energy of the resulting unidirectional impulses is impressed as two alternating currents having twice the frequency of the generators, respectively upon the circuit which includes the condenser C and the direct turn generator G. The generator normally cannot break down a larger gap than S, S-1 and the arresters therefore prevent the discharge

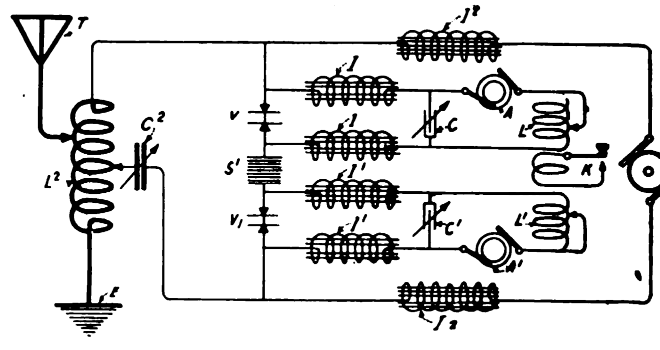


Figure 3—Showing circuit with rectifiers employed as arresters in place of quenched spark gaps

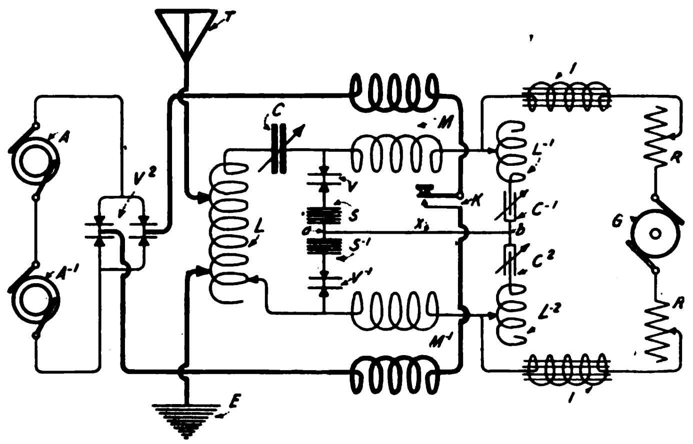


Figure 4—Diagram of connections, showing the auxiliary source of energy for discharging the main circuit, coupled to two alternators connected in series

of condenser C unless they are broken down simultaneously. They will be broken down simultaneously 4 (n—m) times per second where n and m represent the frequencies of the generators A and A-1. The tone produced in the receiving system will be the beat frequency of the alternating current developed, as mentioned before, in the secondaries of the transformers M and M-1 and this tone may be widely varied by slightly altering the speed of one or both of the generators.

The advantage of connecting the generators in series is, that the maximum beat voltage which is always the sum of the voltages of the two machines is much higher for a given beat frequency than that which other things being equal would be obtained from a single machine developing currents of the given frequency.

For example, if the normal or full-speed frequency of the generators is 8,000, then by reducing the speed of one of them so that its frequency is 4,000, the beat frequency will be 4,000 and the total voltage will be the sum of the full-speed voltage of one machine plus the half-speed voltage of the other, or 300% higher than the voltage of either machine running alone at 4,000 cycles. If, however, the beat frequency is much lower the advantage of the serial connection of the generators is more striking. For example, if the frequency of one machine is 8,000 and that of the other 7,500, the beat frequency will be 500, which corresponds to 1/16 full speed, while the total voltage is 31/32 the full voltage of both machines. Either machine running alone at 500 cycles would generate only 1/16 its normal or full speed voltage of 1/31, the voltage obtained by the Roos arrangement.

The generator G is protected from the currents of alternating current generators A and A-1 by a shunt having negligible reactance for the beat frequency. This is connected across the terminals of the generator as in figure 4.

The shunt consists of a circuit L-1, C-1, B-2, L-2 which is tuned to the beat frequency of the alternating currents developed in the secondaries of the transformers M, M-1. This circuit consists of two serially connected branches, one branch C-2, L-2 being tuned to a frequency higher than the beat frequency and the other branch C-1, L-1 to a frequency lower than the beat frequency. The complete circuit L-1, C-1, C-2, L-2 being tuned to the beat frequency, it follows that this circuit has negligible reactance for currents of that frequency, and that the potential drop across the terminal of the circuit is practically nothing. Choke coils I, may be employed to protect the generator G from the effects of the oscillations developed by the discharge of the condenser C across the spark gap.

Because one branch L-2, C-2 is tuned to a frequency higher than the beat frequency and has capacity reactance, and the other branch L-1, C-1 is tuned to a frequency lower than the beat frequency and has induct-

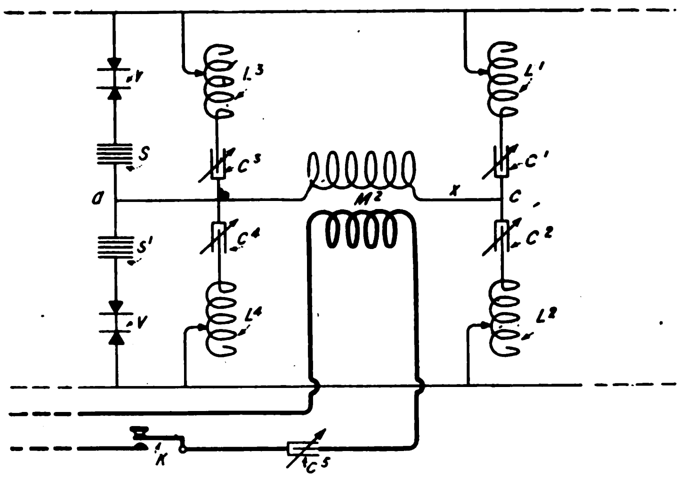


Figure 6—Detail of figure 5 indicating the association of the auxiliary source circuits with the transformer without change in mode of operation

ance reactance, the passage of the beat frequency current through the circuit L-1, C-1, C-2, L-2, L, C, will develop a high potential difference between the terminals of the arresters V, V-1 respectively. They break down simultaneously and permit the condenser C to discharge across the gaps S, S-1.

It will thus be seen that the system shown in figure 4 meets the contradictory requirements of low beat frequency voltage across the choke coils I, I, for the protection of the generator G and high beat frequency voltage across the arresters for momentarily breaking them down and rendering them ineffective.

To augment the effect of the auxiliary source by sharper resonance the high impedance of the radio frequency circuit C, L is eliminated for currents of beat frequencies by using the arrangement shown in figures 5 and 6, in which a second circuit L-3, C-3, C-4, L-4 tuned to the beat frequency, is connected across the system. This circuit consists of the branch L-3, C-3 tuned to a frequency higher than the beat frequency and the branch C-4, L-4 tuned to a frequency lower than the beat frequency.

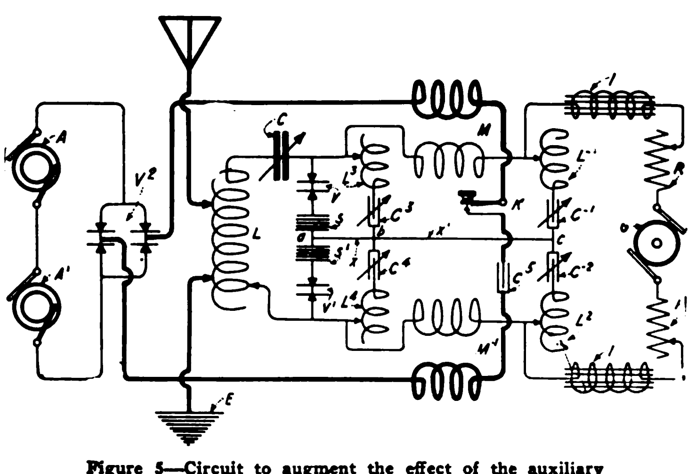


Figure 5—Circuit to augment the effect of the auxiliary source by sharper resonance

The branches L-3, C-3 and C-2, L-2 are both tuned to the same frequency and branches L-4, C-4 and C-1, L-1 are both tuned to the same but lower frequency, so that the circuits L-4, C-4, X-1, C-2, L-2 and L-3, C-3, X-1, C-1, L-1 are each tuned to the beat frequency. The secondaries of the transformers M, M-1 are so connected that the beat frequency currents will flow in the last named circuits and have a common direction in the conductor X-1, thereby avoiding the radio frequency circuit C, L which has a high impedance for this current. These currents are amplified by resonance.

As indicated in figure 6, the circuit of the auxiliary source may be associated with the transformer M-2 or otherwise with the branch X-1 without changing the mode of operation. A transmitting key may be connected in the circuit of the auxiliary source or otherwise associated with the system.

Rouzet Transmitting System for Increasing Spark Frequencies

A SYSTEM of obtaining high spark discharge frequencies from oscillation circuits excited by a three phase low frequency generator, has been devised by Lucien Rouzet of Paris. M. Rouzet mentions one of the advantages of employing multi-phase current is that the generator is kept on load during transmission and the output is therefore more steady than in a single phase system. An objection to the use of a single phase high frequency generator is that it requires a low self induction which increases the problem

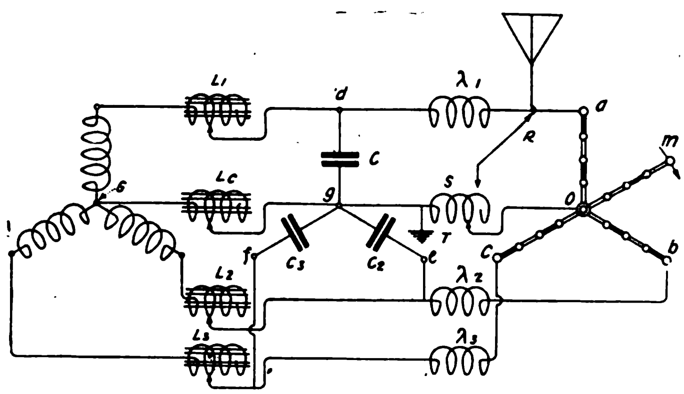


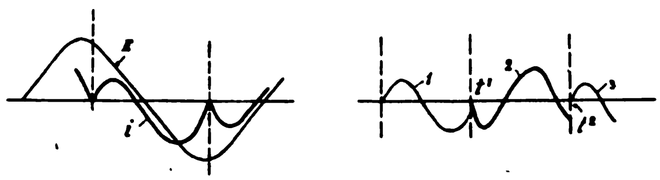
Figure 1—Fundamental wiring diagram of the Rouzet transmitting system for increasing spark frequencies

of design. Furthermore in high frequency systems the time of the charging period is reduced as the frequency is increased, but the discharge period, whether for low or high frequencies, remains the same. On the other hand in systems employing charging currents of low frequency the period of discharge is short compared with the period of charging which increases the efficiency considerably, principally because it reduces the short circuit current which generally occurs while the condenser is discharging across the spark gap.

To show the increase in amplitude of the radio frequency currents generated by the Rouzet system, as compared with the single phase high frequency system, the curves of figures 2, 3 and 4 are shown. Figures 2 and 3 indicate the relative amplitude to be expected from a single phase system, in which the spark discharges synchronously, that is, twice per cycle. Figure 4 indicates the amplitude in the three phases of a three phase system as well as in the neutral wire.

The fundamental wiring diagram in figure 1 shows a star-connected three phase source of current G, which may be a multi-phase alternator or the secondary winding of a high potential three phase transformer. As will be seen each phase feeds a condenser, the three condensers C-1, C-2, and C-3, being star connected. Their neutral point G is connected to the neutral wire. The charging circuit is further made resonant by means of the inductances L-1, L-2, L-3, and L-c.

The rotary spark gap contains three sets of stationary electrodes, A, B, and C, and a rotating member, M, which is so designed that when OM is in the position OA, OB or OC, four spark discharges in series take place and the condensers are discharged successively in resonance with the charging current.



Figures 2 and 3—Graphic curve showing the relative amplitude to be expected from a single phase system

If the rotating arm of the spark gap revolves at a rate of two revolutions for each charging period, two discharges per period will be obtained in each phase, giving a total of 6 discharges per revolution. In order to maintain identical periods of oscillation in each discharge circuit, inductances are inserted in each branch.

In summary, each condenser with its particular phase acts as a single phase system, but the total number of discharges will be three times that of a single phase system or, in other words, the spark frequency is increased. By proper adjustment of the rotary spark gap, the spark can be made to take place when the charging current passes through a zero value, thereby preventing arcing; but this can only be accomplished when the charging circuit is properly tuned itself.

Figure 4 shows the super-position of the curves i_1, i_2 and i_3 of the stages of a three phase star-connected system. The sum of the currents passing through the neutral wire is represented by the curve I_c. In such a system this curve is of the regular shape and the current varies with a frequency equal to the threefold frequency of the phase voltage.

The antenna oscillation transformer is included between the points G and O and in this case is of the conductively coupled type. Inductive coupling, may, however, be employed.

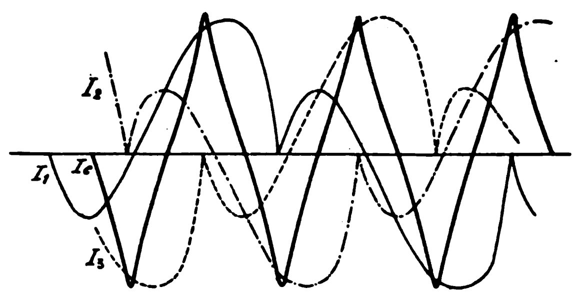


Figure 4—Graphic chart indicating the amplitude in the three phases of a three phase system

Magnetic Modulating System for Wireless Telephony

IN wireless telephony, if the carrier or high frequency currents are modulated by varying the permeability of a radio frequency transformer with an iron core, the speech signals are distorted by hysteresis in the iron. There has been devised by Ralph V. L. Hartley, of New York, a modulating system of the type mentioned, wherein the hysteresis effects are considerably reduced and the quality of the speech signals improved accordingly. It has been found also that a reduction of hysteresis improves the sensitiveness of the modulator. The factor of sensitiveness is defined by Mr. Hartley as the ratio of the modulated high frequency power to the low frequency power affecting the modulation.

One way in which the desired modulation is effected by this invention is by subjecting the magnetic core to a relatively weak and rapidly alternating cross magnetization, which keeps the molecules of the iron in a constant state of agitation and renders them more

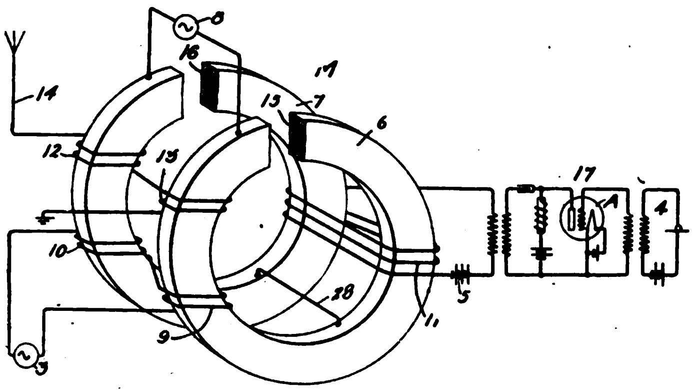


Figure 1—Design of apparatus for the magnetic modulating system of wireless telephony

susceptible to changes in the longitudinal magnetization produced by the currents of speech frequency. Figure 1 illustrates the preferred form of design in which the winding for the reduction of hysteresis is placed at right angles to the signaling and carrier frequency windings. Figure 2 illustrates a modification in which the carrier current windings are at right angles to the remaining winding. Figure 3 shows the details of the magnetic core construction.

In figure 1 the modulator M, which is of the magnetic type, is supplied with radio frequency currents from the source 3, which are to be modulated by speech currents supplied by the signaling circuit 4. The battery 5 supplies a steady current which brings the magnetization of the toroidal cores 6 and 7 to the desired point about which the magnetization is varied by the signaling currents. The source 8 supplies currents of a frequency higher than the carrier frequency supplied by the source 3 for the purpose of reducing the hysteresis. The circuit of source 8 may be traced from the source through the turns of coil 16 in series to conductor 28, through the turns of coil 15 in series, back to source 8.

The carrier source 3 supplies currents to the primary windings 9 and 10, which are individual to each of the cores 6 and 7, and which produce high frequency fluxes in opposite directions in these cores so that the signaling winding 11, which is common to both cores, is substantially non-inductively related to the windings 9 and 10. The opposing high frequency fluxes induce a resultant zero carrier frequency electromotive force in the signaling winding 11. The secondary windings 12 and 13 are adapted to supply speech modulated carrier currents to the radiating antenna system 14. The windings 12 and 13 are wound in opposite directions and are individual to each of the cores 6 and 7.

In order to reduce the hysteresis in the magnetic cores 6 and 7, windings 15 and 16, disposed within the cores 6 and 7, are provided for producing a magnetic field which is at right angles to the magnetic field produced by signaling winding 11 and the windings 9, 10, 13 and 12. The windings 15 and 16 are supplied by the source 8 with comparatively weak and very rapidly alternating currents, which have a frequency which is higher than that supplied by the carrier source 3. The signaling current supplied by the circuit 4 may be amplified, if desired, by one or more amplifiers 17 of the vacuum tube type.

The cores 6 and 7 may be constructed as shown in figure 3, in which the halves of the cores 18 and 19, which are held in assembled position, are made of compressed iron dust, and are channeled to receive the winding.

In figure 2 the antenna circuit may be traced from antenna 14 through the turns of the secondary winding 22 in series to ground at 29. The carrier current sources 3 is connected in series with primary winding 21. Windings 21 and 22 are both disposed within magnetic core 23. The low frequency winding 24 is wound around the core 23 so that the high frequency carrier current windings 21 and 22 produce magnetic fields which are at right angles to that produced by the signaling winding 24. The signaling winding 24 is noninductively related to the carrier frequency windings 21 and 22, and the signaling winding 24 will accordingly not have any carrier frequency currents induced therein. This relative disposition of the carrier frequency winding and the signaling winding reduces the distortion, as the molecules of the core are agitated by the magnetic field due to the carrier currents and are

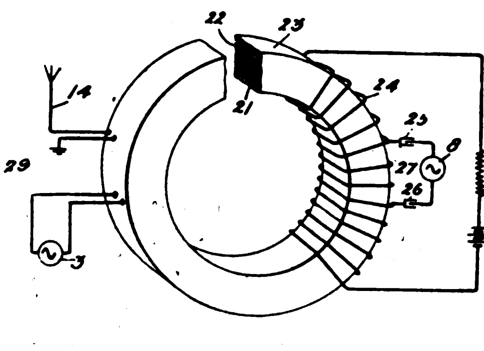


Figure 2—A modification showing the carrier current windings at right angles to remaining windings

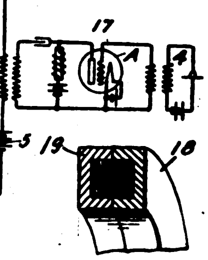


Figure 3 — Showing detail construction of the magnetic core

more readily susceptible to changes in the field due to the signaling current. To reduce the hysteresis loss due to the carrier frequency alternating field in the core 23, the source 8, supplying a frequency higher than the carrier frequency, in this case is connected through condensers 25 and 26 about a portion 27 of the signaling winding 24. The rapidly alternating magnetic field produced by the currents traversing the portion 27 of the winding 24 produces a field which is at right angles to the carrier frequency field so that the hysteresis is reduced, as in figure 1, by the high frequency cross-magnetizing field.

Winding Up the War

Photo Press Ill. Service.

That matters in Russia are still unsettled is recalled by this glimpse of a frowning Japanese gun, above, in a test of fire control by wireless phone

The airplane shown at the left dropped a floral wreath as it flew over the Roosevelt home, a tribute to the dead ex-President who lost an aviator son in France

Photo by Int'l.

A remarkable picture of the President reviewing troops at the front. Watching the victorious Yankee boys go by are Generals Pershing, Liggett and Bullard. Mrs. Wilson is seated behind the President

Photo by Int'l.

The Monthly Service Bulletin of the
NATIONAL WIRELESS ASSOCIATION

Founded to promote the best interests of radio communication among wireless amateurs in America

A Plan for Organization

BEFORE the war there was a duplication of effort in amateur clubs and associations. With the re-opening day well in sight now, it appears that a discussion of better organization of the amateur field is a timely subject.

Organization of amateur interests by States seems the logical solution. State organizations have existed in the past, but in many cases the ends achieved were futile and the percentage of failure high. These failures were generally due to one or more of the following reasons:

1. Lack of funds
2. Insufficient power to control work of members
3. Jealousy between organizations
4. Rivalry between officers and directors
5. Insufficient co-relation between local clubs
6. Not close enough co-operation with State and National organization.

Platforms have not been broad enough. Either promotion of relaying or research work has been the dominating objective. These should be co-related and fostered simultaneously by a central agency.

Spasmodic bulletins and occasional circular letters have generally been the only means for directors to keep in touch with members. This method is inadequate.

The eventual solution should rest in a line-up something like this: Local clubs should maintain close co-operative relations with a State organization, as the basic unit to establish affiliation with a national body.

A member of each State unit should be elected to a national council to represent it in planning for the best interests of the amateur in questions of an inter-state nature.

State organizations should be controlled by a board of directors comprising five elected officers. The term of office should be one year, with re-election by general vote. The offices to be filled may be suggested as follows: President, Vice President, Secretary-Treasurer, Corresponding Secretary, Publicity Director. An important function of the Board's activities would be establishing close co-operation with Committee chairmen.

The following committees should be sufficient to cover all needs in the majority of States:

- Membership
- Affiliation
- Research and Development
- Interference
- Relay
- Publicity
- Meetings and Conventions

The function of most of these committees is evident from their names, but a few may need explanation. The affiliation committee's purpose would be rendering assistance to local clubs in their general activities, such as providing interesting papers and programs for their meetings (to take the place of the usual unprofitable disputes as to who does the most jamming), to give advice on financial problems and difficulties would be a necessary part of this committee's work, the members of which should become informed in the best methods of securing funds and stimulating club members' interest so they continue payment of dues.

The principal function of the interference committee would be to devise regulations for working in congested districts, arrange equitable divisions of time for operation where required, and to secure the earnest co-operation of federal officials through consistent effort to minimize or eliminate the evil of unnecessary interference. Adjustment of apparatus where the owners of stations are not willing or capable, might well become an important part of the field work of this committee. The effectiveness of this committee would, in large measure, be dependent upon the authority it would secure by loyal backing from the members. If a sufficient number would abide by the

(Continued on Page 35.)

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
WASHINGTON

December 20, 1918.

The Radio Laws and Regulations of the United States, edition July 27, 1914, are amended in the following respect:

Par. 122, page 63, amended this date, to read:

Amateur first grade: The applicant must have a sufficient knowledge of the adjustment and operation of the apparatus which he wishes to operate and of the regulations of the international convention and acts of Congress in so far as they relate to interference with other radio communication and impose certain duties on all grades of operators. The applicant must be able to transmit and receive Continental Morse at a speed sufficient to enable him to recognize distress calls or the official "keep-out" signals. A speed of at least ten words per minute (five letters to the word) must be attained.

Par. 126, page 64, amended this date, to read:

The code test shall continue for five minutes at a speed of 20 words, 12 words, and 10 words per minute, respectively, for the commercial first, second, and amateur first grade, 5 letters, numerals, or other characters to the word, and to qualify the applicant must receive 20, 12 and 10 words in consecutive order accurately and legibly written. Operators will not be permitted to break or interrupt while receiving or to correct or alter the transcription after it has been submitted to the examining officer.

You will note from the above amendments that it is the purpose of the Department to require future applicants for amateur first grade radio operator's license to qualify in the transmission and reception of Continental Morse code at the rate of ten words per minute instead of five as heretofore.

Respectfully,
E. T. Chamberlain,
Commissioner.

The Attack on the Alexander Bill

How the Proposed Legislation to Wipe Out Amateur Wireless Was Fought Before the Congressional Committee and the Demand for Prior Rights Recognized

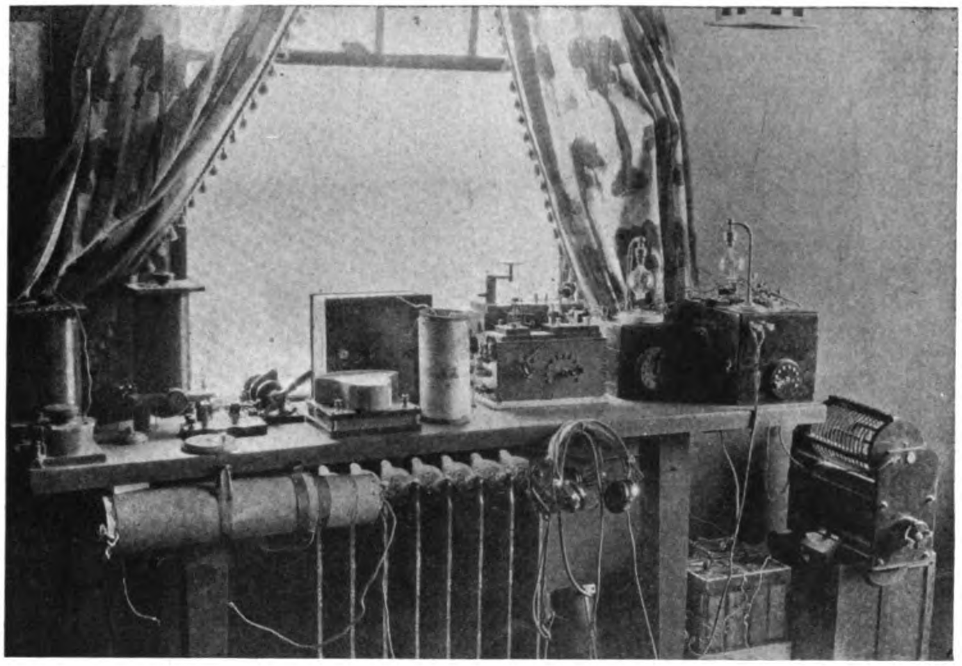
Reported by J. Andrew White

TO relieve the tension and satisfy the natural yearning for details aroused by the Washington dispatch, headed "Victory! Get Ready for Re-Opening of Stations," which appeared in the January issue, the account which follows has been prepared so all members may know what transpired in Washington in the matter of defeating the project for government ownership of wireless.

But—first of all—the amateurs of the United States are open to congratulation for the sane way in which their protests against the Alexander Bill were presented. N. W. A. Headquarters worked overtime replying to letters from members, prior to the opening of the Congressional Committee hearings; all inquirers were told that the matter was in the hands of a Special Committee of the Association and vigorous steps would be taken to kill the proposed legislation. And from what the N. W. A. representatives learned in Washington, the course prescribed was pursued to the letter. This time the "my-son-Johnny-is-being-deprived" type of letter did not appear; the written protests which the Congressmen received were dignified and awakened admiration for the high type of experimenter the field represents. The lesson from previous mistakes was well learned; when the amateur's case was presented this time it had lost the aspect of the youth in short trousers playing with a toy. Congress, from now on, will take amateur wireless seriously.

But, to tell the story: When the association's special Committee arrived in Washington the foundation had been well laid. All amateur interest had worked together in full harmony and so diligently that every member of the Congressional Committee had before him many well-written and pithy protests from all over the nation. Copies of the "Protests with a Point" articles, by the Acting President, the Technical Committee and Vice-Presidents Kennelly and Goldsmith—which were printed in full in the January issue—were placed in all the Congressmen's hands, along with the co-operative pleas of Mr. Maxim, Mr. Pacent, Mr. Rawson, Mr. Grebe and Mr. Grinan. From the beginning, the outlook was very favorable.

On the day before the hearings opened the Navy evidently considered the bill would fail because of the formidable amateur opposition. The officers of the American Radio Relay League were invited to meet in conference with the Naval Radio Officials to effect a compromise in the form of an amendment. The substance of this amendment—which appears a little further on in this article—was agreed upon, it being understood that a neutral position be then taken on the government ownership proposition. The amendment was introduced by the Navy on the very first day of the hearing. That evening an assemblage of leading and representative amateurs met at a dinner in the New Ebbitt Hotel. A difference of opinion developed in the matter of giving the Navy a monopoly, and in accepting the amendment. Twenty or more men, all representative amateurs, discussed these questions to a conclusion which showed the majority opposed, as individuals, to government control, and a desire to continue under the old law.



A wireless club's former receiving apparatus with a daylight range of 1400 miles: night range, 2,800 miles

Naval officials were told about this meeting on the following morning, the second day of the hearing, and advised of the belief that the bill and amendment would fail. **It was then admitted that the N. W. A. officials had been purposely left out of the conference because the attitude of the Association was known; that its officers would not accept any amendment on behalf of the amateurs and that it would actively oppose the proposal for a Naval monopoly, continuing its fight for the resumption of amateur wireless in peace times under the old law.**

That practically all the amateurs who later appeared before the Congressional Committee also took this attitude, without prior understanding, was gratifying to the officers of the Association, for it confirmed the belief upon which their stand was taken—the old law being satisfactory, no change was wanted, and no amendment of the Alexander Bill would be accepted as a compromise.

With complete victory now in sight, there is cause for mutual congratulation. Just how the discussion of amateur affairs was carried on in the hearings thus takes on renewed interest. The summary follows:

Secretary of the Navy Daniels appeared in behalf of the bill, which the Chairman stated was presented by the Navy Department in a large measure, in his belief. Mr. Daniels characterized the bill as one that would give the Navy Department the exclusive ownership of all wireless communication for commercial purposes.

One of the reasons for the proposal was that "the question of interference does not come in at all in the matter of cables and telegraphs, but only in wireless."

"We strongly believe," said the Secretary, "that having demonstrated in the war the excellent service and the necessity of unified ownership, we should not lose the advantage of it in peace." Because the naval organization fulfilled its purpose and won the commendation of not only our country, but of all countries during the war, Mr. Daniels reasoned that the service "is so well prepared to undertake this work and to carry it on that we would lose very much by dissipating it and opening the use of radio communication again to rival companies." The exact reason for the necessity of unified control under the Navy Department appears from Mr. Daniels' testimony to be great increases, present and prospective, in the number of vessels on our coasts and the consequent increase in radio communication on many different wave lengths.

Congressman Green of Massachusetts early in the hearing interrupted the Secretary of the Navy, with the opinion that his statement disclosed "government monopoly, contrary to any control that we hoped for years to establish under the Sherman anti-trust law. This becomes an immense trust, and it also becomes, according to my view of it, the establishment of the Department of the Navy in commercial business." He emphasized his indignation by continuing, "there are a number of gentlemen here who have had some experience in radio communication. I never heard before that it was necessary for one person to own all the air in order to breathe; and I believe that radio business has been and can be carried on without government monopoly. We all admit that during the war it was a very proper thing to have absolute control, but now in times of piping peace, it seems to me that there is a great opportunity to obtain advancement in the radio service even outside of the Navy Department. I do not think that all the wisdom is contained there; it has not been heretofore, and I do not think that it is all contained there now." Mr. Green was unwilling to consider that the Navy personnel was entitled to full credit for what had been accomplished. He stated that in time of war it was right that the Navy Department should have everything it needed, and that they have had it, and also all the advantage of the number of men who enlisted in the Navy for the purpose of extending the radio service. "I know of men in my own city," he remarked, "who were pronounced amateurs; yet they have some brains, and they have improved their brains and have improved their apparatus."

In the discussion of the imperialistic attitude of the Navy reflected in the bill, Congressman Saunders of Virginia, noted that it appeared that the average citizen would be inhibited from establishing a plant of his own. The Secretary of the Navy replied that the bill carried with it the authority to issue special licenses, which might be given wherever the public required it.

Mr. Saunders said he had not found such a provision in the bill, and Secretary Daniels read Section 5, as follows:—

> That the Secretary of the Navy may issue special licenses, subject to such conditions and restrictions and for such periods as he deems proper, for the establishment and operation of stations for special emergency use—

"Yes, for 'special emergency'," Mr. Saunders interrupted. "Now that does not contemplate a general commercial condition, of course. It says, 'in cases where no other rapid means of communication is available'; that makes it more unlikely, therefore, that the man will be able to get any special permit."

The Secretary replied that licenses could be given if they did not interfere with the naval stations, which caused Mr. Saunders to observe, that this action could hardly be called "special emergency use in cases where no other rapid means of communication are available."

During the discussion which followed, the Secretary of the Navy struck out the objectionable features of that paragraph of the bill.

Congressman Saunders asked for a definition of interference from a naval point of view, and received the reply that by this was meant interference with the operation of the general system. The Congressman then observed that this appeared to be a matter of regulation as to the wave lengths to be used; to which Secretary Daniels replied, "we ought to have it absolutely—except in special cases—governmental owned and governmental operated."

Mr. Saunders criticized this viewpoint, saying that if that policy was to be pursued it would be difficult for private enterprise to show such a case of emergency, in fact, under the bill and policy the Navy had in mind, there would be no such private enterprise. This drew the admission from Secretary Daniels, "Well, in the main, there would not be."

Commander Hooper of the Navy replied to the question of Congressman Beshlin, of Pennsylvania, as to whether indiscriminate use of the wireless by people throughout the country interfered with its use by the government, to the effect: Amateur stations could be regulated so that they would not interfere, and still satisfy the amateurs.

Before the close of the first morning's session, the Navy apparently realized the futility of attempting to legislate the amateur out of existence, for at the conclusion of his testimony Secretary Daniels announced that, following the noon recess, an amendment to the bill would be presented by Captain Todd, Director of Naval Communications.

This amendment proved to be one concerning the amateurs. Captain Todd said: "The part of the bill providing for experiment stations I had hoped would cover the question of amateurs. Apparently, from what I have heard, the amateur wishes to be mentioned as such. I had an idea that it would dignify the amateur to have his station considered under the head of experiment stations." The amendment was presented with the comment from Captain Todd that he had every reason to believe that the amateur interests would be thoroughly satisfied. In substance the amendment was as follows:

> The insertion of: "The term, 'amateur station,' means a station used for private practice or experiment in radio communication and not operated for profit in either receiving or sending radio signals."
>
> The addition of the term "amateur stations" after the provision for "training-school stations," thus including amateur stations specifically in the provisions of the law.
>
> Reframing the paragraph relating to licenses for amateur stations, licensed as private stations under the Act of Aug 13, 1912, "Provided, that when such amateur stations are licensed for receiving purposes only, no operator's license shall be required for the operator in charge of operating such

station; but when such amateur station is licensed for transmitting also, the license shall require that the operator of such station shall hold a license showing his ability to send and receive at least 75 letters per minute in the Continental Morse code: And further provided, That the license for such transmitting station may limit the power input to one-half kilowatt in case of amateur stations within one hundred miles of the Atlantic or Pacific Ocean, the Gulf of Mexico, or the Great Lakes, and to one-quarter kilowatt within five miles of a Government receiving station. Amateur stations so licensed shall not use any wave length exceeding two hundred and fifty meters, nor less than one hundred and fifty meters, except by special authority in the license contained."

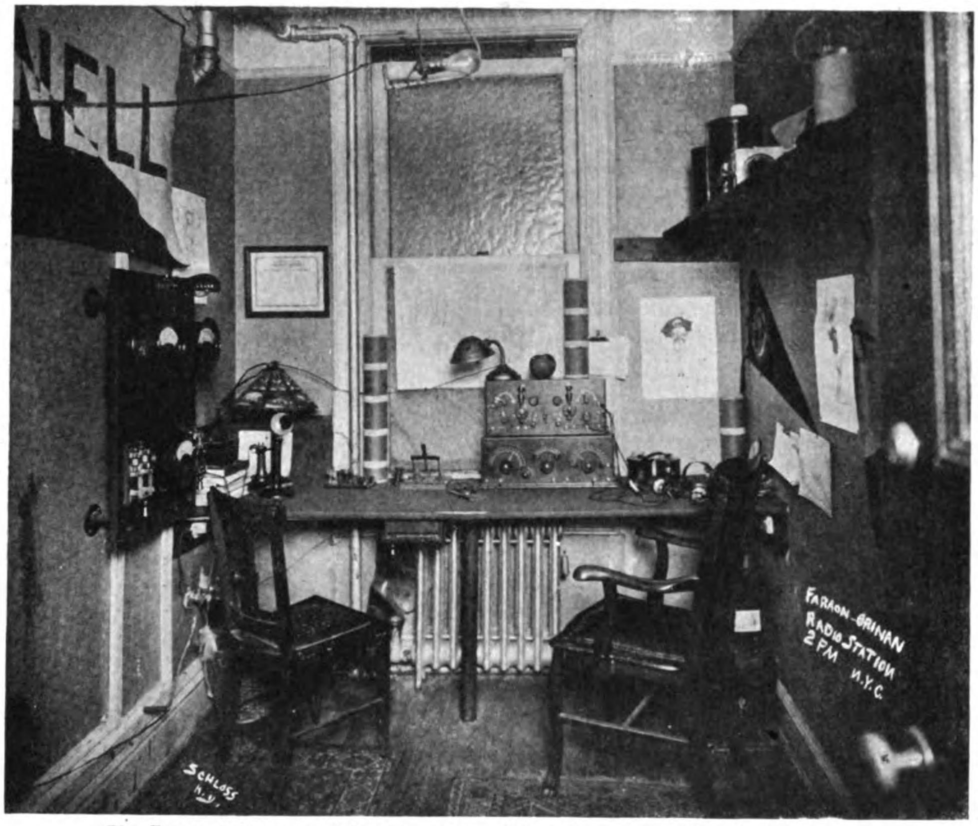
Captain Todd stated that he hoped that this amendment was satisfactory to the amateurs.

During the course of the testimony of the Director of Naval Communications, Congressman Edmonds of Pennsylvania, remarked to Captain Todd: "Of course, you realize that after this bill becomes effective there will be no radio schools, but simply experimental amateurs, and of course there will be no place for a man to get a position."

Congressman Green took exception to the lack of opportunity for the young men if radio was under government ownership. "Harking back to the early days before the days of telegraphy and other things," he said, "and before the days of travel by cars, the country started with very small beginnings and it has grown, and developed, and widened, and broadened, and beaten out all other nations, and now we come to tie everything up so tight that we have to be careful where we step. We have got to have our possibilities bound up by cords that we cannot break. We would be punished if we undertake to do anything. I am of the opinion that it is too much to ask the people of America to punish the people of America by restraining all their abilities and opportunities and all their hopes and expectations. You have to have some place of opportunity that young men can in the future get into, because they cannot get into the Navy because the Navy will not increase as it has during the war, and the Navy bottles up and keeps for itself the opportunities and keeps everybody out.

"I believe in the broadest chance to the American, and especially to the coming American," he continued, "and the coming American would be fully equal to the present, because the opportunities of education are far superior to what they were in my early days. I had no opportunity of education. I may have had the ability, but I did not have the opportunity to secure education, but had to go to work; and the youths that grow up today, even the young men born poor, have every opportunity, and I want them to have some inspiration. This bill ties up all the inspiration that every young man has."

The balance of Captain Todd's statement before the Committee was confined to the broad commercial questions in all wireless communication, other than those affecting the amateurs.



The Faraon-Grinan record breaking relay radio station, a typical amateur plant

He was followed by Lieut. J. C. Cooper, Jr., who announced that he was an ex-amateur who had been in the Naval service during the period of the emergency. Lieut. Cooper disclosed the interesting fact that several days prior to the opening of the Congressional hearing a meeting was called in Capt. Todd's office of all the ex-amateurs who happened to be on duty in the Naval Service in Washington. About thirty responded. It was as the collective judgment of these men that the amendment to the bill was offered.

Lieut. Cooper paid a high tribute to the amateur as a useful member of the community. "I personally, as a Naval officer," he said, "have had many operators under me. I have found that of the new men under me the easiest trained, the most adaptable to the new apparatus, and the most efficient men I had, were ex-amateur operators." He added that two of his best men had been put on the President's ship to receive the official messages from Washington, and that they were both ex-amateur operators.

The amendment, he noted, licensed receiving stations without requiring a license of the operator. In other words, the beginner need not be a radio operator to operate a receiving station. "We do not think," he observed, "on the other hand, that any amateur should have the right to touch a key and to cause possible blundering interference by his lack of ability as an operator unless he can receive and send what is usually called 15 words a minute, that is, 75 letters per minute, in the ordinary standard of 5 letters to a word. If he is required to have that degree of skill it will be an incentive to him when he is first learning the art."

He noted in connection with the amendment submitted by the Navy, a clause limiting the transformer input of amateur stations to one-half kilowatt if within 100 miles of the seacoast or to one-quarter kilowatt if within 5 miles of a Government receiving station. He gave his personal opinion that the limits were as reasonable as could be safe from a point of view of non-interference with official and commercial dispatches. He noted also that a license could be issued up to one kilowatt under these limitations, the amendment stating that the Government may in its discretion put these limits on. The amendment left it in the discretion of the licensing power to cut down to those limitations amateur stations near the centers of commerce, and still allow the amateur to work.

Congressman Saunders asked Lieut. Cooper for an opinion on the original bill, whether he considered that there was any provision whatever in it regarding the amateurs. Lieut. Cooper replied that he understood that it was the intention of the Navy to license amateur wireless operators.

Mr. Saunders disagreed, stating that he did not see where an individual who had been working an isolated amateur station for intellectual improvement would be covered by the term "experimental station." In fact, the Congressman insisted, before any man could start out as an amateur he must have had the opportunity to take some training at some school. The Congressman questioned Lieut. Cooper as to whether he could see any danger of interference with commercial or government message traffic, to which Lieut. Cooper replied, that he thought interfence was eliminated, "with the exception of the fact that adequate inspection of amateur stations must be had in the future if the amateur is to maintain the dignified position that he should in the radio world."

The ex-amateur sounded a note of warning as follows: "There is one coming factor in radio work which may adversely affect amateur operating which should be looked forward to at the present time. The fleet is using for intercommunicating purposes very short wave lengths, shorter than the 150 meters mentioned as the minimum length that an amateur should use. Aircraft are also using various wave lengths, some of which are almost down to 250 meters. There may be trouble in the future between aircraft operating overland and working with their receiving or transmitting stations, and amateur stations. That is a possibility of the future. Aircraft radio was not in existence to any extent when amateurs last operated. There may be interference between amateur operators and aircraft radio stations, but it is hoped that there will not be."

Mr. Saunders then brought out the point that government ownership had nothing to do with that problem, and that it could be met by appropriate regulation.

Commander S. C. Hooper, Executive Officer, Radio Division, Bureau of Steam Engineering, Navy Department, was called. He prefaced his general statement with the following observation:

"I do not think that it will be out of the way if I should pay tribute to the fine co-operation and the fine work of the radio manufacturers and inventors and amateurs in our country. When war came on us we were totally unprepared to handle the entire situation. The amateurs saved the day when we had to man the entire merchant marine by naval operators in order to incorporate the merchant marine into the naval system.

"The manufacturers came down to Washington and placed themselves at our disposal, and in every way possible did their utmost to further the plans and slightest desires of the department. The inventors were keen and active in every effort in their research work to produce what might be used against our common enemy. I take particular pains to mention the assistance given by Mr. Nally, vice president and general manager of the Marconi Company, whose company more than anyone else suffered through what war brought upon them; and also of the Federal Telegraph Company, which stood next in being harmed, due to the Government closing the stations.

"These officers have performed a service as great as any military officer in the radio work for the Government in time of war, and this service should be recognized in some way. They know in their conscience that they have done a great good to the country, the same as the soldiers and sailors have done, and it ought to go down in the records of history that they have done their duty."

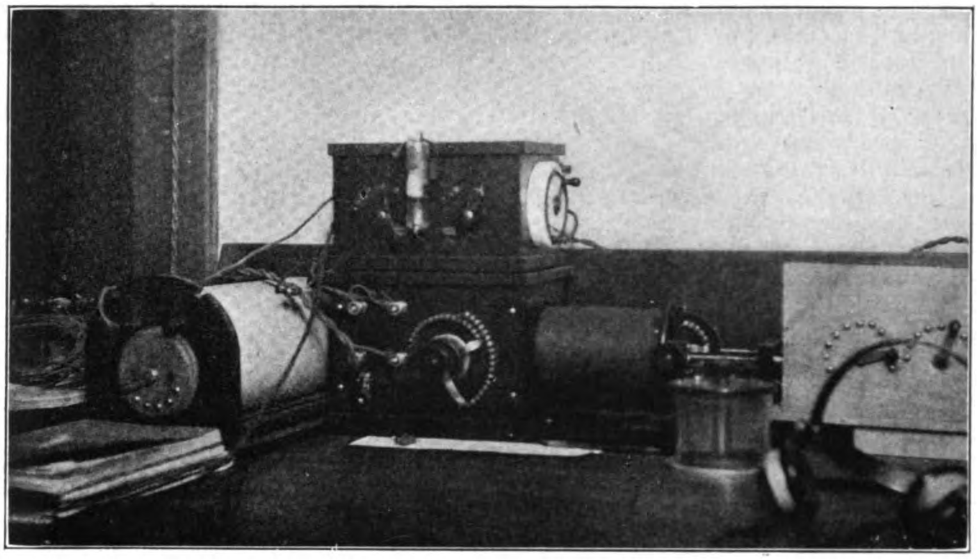
His testimony was mainly on the technical point of view in the subject of government ownership, dealing principally with the cause of interferences. In connection with the amateur problem he stated: "I agree it is very interesting to the amateur, and very educational, and it is a great advantage to the radio art to permit the amateurs to develop themselves, and it is of great value to the Government to have all these operators self-trained in case war comes upon us.

"The amateurs, of course, cannot afford to expend large sums of money on radio stations and build aerials for long wave lengths, and naturally they prefer to have the short wave lengths and small aerials, which fit admirably into our organization and are in accordance with the present law."

Edward J. Nally, vice president and general manager of the Marconi Wireless Telegraph Company of America, who appeared in opposition to the bill, observed in the course of his testimony that if the amendment represented the joint view of the Navy officials and that of the amateurs, the Marconi Company "was glad to add its voice in approval, and to express the opinion that the proposed regulation covering both amateur radio operators and amateur radio stations is both sound and equitable."

Hiram Percy Maxim, President of the American Radio Relay League, presented a plea for amateur wireless toward the end of the hearing, stating that the proposed regulation disclosed a short-sighted policy on the side of the Government, unquestionably imperialistic and thoroughly un-American. He noted that in 1912 those who had erected small private wireless stations were given legal standing in the law under the name "amateurs." In a review of amateur operation he noted especially that the amateurs themselves undertook to reduce unnecessary interference and to set higher standards of efficiency; in fact at the outbreak of the war a proposal had been made to the Department of Commerce for the service of deputy inspectors, organized to report amateur violations as to power, wave length, wave purity and decrement. These inspectors were to be selected from the amateur ranks and to serve at a dollar a year.

In estimating the extent of the experimental interest in radio, he expressed a belief that there must have been 175,000 amateur wireless stations in this country at the outbreak of the war. Of transmitting licenses issued prior to the day of closing, the Commissioner of Navigation stated the actual number to be 8,562.



O. R. Terry's pre-war wireless station at Stoughton, Wis., another amateur assembly

Estimates of the investment represented in amateur wireless stations were placed at ten million dollars. Five amateurs were named who respectively had invested in amateur apparatus for their individual use $5,000, $15,000, $2,500, $5,000 and $2,000. It was also emphasized that the majority of the amateurs in the country were men between the ages of 20 and 30; not. as popularly supposed, boys in short trousers. Twenty-eight electrical supply houses furnishing apparatus to amateurs were listed as typifying the extent of the industry which the law would, at a stroke, wipe out. He estimated the commercial capital they had invested to be from two to three million dollars.

The developments which accompanied wireless experimentation were exemplified by the case of an amateur who was working on a means for the separation of oxygen and nitrogen from the atmosphere, and another case where promising experiments were being made in the joining of metals, both suggested as the result of working an amateur station.

As to the war utility of amateur training, Mr. Maxim quoted from a letter written by a former amateur, who with two friends, enlisted together. "I was the only one of the three that had amateur experience. I finished the training of the electrical class, Brooklyn Navy Yard, in three weeks and went to sea. My two pals took seven months and they did not begin to know what I did." Lieut. Tuska is also on record, stating that in aircraft radio a man without previous experience required fifteen to sixteen weeks to become an operator, whereas an amateur was made ready for service in as few as one hundred hours.

A list of 51 former amateurs serving in the military establishment was introduced, to illustrate their value in time of war. Mr. Maxim then noted that in spite of the utility of experimenters, the bill introduced made not a single mention of the amateur, entirely eliminating him. "It is not satisfactory to us," he said, "to gloss over this question by explaining that the amateur is tacitly included under 'experimental stations.' Such an explanation is to our minds indirect, doubtful, and not what we regard as straightforward and square treatment. Such an arrangement would leave us at the mercy of unfriendly interpretation of the law."

Mr. Maxim, in the early part of his statement, urged the adoption of the amendments which referred to the amateur, and which were presented by the Navy Department. Congressman Bankhead of Alabama, inquired if this amendment was entirely satisfactory to the amateur interests; to which Mr. Maxim replied, broadly speaking, it was satisfactory to the organization he represented. On the question of government ownership, he stated, "We have no comment to make upon the question of Navy control and ownership of communication."

Congressman Burroughs of New Hampshire, inquired, in connection with the proposed amendment, whether the amateurs would not object to the requirement of 75 letters per minute in the Continental code. Mr. Maxim spoke for the American Radio Relay League as an organization, stating that they would not object to it. He noted further that the league's membership was only 4,000 members, and there were other amateurs beside them. It developed on questions from Congressman Edmonds, that second grade commercial operators were required to send but 12 words, or 60 letters, per minute, whereupon Mr. Maxim said the amendment's provision was too high, and that the required speed should be no higher than that for a second grade commercial license.

Congressman Green later referred to the government ownership provisions of the bill, stating: "This proposition as it comes before us is to broaden the opportunity of the Navy to go into commercial business and I want to know whether you amateurs have given any consideration to the fact of the Navy entering that field." Mr. Maxim replied that there was no comment to be made upon that at all, whereupon Congressman Edmonds inquired: "You do not think it will prevent boys from studying wireless because there is no place for them to go, if they want to make a business of it in the future?" Mr. Maxim said he could see where that might be used as an argument.

Mr. Green than referred to the plans of the Department of Commerce to develop foreign trade. Ascertaining that Mr. Maxim had not given any thought to that part of it, he gave the opinion: "you are bound up with the Navy to put this proposition through."

The Congressman stated that he was a great believer in the expansion of trade, and wanted to get something to show that this bill would promote that expansion. His understanding was that it was a contraction, that it meant contraction of trade, and he wanted Mr. Maxim's ideas on that point. The witness asserted that he did not feel himself competent to answer that question.

The question of the amendment's reduction of amateur power to ½ kilowatt was introduced by Mr. Edmonds. Mr. Maxim replied that he thought it a reasonable request to limit the amateurs to ½ kilowatt, and considered it a very healthy condition. As to the ¼ kilowatt within 5 miles of a government receiving station, he stated if evasion or advantage was taken of that provision, then he was opposed to it. This followed the supposition by Congressman Edmonds that a naval officer could install a receiving station in his home, and because the government paid the rent of the house it would technically become a government receiving station.

Mr. Maxim, in later discussion, withdrew his approval of the 75-letter-per-minute provision of the amendment, as it was developed that the intention had been to make this the same as the requirement of a second grade commercial operator, 60 letters per minute, On question, Congressman Hadley of Washington, developed that to Mr. Maxim, the situation was satisfactory if the bill was not passed, the amateur stating that it had been proven satisfactory by the last five years of experience. Mr. Hadley then had confirmation of his opinion that the proposed amendment had merely been offered for self-protection, to reconcile the difference between the amateurs and the Navy as proponents of the bill.

The administration of amateur wireless affairs in the hands of the Department of Commerce in the past had been cordial and satisfactory, Mr. Maxim agreed, and gave his judgment that they would like very much to go back to their "old love."

Francis F. Hamilton, representing the Hoosier Radio Club of Indianapolis, appeared before the Committee and stated that he had recently been an instructor in the Signal Corps. He reiterated the value of preliminary amateur experimentation in preparing men for military service. The first group of students which he handled had been nearly all amateur operators and became very proficient in military signaling when they were through that course. The next group knew nothing of amateur wireless, and after 13 weeks of training, they knew less than when they started.

He gave his opinion that one of the greatest benefits of amateur work was the fostering of ambition; "many amateurs dream of the day when they may be on a large ship at sea operating a wireless station," he said. "With that in view, what is the chance of amateurs operating ship stations after they have fulfilled the requirements, if this bill passes? Why, an amateur would have to join the Navy first, and put himself under military authority in order to develop his commercial profession and ambition!" It was his belief that the amateurs would not look upon this course as desirable.

In further opposition to government ownership, he stated that one who had a fundamental patent on radio apparatus would have no right to use it without giving it to the only bidder, who would be the Secretary of the Navy. Congressman Hadley interposed, "You want a broader market for the inventor?" Mr. Hamilton replied that he wanted a broader market than there would be if the bill should go through. Congressman Hadley then developed the opinion from Mr. Hamilton that private monopoly would be more liberal to inventors than a government monopoly, the thought being that the government was interested in public welfare, whereas private interest would be interested in getting the profit out of the patent. Mr. Hamilton instanced, as an illustration, the purchase by the Marconi Company of the patent of Professor Pupin. He expressed high hopes of amateurs inventing apparatus which would force the commercial companies to buy the improvements "if the wireless business is not bottled and corked up by the Navy Department as this bill proposes."

The Hoosier Club representative stated his belief that should the Congressmen on the Committee themselves become amateur operators, they would much rather be under the Department of Commerce than under the Navy, adding in reference to the amendment, "I want to go on record as stating that I do not see any valid reason why the present law should be changed."

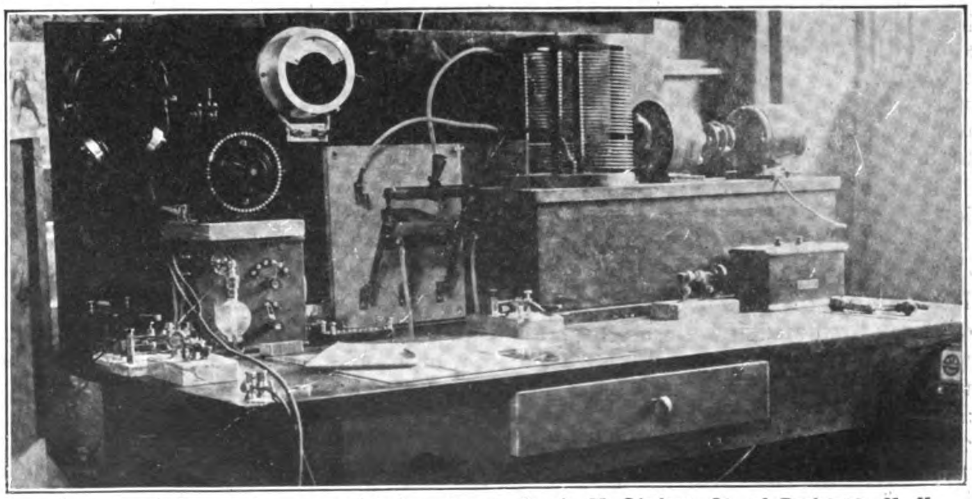
Congressman Hadley said that it was represented to the Committee that the amendment represented an agreement which was satisfactory to both sides. "Mr. Maxim represents a certain number of amateurs," Mr. Hamilton replied. But "each amateur is a little company of his own and each man will have his own ideas. I think that Mr. Maxim said himself that if it were possible he would like to see the law left as it is, but if it were not possible to do that, he would agree to this amendment."

Mr. Hamilton also discussed some of the phraseology of the proposed amendment, disclosing that it did not permit experimentation for profit. On the questioning of licensing receiving stations, he had no objection, but he thought that 50 letters a minute, or 10 words, was "plenty strong enough a requirement." "We do not want these people to be experts," he said; "the old law requires 25 letters per minute but we are willing to make it 50." He further noted that the amendment limited amateurs to ¼ kilowatt within 5 miles of any governmental receiving station. This provision he believed would apply to a station which had been established in the Post Office building in Indianapolis, which he instanced as the likely forerunner of many more receiving stations to be placed on Post Office buildings. He stated that the amateurs he represented would not agree to accept an amendment of this kind. The possibility of the Post Office Department extending its service and putting receiving stations on Post Office buildings in cities of any size should be anticipated.

As particularly limiting the amateurs to ¼ kilowatt, a communication from the Baltimore Radio Club was offered, stating that the members would agree to 12 words per minute, but were opposed to limiting the amateurs to ¼ kilowatt within 5 miles of a government receiving station.

Congressman Humphreys asked Mr. Hamilton's opinion on the creation of a commission to determine wave length and power to be used by amateurs. Mr. Hamilton reiterated that the present law was satisfactory and sufficient. Congressman Green observed: "As I understand it, the amateur is satisfied with the present law, which they had before the war. They have been efficient in the war, and now they want to go back to their former position, and here comes a new law that ties them up so they cannot get back to where they were. I cannot see any reason, after they have rendered good service to the government, why they should not have a chance to return to their former status."

"That is absolutely the condition," confirmed Mr.

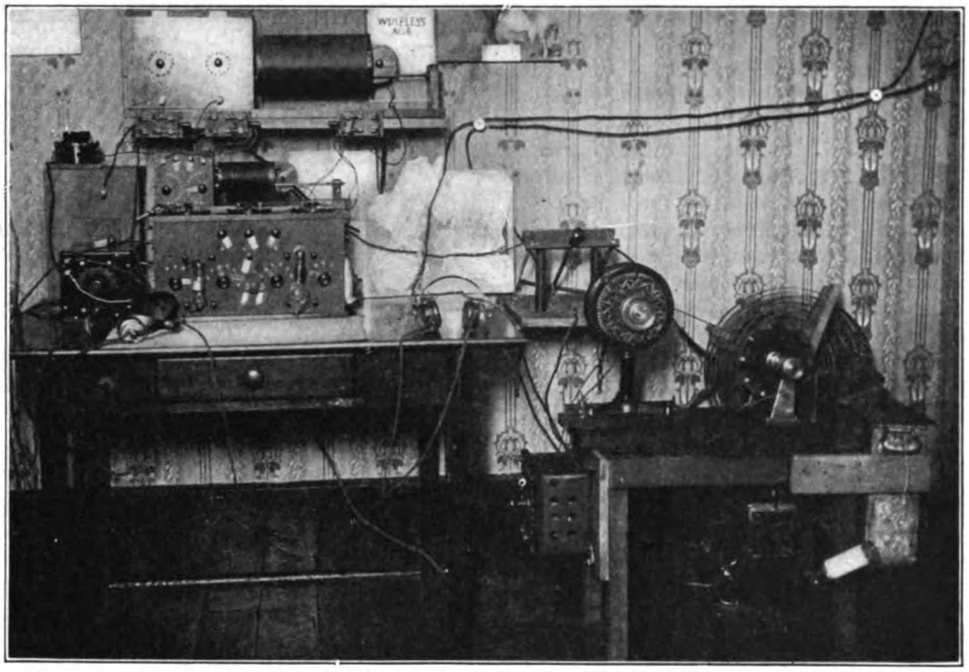


Amateur wireless station operated before the war by A. M. Lindsay, Jr., of Rochester, N. Y.

Hamilton. "None of these amateurs would be here today if that bill had not been written so that it would cut them clear out. The Department of Commerce has treated us fine and we have always gotten along well with them. There is no reason why we should change, that I can see. There is no objection to the existing law."

The next amateur opponent to appear was Edward C. Andrews, president of the Wireless Association of Pennsylvania, who stated they were "unalterably opposed to the change in the present law. We see absolutely no reason for it," he exclaimed, "and lots of reasons against it." The paramount reason was that the Navy sponsored it.

The bill would remove the incentive for experiment, he believed. Experimenters "would have to enlist in the Navy in order to carry on the studies they have undertaken," and "if we have no incentive and no place for any one to go and sell apparatus, naturally that puts an end to experimentation," were two of his pertinent utterances in opposing naval monopoly.



Wireless station owned and operated before the war by Mr. and Mrs. C. Candler of St. Marys, Ohio

Dr. Gordon M. Christine followed Mr. Andrews. He explained that medicine was his profession, and his age was 61, but he was an amateur in wireless telegraphy and had become intensely interested in the art. The work should go on as it was before the war, in his opinion, and he could not understand why power should be reduced to ¼ kilowatt in the amendment to the bill. "We do not like this amendment; we do not want any amendment at all!" he added with emphasis. "Give us this old law. Do not disturb that."

Congressman Beshlin inquired for the Doctor's opinion as to the difference in control by the Department of Commerce and the Navy Department. "My own opinion," he replied, "is that the treatment which the Department of Commerce has given us has been that of man to man; and the treatment which the Navy would give us would be the treatment of a high official to a civilian." Many amateurs seemed to be more afraid of naval authorities than civil branches of the government, stated Congressman Humphreys, referring to the proposed control. "I believe that the Navy has it in for the amateur and wants him out," was the answer returned by Dr. Christine. It would not have presented the original bill if it did not, he thought. "But they became somewhat alarmed at the tremendous uprising of the amateur throughout this country at the prospect of being deprived of their outfits." Questioned by Congressman Hardy, the physician said that the language of the original bill led him to believe that the Navy had something against the amateur.

Congressman Edmonds thought the objection reasonable. "The Department of Commerce is a business department," he said, "and it is used to handling business, and in its report it speaks very highly of the amateur operators. Undoubtedly they have got along very well together, and I do not blame the amateur operators for coming here and objecting to a change in the departments. If I were they, I would do the same thing myself, because they know what they can get from the Department of Commerce and do not know what they can get from the Navy Department."

Joseph Heinrich, a thirteen year old amateur of Washington, received a cordial reception for his courage in appearing before the Committee. The boy put in a strong plea for the rights of the amateur and received the assurance that the Congressmen were not unfriendly.

Charles H. Stewart, of St. Davids, Pa., who has previously appeared for the amateur in opposition to prohibitive legislation, made a brief address. He seconded the expressions on the matter of leaving wireless under the Department of Commerce and noted that operating speeds for sending station licenses could be changed by regulation, no further law being required to do this.

Harry W. Densham, secretary of the South Jersey Radio Association, confirmed what his predecessors had said in opposition to the bill.

Frank B. Chambers, of Philadelphia, added to the testimony for the amateurs, illuminating various points discussed by amusing and graphic word pictures. He also objected strongly to Navy control, and echoed the consensus of opinion that the present law should remain in force without alteration.

(*Continued on Page 44.*)

Experimenters' World

Pertinent Suggestions for the Experimenter's Workshop

By E. T. Jones

Experimental Carbon Amplifier

THE description of an amplifier for radio signals I constructed as follows:

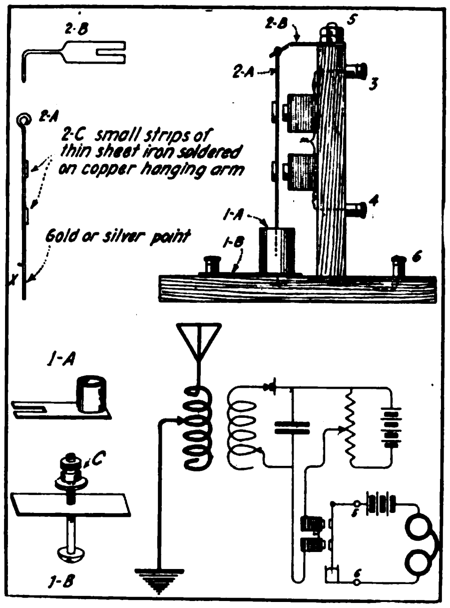


Figure 1—Detailed plan of construction and circuit of the carbon amplifier

Two magnets from a 1,000 ohm receiver are mounted as shown in figure 1 and suitable connections thereto provided by the binding posts 3 and 4. On the base is mounted the cup which holds the carbon granules. It is made adjustable by providing a slotted strip of brass as shown at 1-a which slides over and makes contact with the brass strip 1-b and is held or clamped when the desired adjustment is obtained by the locknut c. The dipping arm 2-a is made of copper wire about No. 24 preferably gold pointed (at x the part which dips into the granules can be gold plated or a small piece of gold wire soldered thereon). The top of this No. 24 wire is bent so as to form a circle and fits on the arm support 2-b which allows it to move freely. The end of this dipping arm is allowed to rest in the cup, 1-a of carbon granules. The arm support 2-b is fastened to the same support which holds the magnets and a binding post is supplied to furnish a connection from the dipping arm through the cup. The detail 2-c is made of two strips of iron which act as armatures for the telephone magnets. They are soldered on the copper hanging arm which dips into the carbon granules.

This amplifier when properly constructed works exceedingly well, and owing to the fact that it is simple in construction there is no reason why pains should not be taken to make as good a job as is possible with the material at hand.

Under actual working conditions the amplifier functioned with a signal whose audibility was a little more than 100. The dipping needle if not provided with a silver or gold point will not work as well, and will have to be constantly cleaned. Better results were obtained by inserting another receiver of 1,000 ohms in series with the two mounted magnets making in all 2,000 ohms. The carbon granules should be of the finest grade and the inside of the cup or retainer should be kept clean. From time to time it is well to remove the granules and clean them. If it is possible to get several of these amplifiers to function efficiently, then the cascade connection can be resorted to for further amplification. As an experimental instrument this is a good one but there is plenty of room for improvements in connection therewith.

A Magnetic Rectifier for Alternating Currents

A magnetic apparatus for A. C. rectification is shown in figure 2. A permanent bar magnet (marked N and S) is pivoted at the center by drilling a hole through the bar and passing an 8/32 screw through same. Both ends rest in the holes made in support A. The magnet B is taken from any old

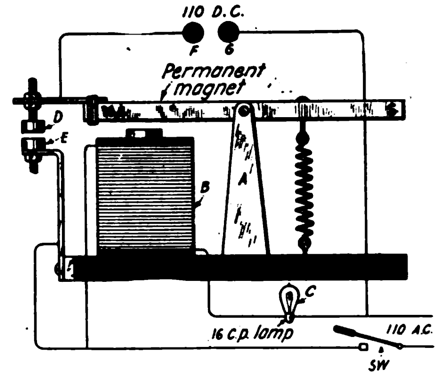


Figure 2—Construction of magnetic rectifier for alternating currents

sounder or constructed along that size throughout. This is in turn put in series with the 16 C. P. carbon lamp C so as to prevent the windings from burning out and at the same time perform its duty. Two contacts are furnished which are insulated from other parts of the mechanism D and E.

The apparatus works on the fundamental law of magnetism; LIKE POLES REPEL and UNLIKE POLES ATTRACT. The alternat-

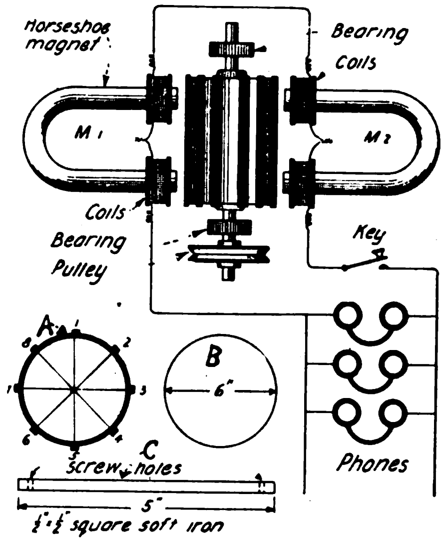


Figure 3—Diagram of construction and circuit of the high frequency generator

ing current flowing through the magnet B changes the poles of its core according to the frequency of the current entering its windings. But at the same time the steel bar magnet retains its poles. The result is that when the current entering the magnet produces a north pole at the top end of the electro-magnet there is no attraction, since like poles repel, but on the other half of the cycle the poles of the electro-magnet are reversed and the top end is made a south pole. Then the law holds good that unlike poles attract thereby drawing the two contacts D and E together causing current to flow through the contacts F and G as direct current. This performance continues so long as the current is turned on at H.

An Economical and Efficient High Frequency Generator for Code Practice

Having had the pleasure all these years of experimenting with several types of buzzers I have found that the contact points always burn out after any considerable use, and numerous other troubles present themselves. I have constructed a form of high frequency generator which gives a clear note of constant amplitude in the telephones and has many advantages which are only to be appreciated under operation. Means should be provided to regulate the strength of signals in the head telephones according to the number of head sets on the line.

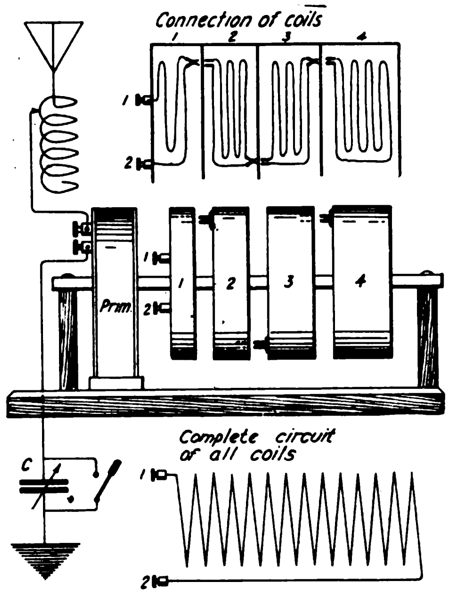


Figure 4—Design and connections of the complete receiving transformer

It is also possible to take off parallel wires and run them to the various tables in series with the ordinary telegraph key for each table.

The apparatus completed is shown in figure 3 where a drum as in detail B is constructed of two round ends of wood 6" in diameter and about 1" thick upon which are mounted bars of soft iron ½" by ½" thick and 5" long. A suitable shaft is run through the centre and two bearing supports are provided together with means for oiling. As is seen in detail A, eight iron bars spaced evenly apart are screwed to the wood ends. This drum is rotated between the two horseshoe magnets M-1 and M-2 upon which have been wound coils consisting each of 200 turns of No. 28 D.C.C. wire. Magnet M-1 is adjusted to have its magnetic circuit completed by the movable iron bar just after magnet M-2

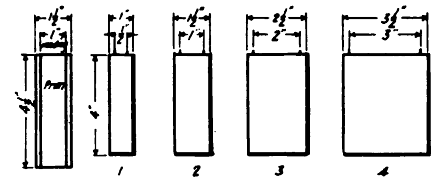


Figure 5—Showing dimensions of primary and secondary coils and their windings

has had its magnetic circuit broken. This gives double the frequency to be obtained with one horseshoe magnet. A suitable pulley about two inches in diameter is mounted on the drum and and a five inch pulley on the motor turning 1500 R.P.M.

In practice considerable frictional losses were experienced owing to the fact that I did not have good bearings and means for oiling them continuously. Therefore, it is wise to benefit from my experience and secure good bearings and an adequate oiling system. As a whole the apparatus is very interesting under operation and provides a means for demonstrating the principles of alternating currents to students during lecture periods.

An Up-to-Date Receiving Transformer

Radio fans are on pinions waiting for the word GO from our Government. Many will construct as the first part of their equipment a receiving transformer. I believe that the design shown in figures 4, 5 and 6 which I have tried out will be a valuable adjunct to their station. This tuner is fitted with a primary coil consisting of thirty turns of wire, this number being sufficient for general practice. Further variation of wave length in the antenna circuit is secured by the loading coil L, external to the transformer. Response from short waves

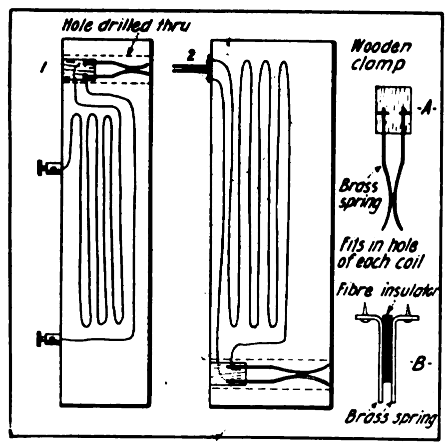


Figure 6—Detailed construction of the plug switch

can be secured by means of the series variable condenser C.

It is to be especially observed that the secondary winding is broken into four units and means are provided whereby they can be connected together by means of a special plug. The primary winding is made on a form, 4½" in diameter, 1½" in length, wound for 1" with 30 turns of No. 22 DCC wire. Approximately 35 feet are required.

The first coil in the secondary is 4" in diameter, 1" in length, wound for ½" with 22 turns of No. 28 DCC wire. Twenty-four feet are required. Secondary unit No. 2 is 4" in diameter, 1½" in length, wound for 1" with 45 turns of No. 28 DCC wire. Forty-seven feet will be required. Secondary unit No. 3 is 4" in diameter, 2½" in length, wound for 2" with 90 turns of No. 28 DCC wire. Ninety-four feet are required. Secondary unit No. 4 is 4" in diameter, 3½" in length wound for 3" with 135 turns of No. 28 DCC wire. One hundred forty-one feet will be required. The total secondary therefore will consist of 292 turns or 306 feet of No. 28 DCC wire. The measurement of all parts are shown fully in figure 5 and the details of the plug switch at A and B in figure 6.

If desired additional secondary units can be provided. Each successive coil should be larger than the preceding one as in the design already shown.

A suitable shunt condenser must be connected across the secondary. In this way, a closeness of adjustment not possible with the secondary inductance alone, can be obtained. The principal advantage of my design is that the unused turns for a small range of wave lengths are disconnected from the used turns which, as is well known, increases the efficiency to a remarkable degree.

A Modulator of Continuous Oscillations

THE successful reception of signals from stations emitting undamped waves requires some means for reducing the radio frequency currents to audio frequency currents of less than 20,000 cycles per second. This can be accomplished in a number of ways, such as by the use of a tikker that breaks the circuit at a speed great enough to give an easily read note in the receivers, by utilizing an interfering current to produce "beats" or current peaks as in the heterodyne system, or by tuning and detuning the circuit at high speed to give an audible note.

The latter method has received little attention from experimenters and should be a fertile field for investigation. The revolving condenser method has been described previously but the instrument described in this paper uses an inductance to tune and detune the circuits. The device is nothing more than a small variometer so constructed that the inner coil can be revolved at a high speed.

In figure 1, is given a broken view of the device to show its assembly. The constructional details and dimensions are given in figure 2. A square, wooden frame is used to support the stationary coils. This should be assembled with small brass screws, one end being left off till the rotor is in place. Bearings for the rotor are made from brass and mounted in the ends as shown.

The rotor is made from a two inch

length of shade roller or other wooden stick one inch in diameter. A slot one-quarter inch square is cut in opposite sides to take the winding. Holes are drilled in the ends to take one-quarter inch brass rods of the lengths given

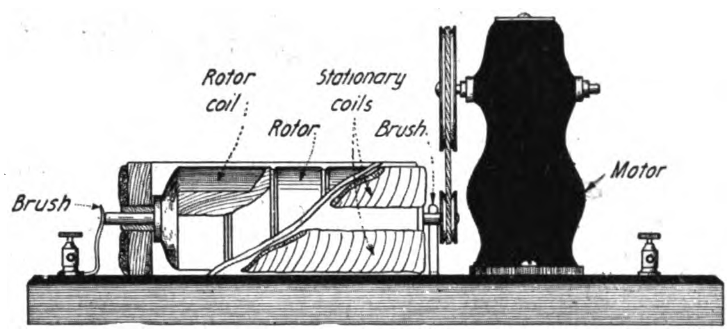


Figure 1—Assembled view of device for modulating continuous oscillations

to form a shaft. Grooves are cut around the rotor for the fine silk or linen binders that hold the winding in place.

The rotor is wound with No. 28 B & S, S.C.C. copper wire. One end of the wire is soldered to one shaft and the wire wound around in the slots similar to a telephone magneto. A little tape should be placed around the shaft where the wire touches. The winding is done in smooth layers, a slip of thin pasteboard being put between layers to keep them smooth and reduce the capacity effect of the winding. When the slots are full the other end of the wire is soldered to the other shaft. A piece of cardboard is put in

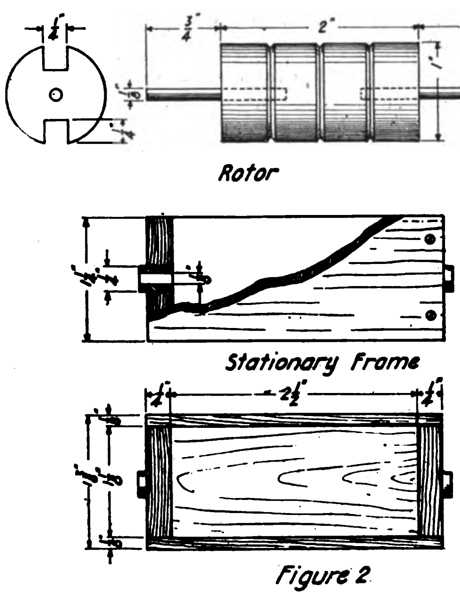


Figure 2—Showing constructional details and dimensions

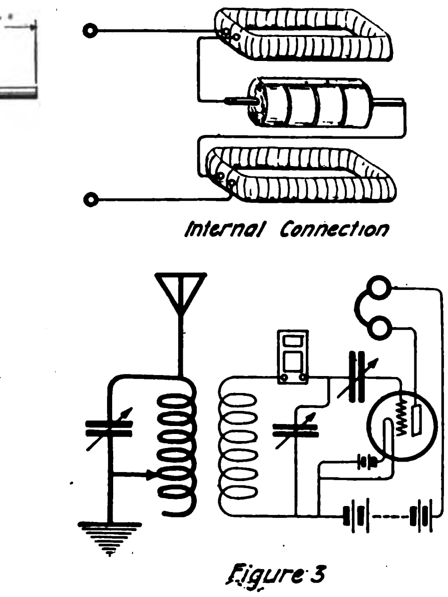


Figure 3—Showing method of wiring the device in the receiving circuit

each slot over the winding and then bound in place with fine silk thread.

The stationary coils may be wound right on the square frame after the rotor has been put in place but it is preferable to make them so they can be easily removed. Each coil of the stationary winding should contain one-half the number of turns on the rotor, they being made of the same size wire. The form used for winding them should be a trifle larger than the square frame, a winding space three-eighths of an inch wide being used. Thin pasteboard should be placed between layers to stiffen the coils and also reduce capacity losses. After being removed from the form the coils are served with a layer of tape to keep them in shape.

The motor used for driving the rotor should be of the series type to give a high speed which can be controlled by a small rheostat. A heavy rubber band forms a very satisfactory belt for the device.

The usual method of wiring this instrument in the receiving circuit is shown in figure 3. By bringing out the leads from the rotor and stator to separate binding posts the experimental possibilities of the device are greatly increased.

THOS. W. BENSON, *Pennsylvania*

Long Wave Variometer

THE variometer possesses a number of features that make it suitable for close tuning but the conventional type with concentric coils limit the range of wave length over which it is possible to tune. This is due mainly to the fact that the winding space must be made very narrow if the coils are to fit closely. Increasing the space results in an instrument with the coils so widely separated that the range is limited and quite a lot of inductance remains in the circuit when tuned to the lowest point on the scale. Realizing the advantages of close tuning and lack of end-turns, the writer has designed an instrument with these advantages that will respond to the higher wave lengths.

This type of variometer can be built for any range of wave length with the simplest of tools. The instrument described will work up to 10,000 meters and is intended for use in oscillating or Armstrong circuits, as a plate circuit loading coil.

Instead of two concentric windings it employs four coils so mounted that by revolving two of them about an axis their magnetic lines can be made to assist or oppose those of the stationary coils and thus obtain a gradual variation of inductance without any dead wire in the circuit. The dimensions of the coils can be changed to suit conditions, the instrument described being merely an example of this type of instrument.

The four coils are all similar in construction, being wound on wooden cores three inches in diameter and two inches long. Heads four inches in diameter are cut from thin fibre and fitted to the ends with glue and brass pins.

The winding is put on in four layers. The first being wound on the core, then a strip of corrugated board being cut to fit snugly around the winding and put in place. Four layers will fill the coils.

The method of assembling the coils is shown in the illustration. The cabinet used with the above coils should measure 9 x 9 x 5¼ inches inside. Two of the coils A and A-1 are mounted on the back, one above the other with a space of ¼ inch between them to pass the brass rod E forming the axis for the movable coils. The windings of these coils are so connected that when viewed from one end the current will flow around them in opposite directions.

A sheet of thin fibre or stiff pasteboard with a ¼ inch hole in the center is fitted into the box in front of the coils to form a smooth surface over which the coils B and B-1 can turn. The moving coils are fastened to a strip of wood D, ¼ inch thick,

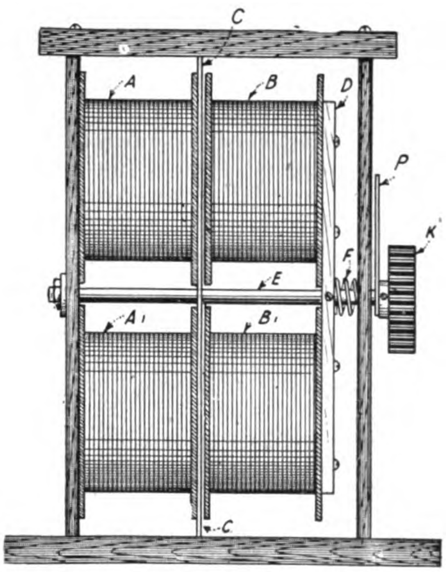


Figure 1—Showing method of assembling the coils of the long wave variometer

½ inch wide and 7¼ inches long. When mounted the coils have a space of ¼ inch between them at which point a hole is drilled in the wood strip to pass the brass rod. A small wood screw is put in one side of the strip opposite the hole to clamp the strip to the brass rod. The connections of the moving coils is similar to that of the fixed coils, so that the current will flow around them in opposite directions. Flexible leads are used to make connections to these coils.

The instrument can be completely assembled by passing the brass rod through the back of the cabinet and the fibre sheet, and slipping the strip over the rod so the coils rest against the separator, making sure to clamp coils B and B-1 by means of the small screw provided.

The four coils are then connected in series, with leads brought out to binding posts. The small spring F is slipped over the rod and the front of the cabinet put in place. A knob and pointer are attached to the projecting end of this rod to operate the instrument. A scale is mounted on the front of the cabinet. This is in the form of a semi-circle since one half-turn will vary the inductance from minimum to maximum. The pointer should be attached in such a position that when at the highest point of the scale the coils are in such a position that the current will flow around both top coils in one direction and around the lower ones in the opposite direction.

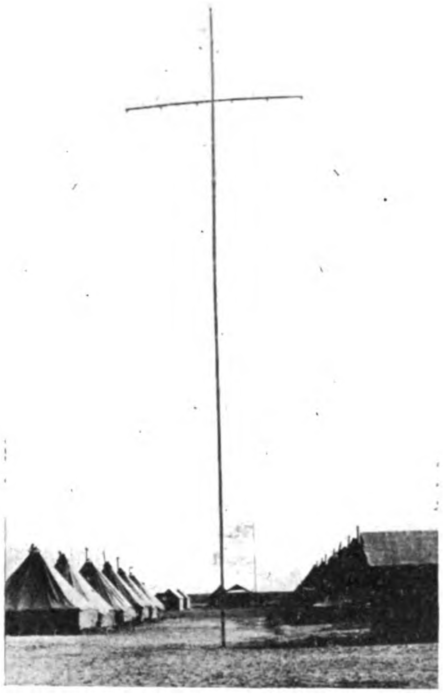
The instrument is now complete and ready for use. By bringing out separate leads from the coils numerous experiments are possible that will make the instrument a favorite of the experimenter.

Thos. W. Benson—*Pennsylvania.*

U. S. Signal Corps Radio Station

The camp station of the Radio Co., 1st Pennsylvania Signal Troops, while quartered at Camp Stewart, El Paso, Texas, is shown in the accompanying photographs. Particular attention is directed to our method of driving a pack set generator with an engine rather than by hand. This method gave very excellent results.

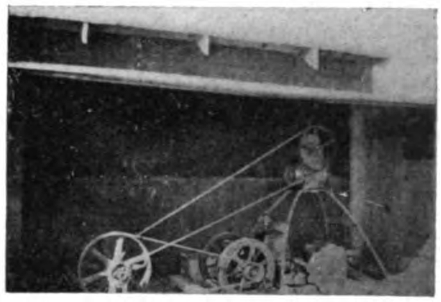
The masts are 60 feet in height and the span 350 feet in length. Using ¼ kw. pack set excellent signals were received at Colona, Dublan and El



The masts were 60 feet high and had a span of 350 feet in length

Valle in the daylight hours over a distance of 160 miles. Press and time signals were received from Radio, Va., every night and practically all commercial stations on the Atlantic and Pacific coasts were heard at one time or another.

K. B. Haines, *Pennsylvania*



Novel method of driving a pack set generator with an engine instead of by hand power

My Views of the Amateur Situation

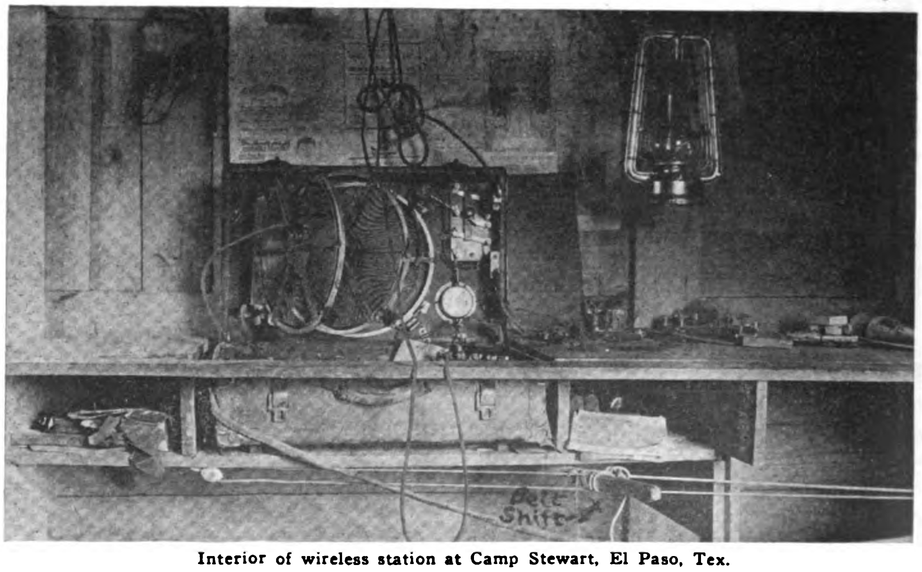
Close observation of the pre-war operations of amateur stations indicates to me that some changes in the methods of licensing are desirable.

I believe the situation can be improved in respect to power input, wave length and licensing of the operator. For example, I would suggest that the owner of a 1-kw. station not in proximity to military or naval stations, be required to hold a second grade commercial license. This would give the assurance that the owner has a far better working knowledge of his apparatus than the average amateur and it is reasonable to assume that he would not misuse the power of his station to create unnecessary interference.

Those unable to qualify for a second grade certificate should be placed in class 7 under the former Radio Laws. In most cases this class includes younger boys who are not interested in the art from a scientific standpoint. I believe your readers will agree with me that this plan will eliminate to a marked degree interference between 200 meter stations.

The owners of stations put in class 7 will thus be given an incentive to improve their ability as an operator and to increase the power and wave of his station.

L. N. Way—"9XD."



Interior of wireless station at Camp Stewart, El Paso, Tex.

The Layout of the Ideal Amateur Station

SOME of your contributors will undoubtedly state at great length the technical requirements of the ideal amateur station, but I will discuss the matter from the view-point of accessibility of apparatus and ease of operation. Amateurs frequently are at a loss how to go about installing their apparatus in a manner that will fulfill these conditions; and while all of us have other ideas on this subject, my years of experience in radio work leads me to believe that the accompanying drawing gives a plan of an amateur station of the detached instrument type that will work towards all-around efficiency and permit the greatest ease of manipulation.

The reader will note that on the top of the pigeon holes which is to retain the message blanks and other stationery, I have mounted the principle elements of the transmitting set, the high voltage transformer, the spark gap and an inductively coupled high frequency oscillation transformer. Immediately to the left of the table is placed an inductively coupled receiving tuner which in the up-to-date station will be fitted with a vacuum tube detector, and at the right the transmitting key in a place convenient to the operator. The switchboard to the extreme right of the table should contain the volt meter and ammeter, a switch for turning on and off the power, and a reactance regulator for controlling the primary current.

This lay-out in addition to presenting a neat appearance permits the shortest possible connections between the elements of the closed oscillation circuit.

The general specifications of the spark transmitter are so well known to the amateur field that we need not enter into a discussion of the problems here. It is believed that if the plan I present is adopted by the rising experimenter, it will prove of great advantage to successful operation.

E. T. JONES—*Louisiana.*

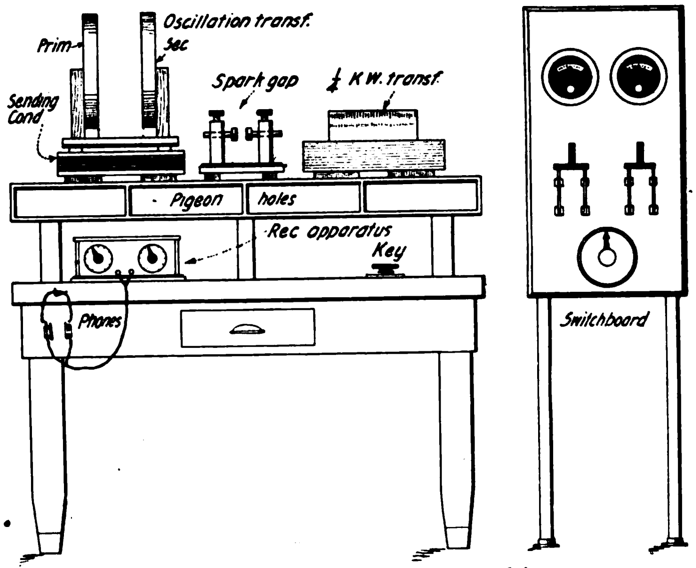


Figure 1—Plan of an amateur station of the detached instrument type

A Plan for Organization

(Continued from page 23.)

regulations prescribed, the rest could be banned and their methods advertised.

The publicity committee, being an important one, should have a capable executive as chairman, the balance of the personnel being selected from members of the other committees, so each division of committee activities would receive its full share of publicity. The State organizations' activities should then be actively covered—and with clocklike regularity—by reports sent to the magazines interested in wireless, provided interesting items were sent to the press regularly.

The subject of raising funds is a pertinent and vital one. Anyone who has had experience with local or State clubs knows how difficult a matter this one is. Ninety per cent of the trouble, however, is due to the fact that service of actual value to the amateur must be rendered if it is expected of him that he continue to pay dues. Numerical membership increases are largely dependent upon the dues being low, yet it is obvious that expenses increase as the membership grows. If dues are placed at a high figure, few care to join and the puropse of the organization—wide mutual benefit—is. defeated.

On the State organization proposition it does not seem practical to look for local clubs to contribute out of their treasuries; they are usually long on enthusiasm but short on cash. Local clubs usually have a sufficiency of financial troubles and are not in a position to help out, even if entirely willing to do so. So, for a State organization, an endowment fund seems a necessity. To secure endowments, it is necessary to incorporate under the State laws. A faultless constitution is also necessary; one that financiers will pass upon without question. Two honorary grades of membership should be provided for, to be bestowed on public-spirited citizens who contribute $50 or $100, or more, to the endowment fund. These men need not necessarily be interested in science; the membership and publicity committees should co-operate closely in connecting with and convincing men of means that their support will greatly benefit a body of serious-minded students of the wireless art. Funds can be raised by endowment, if this course is carefully pursued, which will aggregate a sum ample for all expenses to be paid out of the interest received by wise investment of the principal.

Other than the honorary membership, the Association should have two grades for amateurs, the highest (member) to consist of those who secure Commercial 1st Grade licenses, or the equivalent in experience; and a second grade (associates) comprising the beginners in the art who may later develop into candidates for the higher grade. Standards of membership should never be lowered. Exactly what these standards should consist of and the benefits under each grade, should be determined by the board of directors, as conditions vary in States and various parts of the country.

State organizations could render valuable service through the research and development committee carefully investigating all apparatus on the market. Values and costs of amateur equipment should be thoroughly digested for the information of members, particularly newcomers in amateur wireless, and advice on systems best suited to needs and pocketbooks given free of charge. This committee should also report to the central, or national body, fraudulent practices or misrepresented apparatus so the national body can secure a refund or replacement where poor apparatus has been received by the individual. This plan has been successfully carried out by the N. W. A. and is a valuable service to amateurs.

It is about time to start the ball a-rolling. It is suggested that amateurs begin now to get in touch with as many prominent amateurs as possible and exchange views and formulate plans. In this way the details will be classified when the time comes for State organizations to adopt a platform that, in main essentials, will conform to conditions throughout the country.

I should like to see a thorough discussion of this subject by amateurs in the columns of THE WIRELESS AGE.

RALPH BATCHER, 9 YI

A High Voltage Storage Battery for the Audion

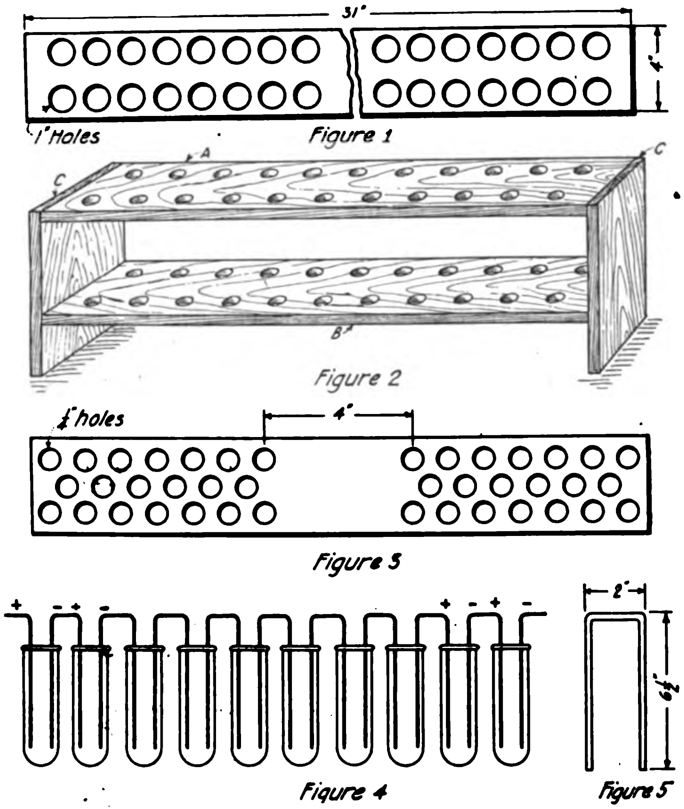
ONE of the principal drawbacks of the vacuum valve detector for amateur use is the expense of keeping up the high voltage battery. The constructional details of a storage battery of about 60 volts follows. The battery may be charged from 110 volts A.C. by placing it in series with a 75 watt lamp and a one jar rectifier of the electrolytic type.

For the stand in figure 1, take two boards about 31 x 4 x ¾ inches and bore in each thirty one-inch holes, in two rows, the holes being one inch apart.

tively. Two of the strips should be cut in half, these being used at the ends of the two rows.

For the containers use thirty test tubes 1 x 6 inches. Set the test tubes in the rack and place the lead strips in their proper positions, so that a positive and a negative plate are in each tube. (Figure 4.)

Some difficulty may be experienced in keeping the strips of lead an equal distance apart in the tubes. However, this may be overcome by taking pieces of heavy cardboard, previously soaked in silicate of soda and dried, placing them between the plates.



Diagrams showing construction plans of the various parts of the high voltage storage battery

Now take two pieces of wood 8 x 4 x ¾ inches and by means of one-inch wood screws, complete the stand as in figure 2. The shelf A should be flush with the tops of the end pieces CC, and shelf B should be about four inches below A. The frame should now be well coated with hot paraffine.

Cut thirty pieces of lead 15 x ¾ x ⅛ inches, and then using a ¼-inch drill, bore the lead strips full of holes, except for four inches in the middle of each strip as in figure 3.

Next bend the strips as shown in figure 5. Take a little red lead, and make a paste with a 10% solution of C.P. H_2SO_4. In one end of each strip fill the holes with the red lead paste, and in the opposite end of each strip fill the holes with a similarly prepared paste of yellow lead. These form the negative and positive plates, respec-

The two rows of cells should be connected in series with a small lead strip.

When this is done, fill each tube to within ½ inch from the top with a 20% solution of C.P. H_2SO_4. The tops of the test tubes and the parts of the plates above the electrolyte should be painted with hot paraffine to prevent the acid from creeping.

The battery is now ready for charging and should be connected to a source of direct current of from 65 to 75 volts. The charging rate of this size battery is from ½ to 1 ampere, and the capacity is about 2 ampere hours.

Care should be taken to see that the battery is never run down, and that the electrolyte is kept at ½ inch from the top of the tubes.

SHELBY J. BLONG, *California.*

Contest Winners for the February Issue

In response to the call in the November issue for manuscripts concerning the ideal amateur set, prizes have been awarded to the writers of the following articles. The suggestion upon which the contest was based was: "AFTER THE WAR, WHAT IN YOUR OPINION WILL CONSTITUTE THE IDEAL AMATEUR TRANSMITTER AND RECEIVER?"

First Prize—General Specifications of an Ideal Amateur Transmitter and Receiver

THE ideal amateur wireless station should be, if possible, located on the ground floor of a building. If above the first floor, the ground wire may be so long as to cause some loss of radiation. On the other hand, if located in the basement, the lead-in where it enters the building will be too close to the ground and in some cases may cause a serious brush discharge to the earth.

THE AERIAL

The aerial should consist of six or more stranded copper wires, spaced at least four feet apart. A 10½" hard rubber or bakelite insulator should be placed in the end of each wire. Insulators should be placed every fifteen or twenty feet in the guy wires to prevent loss of current to ground.

EARTH PLATE

A good earth connection is formed by burying squares of copper or tin sheeting about eight feet beneath the ground, in a circle of fifteen or twenty feet and bringing the connections from the plates in a rat-tail formation to the surface where the ground wire to the apparatus is attached. The ground wire should be at least a No. 4 stranded cable. The plates should be placed flat on the ground as it has been found by several amateurs that they work better than if they are placed on edge.

POWER

Care should be taken when wiring the station to run the lighting wires as near right angles to the aerial as possible, to prevent destructive currents from being set up in the power circuits. All wiring should be done in accordance with the underwriters' specifications, which can be obtained from any local electric light company.

THE TRANSFORMER

The transformer should be both substantial and efficient, and the voltage should approximate 20,000, in order that a small condenser may be used to permit the use of a reasonable amount of power on the 200 meter wave. A transformer with considerable magnetic leakage should be used as it can be adjusted to resonance and will not pull heavily on the lighting circuits.

THE CONDENSER

A good oil-immersed condenser for a ½ to 1 kilowatt transmitter may be constructed as follows: Obtain 10 plates of triple thickness glass each 9" by 12"; coat eight of them on both sides, and two of them on one side each with heavy tinfoil 6" x 9". The lugs and foil are to be cut in one piece. Corners should be rounded to prevent brushing. Shellac can be used for the adhesive, and pieces of fifteen ply cardboard 6" x 9" in size should be placed between the plates for separation, so the oil can get between the plates. Be sure to cut the foil so as to bring the lugs out wherever convenient; then after squaring the plates evenly, tape them together tightly and place them in a box of transformer oil, on their edge, so the oil will force the air-bubbles out between the plates. The box can be made oiltight by pouring boiled sealing-wax along the cracks and letting it harden, then giving it a few coats of shellac.

THE SPARK GAP

The Marconi type of discharger is simple and efficient. On the shaft of a 1/10 h.p., 3,600 r.p.m. induction motor, mount a 10" "Victor" record with eight equally spaced holes drilled around the periphery about ½" from the edge, large enough to insert a battery binding post bolt. Then obtain some battery binding posts; file off their heads; put them in these holes and fasten them with small nuts on both sides of the disc. The stationary electrodes should be so placed that the rotary plugs will pass between them. This gap gives an excellent tone.

THE OSCILLATION TRANSFORMER

The oscillation transformer should be of the "pancake" type with 5 turns of No. 6 and 10 turns of No. 8 copper wire, or 1½" ribbon (copper), for the primary and secondary, respectively. The frame should be made of "Bakelite" or well seasoned wood, and must be constructed so that the primary and secondary windings are accessible to the clips at nearly all points.

All leads connecting together the elements of the closed oscillation circuit should be as short and as heavy as possible. They should have no sharp bends or kinks in them.

The Antenna Switch

The antenna switch should be so constructed that when in sending position it connects the aerial to the oscillation transformer; closes the circuit to the current mains and starts the rotary. When receiving, it should connect the receiving tuner to the aerial; open the circuits to the transformer and rotary gap. It should be extremely well insulated; capable of quick and easy operation, and the current carrying parts should be capable of carrying the antenna current without loss.

The Receiving Station

A long wave regenerative vacuum tube receiver fitted with mica diaphragm telephones and a tubular or other type of bulb should be used. If the set is built into a cabinet, dust can be kept away from the instruments and both the appearance and efficiency improved thereby. Any regenerative connection is good if constructed in accordance with fundamental principles. In place of loading coils for long wave lengths, I have successfully employed condenser units connected across the primary so that one or more may be cut into the circuit. They are just as efficient under some conditions as the loading inductance and take up far less room. A good storage battery should be used to light the filament, because they are more economical in the long run than dry cells.

Every amateur should own a short wave regenerative set as the range is greatly increased when receiving short wave amateur stations. Any of the several types being sold under various trade names may be employed to advantage.

With the above described apparatus the station will be very near present-day amateur perfection.

J. E. Law, Jr., *West Virginia.*

Second Prize—The Ideal Amateur Wireless Station After the War

I SHALL discuss this subject on the basis that the amateur station will be permitted to operate as before the war, i.e., one kw. power input on the two hundred meter wave.

The first and most important part of any wireless station using a short wave, is the aerial. The ideal station should have the aerial supported by a mast at least seventy feet high, if the aerial is near any buildings, trees or wires. Iron pipe masts, wooden towers, or structural steel towers may be used. A very serviceable and satisfactory mast may be constructed of common iron pipe, which may be purchased at any hardware store. By the use of reducing couplings heights up to ninety feet can easily be secured. Some masts over one hundred feet in height have been made, but require a very extensive system of guying and are not easily constructed. Another method is to use wooden 4 by 4's. The transmitting aerial should be seventy-five feet long, and the long wave length receiving aerial two hundred and fifty feet long. The former should be composed of six wires placed three feet apart. The "L" type is preferred. The longer aerial should have at least two wires spaced four feet apart.

The lead-in from the aerials should be composed of the same size wire as the aerials, preferably stranded phosphor-bronze. It should be supported at only one point between the aerial and oscillation transformer. The insulation throughout the aerials should be Electrose insulators. The lead-in may be brought through the wall in a Marconi deck insulator.

The instruments should be five feet or less from the ground connection, which may consist of buried plates, either tin or copper, buried wires or netting, or iron pipes driven in the earth in the form of a circle. In any case the connections should be well soldered. The underground part of the earth plate should extend under the horizontal part of the aerial. The aerial connection should be made directly to the oscillation transformer, the antenna switch breaking only the earth connection.

The oscillation transformer should be made of heavy brass or copper ribbon. The primary should have three turns eleven inches in diameter and the secondary five turns of the same diameter. The transmitting condenser should be made of one-quarter inch plate glass. The plates should be built in a frame and spaced one-quarter inch apart. They should be coated with heavy tin foil, the whole to be immersed in oil. Copper coated Leyden jars may be substituted. A series multiple connection must be employed for potentials above 15,000 volts.

The spark gap may be a rotary, quenched air cooled, or stationary quenched air cooled gap. An efficient non-synchronous rotary gap may be substituted. The transformer should be of the well known ½ to 1 k.w. closed core type. All connections in the closed oscillation circuit should be made of heavy copper or brass ribbon. The key should have heavy silver contacts and a long arm.

The power lines should be protected by micrometer gaps and condensers. Choke coils may be used between the secondary circuit of the transformer, and the condenser. The aerial or antenna switch may be any of the types offered by manufacturers. A marble base is preferred. In selecting a switch the accessibility and efficiency should be considered.

The receiving set should have three

separate tuning transformers. The first for waves from 180 to 600 meters, the second for waves from 600 to 3,000 meters, and the third for waves from 3,000 up to about 15,000 meters. The first should be used in connection with a regenerative circuit. The second is preferably the so-called Navy type, having all variations of inductance made with switches. One turn variation of the primary and ten turns variation of the secondary should be provided for. The secondary should be shunted with a variable condenser. The third transformer is similar to the second, and larger. If large enough only a primary loading inductance is needed, however, very good results may be secured by the use of both "wing" and "grid" inductances with a smaller transformer. All three sets should be used in connection with a good vacuum tube. Any of the types offered are good, although some are more sensitive than others.

The three transformers are used for reception from amateurs and boats, medium long wave spark and arc sets, and long wave arc and spark stations respectively.

In the above specifications a few things have been omitted for separate discussion. The location of the instruments is a very important item for efficient operation. If possible an operating hut should be constructed so as to place the instruments directly under the aerial. This allows short connections which are important. A good hut can easily be constructed by any live amateur.

Another thing to be taken into consideration in the ideal station is the matter of connections. Many different circuits especially for the receiving set have been published. Before making permanent connections different circuits should be tried. Although one gets good results it may be possible to still further improve on them. This applies especially to the long wave receivers.

The transmitter circuit is not susceptible to various connections. The secondary of the transformer is connected in multiple with the condenser, the gap and primary of the oscillation transformer being in series with the condenser.

An important after the war consideration will be the use of undamped wave sets. However, no details can be furnished at the present time.

The operation of amateur stations, after reopening, promises to be a more dignified proposition than at the time of closing. There will be fewer of the old spark coil "jammers" and only the ones who really mean business will open their stations. Also the fellows who enlisted for Government training will be better operators and consequently erect better stations upon returning. Indeed what we have all wished for is about to take place. Ideal conditions as well as ideal stations will prevail.

JAS. B. HOLSTON, *Illinois.*

Third Prize—Ideal Specifications for a Spark Station

MY ideas regarding the ideal radio set may prove of interest to the general type of radio amateur. All component parts of the transmitting set are mounted separately on a suitable sized table—taking particular care to so arrange the apparatus that the leads in the oscillatory circuit are as short as possible.

The condenser is the usual bugbear in the transmitter. It will be given further consideration. The solution of the condenser problem in my opinion is to make it an oil immersed affair —using a good grade of transformer oil. If automobile windshield plate glass of ¼ inch thickness is used, little trouble will be experienced as far as "puncturing" of the plates is concerned. Twelve 10" x 14" plates in parallel give the correct capacity for 200 meter operation. Tinfoil 8" x 12" should be "pasted" onto the glass by putting a few drops of transformer oil on the plates and placing the tinfoil on and squeezing the oil over the surface of the plates with a photographic roller. Then solder copper ribbon at least ½" wide to the tinfoil.

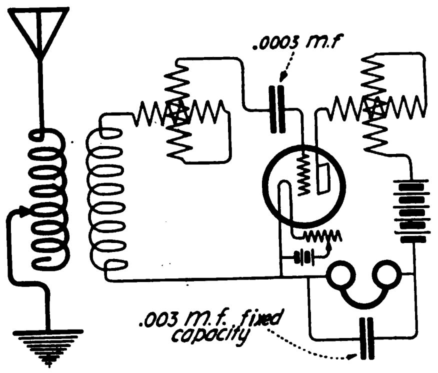


Diagram of the Armstrong circuit for wireless receiving set

After each of the 12 plates have been coated they are stacked together and bound with canvas strip. A suitable containing tank should be next obtained. It should be large enough to allow at least one inch clearance around all the edges of the glass plates. Wood strips one inch thick should be placed on the bottom of the tank to keep the plates insulated from it. A bakelite or hard rubber tap should be cut to cover the tank and keep out all dust and moisture.

The rotary gap is the next item. A bakelite disc 10 inches in diameter should be obtained. The thickness should be ⅛", no more is necessary, and is really harmful, since the lighter the disc the less the amount of power necessary to turn it. Next 10 brass electrodes are constructed from 1/4" threaded brass rod. They should be one inch long, each end finished in a chisel shape with an edge 1/8" thick. Eight of these electrodes should be mounted on the periphery of the disc so that they protrude equally on both sides of the disc and should be held in place by means of a nut on each side of the disc. The stationary electrodes are mounted on brass standards on a marble or bakelite base, one electrode on each side of the disc. The disc itself should be mounted on a polishing lathe, similar to a small jewelers' lathe, which can be bought at any hardware store for the amount of $2.50. I much prefer a belt arrangement such as this type of mounting requires, to the usual method of mounting the disc directly onto the shaft of the motor. One reason is that it allows the speed of the rotor to be more easily changed than the type driven by an induction motor, and another reason is the elimination of the danger of high potentials burning out the winding of the motor. A fan motor or any motor of 1/16 h.p. is entirely suitable for running this gap.

The oscillation transformer is made of 1½ inch brass strip employing the pancake type of winding. The primary is made of 4 turns, the outside diameter of the first turn being 8 inches. The turns should be at least ½ inch apart. The secondary contains 10 turns of similar size. Both primary and secondary are mounted on bakelite strips. The secondary is mounted on a hinge to vary the coupling. Very heavy helix clips should be used.

Any standard make transformer with a secondary potential of at least 15,000 volts is suitable. The Thordarson, 1 kw. 20,000 volt model seems to be the favorite and from a point of efficiency, reliability and cheapness it is the best on the market, in my opinion.

The connections from the secondary to the condenser should be made of, say, No. 24 magnet wire. Two choke coils of No. 24 wire on tubes 2 inches in diameter and 3 inches long are sufficient to take care of all "kick backs" from the condenser.

All connections in the oscillatory circuit should be of very heavy copper sheeting. I buy copper sheet 1/32 inch thick and 6 inches wide in lengths of 2 feet and cut this to the required length with a width of 1½ inches. If all connections in the oscillatory circuit are made as short as possible and the set is tuned by means of a hot wire ammeter and wave meter, no one should experience any great difficulty in working 1,000 miles during the favorable season, provided a modern type of regenerative set is used at the receiver.

RECEIVING SET

If one cannot afford to buy one of the popular makes of regenerative sets on the market the solution is to construct one. Whether it be mounted in a cabinet or not is optional with the constructor. Personally I prefer to leave mine unmounted so that I can readily adapt the circuit to the various changes that are necessary in order to keep abreast with the times.

The primary of the receiving transformer is 3 inches in diameter wound with 50 turns of No. 24 S.S.C. magnet wire with switches for single turn variation of inductance. The secondary is 2½ inches in diameter, wound for one inch with No. 31 S.S.C., no taps are taken off secondary. The necessary changes of inductance are obtained by using a variometer in series with the secondary. A suitable variometer is described in "How to Conduct a Radio Club." Another variometer of similar size is required in the plate circuit. The diagram of connections is enclosed which is the Armstrong circuit. Brandes Superior telephones fill the bill very satisfactorily.

The aerial should be as high as possible and not over 100 feet long unless it is made of the "T" type, in which case it can be 120 feet long.

The ground connection should be attached to water or gas mains and also to a 4 wire counterpoise buried under the ground for a few inches, parallel and underneath the aerial.

With a transmitting set of the above description, I regularly "put" 8.5 amperes into an aerial 80 feet long and 40 feet high and have as my transmitting record a distance of 1,600 miles.

My receiving record is 1,800 miles with a receiving set similar to the one described having copied 6 EA at Los Angeles, Cal., at Little Rock, Ark., six consecutive nights during the latter part of the 1917 season.

JOHN M. CLAYTON, *Arkansas.*

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

I. H. W., Fire Island, N. Y., writes:

In your December issue I notice an article mentioning that the German station at Nauen, (POZ) could only be heard with a long wave undamped receiver. Nauen now employs a damped transmitter operating at six thousand meters which during the war was used both for sending instructions to submarines and for transmitting press and time signals.

I have copied this station (POZ) on the Marconi type 106 receiver with carborundum detector, without any extra loading coils, up to one thousand miles.

* * *

E. B. L., Sergeant Signal Corps, U. S. Army, writes:

Referring to a brief descriptive item on the Nauen, Germany (POZ), radio installation, printed in the October issue of your valued publication; it may be of interest to you to know that I have been copying matter transmitted from that station, day and night, at all points of our Alaskan itinerary. Their signals are powerful and I copy them with a typewriter, without difficulty. In addition to considering the great distances, a relief map of Alaska will show unusual ore-bearing mountainous obstacles, which, however, appear to affect in no way the amplitude of signals of long wave-lengths. We intercept press matter en-route from Eastern United States, Naval Stations to European stations.

* * *

C. V. H., Kingsley, Kans.:

Ques. (1)—Does it make any difference in which direction the turns on the primary and secondary coils of a receiving tuner are wound?

Ans. (1)—It makes no difference.

* * *

G. S., Gary, Ind.:

Replying to the questions in your recent communication: We would not recommend the use of a 25-cycle alternating current for amateur purposes as the spark frequency will be so low that it will be difficult to read your signals. By the use of a non-synchronous rotary spark gap the spark frequency could be improved, but still the note would partake of the characteristic of the 25-cycle current. The inductance of a high voltage transformer primary constructed for 60-cycles is too low for use at 25-cycles. You could best be informed on the rewinding of this particular transformer by communicating with the manufacturer.

* * *

H. S., Jenks, Okla.:

When the expression "resonance between generator and transformer" in radiotelegraphy is spoken of, reference is made to resonance between the complete transformer and its secondary condenser with the frequency of the alternator. Owing to the close coupling between the primary and secondary coils any change of capacity across the secondary will tune the complete circuit from the alternator through the transformer. An article by H. E. Hallborg in a past issue of the Proceedings of the Institute of Radio Engineers will give you more information on this particular point.

* * *

A. D., Manchester, N. H.:

The natural wave of your "T" type aerial, 120 feet in length and 50 feet in height, is close to 200 meters and with the receiving transformer you have mentioned, the complete system will respond to wave lengths to 4,000 meters.

Keep in mind that the ban on amateur communications has not yet been lifted, but we may expect the removal of these restrictions at an early date.

* * *

S. M. G., Hampton, Conn.:

You may expect in a forthcoming issue of THE WIRELESS AGE complete instructions and working drawings for the design of long distance vacuum tube receiving sets. For a two-stage amplifier, we would suggest that the first tube be connected up with a regenerative coupler for the amplification of radio frequencies. The grid circuit of the second bulb should be connected to the plate circuit of the first bulb by an audio frequency transformer with or without iron core. The loading coil described on page 515 of the April, 1917, issue of THE WIRELESS AGE is applicable for this work. No large gain in efficiency, however, is obtained by the use of multi-layered coils. It is possible to design a receiving set for a range of wave lengths from 5,000 to 12,000 meters wherein the entire range of wave lengths is secured by variation of the variable condensers alone. If you will give us a more complete description of just what type of apparatus you contemplate building, we could give you more definite advice.

If multi-layered coils are employed in receiving circuits, we would advise that the inductance be varied by a multi-point switch. We do not recommend the construction of a universal receiving set to cover wave lengths from 200 to 10,000 meters as it complicates the equipment on account of the necessity for eliminating the unused turns when operating on the shorter range of wave lengths. It would perhaps be simpler to construct two receiving tuners, one for lower range of wave lengths and the other for the higher range.

The method you suggest in question No. 3 for varying the inductance of coils is feasible, but not entirely necessary. You can rest assured that vacuum tubes will be supplied to the amateur market when the ban is lifted.

* * *

W. E. H., Auburndale, N. Y.:

The loading coil to accompany the apparatus described on page 82 in an early edition of "How to Conduct a Radio Club" may be 5½ inches in diameter, 28 to 30 inches in length, wound with No. 22 or 24 S.S.C. wire. If this proves insufficient to attain the wave length of 10,000 meters a small variable condenser may be connected in shunt to the primary winding of your transformer. Regarding the taps on the coils L-2 and L-7: A very wide range of wave lengths may be attained simply by employing a fixed number of turns, the wave length being changed by variable condensers.

Under certain conditions, it may be of advantage to bring taps from the coil. Satisfactory closeness of adjustment can be secured by tapping these coils every two or three inches. The books "How to Conduct a Radio Club" and "Practical Wireless Telegraphy" give numerous diagrams for connecting up transmitting apparatus. A fundamental circuit, for example, appears on page 98 of "Practical Wireless Telegraphy." Use this diagram of connections beginning at the notation marked "generator." You perhaps will not employ the wattmeter or reactance coil shown in the diagram. In the third revised edition of "How to Conduct a Radio Club" on page 39, figure 17 is shown a diagram giving the fundamental amateur circuit. The amateur transmitter you will observe is very simple.

* * *

L. R. D., Kinsale, Va., inquires:

Ques. (1)—Which would be the better aerial for all around receiving work, one consisting of two wires, 200 feet long and 40 feet in height, spaced 6 feet apart; or one 100 feet in length 40 feet in height using 4 wires, spaced 3 feet apart?

Ans. (1)—The smaller aerial would be better for amateur reception, but for long waves either aerial would be suitable. As a matter of fact, considering modern types of vacuum tube receivers, the dimensions of the aerial have little to do with range of reception provided the fundamental wave length of the antenna is not too great to establish resonance with the distant transmitting station. No matter how weak the intensity of the incoming signals, by cascade audio or cascade radio frequency amplification, they can be enormously amplified and brought to audibility.

Ques. (2)—What would be the approximate wave length of this aerial?

Ans. (2)—The 200-foot aerial has, approximately, a natural wave length of 335 meters and the 100-foot aerial approximately 165 meters.

Ques. (3)—Please advise the correct hook-up for the attached diagram of connections for galena and silicon crystal detectors.

Ans. (3)—Much better response can be received from distant transmitting stations by shunting the head telephone around the fixed condenser which in your diagram is marked "FC." Otherwise the diagram is correct.

* * *

H. S., Jenks, Okla., inquires:

Ques. (1)—What type arc transmitter does Nauen, Germany employ?

Ans. (1)—We have no knowledge that an arc transmitter is in use at this station. We understand that it is equipped with an 8,000 cycle alternator, the frequency of which is increased to 16,000 by a set of frequency changers. The Nauen station is also equipped with spark apparatus but we have no information regarding the power or the design of the set.

Ques. (2)—How does the von Lepel type of transmitter compare with the ordinary spark system in respect to range and efficiency?

Ans. (2)—We have no definite data on the efficiency and range of this apparatus as compared with other systems. Ship sets have a transmitting range of about 300 miles. Only a very few installations of the von Lepel system have been made.

Ques. (3)—Where can I obtain data on the construction, operation and efficiency of the von Lepel ½ kw. set?

Ans. (3)—A brief description of the Lepel system is given on page 688 of the third edition of the "Principles of Electric Wave Telegraphy and Telephony," by J. A. Fleming. Page 193 of the second edition of Dr. Eccles "Hand Book of Wireless Telegraphy and Telephony" gives some details regarding the system. The only important feature regarding the design of the Lepel transmitters is the arc gap which is sometimes called a quenched arc. It is described briefly in Fleming's text above mentioned.

The von Lepel discharger produces damped oscillations at rates above audibility and hence for telephonic reception these oscillations must be modified to an audio frequency. This is usually effected by shunting the arc with an audio frequency circuit as well as the usual radio frequency circuit, which causes the arc to oscillate at a radio and audio frequency simultaneously when the key is closed. In this way groups of damped oscillations are induced in the antenna circuit. If you will refer to pages 212, 213, 214 and 215 of the "Hand Book of Wireless Telegraphy" by James Erskine-Murray, you will obtain further details regarding the Lepel system.

* * *

Corp. G. M., Fort Sill, Okla.:

Ques. (1)—Can an arc transmitter be operated from a 110-volt 60-cycle current? If so, please give connections of the apparatus.

Ans. (1)—An arc set operated by alternating current would produce damped oscillations and is inefficient. However, it is possible to use alternating current in a semi-arc system such as is described on pages 68 and 69 of Dr. Goldsmith's "Radio Telephony."

Ques. (2)—Why is it that an induction coil will not operate on 110 volts even when there is an incandescent light in series with the primary winding?

Ans. (2)—The inductance of the primary winding of the induction coil may be too low or too high for use with alternating current. The design for an induction coil for interrupted direct current is distinctly different than for an open core alternating current transformer. Now and then one comes across an induction coil which may be used on either alternating or direct current provided a series resistance or a series reactance is employed to regulate the primary current.

With an incandescent light in series with the primary winding of your induction coil the flow of current is governed by lamp, and if the lamp passes but ½ ampere, the primary current is too low to produce an appreciable effect on the secondary.

* * *

A. R., Scottsville, Mich.:

It is considered the better procedure to "bunch" the lead-in wires beginning a few feet from the flat-top portion of the antenna down to the lead-in insulator in the wireless cabin.

The international signal PRB is an intimation to the receiving operator on the part of the transmitting operator that he will use the International code of flag signals in his radiograms. These, of course, are transmitted by radio and not by flags.

The sales price of vacuum tube transmitters can be obtained from the Commercial Department of the Marconi Wireless Telegraph Co. of America, 233 Broadway, New York City. Either alternating or direct current may be employed in connection with the transmitting tube. If alternating current is used it must be rectified for the plate circuit. Alternating current may be used to light the filament. The voltage of the filament battery may vary from 6 to 110 volts and the plate voltage from 150 to 8,000 volts, according to the design of the tube.

Radio Telegraph and Telephone Signal System

A WIRELESS telegraph and telephone system described by August J. Kloneck is shown in the accompanying drawing, figure 1. In the diagram the numeral I is a source of alternating current which furnishes power for the motor generator 2, the motors 3 and 4 of the high frequency generator 5 and the motors 6 and 7 of the rotary spark gap 8.

In operation, current from the generator 2 flows through the wire 10 to the receptacle 11 of a transmitter valve 9 which contains a suitable liquid such as mercury. An electrical circuit is completed through the opening 12, with the mercury of receptacle 13, through the opening 14 of the auxiliary receptacle and the port 16 of slide valve 15. The valve is rigidly secured to the disc 17, which is in reality the diaphragm of a telephone transmitter. Variations of the diaphragm as usual cause a varying speech current to flow through the transmitter and thereby varies the field current of the high frequency alternator 5.

The field of the generator 46 and the armature 47 are attached to shafts 25 and 27 of the motors 3 and 4, which can be substituted by high speed turbines. They are rotated oppositely, producing current of very high frequency.

The frequency of the current is further increased through the special rotary spark gap shown at 8, which works on the vernier principle. For example, if the disc 22 has 9 points and the disc 23, 11 points, then the frequency of the current for one revolution will be 9 x 11. This arrangement permits any desired number of oscillations by varying the number of spark points upon each disc.

The current from the armature of the alternator flows through collector rings 25 and 26 which are attached upon the shaft 27. Brushes 28 and 29 serve to conduct the current from the rings to the terminals of the generator. One terminal is connected through wire 32 to a conductor ring 33 and disc 22, through the spark gap to the disc 23 and ring 34, and through wire 35 to the coil 36 of a spark gap transformer. The current from the second terminal of the generator 5 flows directly to the coil 37 of the spark gap transformer. As will be seen in the illustration, each terminal of the generator 5 is connected with a coil of the spark gap transformer, or the coils 36 and 37, respectively.

It is convenient to have one disc movable in respect to the other in order that the spark distance may be varied. For the purpose of preventing the development of higher voltages an adjustable spark gap 39 shunted across oscillation transformer is provided.

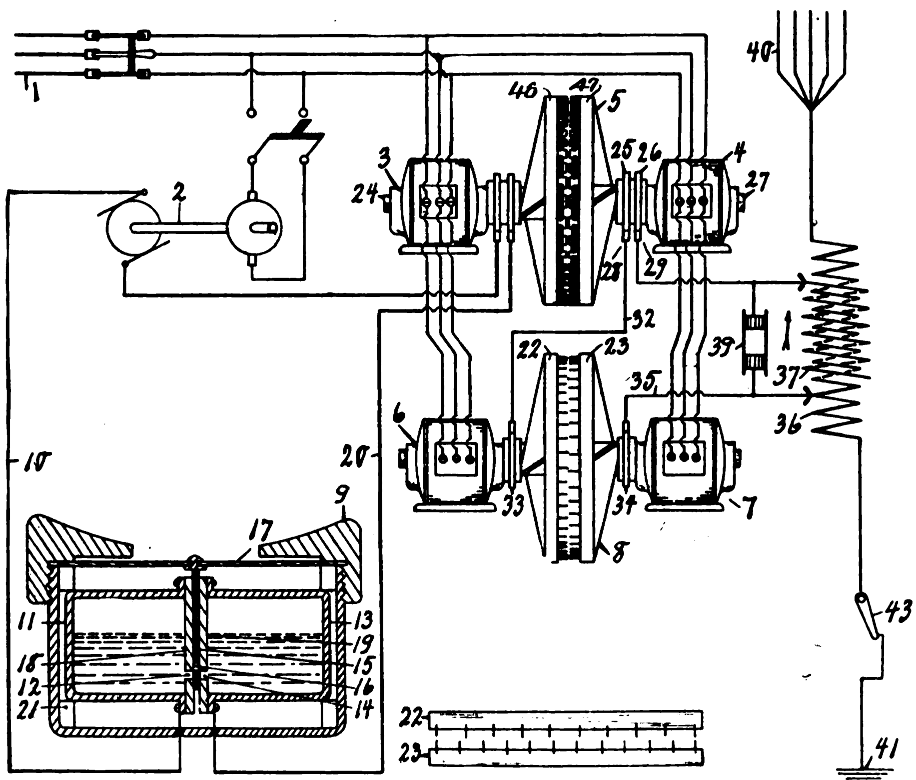


Figure 1.—Plan of construction and diagram of connections of the radio signaling system.

The Attack on the Alexander Bill

(*Continued from Page 30.*)

Paul F. Godley appeared for the amateur on the last day of the hearing. He stated that he represented the Radio Club of America and that in executive session its Board of Directors originally concluded that the amateurs would be satisfactorily and sufficiently represented by Mr. Maxim. But developments since then had made it appear advantageous to clear the atmosphere as it concerned the radio amateur. "The Radio Club of America wishes to go on record as firmly opposed to the bill now before this committee," stated Mr. Godley.

He gave as a reason for this decision, that regulation under the present law and the Department of Commerce had been entirely satisfactory to both amateur and commercial interests, and fair to these and the Navy.

A decidedly greater sense of security would be felt by the amateur under the Department of Commerce, was Mr. Godley's conclusion, because experience has shown "that that department can and does give him a square deal," the amateur's representations being given consideration on an equality basis with those of commercial and governmental stations.

Mr. Godley then asked the congressmen to consider the subject from the standpoint of the inventor. "Whether he knows it or not, every serious amateur is potentially and at heart an inventor," he asserted. "As an inventor, it is decidedly to his interest to do everything in his power to prevent the monopoly of radio by the Navy.

In conclusion, Mr. Godley offered in the name of his club certain recommendations, "should this bill, against the wishes of the amateur, be passed in any form." These were, briefly, a license requirement of 60 letters per minute; receiving stations, but not their operators to be licensed; a general restriction to 250 meters, except in special cases, and no geographical limitation on power excepting within 5 miles of a naval receiving station; that power restrictions remain as defined by the law of 1912, pending a national conference of amateur radio organizations to determine a policy.

In a rebuttal statement, Captain Todd, Director of Naval Communication, said that the hearings had apparently demonstrated how difficult it would be for amateurs to agree among themselves, attempts to get together, he had been told, meeting with very poor success.

Congressman Green took exception to this statement. He illuminated the difficulties of the few present to undertake agreement for the large number who did not come to Washington. But, even so, no great lack of unanimity or agreement appeared in the conversations he had held. "They were largely against it," he stated, "and some of them very fiercely against it." Those who had not been satisfied with explanations of the bill and amendments had said, "that they could not undertake to subscribe to an agreement without conferring with some of the vast number of men engaged in the radio art; it would have been ridiculous for them to have undertaken to bind other people without conferring with them."

Captain Todd said that his point was, it was just as well that the Navy did not try in the beginning to incorporate in the bill anything that would please the entire number of amateurs. "From the earnestness with which the amateurs talked," he added, "I think it probable that you (the Congressional Committee) will pay considerable attention to them."

The hearings closed a few minutes later, at 6 p. m. of December 19. On January 16, by unanimous vote, the committee laid the bill on the table, without a dissenting vote on the resolution to that effect offered by Congressman Bankhead of Alabama.

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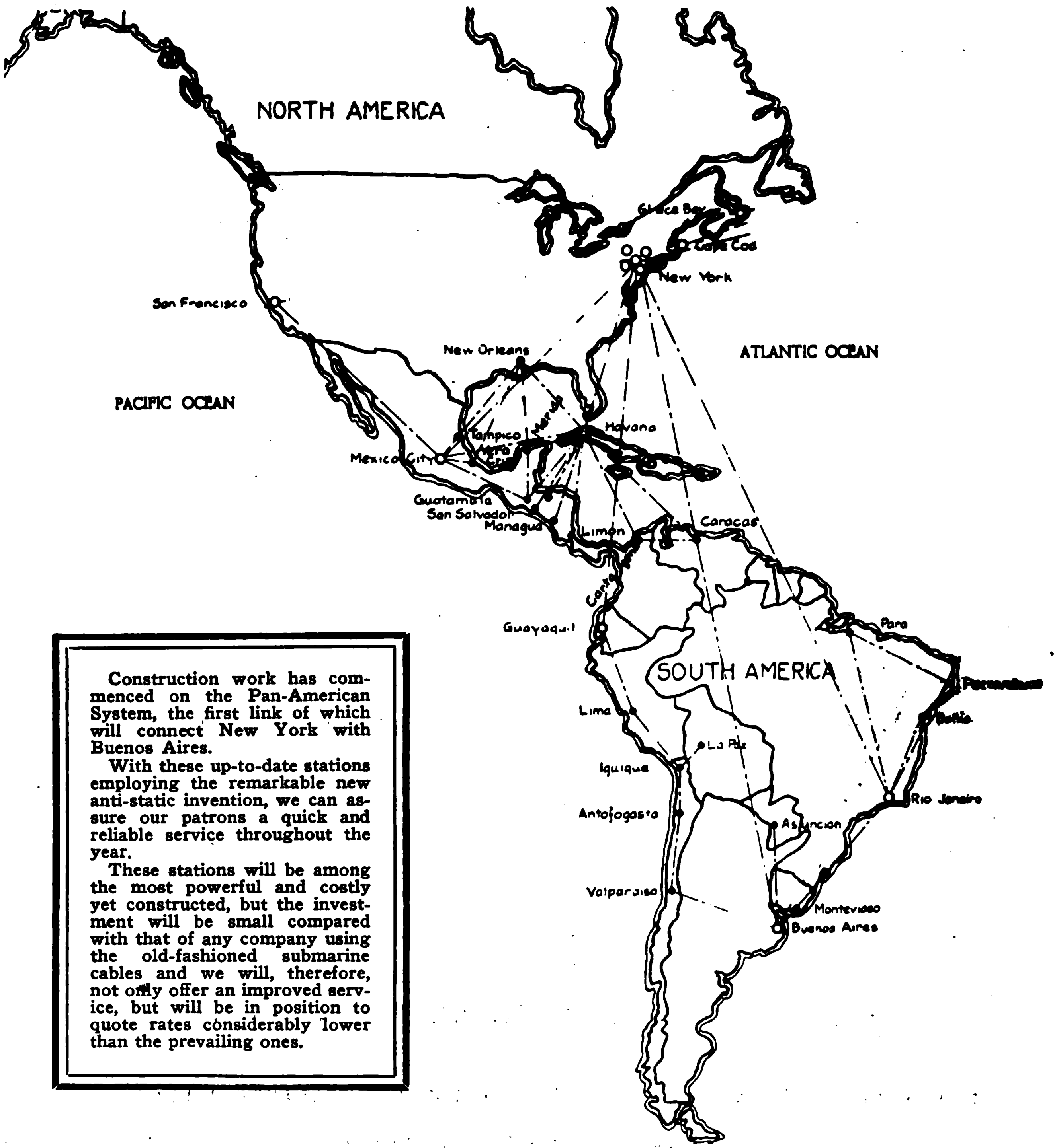

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