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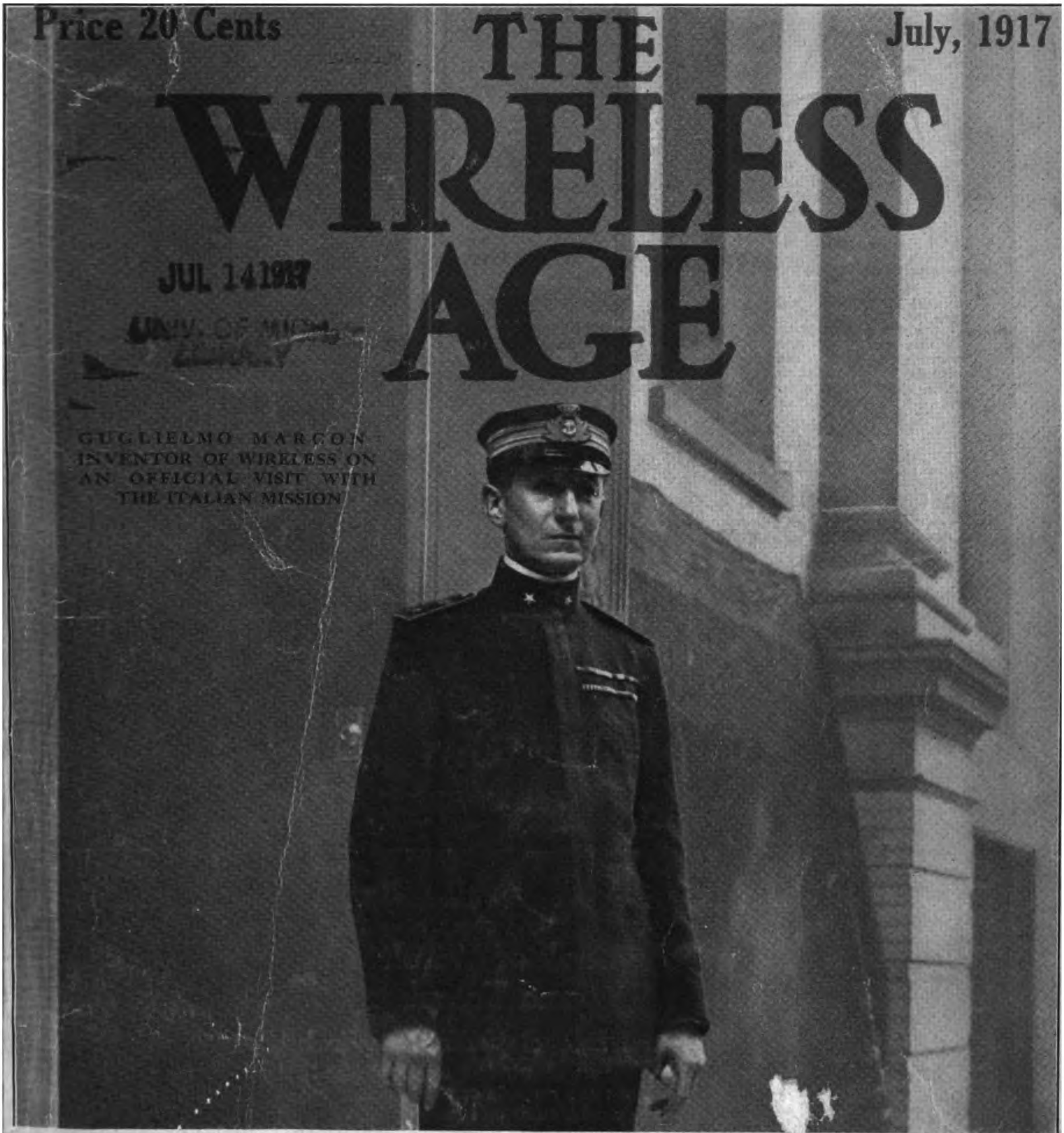
THE WIRELESS AGE



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**What Women Can Do and Are Doing—The Stations of Our Northern Ally—
The Radio Controlled Torpedo—An Operator in the War Zone—and Other Features**

THE WIRELESS AGE

An Illustrated Monthly Magazine of RADIO COMMUNICATION

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THE NEW FACTOR IN WAR

ACCUSTOMED as most persons are to consider war as waste and devastation, it is hard at first to reconcile economics of a permanent order with a view of a nation in arms. Nevertheless, there is such a thing as an economic aspect to war. For mere consideration of the old saw which has to do with necessity being the mother of invention, starts a train of thought which makes it at once obvious that the new inventions required by exigencies which brook no delay have permanent and far-reaching values in the scientific advancement of the world.

Nothing is more significant, for instance, than the daily growing conviction that dominion of the air will ultimately transcend in military importance dominion over the sea, which last has always been considered the deciding factor in the conquest or defense of continents. Air superiority being obtained by preponderance of skill and equipment in the fields of aircraft and radio communication, command of sea and land, therefore, resolves itself largely into superiority of intellect and intensive application of a nation's scientific men. Confidence in the vision and resourcefulness of American military officers is not misplaced; they have no superiors in fighting leadership and will quickly absorb the knowledge of men experienced in the highly modernized warfare. It is obvious, therefore, that, backed up by the skill and resourcefulness of America's scientific men and industrial giants, the national initiative, courage and organized engineering skill will produce for the Allied Powers the means of obtaining the air superiority of flying machines and wireless.

In this situation lie tremendous possibilities for service to the nation in the radio field; inventiveness is more than ever at a premium and every worker in the art will best discharge his patriotic duty by beginning intensive study of military requirements and needs.

The experience of service under field conditions is of first value, and the way to enlistment is easy.

Laboratory or workshop experimenting for those who, for any one of a number of reasons cannot take the field, is an obligation recognized throughout the fraternity as the greatest in history. If ever in the period of the art's development unremitting application has been needed, it is now; this is no time for the wireless man to lose interest. The most important work still remains to be done within the confines of a single room or building; research and experiment is a patriotic function which all are required to discharge.

THE WIRELESS EQUIPPED AIRPLANE

THE very exigencies of war which give it an economic aspect also promote seemingly strange and unusual relationships. Each day sees some reversal of form in matters which have hitherto amounted to veritable traditions. It formerly was considered, old-timers will recall, a highly subtle form of humor to refer to the "horse marines." Yet the mental spectacle of a mounted soldier of the sea is hardly less reconcilable than the latest development of the Army Signal Corps—a 52-foot power boat which Yachting announces is now being built for this army corps. Just why our soldiers are sailors too in this connection, is revealed as a development of airplane work, the boats serving as tenders to the coast patrol, wireless-equipped 'planes.

To date, the wireless-equipped airplane has been considered a more or less theoretical proposition. But, meagre though details may be, reports of efficiency in this field are steadily coming back from the fighting zone. Where once the world was given to understand that wireless on aircraft had been tried early in the war, and quickly abandoned, it is now generally understood to be the combination of greatest reconnaissance effectiveness and fire control value. With power generation solved—as it seems to be—within the required lightness of weight, development of radio for airplane use will rapidly advance. Little can be learned yet of what the warring nations have accomplished in the field, but it is reasonably certain that American wireless men, under the spur of wartime necessity, can do as well, if not better, within the same limits of time.

There are two recent announcements of aviation development of especial interest. One is the claim of an inventor that the stabilizer has now reached a stage of perfection that the pilot can fall asleep at the wheel, allowing the airplane, through its automatic action, to alight safely. Even though this claim be slightly exaggerated, it is obvious that stability is a small cause for worry when at least one hundred airplanes rise for reconnaissance every day on the fighting fronts and fatalities are so few. Of even greater interest is the other announcement, that the wireless-equipped 'plane is the most valuable tool in the hands of our Allies for spotting submarines. It is a fact that aircraft flying overhead can trace the path of the submarine below the surface of the water, and by reporting its position by wireless warning is given to nearby merchantmen to escape or war vessels to destroy the undersea craft.

The Government's appropriation of close to eighteen million dollars for aerial preparation indicates conclusively how large the aircraft will figure in our military plans; where wireless-equipped, as a large percentage will be, wireless men will be needed for installation and operation. Under war conditions the art is growing, not being contracted as some might think. More and better opportunities exist right now than ever before, but the call is for perfection—knowledge is the quality sought. This is the time for intensive study, for amateur as well as engineer.

THE ROUND-UP OF GERMAN WIRELESS AGENTS

GERMAN spies and German agents have held the limelight lately and the startling disclosures of machinations wireless borne have set up a buzz of excited comment throughout the nation. The one clear item in the whole situation seems to be that uncovering plots to smuggle military information out of the country cause great surprise. Why this should be so is not clear. Certainly, if England has not yet been able to rid itself of German secret agents established there before the war, the United States has less chance of clearing out the many here who long have had virtually unrestricted sway for their German propoganda. That the German spy machine did not collapse with our entrance into the war is obvious; if anything, it was to be expected to carry on its function with renewed energy.

Exposure of the scheme to ship wireless equipment into Mexico created a sensation, for with the arrests of three plotters in New York the Commissioner noted that: "In a situation of this kind one is reminded that while our people did not even know of the departure of our destroyers for the war zone the news was published in Berlin four days ahead of their arrival on the other side. I take it, it is in the mind of the Government that this may be part and parcel of the same iniquity." When it was further announced that the elaborate plots of Germans had added one more failure by the seizure of the apparatus by our secret service agents the nation's figurative sigh of relief was tempered with a thought of future possibilities. So the details of the method of supplying apparatus were sought. Briefly, the facts disclosed were these: The apparatus shipped by Harry F. Perissi, New York agent of the Allgemeine-Electricitats-Gesellschaft, or General German Electrical Company, and his accomplices to the Mexican agents of that concern got no further than Vera Cruz, where it was seized through the work of agents of the United States Government, and is now in the possession of the Department of Justice. It did not get off the piers at Vera Cruz. This apparatus was shipped from New York in January.

It is believed that none of the apparatus sent into Mexico was ever put into operation. Some of the papers seized disclosed the activities of agents of the German Government who had been assembling wireless parts in the back of a store in Greenwich Street. During November several of the machinists working on the job, who were Americans, finding out what they were doing, quit their places, and when the owner of the property exhibited curiosity as to what was being done on the premises the "factory" was moved to another house in Greenwich Street, where, the police said, the outer room was disguised as the office of a tea and coffee importing house.

It is not clear why the German electrical concern which Perissi represented did not manufacture wireless plants in Germany instead of here. The police and detectives have found at least 150 plans for wireless outfits, drawn in great detail, and they have also found that all the plans and bills were approved by one man, supposedly a German agent, whose name is withheld until it is assured that he is not in New York. The authorities consider it probable that he is in Mexico. He is believed to have been assigned by the German Government to the task of establishing a system of wireless communication between America and Germany by means of stations in Mexico and Central America.

While the authorities feel confident that the German attempt to send wireless outfits from New York to Mexico was a failure, they are not confident that outfits were not sent to Central American countries and set up. There have been frequent reports of powerful wireless plants working from Central America, and some months ago the authorities at Colon found a complete outfit destined to a Central American consignee.

In view of this condition it would be interesting to know what steps have been taken to detect possible operations of Central American outfits of German origin. What the lay public may accept as reassurances are not so reassuring to wireless men. As an instance, the official word of Mexico that no station in that country exceeded 625 miles in transmitting range sounds impressive. But this distance spanned, with an ocean relay or two, would carry a message to Berlin. And so far as incoming instructions are concerned there are certainly no difficulties in receiving from Germany or hostile vessels and putting the messages over the border on short wave-lengths, undetected by naval stations. An espionage system made up from amateur stations now inactive would certainly detect in short order strange spark notes, if these existed, for the amateur man is familiar by long practice with virtually every note within his receiving range.

Once the bustle of war preparation subsides, the question of utilizing the valuable amateur receiving equipment will be a pertinent subject for Government consideration. At the proper time representative men in the experimental field should be summoned as a committee to work this out on a practical basis. Meanwhile, amateurs may be of real service in reporting promptly anything of a suspicious nature in wireless equipment. Several cases have been so reported to The Wireless Age and prompt action has been taken by the authorities in the various districts from which the information was supplied.

WIRELESS INVALUABLE IN WORLD EVENT

THROUGH correspondence from Bassett Digby in Stockholm an explanation is given why the United States was puzzled over the fact that the first announcements of the Russian revolution reached America from the Nauen wireless station, by way of Sayville, L. I., thus coming from Berlin. The explanation is quite simple.

The first word about the revolution, despatched by the Petrograd Telegraph Agency, was sent by wireless. It reached every capital in Europe simultaneously. The news at once went into print for home consumption in the neutral countries, Germany, and Austria. Some of the entente allies, however, including Britain, held up publication until they received confirmation from the ambassadors at Petrograd. British censors held up all news cables from neutral countries to America which dealt with the revolution until the Foreign Office got a wire from Sir George Buchanan, on the strength of which Bonar Law made his famous declaration to the commons of the abdication of the czar.

In the meanwhile Berlin, free of these restraints, relayed the message to Sayville by wireless.

Had not Marconi invented wireless telegraphy the Russian revolution would have been far bloodier—and it might not have succeeded.

Wireless played a tremendously important part in the democratic upheaval that freed the Russian people from the shackles of the old regime.

There was a period of grave danger in Petrograd when the revolutionaries seemed to be getting the upper hand and the adherents of the czar's corrupt ministry sought to hide themselves. For some hours the wireless stations in the capital were left without authorized supervision or direction. Any group of armed men representing themselves to be delegates of the Duma and producing forged authorizations could have taken charge and directed the despatch of military secrets invaluable to the German army. Such messages need not have aroused the suspicions of the operators, for they could have been in code.

Tidings of this emergency came to the ears of the war committee at the Duma, which immediately formed a wireless division in charge of Captain Roder.

First, strict control was gained over the stations in Petrograd and Finland. Then, one by one, the outlying wireless stations of the empire were talked to and won over to the side of the revolutionaries. In many of these outlying stations the old regime still held sway; the town and provincial governors were not yet dismissed. The stations agreed to accept any amount of messages from them, but merely to spike them without transmission. Thus cohesion between the governors was badly damaged.

In a few hours the Duma was in free communication with the wireless stations in Finland, Tsarskoe Selo, Moscow, Kronstadt, Turkestan, and Siberia. It was in close touch, too, with the Baltic and Black Sea fleets, and the naval station at Vladivostock.

Not taking any chances, the Duma rigged up a special supplementary station at its Tauris palace headquarters, so that should squads of Protopopoff's gendarmerie temporarily regain possession of the regular city stations communication with the world would still be possible. The Duma station was kept busy receiving foreign news and despatches from diplomatic sources in the allied countries to the west.

Telegraph and telephone service all over Russia in the meanwhile was broken or badly disorganized. The Duma station was used not only by the provisional government, but by the obstreperous and anarchic council of soldiers and labor deputies.

THE UNUSUAL EMPLOYMENT OF RADIO AT THE FRONT

FROM the same source comes an interesting description given by a Russian officer of one of the numerous little mobile field wireless outfits operating near the front. The whole wireless station can be unloaded from its auto truck, rigged up and be ready for work in twenty minutes. The seventy foot masts are hollow and made in sections which are screwed together when taken off the truck.

The simple peasant soldiers, many of whom come from remote villages where wireless has never been heard of, are greatly fascinated by the station and like to stand around when they can get a chance and watch the flashing of the spark and listen to its song. "It sounds like butter in a frying pan," they say. They have coined a nickname for the men in the wireless crew, which, as near as possible in English, is "sparkers" or "the spark men."

Normally the station is quiet. In the little cabin, canvas walled and canvas roofed, sits an operator with a telephone cap clamped to his head, always waiting for instructions from "the line," which is another name the Russians have for the trenches.

Often it is absolutely quiet outside in the starry night around the station. Not a shot breaks the stillness. But through the operator's phone comes the uproar of rifle and machine guns, and the bombardments of the heavy batteries, for messages are phoned to him for transmission from dugouts right up on the firing line of the front, twenty or thirty miles away.

These little stations catch the entente's daily communiques, and those of the German and Austrian general staffs. They come at definite times. Sometimes one sees the operator hurriedly finishing a meal or refusing a third glass of tea. He explains that French headquarters will want to talk with him in a few minutes. And, sure enough, in a few minutes along comes France's communique. It is odd to stand a little way off and, glancing at the forlorn canvas hut and its two sticks, lost in the drifted snows, with no other signs of life in sight, hear the aerial voices of all Europe.

Officers visiting the station make a point of getting the right time. The operator nightly sets his watch by the midnight time signal flung out by the Eiffel tower in Paris.

The longest official communiques sent through the air every day are those of the Germans. They are signed by Ludendorf. From Germany, too, every day comes the Radio Gazette, in condensed form—a sort of aerial condensed newspaper, which is dilated and worked up into the daily flysheet newspapers distributed to the German troops on all the fronts.

The station does not have much to do at times of lull on the front, as then all the staffs are linked by telephone and telegraph wire. Its busy times come during the battles.

Some of the mobile stations do much service with floating cavalry units, by which they are prized. During the great Russian advance in Volhynia and Galicia last summer, for instance, cavalry squadrons kept in touch with their bases while pursuing the retreating Austrians almost exclusively by means of these auto wireless outfits that accompanied them wherever they went.

—The Editor.

INTERFERENCE BETWEEN RADIO STATIONS

ITS CAUSES, EFFECTS AND CURES

A Guide Compiled from Expert Opinion on this Important Subject

Part II of the Series, The Control of Wireless—Federal Government Monopoly or Private Enterprise?

Does interference between wireless stations of the United States Navy and those of the commercial companies prevail to a degree that their work is hampered? Is it avoidable? Who is to blame? Does it warrant the taking over by the Government of all commercial stations? Is its existence an incentive for the development of technical discovery and invention?

The following pages present an exhaustive review of all the arguments made on this subject, as brought out in the recent hearings before the Committee of the House of Representatives, held to decide the merits of the proposed bill for the regulation of radio communication.

The Government view was presented by leading members of the Administration and prominent naval officers.

The views held by scientists and heads of the commercial companies were advanced by men eminent in the field of wireless research and officials of wireless companies.

The testimony of Government witnesses is printed in Roman.

The testimony of those favoring the maintenance of private control of wireless enterprise is printed in italics.

Following is a list identifying those who expressed their views on the subject:

Hon. Josephus Daniels, Secretary of the Navy.

Professor Alfred H. Goldsmith, professor in Physics at the College of the City of New York.

George H. Clark, expert aid for the Bureau of Steam Engineering, Navy Department.

David Sarnoff, commercial manager of the Marconi Wireless Telegraph Company of America.

Hon. William C. Redfield, Secretary of Commerce.

Professor M. I. Pupin, of Columbia University.

Dr. L. W. Austin, expert in radio telegraphy for the Navy Department.

Professor Arthur E. Kennelly, of Harvard University.

Lieutenant S. C. Hooper, United States Navy.

Commander D. W. Todd, United States Navy.

George S. Davis, general superintendent wireless department, United Fruit Company.

Hon. Newton D. Baker, Secretary of War.

Professor Charles F. Marvin, Chief of the United States Weather Bureau.

Lieutenant R. R. Waesche, United States Coast Guard.

Captain W. H. G. Bullard, United States Navy.

Secretary Daniels: This mutual interference between stations has always been a very serious question. Many inventors have been and are working on the problem and great improvements in apparatus and methods have resulted, but the number of installations and the consequent extension of radio communication have increased faster than science has increased its possibilities as regards non-interference, while the constantly increasing distances over which these communications take place increase the difficulty to a very great extent. The net result is that the number of communications that can take place at the same time in a given area is still limited. One station or system must wait for another to finish; there are many chances for disputes, which sometimes are carried on between operators by radio, especially when the operators are not under strict control, adding to the time wasted. There is needless duplication of effort, and in cases of distress the confusion resulting from many interests attempting to render aid, get news, or satisfy curiosity, is very dangerous. To permit the greatest amount of business, Government and commercial, being done through consistent changes in apparatus, through systematic apportionment of and prompt and frequent changes of wave-lengths, and through standardized methods of operating, one management is necessary.

Professor Goldsmith: *The proposed act is untimely and useless as a means of eliminating interference, which should not be legislated out of existence by the extinction of healthy development, but avoided by sound engineering expedience. The success of the latter method of procedure is unanswerably demonstrated by the remarkable development of the wire telephone field along engineering lines. The proposed act is in this regard to the last degree reactionary and unimaginative.*

Secretary Baker: The transmission of wireless messages is a thing in which interferences are so destructive that unless somebody controls the means of transmission, nobody can succeed in it.

Professor Pupin: *If interferences exist on account of the present imperfection of the wireless art, then these interferences should be eliminated, not by legislation, but by perfection of the art.*

Commander Todd: Some gentlemen state positively that, with their devices, it is quite possible to have as many conversations as there are telephone wires, or something like that. They have been saying that since about 1909, but they have not yet been able to demonstrate the practicability of their devices. We still have the interference. These inventions are still just about to be given to us.

Professor Goldsmith: *The problem of interference is sure to be solved in the near future by technical means now under development by the companies, through such expedients as sustained wave radiation, beat reception, and certain other methods not as yet published.*

SECRETARY REDFIELD ON THE DISADVANTAGES OF TWO SYSTEMS

Secretary Redfield: The two systems of coastal stations, one owned and operated by the Navy Department and the other by private companies, not only involve an economic waste to the people of the United States, who must support directly or indirectly both of them, but they also at times and in places interfere with each other, and prevent each other from efficient operation, owing to the imperfect development of the art of radio communication. Each deprives the other to an extent and at various times and places of its full measure of usefulness.

Professor Pupin: *In April, 1914, when our bluejackets had landed in Vera Cruz, the Navy could not force a message through between Arlington, or even Key West, and Vera Cruz. It was impossible, not because the Mexicans had a wireless apparatus which interfered with ours, and not because anybody else had* *it, but because there the static was going on in the Gulf of Mexico and prevented our messages from reaching Vera Cruz. Interference in wireless telegraphy due to static, is so serious that sometimes a wireless station can not receive a message for forty-eight hours or even twice forty-eight hours. These are the most serious interferences we have, and you cannot get rid of them by legislation. The only way to get rid of them is by perfection in the wireless art.*

Lieutenant Hooper: I have come to the belief that the interference question is absolutely unsolvable except by Government ownership of coast stations. It can always be proved, apparently, by the scientists, that we should not have any interference, but it cannot be done. In the operation there is interference all the time between the ships, between ship and shore stations, and between rival shore stations, and there always will be unless the Government takes over the coastal stations. I have heard it stated, even recently, that there is no interference between the Navy and shore stations, and yet you can go into any locality at any time and see that there is the most serious interference. You have two or three stations in a restricted area, and one has to wait until the other gets through. It would be much more efficient if you had just the one station there handling all the work, and there would not be any argument about it any time.

SUPPRESSION OF COMMERCIAL STATIONS WOULD NOT SOLVE THE PROBLEM

Professor Kennelly: *So soon as you have scrapped and suppressed the power stations, the commercial stations, you will still be bothered in the antiquated system in undisputed control of the Navy that no longer has interference from power stations—it will still be bothered by this man here and this little amateur there. The whole system will be one of repression and star-chamber action and confiscation.*

If you will go to some central radio station with a big tower anywhere in this country and listen in, you can hear hundreds of people talking to each other, most of them without any interference at all—only occasional interference. It is so when we are talking to each other in a room, using the same air. We have no quarrel, one against the other. We all have difficulties. The real difficulties are capable of being overcome.

Professor Marvin: As long as interference exists as at present, a proper distribution of the stations along the coast will improve conditions. In our Weather Bureau work we experience the ill effects of interference in the transmission of weather reports. There was a case reported a short time ago of a vessel trying to communicate its report to a Government coastal station, but could not do so on account of interference with one of the commercial stations operating at the same time. The commercial station was requested to desist, but declined to do so. These weather reports are made up at a certain hour in the morning and have to be forwarded at once. If they are received in time, we utilize them, but if they are delayed in transmission, our forecasts and warnings are issued without the information contained in those messages. And when those cases occur we do not know what the conditions at sea may be, and very great importance attaches to some of these reports. Naval vessels plying the coast, or merchant vessels, may know of conditions off the coast of which we have no knowledge, and the report from them, in conjunction with the reports from our land stations, gives us an idea of meteorological conditions that may enable us to send warnings of immense value to the shipping along the coast; whereas failure of a report of that kind to come through means a serious loss to the interests.

Mr. Davis: *Until the establishment of a system of stations by the United Fruit Company, there were no adequate means of getting information to the Weather Bureau in regard to storms or approaching storms which cross these waters at certain seasons of the year. I refer particularly to the hurricanes* *which pass up through the Caribbean Sea and the Gulf during the late summer months, and which have proven so disastrous to shipping and to the cities of New Orleans and Galveston and, in fact, to the entire Gulf coast. It is almost entirely through the fruit company's system of stations (and I think that the Weather Bureau will bear me out in this statement) that they are enabled to receive these observations in time to issue warnings which have saved millions of dollars in shipping in the Gulf and Caribbean Sea. True, there is still room for improvement in this service, and we are taking steps to the end that these "observer" messages on which the Weather Bureau bases their forecasts can be dispatched from any point in the Caribbean Sea to New Orleans, and thence to Washington in the shortest possible space of time after they are made. Some of these messages are sent in via the naval station at Guantanamo, but the great majority come in through stations of the fruit company's system.*

The relative opportunities for naval men and civilian scientists becoming wireless experts is covered by the remarks of:

Commander Todd: Ordinarily, in my position, I would stay fully three years ashore. My predecessor stayed nearly four years, but that was very unusual.

Having this matter in charge, I could stay longer by special arrangement.

But it would jeopardize my career. I might make myself a sort of a radio scientist and a very poor naval officer. I must go to sea to learn my profession and to keep in the game, so to speak. We are all anxious to be known as seagoing officers, efficient on board ship above all else.

Professor Kennelly: *Take Captain Bullard. He was in charge of this naval radio station service up to a little while ago. Where is he now? I understand that the Navy Department has called him away, and he has forgotten all about this wireless subject by now. And by the time he is through serving on his ship, in his line of duty, he will find himself behind in the art. Are you going to put this art into the hands of officers who will be taken from one post to another and have all of their efforts thrown to the winds?*

Dr. Austin: The claim is made that if these scientists were left to themselves they would solve this problem of interference; but of course we all know it has not been solved; and that it is only by regulation and control by one central body that successful working can be carried on. And a more complete control would, in my opinion, give even better conditions of working than those which we have to-day.

How Interference Brought About Telephone Improvements

Professor Kennelly: *It was in America that all the important improvements have come about in the telephone as a direct result of interference. In the early days of the telephone you could not talk to your neighbor without hearing all the neighborhood. Inventors came forward, all the brightest minds in the telephonic art were stimulated to do something to overcome this difficulty. But now if you are going to introduce a plan to suppress this interference because it has been causing a little trouble and been preventing some one Government officer from hearing another Government officer, of course, you will have a fool's paradise for the time being. But what of the hereafter?*

Lieutenant Hooper: The radio art is in its infancy now and there are a few big stations, but if they are allowed to go on increasing in number nobody will be able to work at all. It is something you can not see, and therefore you do not realize the conditions that exist. If you saw two trains trying to pass each other on the same track you would not permit it; it would be stopped right away. This is a similar condition; but you do not see it and therefore the seriousness of it does not dawn on you.

Professor Pupin: *Ordinary telegraphy and telephony by wires had the same experience in their early history as we are having in the wireless art. They had inductive disturbances of two different kinds, those produced in a wire by the operation of other wires, and inductive disturbances produced by God. Now although it is possible to get around the inductive disturbances produced by man through legislation, you can not get around those created by God, by means of legislation.*

Commander Todd: We must have flexibility in our range of wave-lengths in order to get away from the intentional interference of the ships of the enemy. The enemy will attempt to break up all our communication by sending signals on the same wave lengths we use. Therefore we must have a wide range of wave lengths from which to choose, and methods for shifting from one to another every few signals, if necessary, and in that way to keep ahead of them. It is understood that some nations have elaborate arrangements for interfering, and they have arrangements by which they can, at the same time they are interfering, get through their own communications. All this has been studied. We are doing the same thing and trying to do it better.

Government Ownership of No Avail in This War Emergency

Professor Pupin: *What legislation is going to prevent the enemy in time of war, from interfering with us? It is told by the English wireless operators who took part in the battle off Falkland Islands, that the Germans, as soon as the battle started, went up and down the scale of their wireless sparks for the purpose of making it impossible for the English ships belonging to that squadron to communicate with each other. How could any act of legislation or Government ownership have prevented that?*

Commander Todd: Unless Government ownership is accomplished, the time will come when one station will insist on saying that it has as much right to work as another station. Where interference is greatest, there are ordinarily three interests involved, the Navy and two others. We have a situation like that in New Orleans, another one on the west coast, in San Francisco, and are soon to have one in Hawaii. Their interests are involved, but without some special arrangements the stations can not work satisfactorily. All three, or more, stations could send together and all could receive together on different wave-lengths. This would make them come to terms with us. If they insisted on working or combined to divide up all the time between themselves, the Government stations could fall back on this and require them to give the Government communications half the time and relieve the Government stations of the necessity of "fighting for the air." There is no dignity in that.

Professor Pupin: *Let us have a committee, such as the National Advisory Committee for Aeronautics appointed by the Government. Let us have four Army and Navy men, four Government officials and four university men. And I think it would be all right to have some men representing the operating companies. Then when it comes to regulating the wireless art for the purpose of avoiding interference with the operations of the Army and Navy, we will have one motive in every member of that committee, the motive of patriotism, which will sweep everything else aside. We want to help the Army and Navy. We do not want to interfere with them.*

Lieutenant Hooper: I went to Key West and while I was attempting to work with one of our ships from the Key West naval radio station, one of the merchant ships passing close by Key West started to call the Marconi station at Tampa, Fla., which is several hundred miles away from Key West, and I was unable to receive anything from the ship I was attempting to work with, several hundred miles away, because the ship close by would insist on calling a station some distance away and trying to work with it, knowingly interfering, in spite of the international regulations. The ship close by should really have given her message to me as being the nearest coastal station; but the ships have operators who are loyal to the concerns for which they work. For example, if they are working for the Marconi company, they won't give their message to the nearest coastal station at all times, if by any possibility they can work with a Marconi station. In this case the passing ship should have given her message to Key West. They were within ten miles of Key West, but they did not do that, the operator insisting on calling a station 300 miles away and making so much noise I could not work with any ship, even the one which should have logically worked with me. If they had given the message to me at Key West, they could have done it on low power and it would have made no trouble.

Commercial Stations Superior To Those of the Navy

Mr. Sarnoff: *I say without hesitation that if the coastal stations in the United States are turned over to the Navy Department the service rendered from ship to shore will be highly inefficient, and there is no doubt about that statement. I have listened to the operations of the Navy wireless stations; I have heard them work with ships at sea and with other stations, and at the same time I have heard the commercial operators working with ships at sea and shore stations. The comparison is about from 25 to 75 per cent. in favor of the commercial station, and any good telegraph man who has handled the traffic will bear me out in that statement.*

Commander Todd: If the high-power stations of the commercial companies could work without interfering with the Government's high-power stations, in all circumstances, all would be right. The inventors and scientists are promising us immunity from this interference, promising us more communication in a given area. And they are succeeding to some extent. The apparatus is very much improved. But we are still far from getting so that we can have a great number of communications. The field is limited, and for that reason they cannot work many high-power stations without actual interference.

Professor Pupin: *If I had my own way I should produce as many interferences as I possibly could, for the purposes of development of the art, so that no ingenuity of man could interfere with a wireless operator when he receives. Things are being done to-day by well organized industrial research laboratories which will undoubtedly lead to wonderful results so far as preventing interferences produced by the acts of man are concerned.*

Captain Bullard: What we are concerned in primarily, and the basic principle of this bill, as I understand, is the prevention of interference with ships at sea, so that we can get messages to ships at sea, where there are no other means of communication with them.

Mr. Davis: *To facilitate radio work in general, to and from ships at sea in particular, no one questions but that the complete elimination of interference would facilitate it, but such elimination must come—as it has been coming for the past 10 or 12 years—by the development of science, due to keen competition and the hope of large returns by scientists and inventors which warrant their spending considerable sums in making experiments, rather than through control by any single administration or company.*

Mr. Clark: Now, a point I wish to bring out is that it is not the ship stations that are interfering. We are not claiming that. It is the shore stations that are interfering with the ships and with each other, as well as with the Navy. Commander Todd will show you a chart indicating how congested the wave-length situation is at the present time between 600 and 15,000 meters. All we desire is to bring the shore stations into harmony so that they will not intentionally or unintentionally interfere with each other. When this chart is shown and the suggestion which is evident is likewise shown, I think the necessity for regulation will be very clear.

Mr. Sarnoff: *When interference does occur, the majority of it must occur from ships, because there are more ship stations than there are coast stations. The proposed bill does not touch upon that question at all. It does not correct the condition in regard to the 600-meter wave length nor the 300-meter wave length, which is insufficient. If the Navy does take over the coastal stations, it will still have to handle the same volume of traffic that is handled by the commercial companies. The time limit will not be cut down, but it will be increased because of inefficient operation on the part of Navy operators. Therefore, how will it aid in solving the problem of interference?*

Lieutenant Waesche: There are a number of cases on record where delay in rendering assistance to vessels in distress has been caused by interference; in other words, the radio stations have not been able to disseminate this information quickly. Coast-guard cutters, being small vessels, cannot use effectively a wave-length of 1,800 meters, or greater, and therefore we are more or less bound by the London Convention to send all of our official traffic to the nearest coastal station. As a result, official business of the Government has to be carried on at times through commercial stations. If the Government controlled that commercial station, we would not have this interference, and would get better results, due to this close co-operation and due to their understanding our work, knowing exactly what to do with the messages when they got them, how to handle distress calls, and where our vessels are located, and all that, which would not be possible with the commercial companies.

Mr. Davis: *There are two things that make that interference—one is the sending of messages and the other is the law itself which requires you to use a certain wave-length for sending those messages. Now Government ownership is not going to reduce the number of messages sent; neither is it going to change the law. So that I do not see that we will be any better off, as far as interference is concerned, with Government ownership than we are now; in fact, either under the control of any one company or a Government department.*

LIEUTENANT HOOPER ON THE ADVANTAGES OF NAVAL WIRELESS

Lieutenant Hooper: There are a good many troubles because the commercial operators won't recognize any one coastal station as the controlling station. The commercial operators think that the commercial only ought to control, and they won't pay any attention sometimes to the naval station when they are told to keep quiet; and the naval operator will think that the naval station ought to control the situation and won't pay any attention to the commercial station. When the question of interference has to be settled immediately on account of a distress call, both sides try to take charge and refuse to give way to the other. That happens right along. I have heard a ship make an S O S, and then a disgraceful condition would follow where several shore stations attempted to communicate with the ship, and several ships and the nearest naval station and the nearest commercial station would all try to take control of the situation and nobody would obey orders from anywhere. Now there has got to be one company running the whole business; it has got to be the Navy or some commercial company, and then the operators will respect the rules of that one company. The Navy is better qualified to do it because the Navy operators are disciplined; they understand that they have to carry out orders; the military service always does have more disciplined employees.

Radio Science

RADIO CONTROLLED TORPEDO

CONTROL of a torpedo by wireless from shore or a distant point has been the subject of investigation by Arthur E. Ericson, of Manchester, Mass., the resulting mechanism having as its distinguishing feature the use of two distinct wave-lengths in transmitting control signals and two separately tuned receivers for operating the torpedo's steering mechanism.

In radiodynamics the selectivity problem is the greatest, and the invention illustrated seeks to overcome operation of the selective receiver by a hostile

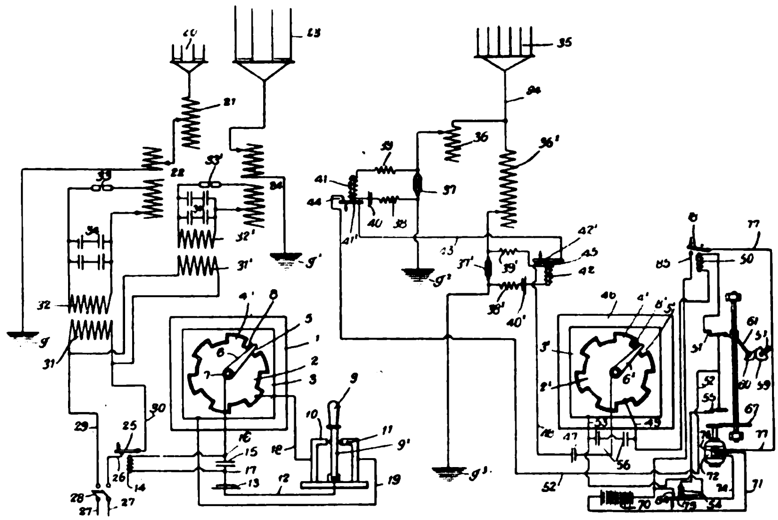


Figure 1—Sending station control *Figure 2—Torpedo control*

transmitter setting up forced oscillations. Under Mr. Ericson's plan an enemy transmitter must be capable of sending simultaneously two waves of exactly the same length employed in controlling the torpedo, otherwise the direction of the torpedo as gauged from the shore control would be little influenced by malicious interference. The great improbability of hostile stations being able to emit two waves of exactly corresponding length adds interest to this device.

The receiving station, or torpedo, is provided with cut-out devices, whereby the steering motor circuit is automatically broken whenever the rudder has been operated into its hardover position, either to port or starboard, so that further impulses designed to turn the rudder to the port or starboard side will have no effect when the rudder is already in its extreme position to that side.

For rotating the rudder a reversible motor is provided; this is connected, in one direction or the other, to a source of current by the energizing of one or the other of its controlling relays. The rotation of this motor in one direction or the other causes the rotation of a threaded rod upon which is mounted a threaded block which travels back and forth by the rotation of the rod, the block being connected to the rudder to rotate the latter in one direction or the other as the block travels in forward or reverse direction upon the rod.

At both sending and receiving stations, use is made of synchronously rotating contact makers, which alternately pass over contacts of a first and a second series, termed the "left contacts" and the "right contacts". A controlling switch at the sending station has two positions, in one of which a local circuit is completed to energize a controlling relay when the contact maker is in engagement with any contact or segment of the first series. When the switch is in the other circuit-closing position, the relay is energized when the contact maker engages any contact of the second series. Radio impulses are emitted while the controlling relay is energized. The radio waves received on the torpedo, or other unit to be controlled, cause the energizing of one or another of two relays, in accordance with the position of the controlling switch at the sending station. When the controlling switch is in its "left" position, impulses are sent out during the times the contact maker at the sending station is in engagement with the contacts of the left series. During such intervals of time, the corresponding relay at the receiving station on the torpedo is energized, resulting in the energizing of a local circuit, which causes the rotation of the rudder in proper direction to turn the torpedo to the left. When the controlling switch at the sending station is in its "right" position, radio impulses are sent out during the intervals of time in which the sending contact maker engages the contacts of the right series, during which time the other relay at the receiving station is energized, resulting in the closing of a local circuit, whereby the rudder is rotated in the opposite direction.

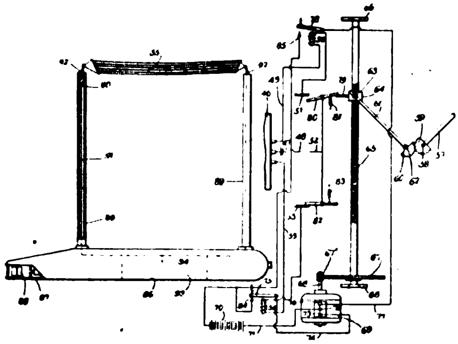
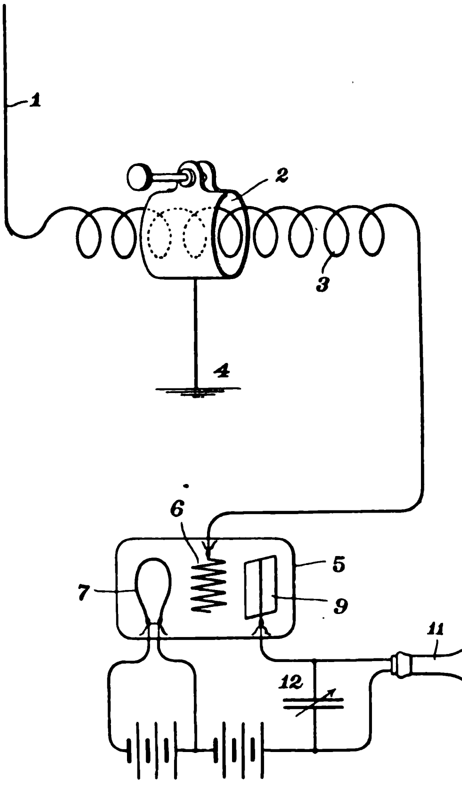


Figure 3—Rudder control of torpedo

NOVEL DESIGN IN RECEIVERS

Selectivity in wireless receiving apparatus, in combination with an improved method of amplifying signals, is the contribution of Elmer E. Bucher in a receiving method recently devised. The usual method of obtaining resonance in a receiver is superceded by the use of a metallic sheet or cylinder in electrostatic relation with a tuning coil, to one end of which is connected the vacuum valve detector. By adjustment of the cylinder shown in the accompanying diagram, a point will be found on the coil where resonance is obtained with the distant transmitter,



Circuit diagram of receiver

or at which the maximum potential is impressed upon the grid element of the valve shown at 6 in the accompanying drawing. This novel form of circuit connection to the detector is found to act as an amplifier of signals.

The merit of the method of varying the inductance of the antenna circuit is its simplicity, the multipoint switch and the usual sliding contact being dispensed with. In relation to the latter, it is noted that mechanical wear on the wire is reduced to a minimum and breaking soldered connections to inductance changing switches eliminated.

This system of tuning has obvious value for portable apparatus of military type which is subject to shock and vibration.

STRADA'S WIRELESS

by F. A. Hassler

AND who was Strada? The writer has tried to find out. All he knows is that the great Scottish Judge, Lord Kames (1696-1782), in his "Elements of Criticism," wrote that "Strada's Belgic History is full of poetical images, which, discording with the subject, are unpleasant, and they have a still worse effect, by giving an air of fiction to a genuine history." The rest of his remarks upon the Belgic historian do not concern us at this time.

From March 1st, 1711, to December 6th, 1712, the English people were daily instructed and amused by "The Spectator," which was conducted by Joseph Addison and Sir Richard Steele. A copy of the first edition of this work published in this country lies before me and in the number for December 6th, 1711, I read as follows:

"Strada, in one of his prolusions, gives an account of a chimerical correspondence between two friends by the help of a certain loadstone, which had such virtue in it, that if it touched two of several needles, when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time, and in the same manner."

Then we are told that these two friends each made dial-plates exactly alike, having letters of the alphabet instead of numbers upon their surface, and arranged the needles in a manner similar to the hands of a clock. These needles were placed on pivots so that they could move easily and point to any letter desired. No matter how many miles the friends were separated they could converse by simply moving the needles to any letter they wished.

Marconi—Man of Action

His Visit to This Country Reveals the Large Part He Has Taken in the World War

The degree of Doctor of Science was recently conferred upon Guglielmo Marconi by Columbia University. This photograph shows the inventor and Professor Benjamin Lawrence

A BRIEF explanation of the purpose of the Italian Missions' visit to this country was given by Guglielmo Marconi, a member of that mission, soon after his arrival in Washington.

"The purpose of this mission to America, of which I happen to be a member, is primarily to pay the respects of our country to President Wilson and to assure you all, through him, what a tremendous confirmation of all our faith of the last two years it is to have this nation of a hundred million people come to make common cause with us." said the inventor.

"We also intend to tell you how you can help us in many material ways other than your participation with troops and fleets. We need your coal and wheat and shipping now, but beyond that we hope to demonstrate to you that Italy will need your enterprise and capital after the war to do what the Germans have done heretofore in developing our industries. We want America to come to Italy to help us solve our industrial problems, as so many hundreds of thousands of our people have been coming to America to help you solve your problems by furnishing the labor. I believe that this emigration to America will be resumed as soon as the war is over, for even then Italy will have a surplus population. But in return for that we need your money and your organizing and inventive ability. Let a better understanding between the countries in these matters be one of the products to grow out of the war. Let the word America in Italy stand for what the word Germany has stood for, in a business way, in the past."

Referring to technical military problems, Mr. Marconi remarked that Italy had the most difficult front in Europe.

It is 540 kilometers long, and much of it extends over mountains 10,000 feet in height. To maintain this and to advance our lines, as the Italian armies have been doing very vigorously since the arrival of this mission in America, 4,000,000 men are under arms. Mr. Marconi explained that at the beginning of our participation. which was at a time when things were not going well with the Allies (that is significant of our motives), we were able to send enough men to the frontier to force Austria to divert 300,000 men from her operations against the then retreating Russians. Our entry into the war at that particular moment made the Russian retreat less disastrous than it otherwise would have been. That has been, for the most part, the nature of the military service which Italy has rendered her allies. She has kept engaged hundreds of thousands of troops who but for Italy would have been available for operations on the west and east fronts.

It has not been generally known that Italy gave Russia 300,000 rifles, millions of cartridges and thousands of motor lorries for her transport service. Mr. Marconi's personal participation in securing these in time for the Brusiloff advance is disclosed in the following letter which he received from the late Earl Kitchener:

War Office, 20th December, 1915.

Dear Sir William Marconi:

I am glad to learn from your letter of the 6th inst. that you have been so successful in your efforts to organize the manufacture of cartridges for the rifles which your Government has lent to Russia. General Delmé-Radcliffe has told me how invaluable your influence and advice have been, and I thank you most heartily for the great trouble which you have taken in this matter. It is of great value to know that I may rely on further help from you should the occasion arise, and I greatly appreciate your kind offer.

The question of the shipment of the cartridges from America is being gone into, and arrangements will probably be made to include them in shipments of other Russian supplies from that country. Perhaps it will be more convenient if we communicate direct with the Italian War Office on this point as soon as we are in a position to make a definite proposal.

With renewed thanks for all your help, believe me, yours very truly,

(Signed) KITCHENER.

The House of Representatives in Washington gave an enthusiastic reception to the inventor on June 2nd; the members of the commission were likewise cordially welcomed, but only the Prince of Udine and Mr. Marconi made speeches. Mr. Marconi said in part:

"It is my privilige to have lived in America for many years, and I flatter myself that I know Americans very well. I have learned to appreciate in America two things that I can express in two words—justice and fair play. You are ready to back anything that you think may be of good to the world, and you are ready to encourage any honest endeavor to advance science or the applications of science, and, although you are the greatest industrial nation in the world, although there is healthy competition—and it is only by that healthy competition there can be such progress—what you do here is always fair. I can say that with absolute conviction from the bottom of my heart."

France has sent three technical experts from her postal service to confer with the United States authorities on wireless and wire interference in war time. Seated at the table is Lieutenant Colonel J. B. Pomey, chief engineer of the Post Office Department; on the left is Lieutenant L. Routhillon, engineer, wireless service; on the right is Captain G. Valensi, engineer, research section

Four days later the father of wireless attended the commencement exercises at Columbia University, in New York. The inventor was among the candidates for honorary degrees. In presenting Marconi Dr. Butler said:

"Guglielmo Marconi—Plenipotentiary of the Italian Government in delicate and important negotiations relative to the war in which our countries are jointly engaged on behalf of free institutions; to whom has been granted the almost superhuman power to give wings to words that they may fly to the uttermost parts of the earth bearing messages from and to the heart of man, and whose name has already become a common noun, I gladly admit you to the degree of Doctor of Science in this university."

Mr. Marconi already possesses degrees from Oxford, Glasgow, Aberdeen, Liverpool and Pennsylvania, and besides being a senator and commissioned officer in the army and navy of Italy, has had bestowed upon him by the King of England the Honorary Knighthood of the Grand Cross of the Victorian Order.

Opportunity for Special Service!

THE Signal Enlisted Reserve Corps of the United States Army needs several thousand trained electrical men, particularly those experienced in radio work, including operators, construction men, maintenance men and electricians, and presents an exceptional chance for service. Ten Field Battalions are now being organized in the Eastern Department of the United States Army and it is expected that they will be mobilized in the near future.

The Signal Enlisted Reserve Corps, which will be a part of the new National Army, comprises both Field and Telegraph Battalions, the former serving with the various divisional headquarters in the field and the latter maintaining communication with interior bases.

The "Nerves of the Army" is a name aptly applied to this very necessary branch of the military service, with its lines of communication between the Commanding General of the Division and his cavalry, artillery and infantry brigades, as well as with regimental and battalion headquarters. In their electrical work the Signal Corps Field battalions maintain telegraph, telephone and radio communication, while in visual signaling they use wig-wag and semaphore flags and heliograph, in the day time; and at night flashlight and lantern.

In signaling parties, three or four men are often employed and there are, therefore, a large proportion of non-commissioned grades, such as Sergeants and Corporals. Competent men have excellent chances for promotion.

The Enlisted Reserve Corps is composed of men from 18 to 45 years of age, and is subject to only 15 days' annual service in peace, while in war time it may be called at the discretion of the President. Pay corresponds to the Regular Army, and uniforms are furnished as well as transportation to place of mobilization.

Enlistment for this exceptionally attractive arm of the service may be made by applying to the Signal Officers of the various Departments of the United States Army, as follows:

Eastern Department, Army Building, 39 Whitehall St., New York, N. Y.
Central Department, Federal Building, Chicago, Ill.
Northeastern Department, Nottingham Chambers, Boston, Mass.
Southeastern Department, People's Bank Building, Charleston, S. C.
Southern Department, Ft. Sam Houston, San Antonio, Tex.
Western Department, San Francisco, Cal.

Signal Officers' Training Course

A Wartime Instruction Series for Advanced Amateurs Preparing for U. S. Army Service

SECOND ARTICLE

By MAJOR J. ANDREW WHITE

Chief Signal Officer, Junior American Guard

THE past few weeks have seen the realization of many developments foreshadowed by predictions which have appeared in these pages. The demand for signalmen is increasing daily and, should the plans for the dominion of the air by airplanes be passed by Congress, the opportunities for radio men in the Signal Corps of the Army will surpass anything hitherto offered in the technical branches of the service.

Those among the readers of this magazine who are not of military age are face to face with the advisability of engaging in courses of intensive military study. The day of universal liability to service is at hand and military training is assured as a national obligation for future generations. The obvious advantage of securing admission to the signal service is disclosed not only in the higher rates of pay but in the unusual opportunities for promotion and recognition of technical skill.

The aviation section of the Army is a branch of the Signal Corps. At present its proportions are decidedly limited, but the probable extent of its future expansion is revealed in the following interview with Brigadier General George O. Squier, Chief Signal Officer of the Army and vice-president of the National Amateur Wireless Association. He had been quoted as being in favor of regiments and brigades of "winged cavalry" to put the "Yankee punch" into the war. Commenting on the $600,000,000 airplane building programme that is to be laid before Congress by the Council of National Defence, Gen. Squier said:

"By the 'Yankee punch' I mean a characteristically American way of working to get big results. We have a reputation of looking at old things from a new angle, and there is no reason why the American Army, when it takes the field, should not live up to what they stand for. The field of glory for us will be in the air, sending our myriads of airplanes over the German lines to teach Germany that we have come to win.

"Airplanes are the logical fighting machines for Americans, because we are an imaginative people, and when our imagination strikes fire nothing can stop us. We are impatient of plodding methods, a nation of individualists. We are willing to send our hundreds of thousands to the front if needs be to dig holes and burrow in the soil for interminable months, but we don't get enthusiastic over the idea. We want something that appeals to our knack for inventing things, for getting over obstacles in an original way. And the air way is our way.

"It might be of interest to point out that all of the picturesque features in the matter of invention and innovations of a startlingly modern nature have been, up to now, advertised exclusively by the German side of the European argument. The talk of coming Zeppelin raids, of artillery ponderously magnificent, of schools of U-boats was spread through Germany. Every housewife, every butcher boy in Germany impatiently awaited the results of the Kaiser's sensational inventions. And when Count Zeppelin's monsters went after England with bombs while 'Big Berthas' began dropping unbelievable gigantic shells into Belgium, it was a signal for the German spirit to go wild with patriotism.

"I haven't the slightest doubt of the Yankee's nerve and ability to endure any hardship as well as—perhaps better than—the citizens of any other country. But what I am considering is how to give American qualities to our brothers in arms at their maximum efficiency.

"The answer gained is airplanes and yet more airplanes. Every young American worthy of a name would be keen to join our flying army. The game ideally suits our national temperament. With the wealth we can devote and our unqualified facilities for manufacturing there is no reason in the world why we should not be able to produce in a comparatively short space of time an overwhelming aerial fleet.

"An army in the air, regiments and brigades of winged cavalry, mounted on gas driven flying horses, could blind the eyes of Germany until her gunners, absolutely deprived of range finders, would be put out of business by the Allied artillery.

"The modern type of land war is dependent upon two things above all others: aviation and artillery. They are co-operating elements in a fighting army, and against an enemy a flying machine is a terror and a menace to big guns. That airplanes are positively essential for directing artillery fire is an axiom among military men who have seen action in the sort of battles being fought on the Western front.

"The magnificently obvious thing, then, is to knock out Germany's eyes by a thrust through the air. But my idea would be something vastly larger than a thrust. An inundation of airplanes would better express the idea in its magnitude. Sweep the Germans from the sky, blind the Prussian cannons and the time would be ripe to release an enormous flock of flying fighters to raid and destroy military camps, ammunition depots, military establishments of all kinds. The idea is so vast that it would read like the dream of an old-fashioned fiction writer. No young boy could be concerned in a story of adventure more wonderful than this 'Yankee punch' should furnish to actual experience. And the Prussians have never dreamed of an expedition so mighty or so sensational. Our air programme should have the effect of working both ways—crushing the nerve out of Germany and inspiring our folks at home with renewed enthusiasm for the war.

"We have seen Germany time and again take 100,000 or 200,000 back or forth for the gain or loss of a little ground. Then there is more digging in, more building of shelters, more living in the mud and dust, burrowing like moles. Our young men cannot go wild over warfare in the trenches, however splendidly they will do their duty. But put the war into the air—and watch us fight!"

This message of inspiration should be the signal for every reader of the

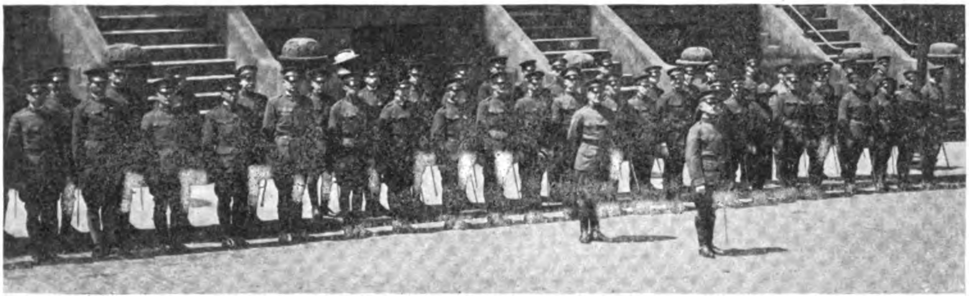
A demonstration of preparedness in New York; 1800 members of the Junior American Guard on parade

WIRELESS AGE to prepare. Wireless operators by the hundred are needed for the air program, young men in the best of physical condition and trained as military observers. More wireless operators and engineers will be needed at the field stations for receiving, in fact, as has been said before in these columns, every available amateur in the country can be used in Uncle Sam's fighting forces.

The process of training a civilian for military duty is more than a perfunctory one, however. Young men subject to the draft know that they will attend encampments for this purpose and remain there for months of arduous work before seeing service. It is well for the younger men to realize also that in this war, or one which may follow, their turn will eventually come. This is the time to prepare. The summer vacation season is here and the woods and fields call. The time formerly spent in enjoyable loafing or sportsmanship pursuits should be profitably devoted to mastering the rudiments of military training.

Probably the most effective and quickest way of accomplishing this is through placing local radio clubs on a military footing, or gathering together the amateurs of a neighborhood and organizing as a cadet signal corps company. Through the arrangements made by the National Amateur Wireless Association with the Junior American Guard the facilities of this organization are made available for all wireless men.

It is necessary only to secure the services of an ex-army man or National Guardsman of experience to take military command for purposes of instruction. A man of this type can usually be found in any community, failing which



The type of men who are preparing young Americans for military service in the future is illustrated in this view of the officers of the 1st Brigade, N. Y., Junior American Guard

attendance at summer cadet posts such as that of the Junior American Guard at Stony Point, N. Y., can be arranged for. Uniforms are necessary; the interest is best sustained and the purpose of military drill made clearer when all persons in the ranks present the same appearance. The cost is small; an excellent grade of khaki uniform, consisting of coat, breeches, cap and leggings may be secured from Junior American Guard headquarters, 52 Beaver Street, New York, for $3.85 or $4.00 delivered out of town. Instruction may then be immediately begun.

Recruits in the Signal Corps of the Army receive their first instruction as infantry, the purpose being to accustom men to act as one and obey commands without question. The initial step in the instruction is known as the School of the Soldier. This is very elementary instruction, but important because it teaches the recruit the courtesies of the service and how to stand, face and march when in ranks.

The extracts which follow are from the writer's "Military Signal Corps Manual," in which volume the instruction of individuals, squads, sections, companies and battalions is given in detail.

GENERAL PRINCIPLES AND OBJECT OF INSTRUCTION

The certain transmission of information and orders from commanding officers to their subordinates and information from subordinates to commanding officers, regardless of conditions or terrain (the country in which the military unit is operating), is the ultimate object of all training.

The instruction is designed to develop resourcefulness, initiative, and self-reliance for the Signal Corps men of all grades. The regulations prescribe the method of training in the ordinary duties of field companies and battalions of the Signal Corps, and all members must be so thoroughly drilled in these duties that in the excitement of action they may be performed readily, naturally, and as a matter of second nature.

Since varied conditions arise in handling signal corps troops, no hard and fast rules can be laid down to cover all conditions; much is left to the energy and ingenuity of the officers and noncommissioned officers.

Instruction must therefore be conducted with a view, first, to drilling the personnel thoroughly in their habitual duties; and second, to afford officers and men practical experience in dealing with the situations and difficulties which arise in campaign.

A progressive order is to be followed in all instruction, commencing with theoretical instruction in the smallest unit and proceeding to the larger one, culminating in field maneuvers.

Thorough training of the individual soldier is the basis of efficiency. Precision and attention to detail are required in this instruction, for from it the soldier must acquire that habit of implicit obedience to orders, and of accurate performance of his individual duties, which is the indispensable requisite for efficiency in combined training. Drills should be frequent, but short.

Recruits are assembled in small squads for the beginning of their instruction. As the instruction progresses it may be consistently carried on by sections, platoons, or by the entire company. This principle also applies to technical training, particularly to visual signaling, telegraphy and telephony. Grouping according to progress and efficiency should be strictly carried out; those who lack aptitude and quickness should be placed under experience instructors.

The training of the recruit includes instruction in the duties of sentinels, the care of equipment, packing of field kits, tent pitching, pistol practice and the customs and courtesies of the service, in addition to his training as a signalman.

The instructor of each unit is its immediate chief, and should be given all due latitude in conducting the instruction, and be held to strict accountability for results attained. The habit of self-reliance and a feeling of responsibility for the instruction of their respective units, as well as the proper feeling of pride in these, may thus be developed among the subordinate commanders.

The instructor always maintains a military bearing and by a quiet, firm demeanor, sets a proper example to the men. Faults should be corrected without nagging.

The drill regulations are furnished as the guide. In the interpretation of the regulations, the spirit must be sought. Quibbling over the minutiæ of form is indicative of failure to grasp the spirit. Drills and ceremonies are disciplinary exercises designed to teach precisive soldierly movements, and to inculcate that prompt subconscious obedience which is essential to proper military control. To this end, smartness and precision should be exacted in the execution of every detail.

GENERAL RULES

Movements that may be executed toward either flank, are explained as toward but one flank, it being necessary merely to substitute *left* for *right,* or the reverse, to have the explanation of the corresponding movement toward the other flank.

Any movement may be executed either from the halt, or when marching, unless otherwise prescribed.

All movements on foot not especially excepted may be executed in double time. If the movement be from the halt, or when marching in quick time, the command *double time* precedes the command *march;* if marching in double time, the command *double time* is omitted.

To hasten the execution of a movement begun in quick time, the command:

1. Double time. 2. MARCH is given. The leading or base unit continues to march at quick time, or remains at halt if already halted; the other units complete the execution of the movements at double time and then conform to the gait of the leading or base unit.

If, in forming elements abreast of each other, the command:

1. Company (platoon, etc.). 2. HALT be given during the movements, only those elements halt which have reached their new position; the others continue the march and halt on reaching their positions.

For the purpose of correcting errors while marching, the instructor may command

1. In place. 2. HALT, when all halt and stand fast. To resume the movement the commands:

1. Resume. 2. MARCH, are given.

To revoke a preparatory command, or being at a halt, to begin anew a movement improperly begun, the instructor commands: "as you were," at which the movement ceases and the former position is resumed.

The first essentials of military drill, as given to the recruit before he is allowed in the ranks are outlined in the following.

This instruction has for its object the training of the individual recruit, and afterwards the squad. It must be given with the greatest attention to detail.

The instructor explains briefly each movement, first executing it himself, if practicable. He requires the recruits to take the positions unassisted and does not touch them for the purpose of correcting faults, except when they are unable to correct themselves. He avoids keeping them too long at the same movement, although each should be understood before passing to another; by degrees the desired precision and uniformity is exacted.

In the instruction of the recruit, frequent short rests are given in order that the men may not be unduly fatigued.

The instructor takes advantage of these rests to instruct the recruits in the customs and courtesies of the service, the duties of the orderlies, the proper manner of receiving messages from and delivering them to officers, etc., so that when the recruit finally reports for duty he will not only know his prescribed drill thoroughly, but will know how to conduct himself as a trained soldier.

For the individual instruction, a few recruits, usually not exceeding four, are placed in single rank, about 4 inches apart.

POSITION OF THE SOLDIER, OR ATTENTION

Heels on the same line and as near each other as the conformation of the man permits.

Feet turned out equally and forming an angle of about 45 degrees.

Knees straight without stiffness.

Hips level and drawn back slightly; body erect and resting equally on hips; chest lifted and arched; shoulders square and falling equally.

Arms and hands hanging naturally, thumb along the seam of the trousers.

Head erect and squarely to the front, chin drawn in so that the axis of the head and neck is vertical; eyes straight to the front.

Weight of the body resting equally upon the heels and balls of the feet.

TO ASSEMBLE

To teach recruits to assemble, the instructor first places them in a single rank arranged according to height, the tallest man on the right; intervals of 4 inches are maintained between men, as nearly as practicable. The objects of the interval, it is explained, are to give freedom of movement in marching. Recruits are directed to open out the right elbow slightly until the left elbow of the man on the right is lightly touched, the elbow is then withdrawn. This is repeated several times and the recruits are then instructed to fall out and the man on the right being placed in position, they are instructed that at the command fall in they successively and quickly take their places in rank as before.

THE RESTS

Being at a halt, the commands are FALL OUT; REST; AT EASE; and, 1. Parade. 2. REST.

At the command *fall out*, the men may leave the ranks, but are required to remain in the immediate vicinity. They resume their former places, at attention, at the command FALL IN.

At the command *rest*, each man keeps one foot in place, but is not required to preserve silence or immobility.

At the command *at ease*, each man keeps one foot in place and is required to preserve silence or immobility.

1. Parade. 2. REST. Carry the right foot 6 inches to the rear, left knee slightly bent; clasp the hands, without constraint, in front of the center of the body, fingers joined, left hand uppermost, left thumb clasped by the thumb and forefinger of the right hand; preserve silence and steadiness of position.

To resume the attention: 1. Squad. 2. ATTENTION.

The men take the position of the soldier.

EYES RIGHT OR LEFT

1. Eyes. 2. RIGHT (left). 3. FRONT.

At the command *right*, turn the head to the right oblique, eyes fixed on the line of eyes of the men in, or supposed to be in, the same rank. At the command *front*, turn the head and eyes to the front.

FACINGS

To the flanks. 1. Right (left). 2. FACE.

Raise slightly the left heel and right toe; face to the right, turning on the right heel, assisted by a slight pressure on the ball of the left foot; place the left foot by the side of the right. Left face is executed on the left heel in the corresponding manner.

Right (left) half face is executed similarly, facing 45 degrees.

"To face in marching" and advance, turn on the ball of either foot, step off with the other foot in the new line of direction; to face in marching without gaining ground in the new direction, turn on the ball of either foot and mark time.

To the rear. 1. About. 2. FACE.

Carry the toe of the right foot about half foot-length to the rear and slightly to the left of the left heel, without changing the position of the left foot; face to the rear, turning to the right on the left heel and right on the left heel and right toe; place the right heel by the side of the left.

SALUTE WITH THE HAND

1. Hand. 2. SALUTE

Raise the right hand smartly until the tip of the forefinger touches the lower part of the headdress (if uncovered, the forehead) above the right eye, thumb and fingers extended and joined, palm to the left, forearm inclined at about 45 degrees, hand and wrist straight; at the same time look toward the person saluted. (Two) Drop the arm smartly by the side.

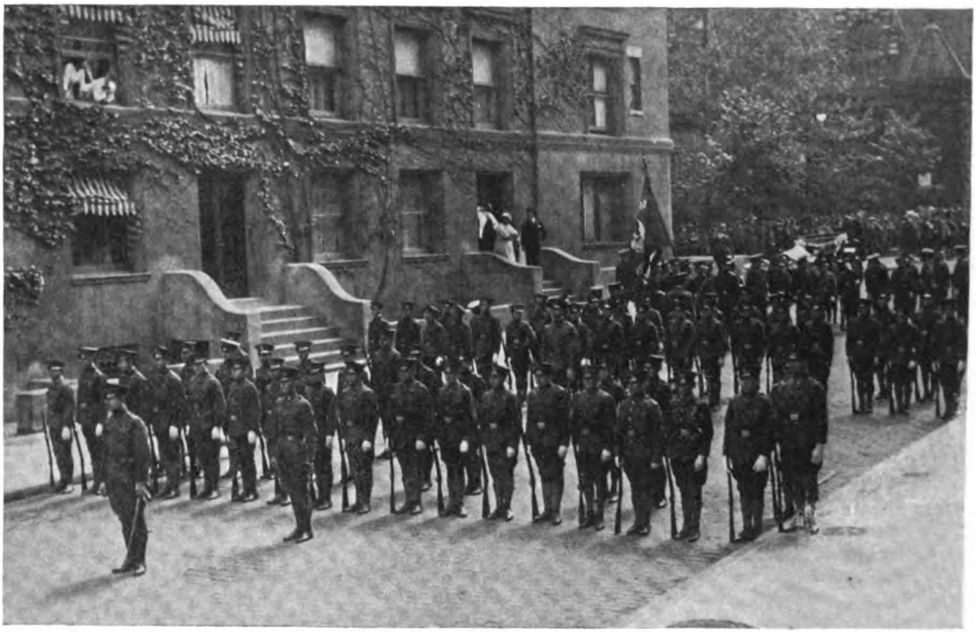
STEPS AND MARCHING

With the exception of right step, all steps in marching executed from a halt begin with the left foot.

The length of the full step in quick time is 30 inches, measured from heel to heel and the cadence is at the rate of 120 steps per minute.

The length of the full step in double time is 36 inches; the cadence is at the rate of 180 steps per minute.

The instructor, when necessary, indicates the cadence of the step by calling 1, 2, 3, 4, or left, right, the instant the left and right foot, respectively, should be planted.



Companies of the Washington Heights Battalion, Junior American Guard, drilling as infantry; an illustration of the position "attention"

The arms hang naturally, the hands moving about six inches to the front and three inches to the rear of the seam of the trousers.

All steps in marching and movements involving march are executed in *quick time* unless the squad be marching in *double time*, or double time be added to the command; in the latter case double time is added to the preparatory command. Examples: 1. Squad right, double time. 2. MARCH.

QUICK TIME

Being at a halt, to march forward in quick time: 1. Forward. 2. MARCH.

At the command *forward*, shift the weight of the body to the right leg, left knee straight.

At the command *march*, move the left foot smartly straight forward 30 inches from the right, sole near the ground, and planted without shock; next, in like manner, advance the right foot and plant it as described; continue the march. The arms swing naturally.

Being at a halt, or in march in quick time, to march in double time: 1. Double time. 2. MARCH.

If at a halt, at the first command shift the weight of the body to the right leg. At the command *march*, raise the forearms, fingers closed, to a horizontal position along the waist line, take up an easy run with a step and cadence of double time, allowing a natural swinging motion to the arms.

If marching in quick time, at the command *march*, given as either foot strikes the ground, take one step in quick time, and then step off in double time.

To resume the quick time: 1. Quick time. 2. MARCH.

At the command *march*, given as either foot strikes the ground, advance and plant the other foot in double time; resume the quick time, dropping the hands by the sides.

TO MARK TIME:

Being in march: 1. Mark time. 2. MARCH. At the command *march* given as either foot strikes the ground, advance and plant the other foot: bring up the foot in rear and continue the cadence by alternating raising each foot about two inches and planting it on a line with the other.

Being at a halt, the command *march*, raise and plant the feet as described above.

THE HALF STEP

1. Half step. 2. MARCH.

Take steps of 15 inches in quick time, 18 inches in double time.

Forward, half step, halt, and *mark time,* may be executed one from the other in quick or double time.

To resume the full step from half step, or mark time: 1. Forward. 2. MARCH.

SIDE STEP

Being at a halt or mark time: 1. Right (left step). 2. MARCH.

Carry and plant the right foot 15 inches to the right; bring the left foot beside it and continue the movement in the cadence of quick time.

The side step is used for short distances only and is not executed in double time.

BACK STEP

Being at a halt or mark time: 1. Backward. 2. MARCH

Take steps of 15 inches straight to the rear.

The back step is used for short distances only and is not executed in double time.

TO HALT

To arrest the march in quick or double time: 1. Squad. 2. HALT.

At the command *halt*, given as either foot strikes the ground, plant the other foot as in marching; raise and place the first foot by the side of the other. If in double time, drop the hands by the sides.

TO MARCH BY THE FLANK

Being in march: 1. By the right (left) flank. 2. MARCH.

At the command *march*, given as the right foot strikes the ground, advance and plant the left foot, then face to the right in marching and step off in the new direction with the right foot.

TO MARCH TO THE REAR

Being in march: 1. To the rear. 2. MARCH.

The command *march*, given as the right foot strikes the ground, advance and plant the left foot; turn to the right about on the balls of both feet and immediately step off with the left foot.

In marching in double time, turn to the right about, taking four steps in place, keeping the cadence, and then step off with the left foot.

COVERING AND MARCHING ON POINTS

The instructor indicates two points and requires recruits, in succession, to place themselves upon the prolongation of a straight line through these points and then to march upon them both in quick and double time.

It is demonstrated to the recruits that they cannot march in a straight line without selecting two points in the desired direction and keeping them covered while advancing.

A distant and conspicuous landmark is next selected as the point of direction. The recruit is required to choose two intermediate points in line with the point of direction and march upon it by covering these points, new points being selected as he advances.

Careful execution of the foregoing is essential to the success of the Signal Corps unit. Too great care cannot be taken to have this first instruction perfected, for without it, the later use of wire carts and wireless in the field will not be efficiently executed and its military value will be negligible.

In the so-called School of the Soldier outlined in the foregoing, amateurs will find sufficient necessary preliminary drill to occupy the evenings or days of the weeks which will intervene until the next article appears.

Wireless Instruction for Military Preparedness

A Practical Course for Radio Operators

ARTICLE III

By Elmer E. Bucher

Instructing Engineer, Marconi School of Instruction

EDITOR'S NOTE.— This is the third installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

ELEMENTARY ELECTRICITY AND MAGNETISM

The Production of Electrical Currents

FRICTIONAL ELECTRICITY

Although the phenomenon of electrification by friction is of interest in so far as the production of so-called **positive and negative electric charges** is concerned, the apparatus for the production of these charges has no direct bearing or relation to modern instruments for the production of currents of radio-frequency; hence the subject will be gone over briefly.

(1) It is found that two such elements as glass and silk when rubbed together exhibit the property of electrification, and will attract like bodies such as bits of paper, wools or feathers. These bodies are then said to be in a state of **electrical charge.** The glass is said to possess **positive** electrification, the silk **negative** electrification.

(2) If a glass rod is rubbed with a piece of silk and is touched to a pith ball suspended by a light thread, the ball will be repelled by the rod, but on the other hand, if the same pith ball is placed near to a stick of sealing wax which is rubbed with cat's fur, the pith ball will be attracted.

(3) Because it has been observed that the electrification produced on glass by rubbing it with silk will have an opposite effect upon an electrified body (such as a pith ball which has previously been electrified by touching it to a charged glass rod) from that of a stick of sealing wax when rubbed by flannel, the terms **positive and negative electrification** have been adopted.

(4) These are purely conventional terms that have no foundation other than that they were convenient to denote the foregoing phenomenon.

(5) A **positively electrified body** is one which has the same effect upon other electrified bodies as a piece of glass when rubbed with silk, and a **negatively electrified body** is one which acts upon another electrified body like a stick of sealing wax rubbed with cat's fur or flannel.

(6) The kind of electrification placed upon glass by rubbing it with another material depends upon the material. Glass, for instance, when rubbed with cat's fur possesses negative electrification, but when rubbed with silk positive electrification. Most electrical textbooks or handbooks have a table showing the various elements which, when rubbed together, will create electric charges.

(7) When electrified bodies are freely suspended, the following effects are observed:

(a) BODIES WITH LIKE CHARGES WILL REPEL.

(b) BODIES WITH UNLIKE CHARGES ATTRACT.

(8) When bodies possessing electric charges are placed in contact, all signs of electrification disappear and they are then said to be discharged.

(9) If bodies containing positive and negative charges are joined together by a wire, a **temporary flow of electrical current** will take place through the wire, and if the electrification is constantly supplied, a continuous flow of current will take place through the wire.

(10) Charged bodies, if connected together by a silk thread, will not discharge, but if joined by any of the metals, such as silver, copper, iron, steel, etc., the charges will neutralize; hence, those materials which conduct electric charges from point to point are termed **conductors** and those which do not permit the free passage of electrical charges are termed **insulators.**

(11) A body which is supposed to have an excess of electrical charge is said to be **positively electrified** and that which has less is said to be **negatively electrified.** This is not known to be the case but is merely assumed.

(12) Hence when a body with a positive charge is joined to one with a negative charge by means of a copper wire, it is generally assumed that an electrical current flows in the direction from the positive charge towards the negative charge.

(13) Whenever positively charged bodies are placed near one another they tend to move together and the space between them is in a state of **electric strain.** This strain is called the **electrostatic field,** and the space is said to contain **electrostatic lines of force.**

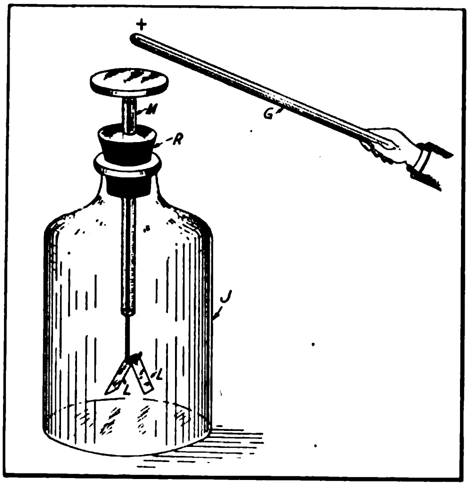


Figure 8

OBJECT OF THE DIAGRAM.

To show the use of the apparatus known as the electroscope.

PRINCIPLE.

When an electrical charge is given to the gold leaves they will diverge or repel one another, and thus show the presence of an electrostatic charge.

DESCRIPTION OF THE INSTRUMENT.

A glass jar, J, having an insulating stopper, R, carries the metal rod, M, on the end of which are hung strips of gold or aluminum foil, L, L.

OPERATION.

If an electrified glass rod, G, with a positive charge is brought near to the upper terminal of the electroscope, a charge of the kind it possesses will be repelled to the leaves and a charge of the unlike kind will be drawn to the upper end.

Hence a positively charged glass rod will place a negative charge on the upper end of the electroscope and a positive charge on the gold leaves.

A negatively charged body brought near the upper terminal will place a positive charge on the upper end and a negative charge on the leaves.

SPECIAL REMARKS.

(1) To determine the sign of an unknown electric charge, proceed as follows:

(a) Rub a piece of sealing wax with cat's fur;

(b) Touch electroscope with sealing wax;

(c) The leaves of the electroscope now possess a negative charge;

(d) Bring charged body with unknown electrification near to the terminal of the electroscope;

(e) If the leaves show greater divergence, the unknown charge possesses the same electrification as the gold leaves, i. e., a negative charge;

(f) If when a body of an unknown charge is brought near to the electroscope the leaves collapse or tend to fall together, the unknown body possesses a positive charge, that is to say, the negative charge on the leaves is drawn towards the upper end.

(2) When an electrified body is brought near to another not electrified, there will be induced in the end of the uncharged body nearest to the charged one, electrification of opposite sign, but in the far end electrification of the same sign.

(3) Thus a positively charged body will induce a negative charge in the end of a body brought near to it.

(4) The charge thus placed in the uncharged body is said to be caused by **electrostatic induction.**

(5) The separation of the gold leaves is a measure of the potential difference between a charged body and the earth.

(6) The term **potential** in electricity is analogous to pressure in water systems. It is the difference of potential between two charged bodies which causes an electric current to flow.

(7) A body which is positively charged is generally considered to be one which has a **higher potential** than that of the earth.

(8) A body negatively charged is considered as one which has a **potential lower** than the earth.

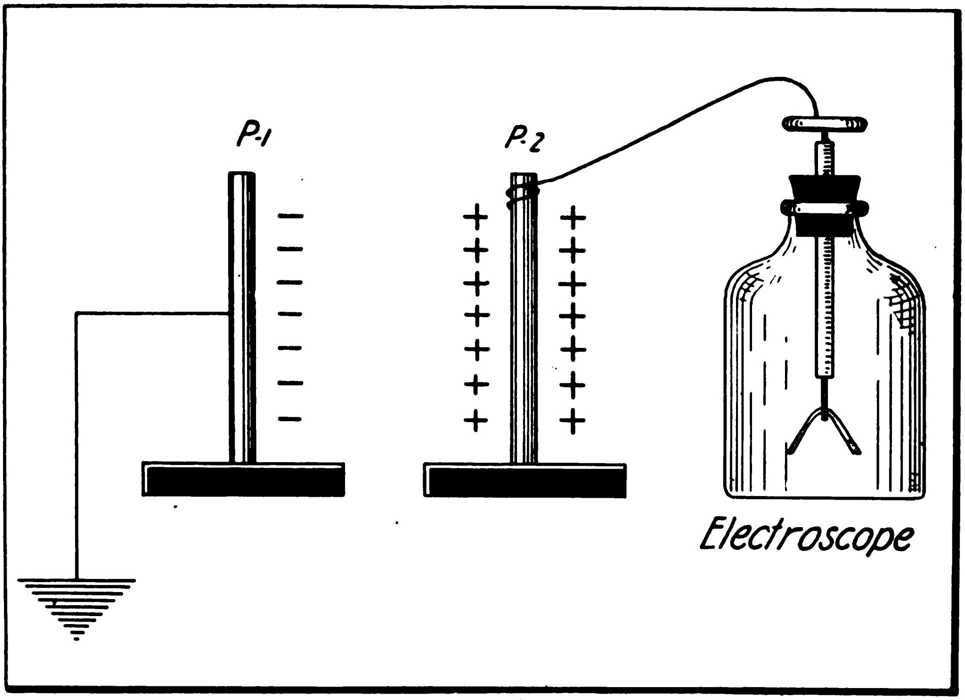


Figure 9

OBJECT OF THE DIAGRAM.

(1) To show how the capacity of a conductor can be increased by placing it near to another conductor.

(2) To show the fundamental principle of the condenser.

PRINCIPLE.

The capacity of the plate, P-2, is greatly increased by bringing it near to another metallic plate, P-1, connected to earth.

DESCRIPTION OF THE APPARATUS.

Two copper plates, P-1 and P-2, are mounted on insulating stands.

P-1 is connected to earth. P-2 is joined to an electroscope by a copper conductor giving an electric charge by one of various means.

OPERATION.

If a positive charge is given to plate P-2 the gold leaves of the electroscope will diverge and as P-2 is placed nearer to P-1 the gold leaves will fall together.

The further from P-I, P-2 is placed the greater will be the divergence of the leaves and the closer, the less the divergence.

SPECIAL REMARKS.

(1) If plates P-1 and P-2 are placed very close and a number of additional charges are supplied to P-2, the normal charge of P-2 will be restored as shown by the divergence of the leaves, that is to say, P-2 returns to its original **electrical potential.**

(2) It is to be especially noted that, inasmuch as a greater quantity of electric charge is required to raise P-2 to its original potential when placed near to P-1, it is said that the capacity of P-2 for holding an electric charge has under these conditions been increased.

(3) It should now be clear that the capacity of a body is measured by the amount of electricity which must be placed upon it in order to raise its electrical potential to a definite value.

(4) The apparatus of Figure 9 is called a **condenser** and a condenser always consists of **two metallic plates** separated by an **insulating material** which may be air, glass, micanite, hard rubber or any of the well known insulating materials. The most common form of electric condenser is the **Leyden jar.**

The Production of Electrical Currents.

In order to produce a steady flow of electric current in an electrical circuit, two conditions are necessary.

(1) There must be maintained a steady electrical pressure known as electromotive force or potential difference;

(2) A suitable conducting path to pass the current.

(1) A metallic circuit in which a current flows with little opposition is said to be a **conductor.** One which offers considerable resistance is known as **a partial or fair conductor** and a substance which greatly impedes the flow of electrical current is termed an **insulator.**

(2) Conductors, therefore, are distinguished from insulators by their ability to transmit electric charges from point to point.

Conductors In the order of their increasing resistance.	Insulators In order of their increasing resistance.
Silver	**Dry air**
Copper	**Shellac**
Gold	**Paraffin**
Aluminum	**Resin**
Zinc	**Silver**
Iron	**Wax**
Platinum	**Glass**
Nickel	**Mica**
	Ebonite
	India Rubber
	Silk
	Paper
	Oils

(3) There is no hard and fast line to be drawn between a conductor and an insulator. All so-called insulators conduct electricity to some extent and all so-called conductors possess varying degrees of **resistance** according to the material.

(4) The **specific resistance** of any material is the resistance of a piece of unit length and unit cross section at an arbitrarily adopted degree of temperature. It is, in fact, the resistance of an inch cube of any substance at the temperature of melting ice.

(5) Silver is taken as unity and the relative resistance of any other material is calculated from this as a base.

(6) For example, with annealed silver taken as a unity or 1, the specific resistance of German silver is 13.92 and for platinum 6.022.

(7) **Resistance** may be defined as that property of a conductor which opposes the flow of an electric current, the spent energy being manifested in the form of **heat.**

METHODS OF GENERATING ELECTROMOTIVE FORCE.

	HOW ACCOMPLISHED.	NAME OF DEVICE OR APPARATUS.
(1) By friction.	Rubbing Together of two unlike materials, such as silk and glass.	Frictional machine.
(2) By chemical action.	Chemical action of a liquid upon two unlike elements such as copper and zinc.	Primary or secondary batteries (storage cells).
(3) By mechanical motion.	The dragging of a copper conductor through a magnetic field.	The dynamo or generator.
(4) By thermal action.	The heating of the junction of two metallic elements.	The thermo couple.

QUES.—What are some of the effects of the flow of an electrical current through a metallic conductor?

ANS.—(1) The production of a magnetic field;

(2) The heating of a wire;

(3) The electrochemical decomposition of a liquid.

QUES.—What is meant by an electrical circuit?

ANS.—The term circuit is applied to the entire path through which the transference of electrical energy takes place.

QUES.—What is an electrical circuit ordinarily composed of?

ANS.—It generally consists of a number of pieces of electrical apparatus, joined together, either in series or in parallel, which in turn are connected to a source of electromotive force.

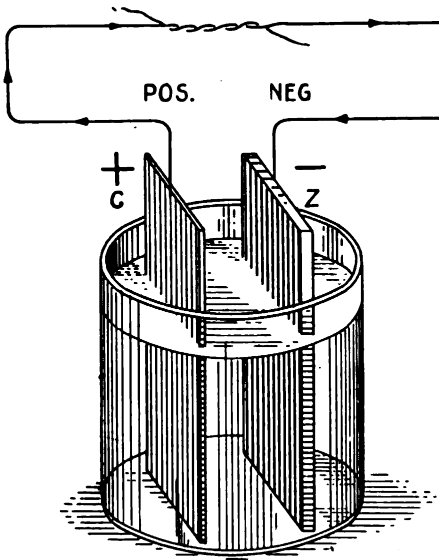


Figure 10

OBJECT OF THE DIAGRAM.

To show fundamentally the construction of an electro-chemical cell, i. e., one type of apparatus for the generation of electromotive force by chemical action.

PRINCIPLE.

Two unlike metallic elements, such as copper and zinc, when placed in a dilute solution of acid or alkali exhibit signs of electrification and either element takes a higher or lower electrical potential than the liquid. When the terminals of the plates are joined together by a copper wire, an electric current will flow through the external circuit.

An electroscope placed near to the zinc terminal will show the same electrification as appears on silk when rubbed with glass.

DESCRIPTION OF A SIMPLE CELL.

A glass jar partially filled with a dilute solution of acid or alkali has a plate of zinc, Z, and a plate of copper, C, slightly separated.

OPERATION.

When the outside terminals of the plates are joined together, an **electric current** will flow through the wire.

During the flow of the current, the zinc strip gradually wastes away; the consumption of the zinc, in fact, furnishes the energy to drive the current through the cell and through the external circuit.

The chemical action within a copper and zinc cell during the flow of current may be summed up as follows:

(a) When the current starts to flow the sulphuric acid attacks the zinc plates and forms zinc sulphate;

(b) Some of the hydrogen in the solution is liberated and it appears on the copper element;

(c) Many of the gas bubbles cling to the copper plate which tend to insulate it from the liquid.

(d) The accumulation of hydrogen gas also tends to set up a pressure against that produced by the cell proper;

(e) These two actions tend to reduce the flow of current and when the electromotive force of the cell drops, or in other words, its ability to deliver an electric current is considerably reduced, the cell is said to be polarized.

QUES.—How may polarization of an electro-chemical cell be prevented?

ANS.—In three ways:

(1) By chemical methods;

(2) By mechanical methods.

Example of Chemical Methods.

(1) The destruction of the hydrogen by the addition to the solution of bichromate of potash or nitric acid;

(2) The use of a double fluid cell such as the Daniell cell which consists of a zinc plate immersed in zinc sulphate and a copper plate immersed in copper sulphate. In this cell the material driven out of the solution at the copper plate is metallic copper rather than hydrogen. In its most commonly used form, this particular type is known as the gravity cell;

(3) The packing of manganese dioxide about the carbon or positive plate of a cell. The hydrogen is slowly attacked by the manganese dioxide which, to a large extent, will prevent polarization.

Example of Mechanical Methods.

(1) The agitation of the liquid or actual shaking of the negative element of the cell to destroy the accumulation of hydrogen bubbles;

(2) Corrugating or roughening the surface of the negative element which causes the gas to form into large bubbles and slowly rise to the surface.

In a simple cell which is not supplied with means to prevent polarization, current will only flow for a short time. Such a cell is usually classified as an **open circuit** cell.

In cells in which polarization does not take place, such as the gravity cell, current can be taken from it for a period until the zinc is consumed or the liquid spent. Such cells are known as **closed circuit** cells.

Closed circuit cells generally deliver low values of current and are required to be kept on closed circuit continuously in order that the two solutions may not diffuse.

EXAMPLES OF COMMONLY USED ELECTRO-CHEMICAL CELLS.

Type	Positive Element	Negative Element	Solution	E.M.F. Volts	Remarks
Daniell Cell	Zinc "crow-foot"	Copper	Zinc sulphate Copper sulphate	1.08	Continuous service
Leclanche Cell	Zinc rod	Carbon plate inside porous cup	Ammonium chloride sal ammoniac	1.5	Momentary currents of intermittent service.
Bichromate Cell	Zinc plate	2 carbon plates	Sulphuric acid and bichromate of potash	2.1	Momentary current zinc must be withdrawn when cell is not in use.
Edison Cell (R. R. type)	Zinc (zinc plate on either side of a copper element)	Black oxide of copper	Caustic potash	0.7	Continuous service

SPECIAL REMARKS.

(1) The so-called **dry cell** is not really dry.

(2) The zinc plate is used as a container and the carbon plate is placed in a moist paste which generally consists of one part of zinc chloride, one part of zinc oxide, three parts of plaster paris, one part of crystals of sal-ammoniac and two parts of water.

(3) It should be understood that the terminal of the copper plate of an electro-chemical cell is known as the positive terminal, but the immersed portion is known as the electro negative element; whereas the terminal of the zinc plate is known as the negative pole, but the immersed portion is the electro positive element.

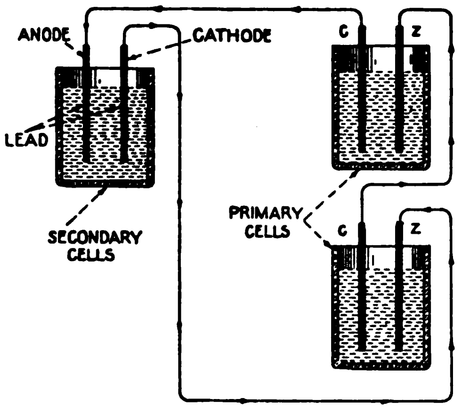


Figure 11

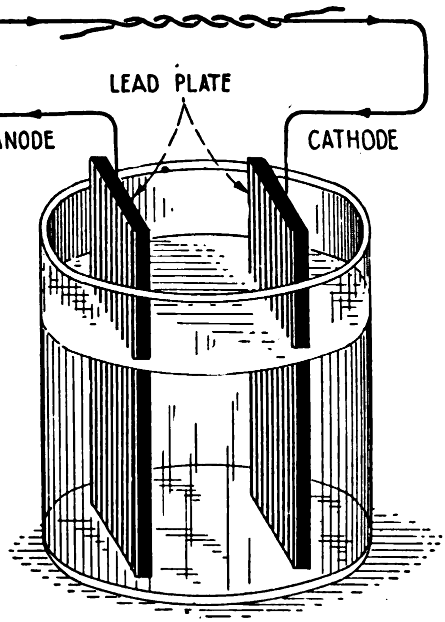


Figure 12

OBJECT OF THE DIAGRAM.

(Figure 11) To show the fundamental construction of a simple storage cell.

(Figure 12) To show the direction of the flow of current after the cell has been "charged."

PRINCIPLE.

When an electrical current from an outside source is made to flow from one lead plate to another through a dilute solution of sulphuric acid, an electro-chemical change is produced which gives these plates dis-similar properties.

The plate connected to the positive pole of the primary cells receives a brown coating of peroxide of lead.

The opposite plate becomes spongy or porous.

DESCRIPTION OF A SIMPLE STORAGE CELL.

Two lead plates are immersed in a 16% to 20% solution of sulphuric acid and their terminals connected to the positive and negative poles of a primary battery.

A storage cell may have several plates connected in parallel and its capacity for furnishing current thereby increased.

Modern storage cells are **charged** by direct current dynamos.

SPECIAL REMARKS.

(1) Electricity is not stored up in a storage cell, but the current supplied to the cell during the charging process produces an **electrochemical change** which gives the plates dis-similar properties, and so long as this change is evident, there will be a difference of potential at the terminals, and therefore, an electromotive force.

(2) The plate connected to the positive pole of a dynamo or battery of primary cells is called the **anode** and the opposite plate the **cathode.**

(3) When the anode is joined to the cathode by a wire (as shown) the current will flow from the anode to the cathode outside the cell and from the cathode to the anode inside the cell.

(4) A storage cell will continue to supply current until the lead peroxide is partly used up, and during the process of discharge, the plates will gradually return to the state they were in before the charging process took place.

(Storage cells will be described in detail further on, particularly in the chapters devoted to emergency apparatus and auxiliary radio transmitters.)

QUES.—How can the electric circuit of a battery, such as shown in Figure 3 be closed?

ANS.—The circuit is closed by connecting together the wires leading from the terminals of the copper and zinc plates.

QUES.—What is meant by an external circuit?

ANS.—An external circuit is the path the current takes from plate to plate outside the cell.

QUES.—How may the strength of the current in the external circuit be regulated?

ANS.—By means of a variable resistance coil, i. e., a coil made of wire having a high specific resistance such as German silver.

QUES.—What determines the rate of current flow of a primary cell?

ANS.—The size of the plates, their proximity, and the resistance of the liquid; also the resistance of the external circuit.

QUES.—What is the unit of electromotive force?

ANS.—The volt.

QUES.—What is the unit of current strength?

ANS.—The ampere.

QUES.—What is the unit of resistance?

ANS.—The ohm.

QUES.—What is the unit of current quantity?

ANS.—The coulomb.

QUES.—What is the unit of electric power?

ANS.—The watt. (1 watt=1 volt×1 ampere; 746 watts=1 horsepower.)

QUES.—What is the current output of the average primary cell such as commercial types of dry cells?

ANS.—The current output varies from 15 to 50 amperes.

QUES.—What is the electromotive force of the average primary and secondary cell?

ANS.—The electromotive force of primary cells varies from 0.6 to 2.1 volts. The E. M. F. of the Edison Storage Cell is 1.2 volts and of the lead plate storage cells from 2.1 to 2.6 volts.

QUES.—What is the physical standard for the volt, the ampere and the ohm?

ANS.—The standard for the volt is the E. M. F. of the Weston Cadmium cell which has an electromotive force of 1.018 volts at a temperature of 20 degrees Centigrade.

The physical standard for the ampere is designated as follows: It is found that if a silver and copper electrode is dipped in a neutral solution of silver nitrate (consisting of 15 parts by weight of silver nitrate and 18 parts of water) a steady current of one ampere flowing from the silver to the platinum plate will deposit .001118 grams of silver on the platinum per second.

The international ohm is the resistance offered to the flow of an unvarying electric current by a column of mercury 106.3 centimeters long, weighing 14.4531 grams, at a temperature of 32 degrees Fahrenheit.

QUES.—How may the total E. M. F. of a given battery in chemical cells be increased?

ANS.—By joining them in series.

QUES.—What does a series connection consist of?

ANS.—In joining the positive terminal of one cell to the negative terminal of the next cell and so on throughout the series. By this connection the total E. M. F. is that of one cell multiplied by the number of cells in the circuit (provided their E. M. F.'s are equal.)

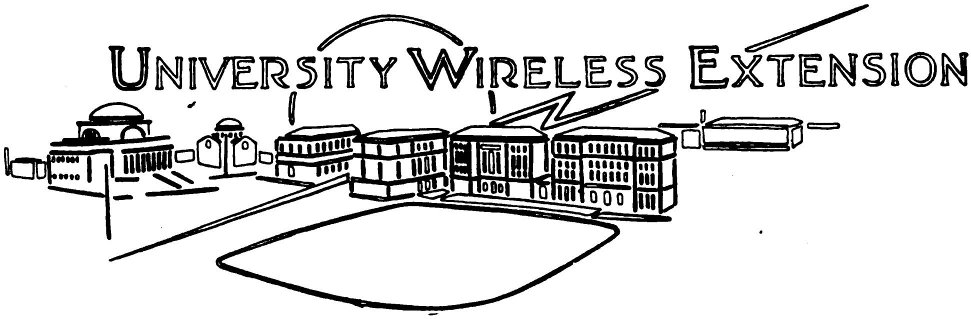
QUES.—How may the current output of a number of cells be increased?

ANS.—By arranging the cells in parallel.

QUES.—What does a parallel connection consist of?

ANS.—The connecting together of all positive terminals and of all negative terminals. By this connection, the current output is that of one cell multiplied by the number of cells.

(To be Continued)



Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE VII

ONE of the circuits devised in 1914 by Mr. Franklin of Marconi's Wireless Telegraph Company of England is shown in Figure 74.* It will be noticed that the plate oscillating circuit is tuned by means of the condenser, C' and that one of its inductances, L'', is coupled to the grid circuit inductance, L'. The grid circuit, $L\ L'\ C$, is also tuned. Energetic oscillations can thus be obtained. It will be noticed further that there is included in the circuit between filament and grid the battery, B'. The purpose of this battery is to enable choosing such normal grid potential as shall give a desired plate current through the bulb, and desired output with high efficiency. Indeed, it is necessary with most bulbs to keep the grid at a negative potential, since, if the grid becomes positive, current begins to flow from the grid to the filament with consequent absorption of energy in the grid circuit. The amplifying action of the tube and its efficiency as a sustained current generator are then impaired.

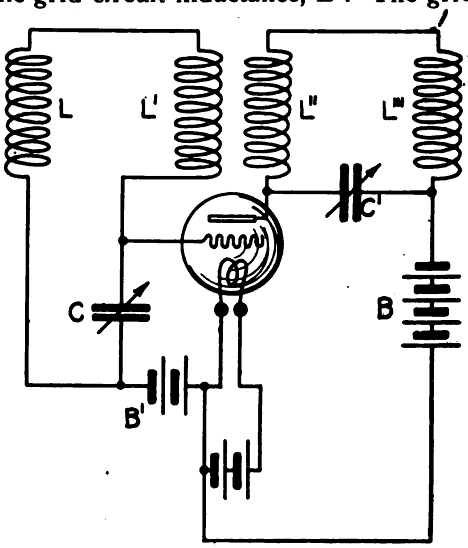


Figure 74—Marconi Company-Franklin Circuit, 1914

In Figure 75 is shown a simplified diagram of another form of transmitting circuit used by the English Marconi Company in its ship radiophone transmitters. The details of the wiring diagram will be given under "Control Systems." It need only be mentioned that the alternating current energy is withdrawn from the oscillator at L_1.

Dr. de Forest has carried on extensive experiments with vacuum tube oscillators. One of the earliest and simplest circuits is his "ultraudion" circuit, shown in Figure 76. It is normally used in receiving, though it is naturally available also

* British patent, No. 13,248, of 1914.

for generation of greater power. As shown, the telephone *T* and battery *B* in the plate circuit are shunted by the "a bridging condenser" *C″*. Connected between the plate and grid is the oscillating circuit, *L C*, one side of which is directly connected to the plate, and the other to the grid by the small condenser, *C′*. This condenser is usually shunted by a leakage resistance (not shown in the figure) which prevents the accumulation of an excessive negative charge on the grid and consequent limitation of the plate current.

Dr. de Forest explains the action as

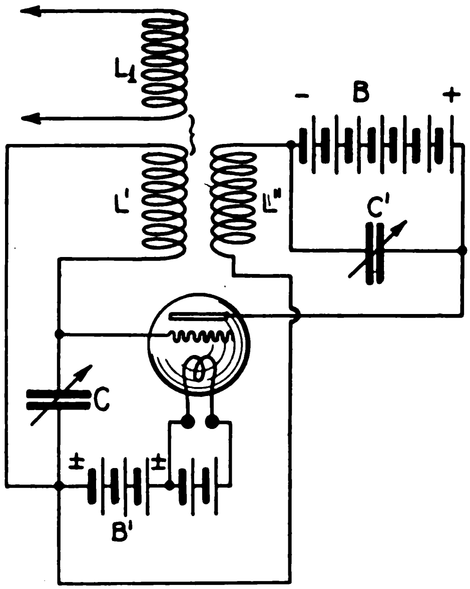


Figure 75—English Marconi Company oscillating circuit; modified form

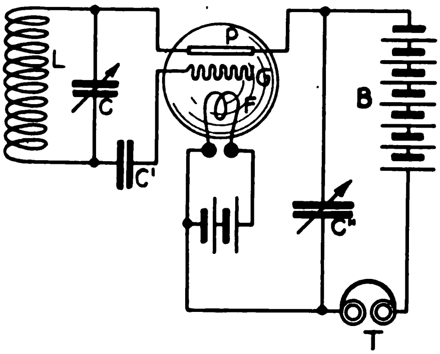


Figure 76—de Forest ultraudion circuit

follows: "There is only one oscillating circuit. This circuit is such that a sudden change of potential impressed on the plate produces in turn a change in the potential impressed on the grid of such a character as to produce, in its turn, an opposite change of value of potential on the plate, etc. Thus the to-and-fro action is reciprocal and self-sustaining." In thus explaining the action of the device, Dr. de Forest takes sharp issue with Mr. Armstrong, who claims that the circuit is "regenerative" in the sense that there is an inductive-capacity coupling between the plate and grid circuits, which latter circuits are claimed by Mr. Armstrong to be existent and clearly defined.

A later oscillating circuit (1915), due to de Forest, is shown in Figure 77. It will be seen that this circuit differs from the normal ultraudion in that there is a coupling added between the grid and plate circuits. This coupling is *L* and *L″* and is presumably intended to reinforce the production of oscillations and produced greater outputs in consequence. The coil, *L″*, is referred to as a "tickler" coil.

Though detailed wiring diagrams of the arrangement shown in Figure 78 are not available, it is of some interest. It shows a complete de Forest radiophone transmitter and receiver. At the left is shown the bulb-mounting panel. Dr. de Forest has given the name of "oscillion" to the bulb shown in the

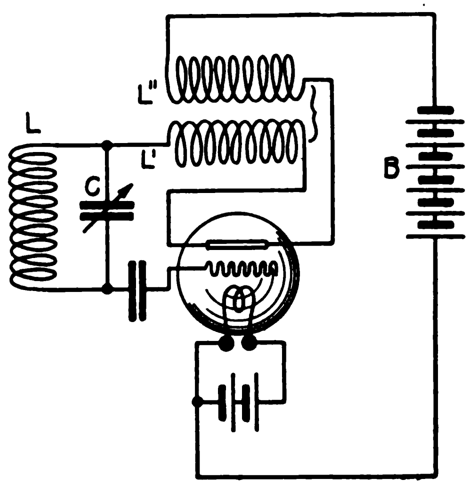


Figure 77—de Forest oscillating circuit, 1915

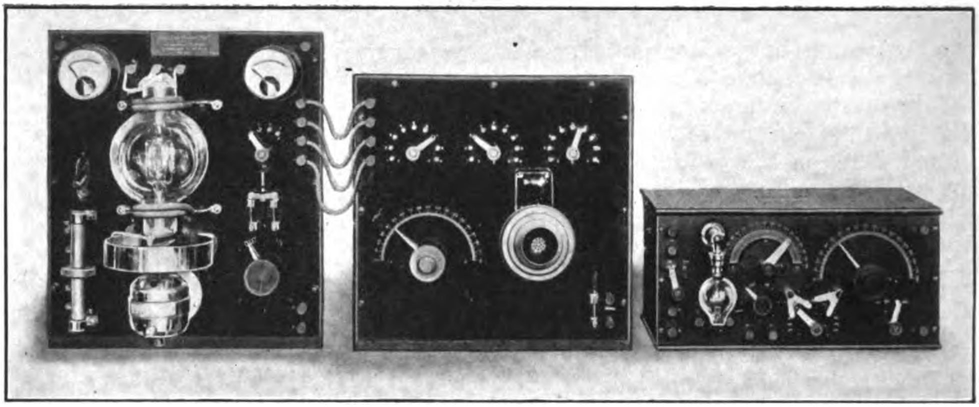


Figure 78—de Forest "oscillion" radiophone transmitter (and receiving set)

figure. This bulb has a tungsten "W" filament, a grid of tungsten wire wound on a glass support, and two nickel plates. As seen from the figure, the bulb is air-cooled by means of the small fan placed underneath it. The two instruments mounted on top of the panel are respectively indicators of the filament amperage and plate circuit current of the oscillion. The switch at the left hand side turns the plate current of the tube on and off. The filament current control-rheostat handle is shown in the lower right hand corner of this panel. In the middle box are mounted the various portions of the oscillating circuits and microphone control apparatus. The microphone transmitter is visible on the front. The equipment to the right of the figure is a fairly normal audion receiving set.

The question of considerable outputs from vacuum tube oscillators has led to the consideration of methods of heat-resistant tube construction. An attempt in this direction is shown in Figure 79 and is due to de Forest. The two metal vessels, 6 and 7, are so arranged that the space between them is filled by a heat-conducting fluid, *e. g.*, mercury or certain oils. This fluid acts at the same time as a means of sealing the inner vessel and of preventing air leakage. The grid, filament, and plate structure are mounted inside the inner vessel in the usual manner. The inner vessel is corrugated in the region, 20, so as to provide plenty of heat conducting surface where this is most needed.

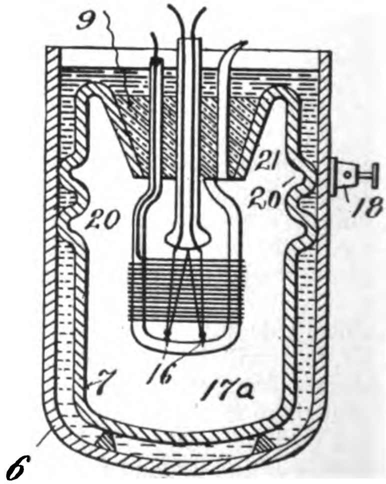


Figure 79—de Forest high-power tube construction

The General Electric Company has developed a number of types of extremely high vacuum tubes and the circuits necessary for their use. One of the simplest of these, and one having marked advantages, is shown in Figure 80. Here both plate circuit $L'' C'' G$ and grid circuit $L' C'$ are tuned and coupled to each other. The output circuit is connected to the inductance, L, coupled as shown. A unique feature of the circuit is that the same generator, G, is used both for lighting the filament through the auxiliary regulating resistance, R, and for supplying the plate circuit directly. It is thus possible to connect such an arrangement directly to a single source of direct current and to start the oscillation by merely closing a single switch. Such automatic action is a desideratum in radiophone equipment.

The actual appearance of the General Electric pliotron or three-electrode tube is indicated in Figures 81, 82 and 83. The first of these figures shows the mode of mounting the filament and grid member of a pliotron. The "W" filament is suitably anchored and supported. The grid itself is wound on a tungsten frame. Figure 82 represents a later type of filament and grid support. This type has increased rigidity and is more heat resistant. In addition, the insulation has been improved, particularly with a view to resisting the extremely high temperatures attained within the bulbs when in operation. The appearance of one of the complete bulbs is clearly shown in Figure 83. The massive tungsten plates are seen to be properly supported outside the filament grid structure, and from the opposite end of the tube. Tubes of this sort can stand thousands, and even tens of thousands, of volts between plate and filament without showing any blue glow due to gas present in the tube. The output of even a comparatively small tube of the type shown in Figure 83 runs into hundreds of watts at plate voltages of about one thousand volts. Such tubes and the circuits associated with them will be further considered under a later heading, wherein complete radiophone sets of the General Electric Company are shown.

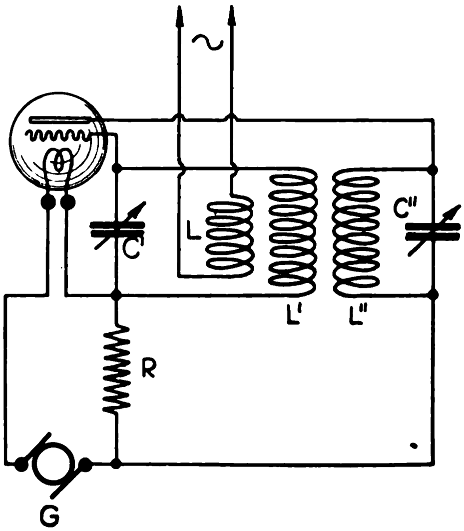


Figure 80—General Electric Company oscillating circuit

We consider next certain phases of the work of the Western Electric Company. A circuit used for the production of oscillations by that company and due to Mr. Edwin Colpitts in 1915 is shown in Figure 84. The plate circuit is fed from the battery, *B*, which is in series with the choke coil or inductance, L_1. Consequently the plate voltage does not remain constant. The tuned plate oscillating circuit is L' C'; this being inductively coupled to the tuned grid

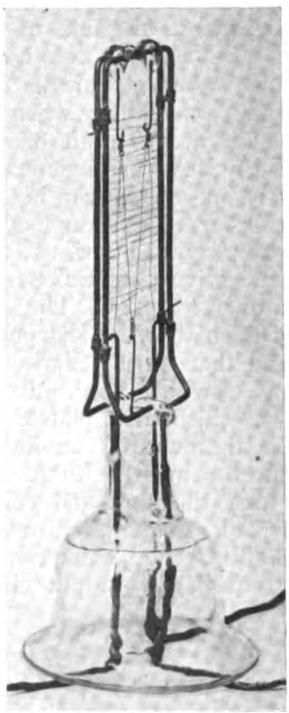


Figure 81—Filament and grid element of pliotron

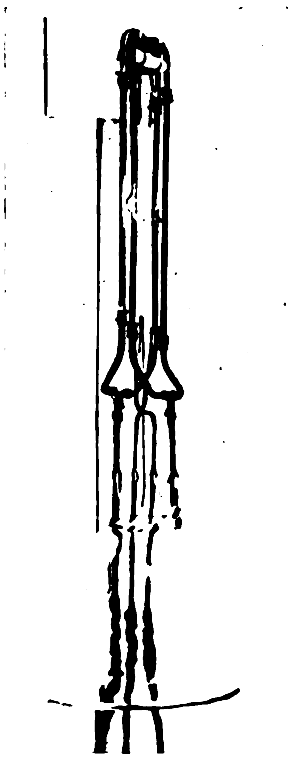


Figure 82—Filament and grid element of pliotron

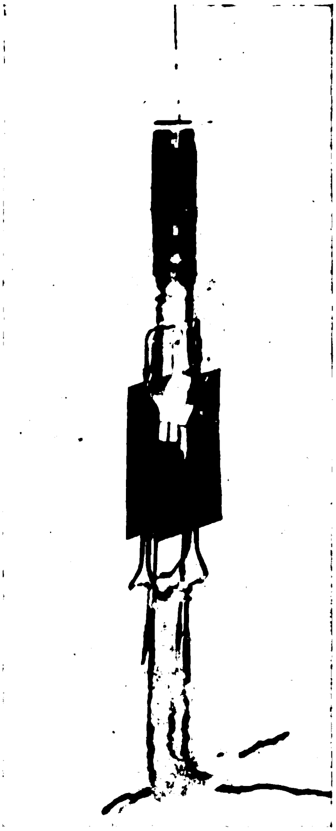


Figure 83—General Electric Company pliotron

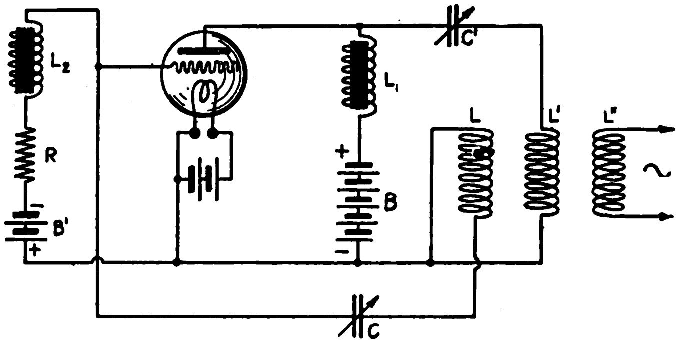


Figure 84—Western Electric Company—Colpitts oscillating circuit

circuit, L. C. The grid is maintained at a negative potential by means of the battery, B', the oscillations impressed on the grid being prevented from passing through the battery, B', by means of the inductance, L_2. The output of the bulb is drawn from the coil, L'', which is inductively coupled to the inductance in the plate circuit.

A line of development which the Western Electric Company, among others, has pursued in connection with the obtaining of considerable outputs has been the amplification of the output of a single oscillator by a bank or banks of vacuum tube amplifiers, these individual amplifiers being placed in groups in parallel. While apparatus of this type tends to become bulky and clumsy when a very considerable number of bulbs are used, it has considerable electrical flexibility. An arrangement of this sort due to Mr. R. Heising is shown in Figure 85. Herein the oscillator A, is coupled inductively to the combined grid circuit of a number of amplifying bulbs, A', A'. The grids of these bulbs are maintained at a suitable negative potential by the battery, B'. The circuit, L C, is tuned to the oscillator frequency. The resistance, R (which is non-inductive), is shunted across C so that the sharpness of resonance of the combined circuit is adjustable and that its impedance at a definite frequency shall have a sharply defined value. As will be seen, all the grids of the amplifiers, A', are connected in parallel, as are also their plates. A common plate battery, B, feeds all of them. In series therewith is an inductance which is coupled to the circuit, L' R' C', this latter being the input circuit of the second bank of amplifiers, A'', A''. In this way the amplified voltages which are produced in the plate circuit of the first bank of amplifiers are brought to the grids of the second bank of amplifiers. This second bank of amplifiers is intended for increasing the alternating current in the output circuit, whereas the first bank

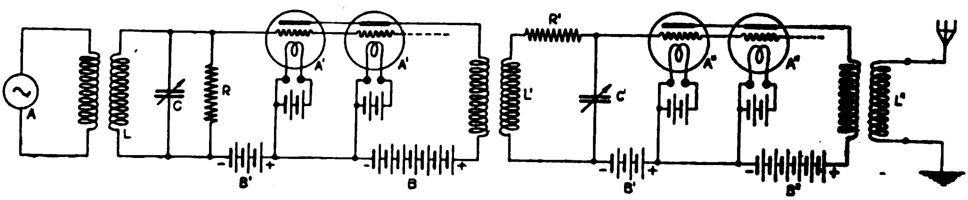


Figure 85—Western Electric Company-Heising oscillator—amplifier arrangement

was intended primarily for a voltage increase. The resistance, R' is inserted in the grid input circuit of the second bank of amplifiers to render the operation more stable. The plate circuit of all the amplifiers, A'', are fed from the common battery, B'', and an inductance in this plate circuit is coupled to the antenna tuning coil, L''. By this means the amplified currents are set up in the antenna or final output circuit. This system will be further considered under another heading in connection with the radiophone work of the Western Electric Company.

The construction of vacuum bulbs for large outputs has engaged the attention of the engineers of this company as well. A well-defined trend of their development has been the attempt to secure very effective control by placing the filament and grid very close together. In fact, actual contact (though with an insulator, such as nickelous oxide, between) has been considered. The arrangements developed for this purpose will be considered in greater detail in connection with receiving apparatus. For transmitting work Mr. A. Nicolson has developed the type of bulb shown in Figure 86. A glass tube, *A*, of cylindrical form, is sealed inside another cylindrical glass tube, *B*, and the space between is exhausted through the seal *C*.

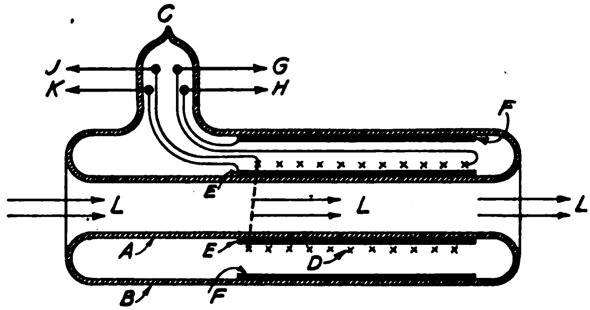


Figure 86—Western Electric Company—Nicolson high-power bulb

Prior to the exhaustion, the filament, grid, and plate members are inserted or slid into the space between the inner and outer tubes. The filament is a twisted platinum strip coated with nickelous oxide and wound around the metal cylinder *E*, which is the grid. The filament, *D*, is represented by the two lines of crosses along the length of the cylindrical grid. The filament terminals are brought out of the tube through the leads, *J* and *G*. It will be noticed that the grid is ***internal*** to the filament in this particular tube, a comparatively rare construction. The grid lead out of the tube is *K*. The plate is the outer cylinder, *F*, and its connection to the outside of the tube is *H*. The plate is inserted into the tube at the same time as the grid and filament, that is, before exhaustion. Cooling of the tube is accomplished by passing a liquid or gas through the central orifice as indicated by the arrows, *L*. The exterior portions of the tube are similarly cooled, and this is claimed to enable the tube to operate continuously with heavy plate currents.

Through the courtesy of the General Electric Company and Dr. Albert W. Hull, we are enabled to present to our readers a more recent development in vacuum tube amplifiers and oscillators, namely the "dynatron." This device depends on a principle hitherto not used in this connection, namely secondary emission. This phenomenon is as follows: When a stream of rapidly moving negative electrons falls on a metal plate, if the velocity of the stream is not very great, no unusual effect will be noticed. If the velocity is somewhat increased each electron impinging on the plate will liberate from the molecule which it strikes one slowly moving electron. As the velocity of the impinging or "primary" electron stream is increased, at each collision, two electrons will be liberated from the plate, and the number of "secondary" electrons liberated by each primary electron on impact may be as many as twenty for very high primary electron velocities.

Let us now consider the arrangement of circuits shown in Figure 87. The bulb shown is a dynatron, containing an incandescent filament, *F*, an ***anode***, *A* (which is a perforated plate), and the plate, *P*. It is at once to be noted that the anode, *A* is ***not a grid***, being maintained at a ***fixed*** and high ***positive*** potential and not serving as an ***input*** member of the system. Unless this is kept in mind, the action of the device can not be understood. The filament is maintained incandescent by the battery, *B*. Between the filament and the anode, *A*, is connected the battery, *B'*, with its positive end connected to *A*. So far the device will act just as does an ordinary hot cathode rectifier, *e. g.*, a kenotron, with the exception that a great number of electrons moving from the filament, *F*, to the anode, *A*, will pass through the hole or holes in the anode and strike the plate. So long as the velocity of the electrons striking the plate, *P*, is not high the curve connecting applied voltage (between the plate, *P*, and the filament, *F*) and the current flowing in the plate circuit (*e. g.*, between points *E* and *F*) will be similar to that for a kenotron. Suppose for the present the resistance, *R*, in the plate circuit to be zero. As long, then, as the tap, *D*, is so placed that the plate is not very positive, we get the usually characteristic indicated by the portion *OA* of the curve of Figure 88, which, as stated, resembles the normal current-voltage curve of a kenotron rectifier.

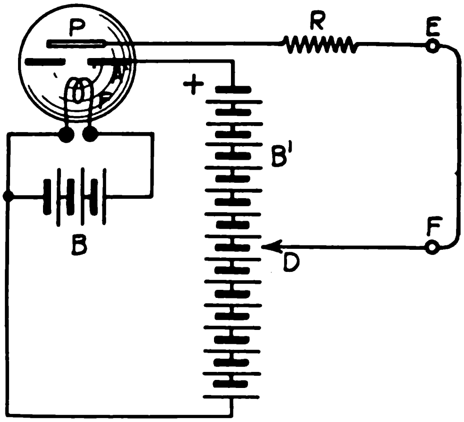


Figure 87—General Electric Company—Hull dynatron amplifier circuit

As we approach the point, *A*, of the curve, however (by raising the voltage of the plate by moving the tap, *D*, up the battery, *B'*), the electrons striking the plate begin to have higher velocities and secondary emission occurs. In consequence the electrons released by the secondary emission are produced in increasing quantities. Since the anode is ***more positive*** than the plate, these electrons will be attracted to the anode and there absorbed. As for the plate, it begins to lose by secondary emission an appreciable portion of the current which strikes it so that the net current in the plate circuit (*DFERP*) becomes smaller and smaller as the plate voltage is increased. This is shown in the portion, *AB*, of the curve of Figure 88, which shows that the current in the plate circuit is *diminishing* for *increasing* plate voltage. At *B* the plate loses as many electrons as strike it, and the net current is zero. From *B* to *C*, as the voltage of the plate is further increased, each electron that strikes the plate liberates more than one electron so that the plate on the whole *loses* electrons and the plate current is actually reversed and negative. At *C* the

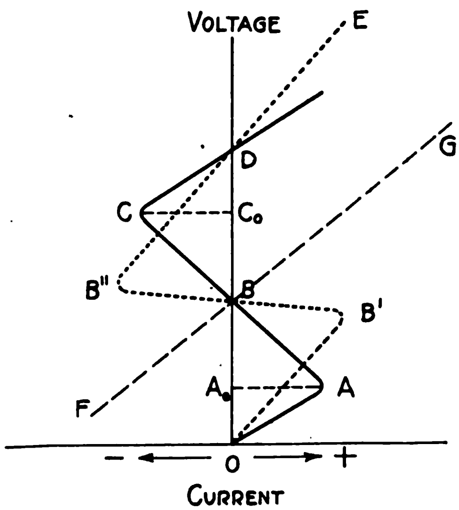


Figure 88—Dynatron voltage amplifier characteristics

limit of re-emission is reached, and thereafter the plate current rises along the curve, CDE, as the voltage is increased. We have, in the range, ABC, of the applied plate voltage a most curious effect, namely that an increase of voltage causes an increase of current *in the wrong direction.* That is, between voltages A_0 and C_0 the plate-to-filament circuit of the dynatron acts as a true "negative resistance" which, so far from opposing the flow of current, actually assists it. It acts, therefore, in a manner very roughly analogous to the electrical (though not to the physical) behavior of the Poulsen arc and is capable of being an amplifier or oscillator. The arc, however, has a negative resistance characteristic only for *increasing* current, but acts as an open circuit for *decreasing* current. The dynatron has a stable negative resistance in either case. Furthermore, the dynatron has no hysteresis or lag, but responds instantaneously, because it does not depend on gas ionization, as does the arc.

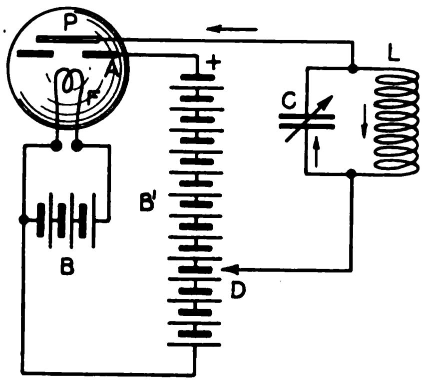


Figure 89a—Dynatron oscillator

To make the device a strong amplifier, we insert a resistance, R, in the plate circuit, which resistance has a positive value nearly equal to the negative resistance of the dynatron plate circuit. The current-voltage curve of such a resistance will be parallel to the line FG in Figure 88, where FG slopes to the right nearly as much as AC to the left. The plate circuit characteristic of the dynatron will then become the curve, $OB'B''E$, which is dotted in the figure. It will be seen that a very small change in voltage in the neighborhood of the value, B, will cause a very great change in the current in the circuit from B' to B''. The small exciting voltage would be inserted into the plate circuit, for example between the points E and F.

Since the dynatron is a negative resistance, it is essentially an unstable device and will, if an oscillating circuit is included in the plate circuit, produce in that oscillating circuit sustained alternating currents. The circuit diagram, therefore, is shown in Figure 89a, which is quite similar to Figure 87, except that the oscillating circuit, LC, is added in the plate circuit. The directions of current while the capacity, C, is discharging are shown by the small arrows, and it will be seen that the capacity discharges partly through the inductance, L, and partly through the plate circuit of the bulb.

Using the dynatron as an amplifier, voltage amplifications of as much as 1,000-fold have been obtained, and 100-fold amplifications are very readily available. Used as an oscillator, the dynatron has shown itself capable so far of producing all frequencies between less than one cycle per second and 20,000,000 cycles per second (corresponding to a wave-length of 15 meters). The output of a single bulb has been as much as 100 watts.

A still more recent device, also due to Dr. Hull, is the pliodynatron, a combination of the pliotron and the dynatron. This device has a true grid as well as the anode and plate electrodes and is an interesting four-electrode device. The grid, as usual, is an electrostatic control member, and, if the conditions are properly chosen, enables the stable control of the oscillating energy in the circuit, LC. That is, the variation of the grid potential (as determined by the battery, B'', or otherwise) will cause variations in the oscillation output of the bulb. This feature will be further considered under "Modulation Control for Radio Telephony." The wiring of a pliodynatron is clearly indicated in Figure 89b.

The actual appearance of the dynatron is illustrated in Figure 90a and of the pliodynatron in figure 90b. It will be noted that the anodes are naturally much heavier than the grids of pliotrons, which must, of course, be the case, since its function is quite a different one and since it must carry very considerable currents in its own circuit and be subjected to very energetic electron bombardment.

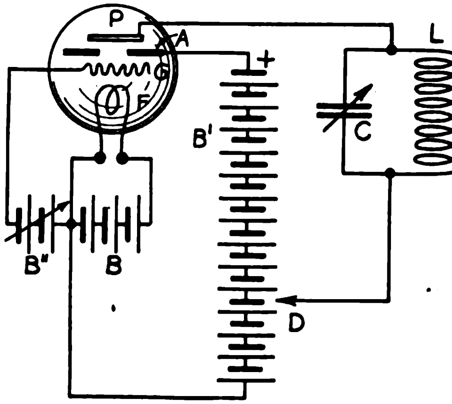


Figure 89b—General Electric Company-Hull pliodynatron controlled oscillator

(d) Alternators of Radio Frequency.—As we have repeatedly seen, the first necessity in radio telephony is a steady stream of alternating current of radio frequency, available for modulation into speech form. We have treated in succession the arc, radio frequent spark and vacuum tube generators of such currents (or first approximations to such currents). It would seem, at first sight, as if we had neglected deliberately an apparently far more natural and simple means of securing such currents and one well known to ordinary commercial electrical engineering. We refer, of course, to the normal alternator.

As a matter of fact, we have deferred the study of the radio frequency alternator because of the real difficulties in the generation of such very high frequency alternating currents directly. This can be seen if we consider the pitch or distance between adjacent armature windings for a 100,000-cycle alternator. If we assume the diameter of the rotor to be 2.0 feet (60 cm.) and a normal speed of rotation of 2,500 revolutions per minute, we find that the pole pitch has the extraordinarily small value of 0.016 inch (0.04 cm.), which is entirely impracticable when one considers that wire and insulation must all be crowded into the winding slot. In addition, there would have to be 4,800 poles.

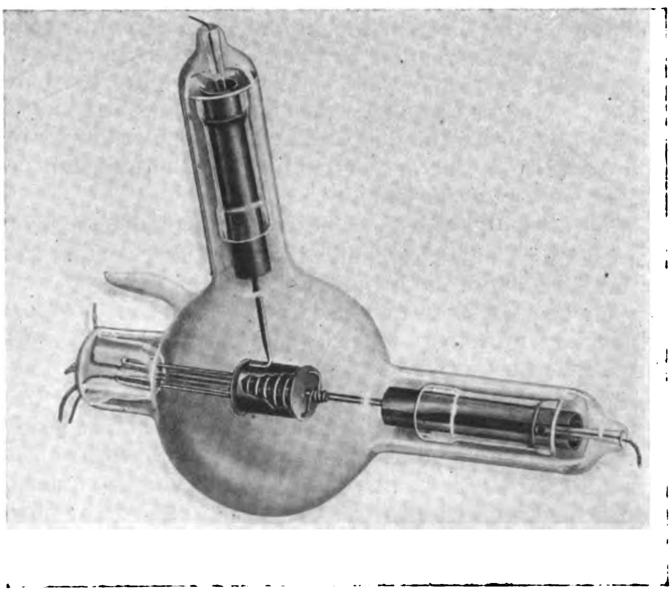


Figure 90a—General Electric Company-Hull dynatron, showing internal structure

It becomes necessary, then, if we persist in the process of direct generation of the current, to have a higher speed of rotation, since the pole number must obviously be reduced. Suppose we choose the extremely high speed of rotation of 20,000 revolutions per

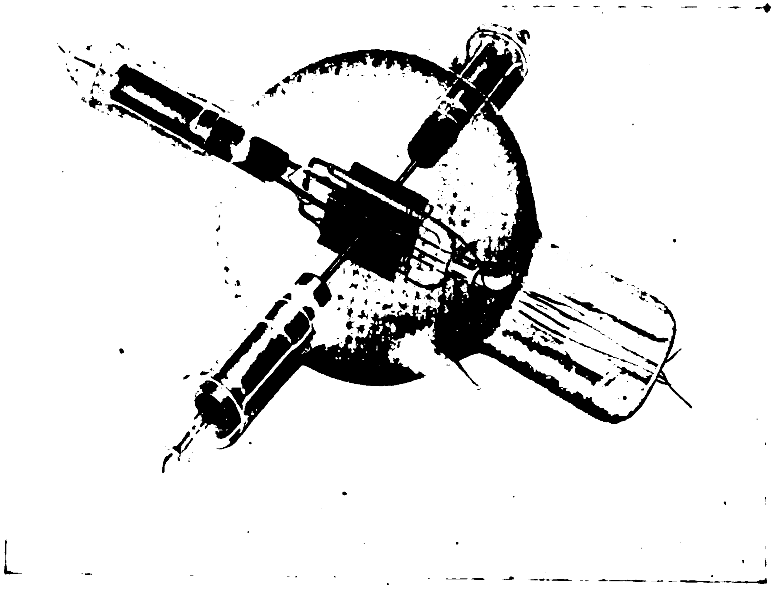


Figure 90b—General Electric Company-Hull pliodynatron controlled oscillator

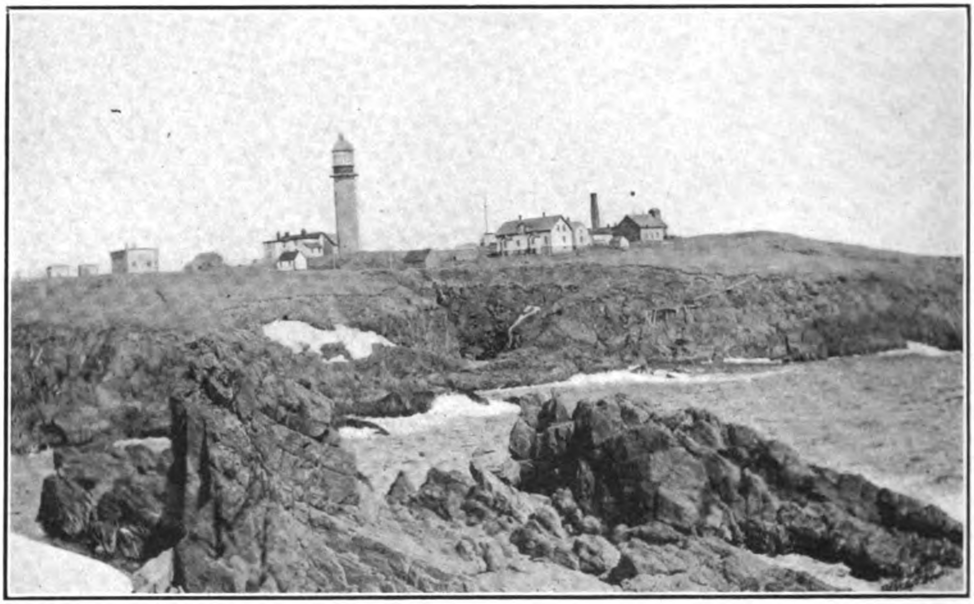
minute. We shall need then 600 poles, and the width of winding becomes 0.12 inch (0.30 cm.) approximately. So close a winding can be accomplished if great care is exercised in the choice of wire insulation and in the milling out of the slots. The requirement of a speed of rotation of 20.000 revolutions per second makes a solid steel rotor and an alternator of the inductor type essential; and this is indeed the case for the radio frequency alternators of the present, which (with the exception of the Goldschmidt type, which must have a wound armature for electrical reasons) are all of the inductor type.

We shall see that there are thus at least three general lines of endeavor in connection with the generation of radio frequent currents by alternators. These are, firstly, the multiplication of frequency within the machine (Goldschmidt type); secondly, the multiplication of frequency outside the machine (*e. g.*, Arco alternator of the Telefunken Company, with frequency changers), and, thirdly, the direct generation in the machine of the frequency used (Alexanderson alternator of the General Electric Company). It is interesting to note that a solution of the problem of producing currents of frequencies of the order of 50,000 cycles per second (and wave-lengths of 6,000 meters) turns out to be possible for considerable output powers (100 kilowatts or more) by all three methods. The details of these methods will be next considered.

This is the seventh article of a series on "Radio Telephony," by Dr. Goldsmith. In article VIII, in the August issue, he takes up the subject of the details of methods employed in generating radio frequent currents in alternators. The Goldschmidt alternator and those used by the Telefunken Company are described.

Our Northern Ally's Stations

By Frank C. Perkins



The old Cape Race station, with a mast just discernible in the background. A new station has taken the place of the one shown

Editor's note—Not only because of the close relationships established with our northern neighbor in wartime, is this article of interest to wireless men. The prominent part Canada has played in the history of the art on this continent makes the present status of that colony's wireless system of importance. It will be recalled that in the early days of commercial working Cape Race and Sable Island stations were the means of establishing first touch with this continent for inward bound steamers, and from another Canadian station, Glace Bay, the first trans-Atlantic communication was established with Clifden, Ireland. Mr. Perkins' article gives an informative survey of the work accomplished by Marconi interests both in the Lake District and on the coast.

THE accompanying photographs show the electrical equipment of typical Canadian Great Lakes Wireless Telegraph Stations, as operated by the Marconi Wireless Telegraph Company of Canada, Ltd. Apart from the trans-Atlantic station at Glace Bay, N. S., which communicates with the English Marconi Company's plant at Clifden, Ireland, the outstanding feature of wireless in the Dominion is the chain of intercommunicating stations—the longest in the world—extending from Port Arthur at the head of Lake Superior down through the Great Lakes along the River and Gulf of St. Lawrence to far-off Labrador. Along the Atlantic Coast of New Brunswick, Nova Scotia and Newfoundland, stations are located, and one of the busiest stations in the entire group is located at Sable Island, "the graveyard of the Atlantic," about 200 miles from Halifax.

Stations on the Great Lakes at Port Arthur Soo, Toberymory, Midland, and Sarnie, Port Burwell, Toronto, and Kingston make up the chain. The stations on the River and Gulf include those at Montreal, Three Rivers, Quebec, Gross Isle, Father Point, Eame Point, Heath Point, Harrington, Grindstone Island, Cape Bear, Pictou, Point Amour and Clarke City.

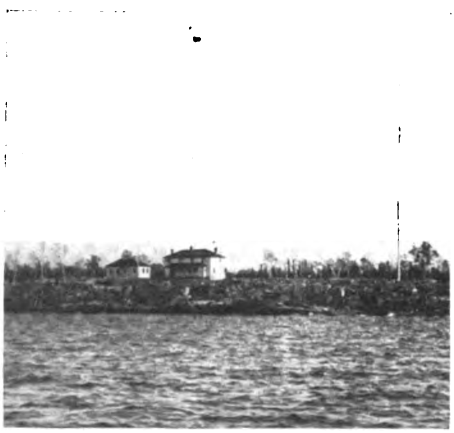
It is of interest to note that the Newfoundland and Labrador wireless stations have been established at Battle Harbor, Venison Island, American Tickel and Domino; also at Grady, Indian Harbor, Holton, Cape Harrison, Makkovik, Fogo and Pointe Riche. The Atlantic stations of long range include those at Cape Race, Cape Ray, Belle Isle and Camperdown (Halifax). Stations are also located at Cape Sable, Partridge Island (St. John), Sable Island and North Sydney.

The Great Lakes stations have electric generators of 5½ K. W. power, driven by 8 h. p. horizontal gasoline engines of the Fairbanks-Morse type, and wooden masts 185 feet high. The range of the stations is from 250 to 300 miles. The river, Gulf and Atlantic stations, with the exception of that at Cape Race, have 2 K. W. generators, driven by 4 h. p. gasoline engines, Sixty-cycle dynamos are employed. The masts are 180 feet in height and the station has a range of from 200 to 300 miles. The Cape Race 5 K. W. station has duplicate sets driven by a 10 h. p. engine. There are two masts of steel 250 feet in height. The range of this station is 600 miles. The Newfoundland and Labrador stations use 2 h. p. gasoline engines with D. C. dynamos, and accumulator battery sets. Each station has a range of fifty miles.

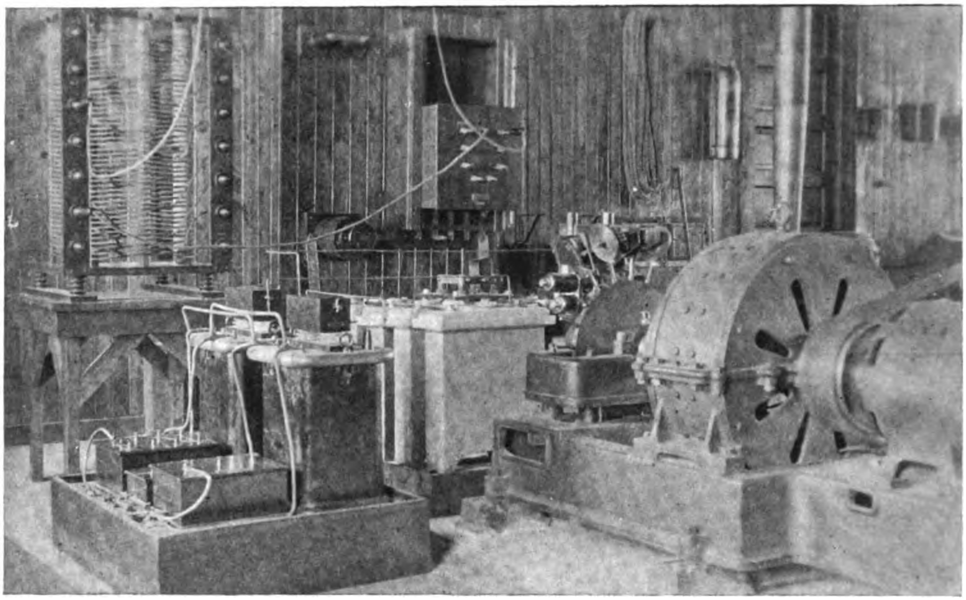
In view of the fact that wireless telegraphy in Canada is only thirteen years old, the remarkable advance which it has made discourages any attempts to determine the limits of its application. Its value as an aid to shipping has been proven a hundred times. A striking instance of the value of the Great Lakes system occurred during the great storm of November, 1913. Many vessels with their crews were lost, but not a single ship equipped with Marconi apparatus met with disaster, due to the fact that each vessel received notification of the approaching storm by means of the stations that stand sentinel on the shores of the Great Lakes.

It is pointed out that the repeated instances of the saving of life and property by these ship and shore stations have created a strong sentiment among owners of ships of the Canadian Mercantile Marine that no vessel engaged in coastwise or ocean trade is fully protected unless it is equipped with wireless, and the establishment of radio stations on vessels exempt by law from compulsory equipment is now being viewed with favor.

Cape Race projects far into the Atlantic and the station at this point transmits messages from New York and Montreal to vessels in mid-Atlantic. Almost all advices regarding casualties to ships on the trans-Atlantic routes have their origin at Cape Race. Although the normal range of the station is 600 miles, instances of messages handled at far greater distances have been repeatedly recorded. Messages are received from points more than 1,000 miles away and signals from the Cape have been heard



One of the stations making up the Canadian wireless chain is located at Tobermory Bay



The generating plant at Le Pas

on the other side of the Atlantic and as far south as Gibraltar. The power of the station is 5½ K. W.

The Labrador stations are best known because of the services which they render to the Newfoundland fishing fleets and to vessels en route to Hudson Bay. Wireless telegraphy offers the only practical means of communication between Labrador points, as land lines may be put out of commission by storms and blizzards. Trappers in Labrador obtain freightage for their catch, and the Newfoundland Fishing Fleet is kept in touch with the markets of St. John's and other ports by wireless. As many as 30,000 fishermen visit the Labrador waters in one season and the value of the catch exceeds $1,000,000.

The seal fishing fleet had a forcible illustration of the value of wireless in a disaster which occurred in 1914. On April 2nd of that year the crews of some of the vessels of the Newfoundland Fleet were caught during a blizzard on the ice floes three or four miles from the ships. The steamship Bellaventure, equipped with wireless, first received the news and at once steamed to the scene. With aid from other vessels which had received her radio signals, she was instrumental in saving hundreds of lives. Following this incident, the Newfoundland Government legislation made wireless telegraphy compulsory on all vessels engaged in the sealing industry.

The establishment of stations at Le Pas, Man., the connecting point of the Hudson Bay Railway with the Government Railway system, and Port Nelson on St. James Bay, a terminus of the Hudson Bay Railway, marked an important step in the opening of the new outlet to the sea, the need of which had been felt so long by the Canadian West. In establishing these stations the Government showed that it fully realized the great advantage to be derived from wireless.

The object of the Hudson Bay Railway, it is asserted, is to give the grain growers of the Northwest means of cheap communication between the Interior and Europe via Hudson Bay and the Atlantic. Wireless has played an important part in the construction of the railway. Primarily it has served as an intermediary for the ordering and forwarding of material and labor from the base to the scene of operations. The town of Port Nelson, which was formerly cut off from communication with Ottawa for nine months in the year, is now in constant touch with the Capital and by means of wireless the constructional work has been greatly facilitated. The stations are of 10 K. W. power, each station having a range over land of 500 miles.

It is of interest to note that at Port Nelson, which, it is anticipated, will become a summer port of importance, the plant comprises an additional installation to communicate with vessels trading to that point. These stations, according to plans, will form the commencement of the wireless chain linking up the far Hudson's Bay with Northern Ontario and Quebec and the Government stations on the Labrador. Sites for the new stations on the Hudson Bay route have already been chosen, and preliminary work on the foundations has been accomplished.

The Glace Bay and Louisburg trans-Atlantic duplex high-power stations are of great importance. Early in 1902, Marconi began the erection of the high-power station in Cape Breton. For a considerable period experiments have been conducted at various points on the Atlantic, none of which gave the results desired, and Glace Bay was finally decided upon as a suitable site for these tests. In the autumn messages were exchanged for the first time between Poldhu, Cornwall, and Glace Bay, and trans-Atlantic wireless telegraphy became an accomplished fact. In the Spring of the following year, 1903, the transmission of news messages from New York to the London Times was attempted, and for a time such messages were correctly received and published. A breakdown in the insulation of the apparatus at Glace Bay made it necessary, however, to suspend the service until it could be maintained in both directions under all ordinary conditions. To attain this end it was decided to erect a long distance new station in Ireland, and a larger and more modern station was erected at Glace Bay. In 1908, the opening of permanent commercial service was inaugurated. From that date developments in the trans-Atlantic service have been rapid. Various improvements have been made in stations, including the installation of apparatus for the automatic transmission and reception of messages, with the aid of which traffic can be handled at a rate as high as 150 words a minute. Duplex stations have been erected on both sides of the Atlantic, enabling the simultaneous dispatch and receipt of traffic.

"JACK" BINNS ENLISTS

"Jack Binns," wireless hero of the steamship Republic, was among the first of the British subjects to register at the British Recruiting Mission, 280 Broadway, New York City, when it opened. Anxious to add to his fame by exploits in the air, he enrolled for the Royal Flying Corps.

Binns was the wireless operator aboard the Republic when she was rammed by the Florida off Nantucket January 23, 1909. His persistent calls for help brought the Baltic to the rescue, and those on the rammed vessel were saved.

Since that time Binns has made his home in New York and has been a member of the reportorial staff of the New York American. The day the United States declared war on Germany he took out his first papers for American citizenship. Three years ago he married an American girl.

How the Pearl Shell Stood Up Under the Test

Some Observations on the First Voyage of a Steamship Across War-Swept Seas

By LEO GOLDBLATT

A corner of a French village visited by the author

WHILE many readers of THE WIRELESS AGE are professional operators and world-wide travelers, there are others who have never been outside the waters included in the territory of the United States. And there are a number, it is likely, who have never seen salt water.

Persons who are strangers to the briny deep, or who know very little regarding vessels, inevitably say, when meeting a ship operator, "Tell us some of your experiences."

He who sails the sea learns early the art of spinning yarns, and the adventures which he relates seldom fail to thrill (or chill) the blood of the auditor, provoking in some a spirit of take-a-chance, and drawing from others a brief but heartfelt, " I think I'll stick to land."

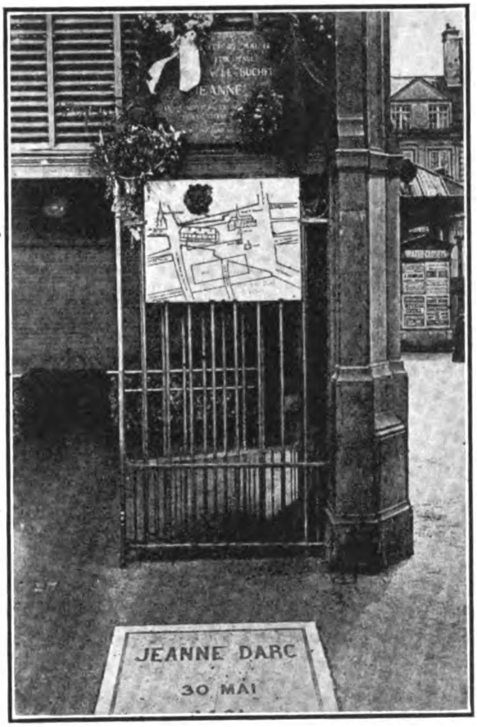
These tales, often exaggerated and distorted, are seldom told in proper sequence, and when a date is assigned to each, the period between them is so great as to give an impression that circumstances worth recording occur but once in four or five years. As a matter of fact, incidents which would appear strange and interesting to a landsman are of common occurrence on the sea. However, the wireless operator, as a rule, considers them too commonplace to mention.

As I have recorded in this narrative the events during a seven weeks' voyage on a ship making her maiden trip, a description of the vessel will be of interest. The Pearl Shell, about which the events in my recital center, is a steel oil tanker almost 500 feet long and carries approximately 70,000 barrels of oil (kerosene, gasoline, benzine, etc.) in bulk. She is equipped to burn as fuel either coal or crude oil.

To the accompaniment of salutes from factory whistles, sirens from ships large and small, the cheers of crowds lining the banks of the Christiana River, and the clicking of cameras, the Pearl Shell left the shipyards at Wilmington, Delaware, on the afternoon of November 1st, 1916, for her first "dip" in the ocean, bound for Bayonne, N. J., to load a cargo for ports unknown. The voyage from Wilmington to Bayonne was also a trial trip. Representatives of both the ship owners and shipbuilders were aboard. After the vessel had successfully undergone the numerous tests necessary to determine whether she agreed with contract specifications, the steamship company's representatives expressed themselves as satisfied, and the ship was formally handed over by the builders.

At Bayonne, the loading was quickly accomplished, and we steamed away from the dock and anchored in New York harbor to await orders.

The latest election returns were known aboard ship before many persons ashore heard them, as WHB (the New York Herald) sent them out every half hour. In the intervals, some unknown had attached a phonograph to a wireless telephone. Several members of the crew were invited into our wireless room, where they were able to hear band music, marches and patriotic songs as clearly as if they were sitting in the same room where the phonograph was located. At times the phonograph was disconnected, and a person with a deep bass voice announced the election returns.



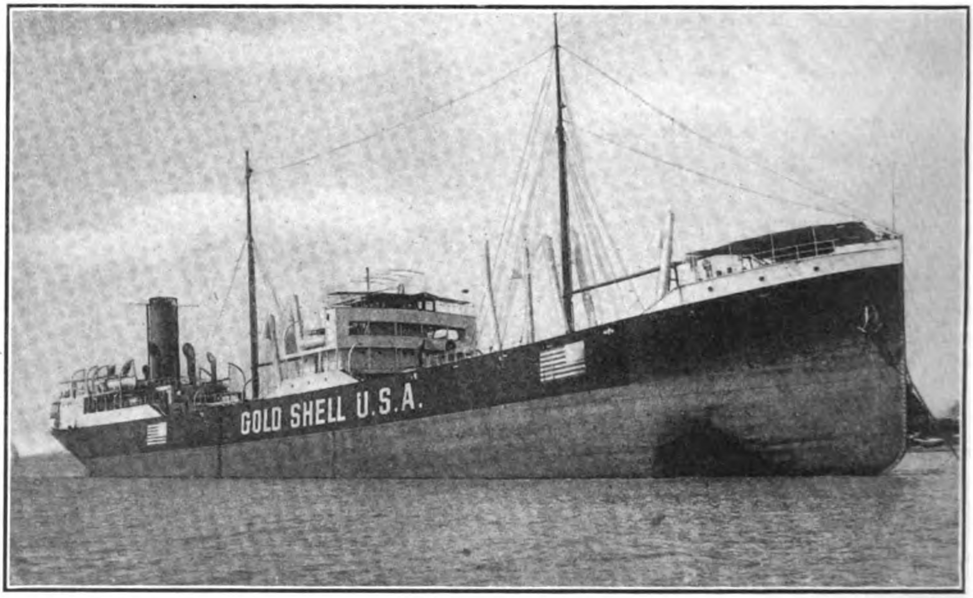
In Rouen you will be shown the memorial to Joan of Arc, who, as history relates, was tortured to death as a witch

The Pearl Shell weighed anchor on November 8th, and we headed toward the rising sun, bound for Bordeaux, France. We ran into a strong northerly gale on the second day out. It attained hurricane force at times, raising formidable seas. This weather we were compelled to combat during the greater part of the voyage.

One night we picked up a message from VCE (Cape Race, New Foundland) warning all ships that "German armored submarines may be met with anywhere in the Atlantic. Keep a good lookout and show no unnecessary lights."

Even after the hoarse rumblings of Cape Cod had died out in the distance, the musical notes of the 100 K.W. set at NAA (Arlington) kept us supplied with news of the day. Once within range of MPD (Poldhu, England) we had war news sufficient to satiate the longings of those most eager for information; and the latest British official and French bulletins were faithfully repeated.

All of the Allied nations had something to report. Even Serbia and busy little Belgium had time to send word that the enemy had been routed. FL



The Gold Shell, a sister ship of the Pearl Shell. The former vessel struck a mine just off the mouth of the Gironde River

(Eiffel Tower, Paris) was short and to the point: "We are winning." From KAV (Norddeich, Germany) came a high pitched musical spark announcing to the world that "the land of the Kaiser is still on top and intends to stay there."

Before entering the war zone various precautions were taken. The life boats were provisioned and swung over the ship's side, ready to be lowered at a moment's notice, while drills were held so that each man might know his proper station and duty in case of necessity. Extra lookout men were posted, and at night all the port holes were darkened to prevent any lights from being seen.

Word was received several days before the French coast was sighted that an unknown vessel, believed to be the American schooner Manga Reva, had been damaged by the storm then raging, and was in urgent need of assistance. The American steamer Nebraskan was only fifty miles from the position given, and her captain sent word that he was proceeding to assist her at full speed.

The Pearl Shell picked up the coast of France on November 23rd, having made the crossing in fourteen days. We hugged the coast a short time and at length came to the Gironde River, which we ascended as far as Blaye, thirty-five miles below Bordeaux. It was just off the mouth of the Gironde that the Gold Shell, a sister ship of the Pearl Shell, struck a mine four months previous to our arrival.

Blaye, a typical French village, with a population in peace times of about 20,000, is in the heart of the wine district, and for miles around carefully-kept vineyards can be seen. In these days of high prices of footwear it is interesting to note that persons in the humbler walks of life in Blaye wear wooden shoes.

Sunday is "fair" day, which is devoted to recreation. In an open space near a small wooded park, tents and stalls are put up in which are displayed such varied articles as candy, cheap jewelry, hats, second-hand clothing, shoes, scrap iron, farm implements, and colored post-cards. The village had neither footlight nor motion picture theater.

All the work on the farms and in the town is performed by old men, women and children. Only a few were able-bodied men and all of these were soldiers. A number of Austrians and Germans, sent back from the front as prisoners, do various kinds of hard labor under guard. Most of those I saw ranged in age from twenty to twenty-eight years.

Before entering the Gironde our aerial had been taken down, as a result of orders from French naval authorities. After we left Blaye behind and were outside the three-mile limit the aerial was again raised. The WTY (Standard Oil Barge No. 93) was heard sending SOS signals on November 29th. Her calls were picked up by GLD (Land's End, England), which promptly informed the patrol boats ZAAW and YZK, ordering them to the tanker's assistance. We were too far away at the time to render aid.

The following day it was found that our steward, a Japanese, was missing. He had last been seen the previous evening, while the ship was about ten miles off shore. It was believed he fell overboard, but the circumstances of his death are still shrouded in mystery.

The Pearl Shell anchored in Cherbourg harbor on December 1st to await orders. It was there we met one of the mysteries of the sea. While proceeding up the harbor to an anchorage, we steamed close to an anchored steamer whose entire forecastle head was blown off, as if by an internal explosion. We learned later that she had been picked up off the coast by fishermen about a week before, carrying a full cargo of crude oil. Not a living person was found aboard, but in the remains of the shattered forecastle were the bodies of eleven men. Several were wedged in portholes. They had, it is believed, attempted unsuccessfully to escape. The vessel's amidship house and after-quarters were not damaged and all of the lifeboats were in place. The fate of the remainder of the crew and their reasons for leaving the vessel, is still an unsolved riddle.

Our next port of call was Rouen, which is about sixty miles from the front and the same distance from Paris. A short distance below Rouen, along the banks of the Seine, up which we steamed, we passed several "prison camps" in which the French confine their prisoners of war. These prison camps consist of rows of long one-story barns, having windows similar to houses, with some form of arrangement within for sleeping. The entire "camp" is surrounded by a high barbed wire fence, along which patrol armed guards. The prisoners work in squads of six or eight, each squad being accompanied by a guard when working outside the prison limits.

On arriving at Rouen, we found, to our dismay, that none of the ship's crew could go ashore, by orders of the French military authorities. They cheerfully informed us that anyone caught ashore would either pay a fine of $1,000 or remain in jail until the conclusion of the war. In spite of the severity of the penalty, several members of our crew went ashore, and came back undetected. The next day the police came aboard, and all of the crew who could prove that they were American citizens were given passes permitting them to go ashore. Citizens of other neutral countries, a Dane and several Spaniards, were refused passes and told that if caught ashore they would be imprisoned.

Two detectives were stationed at the foot of the gangplank and they allowed no one to pass until a police pass was shown. An amusing incident occurred as a result of this espionage. One of our

Japanese messboys tried to get ashore, although for some reason, the French authorities would not give him a pass. He was stopped by a detective, and when no permit was shown the Japanese was ordered back to the ship. He demurred and to enforce his commands the officer drew a blackjack and threatened to use it. The Japanese went aboard the ship, obtained a huge butcher knife from the galley and again went ashore. The officer came over to chase him back, but on catching sight of the knife he fled with the messboy in hot pursuit. The Japanese was an excellent runner, but the Frenchman literally faded from view.

Rouen is famous as the place where Joan of Arc was tortured to death as a witch, a slab of marble marking the spot where she died. Another point of interest is the cathedral, which was begun about the year 1200. The Flying Bridge which spans the Seine, should not be overlooked by the visitor. A platform running on trolleys is suspended from the bridge and a fee of two cents is charged for passing over it.

Thousands of English "Tommies" are to be seen in Rouen. Canadians, Australians and New Zealanders are numerous, while an occasional Belgian or a group of coffee-colored East Indians may be met with. The turbans worn by the latter give them a picturesque appearance.

While we were at Rouen the military authorities received a report one night stating that Zeppelins had been seen flying in a direction which would take them over the town. Huge searchlights were immediately put into operation, and the powerful beams of light searched every corner of the heavens, but the airships could not be seen.

Our departure from Rouen was without incident, but while crossing the English Channel we passed the wrecks of six vessels which had been sunk by mines and submarines. About a hundred minesweepers and patrol boats on the lookout for mines or under-sea boats, were sighted.

Submarines are very active in the vicinity of Brixham. A ship which left soon after we arrived there was torpedoed within ten miles of the harbor, as were several fishing smacks. This resulted in orders from the British government for all fishing boats to stay in port, while a number of mine-sweepers armed with small guns patrolled the surrounding waters in the hope of bagging the submarine. As the population of Brixham is in the main engaged in the fish trade, an idle day hits it hard.

We lay two days at Brixham, coaling up, and on December 10th we said "good-bye" to the shores of England, and headed westward, bound for the land which all of us were now calling "God's country." Our course took us through waters in which several ships, one an American craft, had been sunk or shelled only a few days before, but fortune favored us, and we passed the scene of destruction unscathed.

Wireless communication throughout the voyage was excellent. On the return trip, press was received nightly from Poldhu and later from Arlington, while time for the chronometers was regularly received from Paris and Arlington. On four nights time was received from Paris and a few hours later from Arlington. Paris was copied at a distance of more than 2,300 miles through static.

Stormy weather handicapped us all the way back. At one time, with the engines going at full speed, we made about a mile an hour. Another vessel, caught in the same blow, had a 100-ton deckload of coal washed away, and was so battered by the heavy seas that it was necessary to steam to the nearest port for repairs. Her captain described the weather as "terrific."

But the Pearl Shell proved that she was seaworthy by riding the storm without bringing peril to the ship's company, and arrived at Philadelphia none the worse for her battle with wind and wave. She had undergone the severest of tests and emerged with credit. And we who had kept company with her during the ordeal agreed that we would trust ourselves to her in any and all circumstances.

Amateur Department

Announcement

THE EDITOR has decided to extend the scope of this department to include general electrical experimental apparatus as well as radio telegraph equipment.

Readers who have made exceptional and unusual experimental apparatus for use in the workshop or in the home are invited to send in a complete and brief description of its construction and working, accompanied by clear drawings. Articles from amateur electricians and wireless operators who have developed devices of particular merit both in and outside of the radio telegraph field will be particularly acceptable.

In preparing such articles, it is suggested that contributors state fully:

The object of the device;
Prominent or unusual features of utility of your construction;
A detailed description of the construction;
Results obtained by actual use.

Such contributions will be paid for at a rate depending upon their merit. Prizes will be given for the better class of articles, and those which are used outside of this department will be paid for.

In addition to the articles covering experimental electrical apparatus in general, the editor will welcome articles of timely interest to the amateur field at large, such as criticisms and comments on Government legislation, unusual experiences during previous years of experimental work and suggestions for establishing amateur communications on a more scientific basis.

Experimenters who owned wireless stations in the early days—say, about the year 1904—should be able to write highly interesting articles on early experiences and attempts at communication with the type of apparatus in use at that time.

All contributions designed for the amateur field should be addressed to the Editor of the Amateur Department, The Wireless Age, 42 Broad Street, New York City.

The Monthly Service Bulletin
of the
NATIONAL AMATEUR WIRELESS ASSOCIATION

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

NEVER have the members of the N. A. W. A. been afforded a better opportunity to advance their knowledge of technical wireless telegraphy than during the present crisis. The enforced closing of stations should not decrease interest in experimental work, for it is obviously the duty of all amateurs to prepare themselves technically and in key manipulation so as to serve the Government in one of the signaling divisions of the Army or Navy.

Amateur experimenters do not give sufficient attention to acquiring skill as telegraphers. They frequently adopt a haphazard mode of forming the telegraph characters, many in fact, believing that ability to carry on an abbreviated conversation with the neighboring stations is the ultimate goal.

Those who enlist in the Signal Corps will eventually be required to become first class telegraphers. Morse code must be sent and received at a fair rate and clean, clear, legible copy made when receiving at speeds up to twenty-five words per minute. Technical knowledge is of great importance, but a good signalman must be able to get off "the business" at high speed.

Since preference will be given to the technical man who can handle important field orders speedily and legibly every amateur who hopes to serve in the U. S. Army Signal Corps or as a Naval operator, must therefore (1) practice style in penmanship; (2) acquire skill as a first grade operator.

There is only one way to obtain such skill, and that is by practice—continuous practice day after day with an amateur friend who has attained the required degree of proficiency.

Many members of the Association not subject to conscription—unless, of course, they serve the country in some other way at home—will have plenty of leisure time. This presents to them an excellent opportunity to re-equip their stations or rebuild certain parts of the apparatus which do not come up to the final mark of efficiency.

For example, there may be a leaky high voltage condenser which should be rebuilt.

Perhaps a greater degree of efficiency can be obtained by re-designing the high voltage transformer.

The rotary spark gap may require attention; its disc may be "wobbly" or the insulation faulty. Some of the amateur disc dischargers which have passed our observation, even when used with ¼ K. W. transmitting sets, were fitted with electrodes of a size as large as the Marconi Company uses on 5 K. W. and 10 K. W. transmitters.

Attention might be turned to simplifying the receiving apparatus. Time might be conveniently employed, for instance, in building a universal receiving set, fitted with properly located "end turn" switches and regenerative features.

Experimenters would do well to direct their efforts toward design of receiving apparatus, scientifically making use of one of the well known formulae for calculating the inductance and capacity of an oscillation circuit. Even if the calculations fall somewhat short of the mark, the final results are bound to be more accurate than those obtained by mere guesswork. In many an amateur station may be found a receiving set which has an ultimate range of 5,000 to 6,000 meters, but which is used for reception at the wave-length of 200 meters. The end turn losses, of course, are in such tuners exorbitant, and in consequence, without re-design the apparatus is way below the required degree of efficiency.

An important matter upon which scientific data is lacking is the design of a regenerative circuit for the reception of signals at short wave-lengths. Most every amateur has his private "hook-up," and the result is that the beginner who has had no experience in the design of these sets is somewhat confused in building a set to meet his particular requirements. More queries have, in fact, been received at headquarters upon this one point than on any other technical matter bearing upon receiving apparatus.

Members of the Association who have had experience with the regenerative receiver are invited to send full details of construction, showing the exact number of turns in use in the inductance coils of all circuits, the capacity of the condensers and the general operating characteristics of the set, as a whole. From time to time, such information will be given full publicity in this department, with full credit to the contributor.

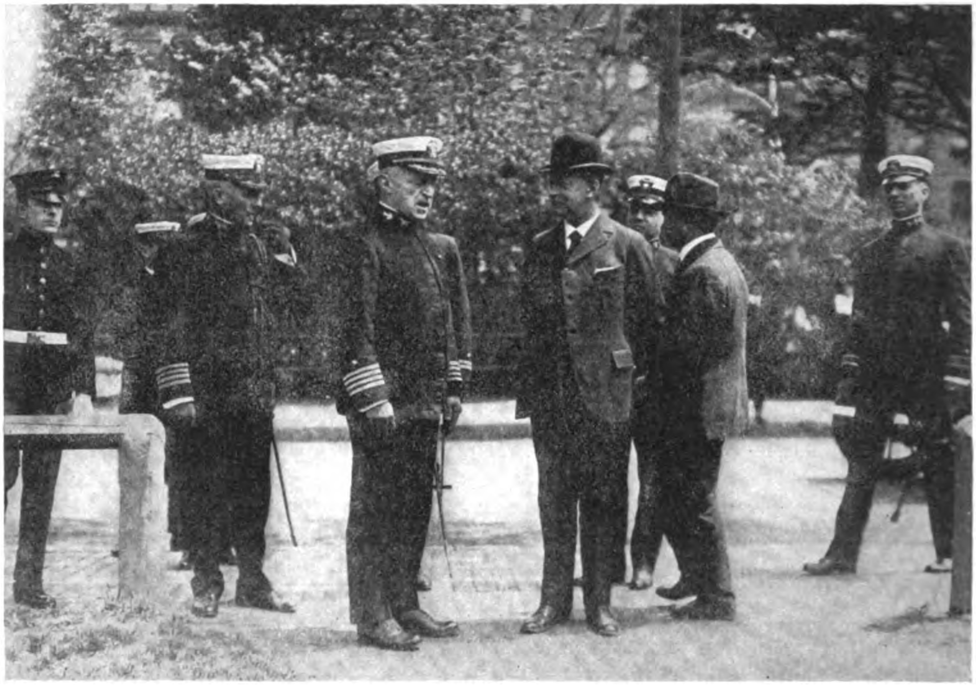
Another matter which comes in for attention in connection with the design of receiving sets is the use of multi-layered windings. Many of our members now employ a receiving tuner of small physical dimensions, which, through the use of multi-layered windings, will respond to wave lengths in the vicinity of 10,000 meters. Some report better results obtained with such a winding than with the more commonly used single layer windings. Data on this important point will also be welcomed and will be published from time to time.

There have been doubts expressed among amateurs as to whether or not they will be able to obtain vacuum valves in the future. No definite advice can be given at this time, but there is little doubt that such apparatus will again be placed on the market. Although a final decision has been handed down by the courts, a complete settlement between the parties concerned has not been concluded.

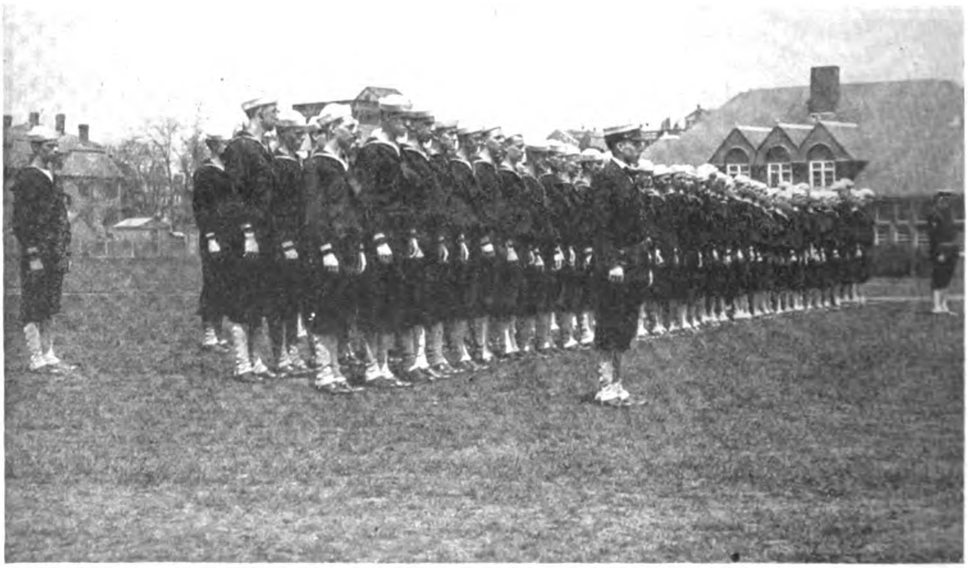
It appears that certain experimenters believe the magnetic detector to be so highly insensitive that it is of no value for their work. As a matter of fact, the magnetic detector is very sensitive for wave-lengths around 3,000 meters. Stations located at a considerable distance from Arlington have received the time signals with little difficulty with receiving tuners of proper design. The advantage which the magnetic detector possesses is that it requires practically no attention except to the mechanism which keeps the iron band in rotation.

Complete descriptions of this detector which should enable any experimenter to duplicate its construction, have been published in THE WIRELESS AGE and included in the third revised edition of the book, "How to Conduct a Radio Club."

(*Concluded on page* 786)



Commandant Rush of the Charleston Navy Yard and his staff recently made a tour of inspection at Harvard University, visiting the Pierce and Crust laboratories where students are engaged in studying wireless. In the photograph above are shown in the foreground, from left to right, Commandant Rush, President Lowell of Harvard and Professor Pierce, who is in charge of the electrical department at Harvard. Below are pictured the members of the Harvard Radio School, lined up for inspection



What Women Can Do and Are Doing

Progress of the Hunter College Students

The following statement has been made by the Wireless Section of the National League for Woman's Service:

THE members of the Wireless Class For Women at Hunter College, New York City, under the auspices of the National League for Woman's Service are making excellent progress. More than 100 pupils are studying the art.

L. R. Krumm, technical lecturer of the class, has received his commission as captain in the Signal Corps of the United States Army and Otto Redfern, code instructor, has received his commission as lieutenant in the Navy. Both Captain Krumm and Lieutenant Redfern are now stationed in the New York Navy Yard, but will continue their work with the wireless classes until their duties make it impossible for them to do so.

One of the possibilities open to the members of the class was pointed out by Professor Michael I. Pupin, of the National Advisory Board. He suggested that the students showing marked ability should be encouraged to fit themselves to be instructors in radio telegraphy. It is well within the bounds of possibility that the present corps of instructors throughout the United States will be considerably depleted, in which event women may qualify as teachers of wireless and take the places of men needed at the front.

"What use will they make of the art after they have mastered it?" is a remark frequently made regarding this new activity of women. We know almost nothing of what women among our Allies are doing, but occasionally we hear of inspiring service which those in England and France are performing. What we have to do is to be ready. Suppose in six months we are called upon to provide a number of radio operators in order that the wireless men may be released from their regular posts and go to the front. We shall be ready. In a year we shall have hundreds of operators. What the women have to look forward to is a chance for service. It may not materialize within the next year, but the signs of the times give us absolute assurance that when we are ready we shall be wanted.

There is no doubt in the minds of those who know what is really going on in the circles having to do with the preparations for actual warfare, that the woman power of the United States will be called on in ways that now seem out of consideration altogether.

In an interview which Mrs. Herbert Sumner Owen, chairman of the National Committee of the National League for Woman's Service, had recently in Washington with two of the men who stand high in the councils of the Navy Department, she was told that there were five electrical schools under the control and authority of the navy. "I will promise you in the name of the National League 500 radio operators six months from the day that the navy co-operate with me," she said. There was a possibility at the time that an electrical school in one of the navy yards would be thrown open to a class of 100 women. There has since been an influx of men into the various navy schools, particularly the one which was in question, and had there been no opposition, it would have been impossible for women to have received training in this navy yard. A reporter who heard Mrs. Owen's assertion probably misunderstood her, for a statement that she had undertaken to present the Navy

Mrs. J. C. Sheehan, an active figure among the women who took up wireless to aid the nation

Department with 500 radio operators in six months was published. While all of the members of the class at Hunter cannot expect to be graduated as full-fledged operators in six months, there is little doubt that a large percentage of their number will complete the course within that time.

Another misapprehension, due to published reports, should be corrected. Miss Helen Campbell was understood by a reporter to say that any girl of alert intelligence could become a radio operator in three months. Miss Campbell was surprised when she read the statement.

"I had had three years of actual service in telegraphy as preparation," she said, "and it took me six weeks to prepare myself to take the emergency license. I shall not go up for my commercial license before the end of six months."

It must be remembered that the girls in the wireless class are receiving instruction only at the evening sessions. The larger proportion of them are self-supporting and attend the wireless class after a hard day's work. They display admirable spirit and enthusiasm.

One of the students is a girl who is earning $6 a week. She lives at home, but is compelled to defray all her personal expenses except those for board and lodging out of her pay. When she made application to join the class Mrs. Owen attempted to dissuade her. She works from eight o'clock in the morning until five o'clock at night and is barely of the age required for admission to the class. However, she begged with tears in her eyes to be allowed to carry out her ambition.

"I have read everything I can get my hands on in the libraries," she said. "A boy I know got me an old buzzer and I have done what I can to learn the code, but I cannot go on any longer by myself. Please let me come into the class. I'd rather go without everything else and pay my fee to come in."

It goes without saying that the applicant's plea for admission was successful. "I take off my hat to that child," said Mrs. Owen. "She is the type of girl that we are coming in touch with through this new activity. We ought to have some scholarships, and when I get time I am going to go out and beg for a reserve fund so that girls like her can have the chance that they want so much."

David Sarnoff of the Marconi Wireless Telegraph Company of America, in conversation with Mrs. Owen, recently, said: "How many girls in your classes do you suppose would volunteer for service on coast-wise steamers? It would be practically safe, and if we could put women on those steamers we could set free for navy service the men detailed on these craft."

"I had never imagined that this was the sort of call that might come to my girls," said Mrs. Owen. "However, I don't believe Mr. Sarnoff realized how amazed I was, for I managed to respond that I believed my girls would volunteer for any service that the United States might ask of them."

That night, when the classes were gathering, Mrs. Owen told the pupils what Mr. Sarnoff had said.

"Now don't answer hurriedly the question I am going to ask you," she said, "think over soberly what it means and then tell me how many of you are ready to volunteer for such a service."

Every girl present signified her willingness to go wherever the United States might call her.

Miss Helen Campbell, the only one of the class who now has a license making her eligible for this service, was advised by Professor Hill to prepare herself to instruct students. She was absent when Mrs. Owen spoke to the classes, but when informed of what Mr. Sarnoff had said, she replied: "I will volunteer today if they want me."

Besides the coastwise steamers going through the canal and up the Pacific coast and along the Central and South American coasts and Mexico, there are the river steamers, sound steamers and craft of the short lines all about our home waters on which girls might serve as operators.

Although the Navy Department has not taken up Mrs. Owen's promise to provide operators, the appeals for aid and instruction are pouring in in such numbers that perhaps the 500 operators may be ready by the time the Navy Department is ready to co-operate in the plan. There are four divisions of the wireless classes at Hunter College, with approximately twenty-five women in each division. Each division has its commandant who calls the class to order, calls the roll, leads in the salute to the flag, receives the excuses and explanations of tardiness, jogs the memories of the delinquents as to fees, and is, in general, responsible for her particular division.

Miss Rebecca Parker, who is commandant of the first division, is soft-voiced and gentle, with a firm will. She is attached to Grace Church, where she accomplished excellent work last summer in the fight against infantile paralysis.

Mrs. Eila Haggin is the commandant of the second class. Mrs. Haggin is a woman of leisure and is detailed on special work at the Marconi School of

Instruction, New York, in the morning. She spends the evening with her class at Hunter. Mrs. Henry M. Warner is the commandant of the afternoon class, which is made up of women of leisure. Miss Helen Hemphill, commandant, is employed as translator in the engineer's library of the Western Electric Company.

The committee of the National League for Woman's Service in Atlanta, Ga., has started a preparatory class on the lines blocked out by the National Advisory Board and has sent its most promising pupil, Mrs. J. C. Sheehan, to New York City to take advantage of a scholarship, one of three that has been put at Mrs. Owen's disposal. Mrs. Sheehan had worked up her speed to ten words a minute, but had had no opportunity for technical or laboratory training. She is detailed for special training at the Marconi School during the morning and afternoon sessions and is at Hunter for the evening session. She shows marked ability. Mrs. Sheehan took up radio telegraphy purely from a patriotic motive. Naturally it appealed to her, but it is because of her desire to fit herself for real service in the national emergency that she is giving up her whole time to this work. It is to be borne in mind that six hours' concentrated mental effort a day through the hot summer months is no holiday proposition, even though our beloved New York may be, as it has been described, a delightful summer resort.

A close connection between the ramifications of the wireless divisions of the National League for Woman's Service, is being established and a coherent scheme has been instituted. The outline of the plan follows:

In collaboration with the Marconi School of Instruction, an Extension Wireless Course is being arranged for. Each wireless chairman will receive registrations for her particular group. These groups will engage instructors. Each member of the group will subscribe to THE WIRELESS AGE. which contains each month an article by Elmer E. Bucher. The instructors of the various groups will use these articles of Mr. Bucher as a structure round which to build the class. The individual members of the class will be enabled to purchase the necessary outfit for $7.50, plus expressage or postage. This preliminary training will carry the members of the class to the point where it can be decided whether they intend to finish the training and take their commercial licenses. The Marconi Schools in San Francisco and in New York and the National League's Wireless Class for Women at Hunter College will be open to members of these various classes throughout the United States.

It is probable that the establishment of these preparatory classes will give an opportunity to all those who desire this training to prove themselves; in fact, it will winnow out the "real stuff" of which radio operators must be made. The fact that the art is not an easy one cannot be too strongly emphasized. But is there any real achievement that is soft and easy? Radio telegraphy is now in its infancy, it stimulates the imagination, opens up vistas of fascination and has such unlimited possibilities for the inquiring mind as to make it well worth the price that must be paid in hard work and in the achieving of success in this particular sphere of activity.

Apparatus which was the accepted model a year ago is being "scrapped" today. Pupin's experience shows what lies in the grasp of the young minds which take up the consideration of this most wonderful of problems. The immigrant boy of several years ago is the man whose "coils" have made impossibilities accomplished facts. To you, girls, who have this door open to you, congratulation is a poor and weak word. Those of you who pass the tests have a fairyland of the intellect opening to you. There is no reason why you should not achieve. There is no reason why we should not have a great woman radio engineer. The privilege is put into your hands. It remains now for you to prove that you are worth the opportunity which is given you.

Intensive Course in Wireless Planned

In response to numerous applications, it has been decided by the National Advisory Board of the National League for Woman's Service to offer to the women of the United States an intensive course in wireless telegraphy to be held in Hunter College, Lexington Avenue, between Sixty-eighth and Sixty-ninth Streets, New York City. This course will be of three months' duration, beginning July 9th. Arrangements have been made to hold sessions of six hours a day, five days a week.

This course is designed for students and teachers who are ambitious to take up this branch of national service. "We believe," says a statement issued by Mrs. Herbert Sumner Owen, chairman of the National Advisory Board, "they can prepare for the test required by the United States Government, before granting a commercial license, in three months' time.

"It is not desirable to take this intensive course unless it is a necessity as it entails concentrated study of the most severe type."

Anyone desiring to apply for this course must register with the National League for Woman's Service in her community and send to Hunter College application for membership in this class.

The fee for the course will be $35. Text books $0.75.

The course has been approved by Professor Michael I. Pupin, Dr. Alfred N. Goldsmith, Edward J. Nally, Gano Dunn, Professor Lewis D. Hill and John Stone Stone.

COLLEGE OF CITY OF NEW YORK STATION OPEN

After an inspection by naval officers of the radio laboratories of the College of the City of New York, a recommendation was made to the War Department that an exception be made to the order of President Wilson that all non-official wireless stations be shut down during the war. The authorities have allowed the use of the entire radio equipment for experiment and instruction.

PENNSYLVANIA STATE COLLEGE GIRLS ORGANIZE

Seventy girl students at the Pennsylvania State College have organized a reserve unit of wireless telegraph operators. They expect to offer their services to the Government after they become efficient with the codes and apparatus.

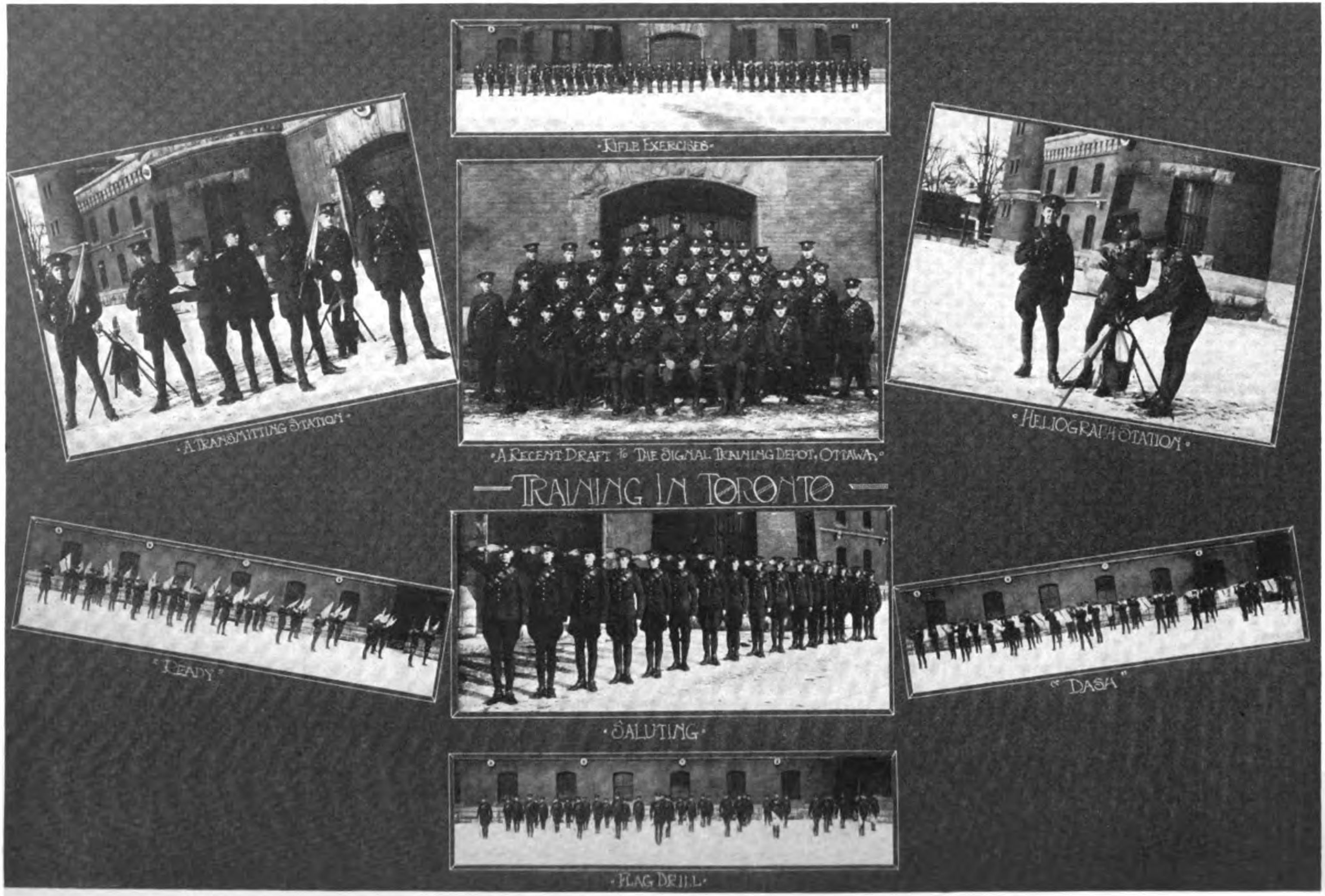
Practical work with instruments and lectures are given regularly to the class of co-eds by F. R. Amthor, a student, who is versed in military communication. Twenty-five other young women are learning flag signaling under the semaphore or two-flag code.

With more than 300 of the men students already out of college for patriotic service under arms and on farms, the girls said they would not be outdone. Immediately they formed Red Cross units, took lessons in first-aid work and established the class in wireless.

BOSTON YOUNG WOMEN REPORT FOR DUTY

Miss Charlotte Bayliss and Miss Edith Sigourney, who are among the first young women to pass the examination for enrollment in the Naval Reserves in Boston, have reported for duty as wireless operators. Both young women have been active in charitable work in Boston.

Clark College in Worcester, Mass., has petitioned War Department officials for permission to establish a class in wireless at the college.



The wireless men of Canada have found a field for their activities in the signal corps of that colony. In these photographs the members of a signaling company are pictured at drill

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

Suggestions for Improving the Design of Receiving Apparatus

This article was prepared to convey suggestions regarding the methods followed in the design of receiving tuners and associated apparatus.

On the panels of some receiving sets are too many binding posts and name plates. Not only do the posts detract from the appearance of the set, but they are sometimes placed in the most inaccessible places.

There is on the market a set for receiving undamped signals, on which the binding posts are located at least eighteen inches from the base. Imagine this set wired up in a station! The whole beauty of the cabinet design is destroyed by the wires running that distance up the side of the apparatus.

If the only defense that can be put forward for this construction is the high insulating qualities of the panel on which the posts are mounted, why not use inexpensive bushings and employ cheaper posts at the back of the set? A simple connection employing a machine screw and a washer will serve the purpose as well, if not better.

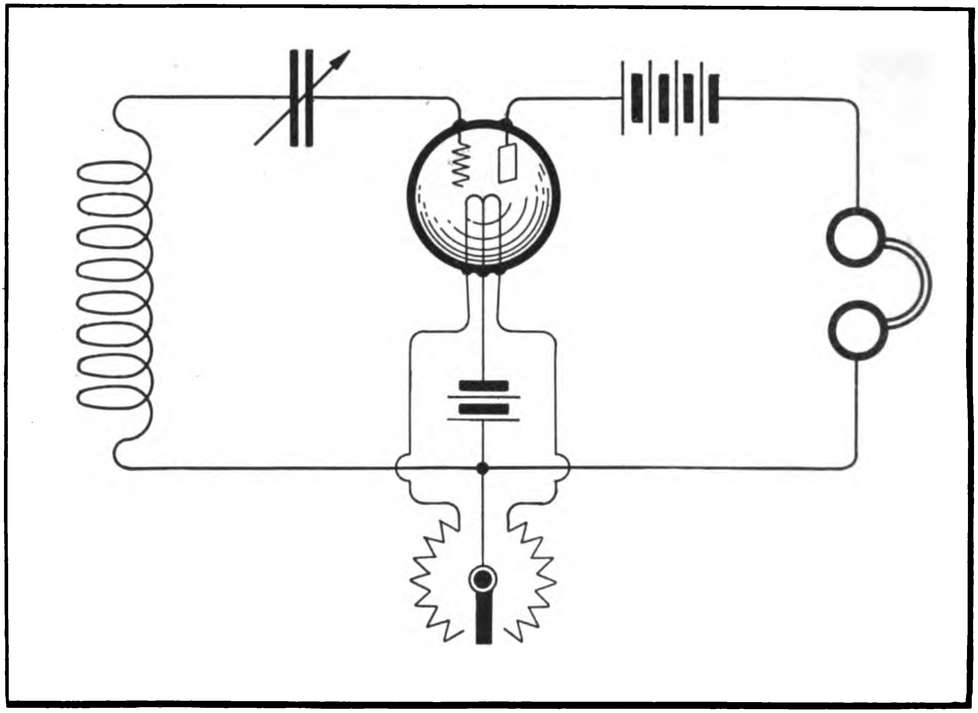
Going to the other extreme and selecting a cheap set, there is a little cabinet set less than a foot each way on the panel and less than four fingers thick. This has six large binding posts and four name plates on the tiny panel.

These name plates are intended to indicate where to make connections. A blueprint will give more information at less cost and simplify the construction. Another set, alike as to size of panel, but twice as thick, has eight binding posts and seven name plates on the panel.

Then, again, there are variable condensers which have binding posts on the top. They are not in themselves very objectionable, except that they necessitate unsightly wiring. I suggest a simple method of connection that is not so noticeable.

The arrangement of the controls on a cabinet set has important bearing on its appearance. In the construction of some sets the switches and other knobs are placed without regard to appearance and symmetry. On the other hand, unnecessary switches are employed to effect the appearance of a well balanced panel. This does not improve the set. One coupler I have in mind has twice as many contacts as are required on one switch for the reason referred to; in fact, each of the two switches has twenty-five contacts. Imagine the end turn losses and capacity losses in all those leads! The same effect, perhaps closer tuning, could be obtained by using a variometer for fine tuning, and tapping off the remainder of the primary in units equal to the maximum value of the variometer.

The carrying out of my suggestions, of course, would make for simplicity, and this is the keynote of successful results. Turning to the small "Tron" panels, it will be noted that a small two-point switch is used to select one of two filaments. This is not necessary by any means and too often unbalances the whole design. A circuit that eliminates this switch is shown in the accompanying drawing. It is only necessary that the resistance wire on the rheostat be cut at the center and a small piece of fibre be



Drawing, First Prize Article

inserted in the cut. The open end of the winding is connected to the filaments. The switch lever is normally in the small fibre block; moving it one way or the other will cut in either filament gradually. It is thus impossible to suddenly throw the current into the filament with resistance nearly all cut out and burn it out.

Examine the more complicated amplifying "Tron" panels. They are usually a motley collection of switches and variables. Name plates, letters and figures are distributed with a lavish hand and all to the detriment of the appearance of the set.

Manufacturers are beginning to realize that variometers are superior to condensers for fine tuning, particularly with the regenerative circuits now in vogue. This is a sign of further development in receiving apparatus.

Another matter of importance is the arrangement of the wiring of a receiving cabinet so it may be changed easily and quickly. The writer has just designed an amplifying "Tron" cabinet that meets these requirements. All the instruments have leads brought up to a panel mounted two inches below the level of the top of the cabinet. The set contains three variables, two "Tron" tubes, two sets of high voltage batteries with allied potentiometers, two rheostats and two telephone keys. A separate lead is brought up from each of these and connected to a spring binding post. The top of the cabinet is held in place with hinges and, when closed, covers the panel with all the binding posts.

With this set any desired hookup can be tried out. All that is necessary to effect a change is to raise the top, and, by means of short lengths of copper wire, connect the proper posts together.

In conclusion I make the following recommendations: Employ less variable condensers, more variometers, fewer switches, and place them symmetrically, find a less conspicuous place for the binding posts and arrange the set so the connections may be changed and the station wired up in accordance with the latest advances in the art.

T. W. Benson, *Pennsylvania.*

SECOND PRIZE, FIVE DOLLARS

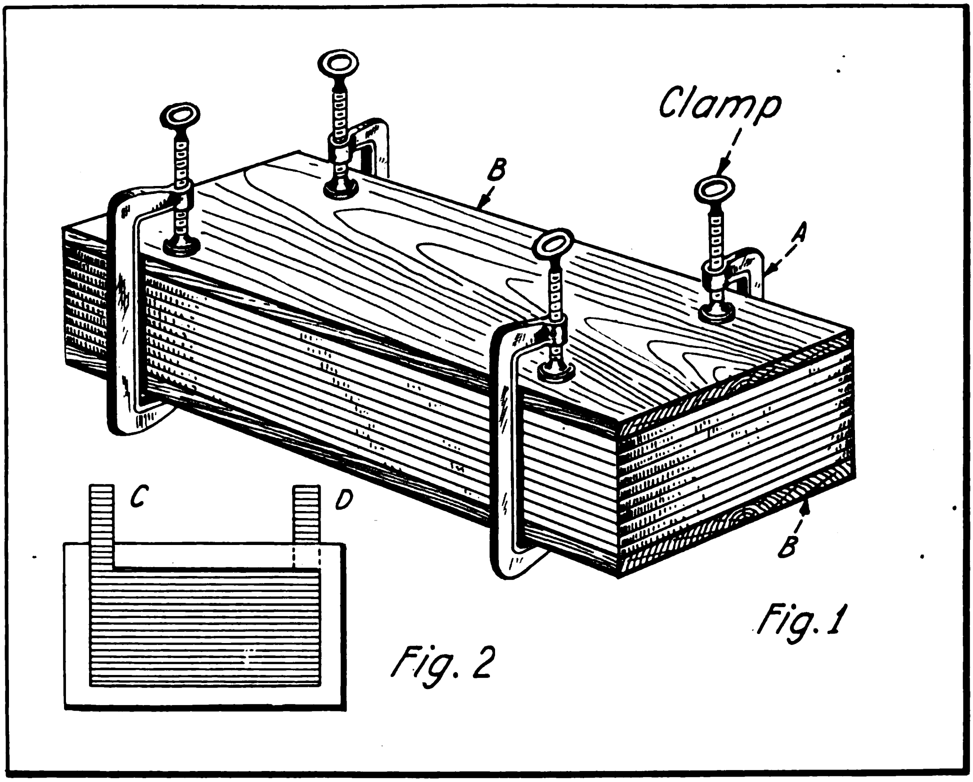
A 1 K. W. Oil-Immersed High Voltage Condenser

The condenser described in this article has the correct capacity for a 1 K. W. transformer. The glass plates can be secured from a photographer and should be 10 inches by 8 inches, and one-eighth of an inch in thickness.

Thirty-five of these plates will be required. They should be covered with tinfoil on both sides, each sheet measuring 8 inches by 6 inches. The glass is coated with the tinfoil in the following manner: First heat the plate of glass and rub the surface with a piece of bees wax. When the wax melts, cover each side of the glass with the tinfoil. While the glass is still warm, stick the terminal, C (Figure 2) on one side of the glass and the terminal, D (Figure 2) on the opposite side of the glass. These are cut from tinfoil, measuring 1 inch by 4 inches, and they are attached to the glass by means of melted wax.

Thirty-three plates should be covered in this manner, the other two being used for the top and bottom plates. Coating both sides of the glass makes two thicknesses of tinfoil between each plate.

This having been completed, cut out two pieces of wood of the same dimensions as the plates of glass, except that the wood should be about one-fourth of an inch thick. Secure four clamps (A, Figure 1), such as are used to hold the corners of curtain stretchers.



Drawings, Second Prize Article

On one side of the pieces of wood (B, Figure 1) lay the glass plate having no tinfoil on it. Then place the other thirty-three plates on this and cover them with a plain piece of glass and finally with the wood. Arrange the plates during assembly so that the terminals come out on alternate sides. For instance, terminal C, Figure 2, comes from the top plate, while terminal D, Figure 2, comes from the next plate.

When all plates are assembled, the clamps should be attached at each corner, as in Figure 1, and the condenser heated until the wax begins to melt. Then the clamps should be tightened and the wax allowed to harden.

The condenser is now ready to be placed in the oil. The dimensions for the tank are not given, but it should be large enough to admit the condenser with ease. The cover of the tank should be of some insulating material so that the terminals may be brought out to binding posts. Finally the tank should be filled with insulating or transformer oil until the plates are completely submerged.

W. Bradshaw, *Connecticut.*

THIRD PRIZE, THREE DOLLARS

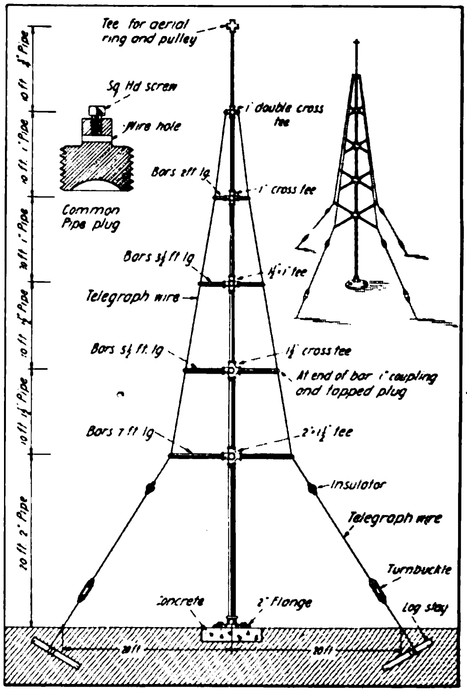
Description of an Aerial Mast of Unique Construction

This article contains a description of an aerial mast which I designed. My mast is 70 feet in height, made of specified lengths of pipe, ranging from 2 inches at the base to ¾ of an inch at the mast top. It is supported by four strands of telegraph wire, which in turn are fastened by log stays as shown in the accompanying drawing.

The chief difficulty found was that the supporting wires gradually became slack. This fault I entirely eliminated by a tapped plug scheme for tightening and fastening the wire to the cross bars. This tapped plug is of simple design as shown in the lower left hand detail. The base is made from a pipe plug and a hole drilled to take the wire. Perpendicular to this hole is a tap in which is placed a screw for fastening the wire permanently when it is once pulled tight.

If double cross ties, such as shown in the drawing, cannot be obtained easily, it would be possible to use two cross ties connected by a nipple. Then one set of bars would be slightly above the others.

The obvious simplicity of the mast does not call for further explanation on my part, and I trust that my drawing



Drawing, Third Prize Article

will show at least the general principle of design.

George H. P. Gannon, *Massachusetts.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

How to Make a Highly Polished Black Panel

The following should be of interest to amateurs who desire a highly polished black panel and do not wish to spend the amount of cash necessary for hard rubber or bakelite:

Take a piece of some soft porous wood, such as cypress, cut it to the desired size, drill all holes that are needed, then cut down the rising of the grain with a piece of pumice stone and some water. Pour two quarts of boiling water over one ounce of powdered extract of logwood and when the solution is effected, add one drachm of yellow chromate of potash and stir the solution well.

Apply two or three coats of this to the wood until a deep black is produced. The panel is then polished by the use of powdered tripoli and boiled linseed oil.

This wood is then put in a solution of equal parts of gem salt, rock alum, white vinegar, chalk and Peebles' powder. Mix these together well and put the wood in after the ebullition is over. The latter solution will petrify the wood making it hard like rock.

Panels made in this way, while slightly inferior to hard rubber in respect to insulation qualities, will never warp or twist, and will have a bright, shiny black face.

If the amateur will follow my directions closely, he will have a panel that will be a credit to his station and will represent a decided saving in cash.

If a cherry colored panel instead of the solid black is desired, use the following solution: Three quarts of rain water and four ounces of anotto boiled in a copper kettle until the anotto is dissolved. Put in a piece of potash about the size of a walnut and boil for about half an hour longer. This gives a bright cherry color.

V. C. McILVAINE, *Florida.*

HONORARY MENTION

Antimony Silicon Detectors and Their Advantages

A great many amateurs have trouble keeping the adjustment of silicon detectors. To a great extent this may be remedied by using as a contact, in place of the customary point or wire, a wedge-shaped piece of antimony. The edge should be as sharp as possible and only a small part should be in contact with the silicon. The use of this mineral allows a greater pressure on the silicon without making the signals inaudible. The signals may not be as strong in some cases as by using a light contact (as a point), but the keeping of adjustment must be taken into consideration.

A. C. STANSFIELD, *New York.*

HONORARY MENTION

Supposed Wireless Telephone Conversations and an Actual Experience

Speaking of wireless telephone conversations which so many amateurs have heard, particularly around the zones where such transmitters are in operation, I am firmly of the opinion that in a number of cases these supposed conversations are the result of an elastic imagination working jointly with a few solid facts.

It is often noticed that the average amateur is so greatly interested when he operates his apparatus, in fact, he is so fascinated at hearing far-off stations, that his imagination carries him beyond all bounds, and while in this state it is likely that he will hear almost anything.

Others may have been fooled as I was. One night about six months ago, just after adjusting my vacuum valve to its best degree of sensitiveness and getting results not to be compared with previous detectors in use, I put my telephones on to pick up anything within range. After turning the switches here and there and adjusting the apparatus for a few minutes, I came upon a distinct voice saying, "Hello, Hello; who is this?" Then I heard nothing further that night.

I was of course of the firm belief that I had heard a wireless telephone conversation, and I thought possibly that the signals emanated from the telephone transmitter at Arlington. But when I heard a similar conversation a couple of nights later, I began to retrench and wonder.

Two or three days later I traced out my connections thoroughly and found that the wireless apparatus was connected to earth by the same ground wire attached to the house telephone and which, by the way, was a party line. Therefore, what I had really heard was a part of an actual wireless telephone conversation.

It may be that some amateurs have been fooled in the same way that I was, and I advise them to trace down their connections and make sure that they have an individual earth connection.

J. F. MILLER, *Illinois.*

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.

C. T. H., Barto, Pa., inquires:

Ques.—(1) I am attaching to this communication two circuit diagrams for the charging of a 6-volt 40-ampere hour storage battery and desire to know which one is correct. In the first diagram five lights are connected in parallel and the entire bank in series with the cell, and in the second diagram five lights are connected in series with one another and with the cells.

Ans.—(1) The parallel connection of lamps is the correct one. Each lamp will pass approximately ½ ampere and therefore five in parallel will permit about 2½ amperes to flow on charge. If this is the normal charging rate of the particular cell it will effect the purpose, but it is usual to pass about 5 amperes through a 40-ampere hour storage cell during the charging period.

* * *

A. E., Sargent, Neb., inquires:

Ques.—(1) I am addressing this letter to your "Queries Answered" Department because I want reliable information. I should like to know first if portable wireless stations are as effective as stationary.

Ans.—(1) Portable stations generally cannot cover the range of the fixed stations because usually the earth connection is not as efficient and the antenna is of small dimensions. Modern military portable transmitting sets are very powerful and have been used for communication up to 400 miles.

Ques.—(2) Can undamped waves be received by small receiving sets?

Ans.—(2) We do not understand what you mean by small receiving sets. The majority of high-power stations using undamped waves transmit at very long wavelengths in excess of 6,000 meters, and consequently a rather large receiving tuner is required. A special detector is required for the reception of undamped oscillations, such as the tikker, the slipping contact detector or the vacuum valve used as a beat receiver and amplifier.

Your third query is not clearly understood. Just what you mean by tuned or untuned amateur stations is not clear. It is necessary that all types of transmitting apparatus in use by amateurs be accurately tuned to a definite wave-length and to resonance with the local oscillation circuit.

Ques.—(4) If I can pass the Government license wireless examinations what are the opportunities and the salary to be expected?

Ans.—(4) You would receive, provided your qualifications were in accordance with their requirements, immediate employment in the ship service of the Marconi Wireless Telegraph Company of America.

Ques.—(5) Is the demand for wireless telegraph operators great?

Ans.—(5) There is a large demand for the services of properly qualified telegraphists and you would have no difficulty in obtaining employment within a few days after sending in your application.

Now that amateur stations have been closed by Government order, there is no necessity for answering your last query.

* * *

W. G., Oak Park, Ill.:

The glass plates of a condenser should be free from lead and at least ⅛th of an inch in thickness. For amateur use, a plate, 8 inches by 10 inches, covered with tinfoil, 6 inches by 8 inches, makes the condenser unit easy to assemble and one which will not take an inordinate amount of space.

The average ½ K. W. transformer will require about twelve such plates connected in parallel, but if a series parallel connection is required, you will need forty-eight plates, twenty-four connected in parallel on each bank, and the two banks finally connected in series.

All types of oscillation transformers are equally efficient provided they are of the correct dimensions and have sufficient conductivity to carry the current without losses. The flat spiral pancake type is probably more convenient because it permits the sliding contact to be fastened on a control handle which can be revolved inch by inch over the inductance and thus permits a very fine adjustment to be obtained in the quickest possible manner.

The November, 1916, issue of The Wireless Age gives complete information

(*Continued on page 778*)

EARNING A NAVAL NICK-NAME

By L. E. Fetter

IT was thrust upon me—I didn't really earn it. The reason was this:

I was sent to the U. S. S. Marietta soon after leaving the Navy electrical school.

One day when the mail steamer was due I sat listening in for her report, and after she had called I told her to go ahead. I judged from the signals that she was miles away, yet she came in strong the first time. All I got was "To the Capt."

The only information the steamer could have for us, I reasoned, would be to announce the prospective delivery of mail. I knew the last stop was Livingston, which was fifty miles away, about three hours' sail; she would probably call as soon as she left there. So I wrote out the following:

"To the Capt., U. S. S. Marietta. Have mail for you. Will arrive about five P. M. (Signed) Bluefields."

It was about two o'clock when I sent this in to the captain. An orderly sought me out fifteen minutes afterward and said that the skipper wanted me. I surmised that he wanted to send a message, but he said: "Fetter, if you get a spud from the locker over there you can toss it aboard the Bluefields."

I looked over the side and saw the Bluefields not a hundred feet away. I'd forgotten to close the aerial switch which was fastened to the deck above and worked by pulling a couple of cords. It was in when I got the call; I pulled it out to answer (it worked on the transmitting side when out and on the receiving set when in, an old style now), and, in my haste, forgot to pull it in again. The only reason for hearing the Bluefields operator at all, the second time was that he either came in strong enough to jump the open switch or I picked him up through the grounded ship's line.

QUERIES ANSWERED

(*Continued from page 776*)

concerning dimensions of aerials suitable for transmission at wave-lengths of about 200 meters. You are advised to obtain a copy of the November issue and note carefully the article by A. S. Blattermann.

* * *

T. E., Troy, Mo., inquires:

Ques.—(1) Please advise me how to construct a 1 K. W. oil-immersed condenser out of 5 inches by 7 inches photographic negative?

Ans.—(1) These plates are rather small but will work efficiently provided you have a sufficient number. They should be covered with tinfoil, 4 inches by 6 inches, and each will then have a capacity of approximately .00033 microfarad.

You will require 300 plates connected in parallel for an approximate value of .01 microfarad.

* * *

S. X. M., Stockholm, Me., inquires:

Ques.—(1) While I have noticed in your magazine many articles telling of the great success obtained by many amateurs who have covered several hundred miles with crystal receiving sets, etc., I have never heard a word about the man of failure like myself. You will note, as per the sketch enclosed, that my equipment consists of the usual apparatus connected to an antenna 150 feet in length, 72 feet in height at one end and 67 feet at the other with a lead-in 35 feet in length.

I have tried the wiring diagrams shown in several of your publications, but so far although I have listened for several hours at a time, I have had no success. I feel quite sure that there must be something wrong with the apparatus, although I cannot understand why I do not receive signals.

Ans.—(1) We have noted carefully the diagram and your error is easy to locate. You have the fixed or stopping condenser in series with the variable condenser and in shunt to the variable you have a crystal detector and head telephone; in other words, you have short-circuited the secondary variable condenser by the head telephone and therefore have destroyed the efficiency of the set because the receiving detector is practically cut out of the circuit.

Connect your fixed stopping condenser between one terminal of the variable condenser and one terminal of the crystal detector. Put the telephone in shunt to the stopping condenser, C-2, and you will have an efficient working set. You are, of course, aware that all amateur stations must be closed until further notice.

* * *

L. S. H., Pennsylvania, inquires:

Ques.—(1) Will you please describe how to make a small tubular fixed condenser for a receiving set?

Ans.—(1) We see no advantage in constructing a condenser of this particular shape. Ordinarily the fixed or stopping condenser has capacity of approximately .005 microfarad although it may vary from .0005 to .05 microfarad. The usual procedure is to take a number of sheets of tinfoil, about 2½ by 2½ inches, and separate them by extremely thin sheets of paraffin paper, and after a number of such sheets have been filled up, to compress the entire unit between two blocks of wood and immerse it in paraffin. Connections of course, are brought out from alternate sheets throughout the sides of the condenser frame and connected to binding posts which are mounted on the wooden block.

* * *

F. C. C., Winfield, Kans.:

There is no difference in the construction of a receiving tuner for a short wave regenerative receiver and one used for ordinary purposes. The regenerative loose coupler can have the dimensions of the variometer described in the book, "How to Conduct a Radio Club." The regenerative tuner for a certain range of wave-lengths will have the same dimensions as when used with a vacuum valve detector and the ordinary circuit. A regenerative circuit was shown in a previous issue of the Bulletin of the National Amateur Wireless Association.

* * *

W. S., Daconia, Okla.:

Now that the ban has been placed on amateur stations, you will not be able to erect the contemplated aerial.

In the book, "Practical Wireless Telegraphy" on sale by the Wireless Press, Inc., you will find a detailed diagram showing the construction of a modern Marconi aerial and you would do well to duplicate the particular type shown in so far as possible.

In commercial radio service silicon bronze wire (7 strands of No. 21) is almost universally employed. Occasionally aerials have been erected made of a special copper coated steel wire which combines the conductivity of copper with the tensile strength of steel.

You would do well in erecting an aerial to be sure that the dimensions are correct for the transmission and reception of waves of 200 meters. Complete dimensions of aerials for operation at this wavelength were printed in the November, 1916, issue of The Wireless Age.

* * *

E. C. S. T. J., Dayton, Ohio.:

If you desire to build a receiving tuner responsive to wave-lengths up to 6,000 meters, we advise you to secure a copy of the fourth revised edition of the book, "How to Conduct a Radio Club" and construct a tuner after the dimensions given therein.

P. H. L., Fort Wayne, Neb.:

We have no data at hand for calculating the inductance of multi-layer coils such as may be used in the wing and grid circuits of the vacuum valve. It is customary to wind these coils on concentric tubes, adjacent windings being spaced about ¼th of an inch. If you will mount these coils so that they can be telescoped, one within the other, you will have a variable inductance of considerable range. Multi-layered coils are of particular value for tuners operating on long waves although many tuners are in use wherein multi-layered coils are used for the reception of short wave-lengths, not over 600 meters.

* * *

L. N., Bay City, Mich.:

A complete course in radio engineering is given periodically at the College of the City of New York and also a special course at Columbia University, New York City. Full information concerning the entrance requirements can be obtained from the dean of either college.

Graduates of technical schools will be given an engineering course at the Marconi Company's factory at Aldene, N. J. If the applicant possesses the proper credentials he is assigned to the manufacturing department on a salary which is periodically increased over a space of three years.

The Marconi Wireless Telegraph Company of America will give you employment during the summer months in the Great Lakes Division if you desire such an appointment.

* * *

B. C., Tampa, Fla.:

In order to construct the variable high voltage condenser you propose it will be necessary to separate the adjacent plates, even though oil-immersed, by sheets of glass or by a good grade of micanite. A condenser of this type is feasible but not essential. The average radio transmitter, with the exception of one to be operated over a large range of wave-length adjustment, operates most efficiently with a condenser of fixed capacity across the secondary winding. For experimental laboratory work a high voltage condenser of variable capacity is of considerable value.

The formula for calculating the capacity of a variable condenser appeared in the April issue of The Wireless Age.

Your last query is answered in an article by A. S. Blattermann in the November, 1916, issue of The Wireless Age.

* * *

Howard D., Brooklyn, N. Y., inquires:

Ques.—(1) Please note the circuit diagram accompanying this inquiry. I should like to have the dimensions of all coils for this regenerative receiving tuner responsive to waves up to 3,000 meters.

Ans.—(1) The secondary winding of a receiving tuner may be 5 inches in length, 3½ inches in diameter, wound closely with No. 32 S. S. C. wire. The primary winding may be 4 inches in diameter, 6 inches in length, wound closely with No. 24 S. S. C. wire. The loading coil, L-3, may be 3 inches in diameter, 5 inches in length, wound closely with No. 32 S. S. C. wire. Similar dimensions will hold good for the coil, L-4. The condenser, C-1, need not have at its maximum value capacity in excess of .0001 microfarad, while the condenser, C-3, should have a maximum value of about .001 microfarad. The condenser, C-2, is one of extremely small capacity and is not absolutely necessary in all cases.

* * *

J. E., Milwaukee, Wis.:

We have no details of the aeroplane set which you mention, nor the connections of the receiving apparatus which is supposed to have given good results.

* * *

H. H., Brooklyn, N. Y.:

The diagram of connections you have attached to your inquiry are feasible, but we do not see where you will derive any particular advantage in breaking the circuit by means of a tikker at the point mentioned. Ordinarily, the tikker is placed in series with the telephone condenser. In fact, there is no necessity for interposing a crystal rectifier in the circuit. The apparatus will respond to undamped waves without a rectifier although it is often noted that the presence of the rectifier smooths out the note. The apparatus you have shown will respond to undamped wave stations in the United States, but not to stations located in foreign countries for the reason that it is not sensitive enough for the purpose. You, of course, understand that all amateur stations will remain closed for the period of the war.

* * *

H. P. W., Lansing, Mich.:

The book, "How to Conduct a Radio Club" contains complete diagrams of the vacuum valve connected in various ways. Copies of this book can be secured from The Wireless Press, Inc., 42 Broad Street, New York City.

* * *

F. E. P., Port au Prince, Haiti:

The allowable flux density of 500-cycle transformers is from 10,000 to 15,000 lines of force per square inch. The primary of a 3 K. W. transformer may be wound with No. 8 S. S. C. wire and the secondary with No. 26.

The irregularity in the note of your quenched spark transmitter can probably be eliminated by careful adjustment of the generator voltage when the point of resonance between the primary and secondary circuits of the oscillation transformer has been reached.

After a quenched spark set has been tuned to resonance, it is necessary to carefully adjust the generator voltage to get

a clear spark tone and this may be the difficulty in your particular case. The 200-mile range which you have obtained with your ¼ K. W. is very good indeed and about all to be expected with an apparatus of this power input.

* * *

E. M. T., St. Joseph. Ark.:

The best way to keep up your code practice during the period of the war is to purchase an automatic transmitter such as the omnigraph and connect it to a small buzzer practice set, or you might install a small buzzer and key and have a friend who is familiar with the telegraph code send to you daily. In this way you would soon be enabled to pass the Government license examination and would be able to secure a position with a Commercial Company, the Army or the Navy.

* * *

A. B. S., New Orleans, La., inquires:

Ques.—(1) I have been an operator in the Marconi service and should like to know the use of the protective choke coil on the Marconi 107-a tuner.

Ans.—(1) It is a coil of high self-inductance which is shunted around the short wave condenser and the primary winding of the receiving transformer. Its function is to prevent the accumulation of extra high potentials on the di-electric of the Marconi disc variable condenser.

It is not connected in the circuit of the tuners of the American Marconi Company.

Ques.—(2) How is the Marconi magnetic detector connected at the "stand-by" side?

Ans.—(2) When the change-over switch is thrown to the stand-by position the detector is disconnected from the secondary circuit and placed in series with the antenna. Tuning is then effected by variation of the aerial tuning inductance or the short wave condenser.

On the "tuned" side of the switch the magnetic detector is connected in series with the closed oscillation circuit.

An intermediate oscillation circuit is placed between the antenna and the local detector circuit.

Ques.—(3) What is the receiving range of the Marconi direction finder?

Ans.—(3) Its range is only limited by the size of the aerial and the sensitiveness of the receiving detector. Recent tests made by the Marconi Wireless Telegraph Company of America indicate that the looped aerials of the direction finder can be used for the reception of signals over extremely long distances.

* * *

A. D. R., New York City, inquires:

Ques.—(1) How can a commercial wireless operator be assured that his transmitting set is working at the maximum degree of efficiency?

Ans.—(1) This is easily determined by the data given on the tuning cards which are posted in the wireless cabin. These cards show the number of primary and secondary turns in use at the oscillation transformer for all wave-lengths, and also the amount of antenna current to be expected under normal operating conditions.

If these adjustments are thoroughly duplicated and the reading of the ammeter is below normal, it is evident that some part of the apparatus is not functioning properly.

A commercial operator should first check up the antenna current, noting at the same time the reading of the primary wattmeter. The normal power consumption of the set should not be exceeded in any case. When the transmitting set is properly tuned is evidenced by an aerial ammeter, and the next thing in the order of the adjustment is to determine the note of the spark. If the note is not clear the range of the apparatus will be considerably reduced because receiving telephones are generally more sensitive to a certain critical spark frequency. The tone of the note can be regulated by the generator field rheostat or by cutting in and out gaps in the case of the series or multiple plate discharger.

The rotary gaps are adjusted for a clear note by means of an adjusting handle attached to the muffling drum which shifts the position of the stationary electrodes in respect to the disc electrodes.

* * *

A. N. D., New York City, inquires:

Ques.—(1) Will you please state some causes for the sparking of the brushes of a motor generator?

Ans.—(1) We presume that reference is made to the motor brushes. Some of the causes of sparking are as follows: (1) The commutator may be worn in ridges causing an uneven surface for the brush contact; (2) There may be a loose connection between the armature coil and the commutator bar; (3) There may be a high or low commutator bar which causes poor contact with the brush each time that this particular section passes underneath; (4) The brushes may be in very light contact with the commutator; in other words, they are not set with sufficient pressure; (5) The brushes are not set at the neutral point and they should be shifted back and forth until the correct point is found; (6) There may be an open coil in the armature, which, if it exists, will cause very severe sparking; (7) There may be a collection of dirt and grease in the commutator which prevents good contact at the brushes.

There are still other causes, but in general the foregoing will cover the troubles encountered by the wireless operator.

* * *

H. M. T., Seattle, Wash.:

The Marconi direction finder is a very accurate instrument and gives the line of direction of a given station, but does not indicate

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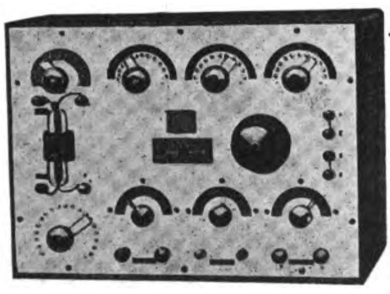

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ELMIRA, N. Y., U. S. A.

whether the signals come from the north, for instance, or from the south. In the case of a ship there need be no argument on this point if the reception is at a land station, as it is generally known on which side of the vessel the land station is situated.

* * *

A. Z. B., Washington, D. C., inquires:

Ques.—(1) I frequently run across the terms "skin effect" in connection with wireless apparatus and am not quite sure that I actually understand its application.

Ans.—(1) The skin effect in a conductor is a tendency of alternating current to avoid the central portions of solid conductors and to flow on or near to the surface. This effect is more pronounced as the frequency is increased and when the frequency becomes of the order of several thousand cycles per second, a hollow conductor is just as effective as a solid conductor.

* * *

A. B. L., Brooklyn, N. Y., inquires:

Ques.—(1) What is meant by an "earth" arrester of the transmitting set?

Ans.—(1) It is a particular type of series spark gap used by the Marconi Company in connection with its transmitting and receiving sets. It consists of a brass plate gap, the length of the gap being exceedingly small, and connected in series with the earth lead of the transmitting system. The antenna and earth connections of a receiving transformer are connected directly across the gap and when the transmitter ceases operation. The receiving set is connected directly in series with the aerial for receiving purposes.

Connecting the receiving tuner in this way requires a rigid oscillation detector such as the Fleming oscillation valve or the Marconi magnetic detector. Sensitive crystal detectors would not stand the induced potentials that would be set up in the receiving circuits.

Ques.—(2) How is the correct direction for the flow of the local battery current through a carborundum crystal determined?

Ans.—(2) It is best determined by actual experiment. The connections from the battery to the potentiometer are reversed until the best signals are obtained. It is well in making this test to cut down the strength of the incoming signals until they are rather weak, for it is often observed that the adjustment of the local battery that will give loud signals from a near-by station is not the correct adjustment for a far distant transmitter. This is more or less true of all types of oscillation detectors in which a local battery current flows.

* * *

C. V. H., Kinsley, Kans., inquires:

Ques.—(1) What is the wave-length of an aerial consisting of a single wire 550 feet in length, 64 feet in height at one end and 68 feet at the other? The lead-in is 70 feet in length. I believe that this aerial has a wave-length of more than 200 meters. Amateur stations have been heard on it. Why?

Ans.—(1) The natural wave-length of the antenna under consideration is about 890 meters which is several times the value it should be for the efficient reception of 200 meters. Amateur stations can be heard on this aerial, but the effect is one of forced oscillations. If a transmitting station is located close to a receiving station and radiates a considerable amount of energy, oscillations will be forced into the receiving aerial even if the receiving apparatus is out of resonance with the emitted wave from the transmitter. This may be the condition that prevails at your station.

Ques.—(2) What effect do galena and other minerals have on electro-magnetic waves which causes them to be audible in the receiving telephones?

Ans.—(2) Mineral detectors are rectifiers possessing the peculiar property of changing a high frequency current into a series of direct current pulses. The alternating currents of radio frequency which flow in the secondary circuits of the receiving apparatus could not operate the telephones direct because the mechanical time period of the diaphragm of the receiver will not permit it to vibrate at such a rapid rate per second of time. Therefore it becomes necessary to convert the high frequency current into an audio-frequency current to which the receiving telephones will readily respond.

In the case of a spark transmitter the entire action may be summed up as follows: For each spark of the transmitting apparatus a train of high frequency electrical oscillations, from twenty-five to 100 in number, passes up and down the aerial system. Corresponding displacement currents are set up in the immediate region of the antenna system and travel through space at the speed of light—300,000,000 meters a second. At the receiving apparatus the train of oscillations comprising each individual spark at the transmitter is rectified into a single series of decaying direct current pulses which cause a single movement of the telephone diaphragm for a single spark of the transmitter. In other words, a complete train of oscillations has an integral effect on the diaphragm, creating a single sound.

Ques.—(3) Why are the minerals sensitive only in certain parts?

Ans.—(3) The cause of this phenomenon has never been determined. In fact it is not definitely known just why crystals possess the property of rectification. The most complete answer to this query can be found in the book, "Principles of Wireless Telegraphy," by G. W. Pierce. Investigations concerning the actions of the various crystalline detectors are fully described in certain experiments and the effects on the oscillograph are observed.

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NEWARK, N. J.

R. H. L., Rutland, Vt., asks:

Ques.—(1) Would a rotary spark gap operated on a spark coil in synchronism with the gap by means of a mechanical interrupter (on the same shaft as the gap wheel) be termed "efficient" by a radio inspector?

Ans.—(1) We cannot possibly see why there should be any objection to this construction, provided the decrement of the spark gap circuit is not too great. Of course the United States authorities are chiefly interested in the decrement of the emitted wave rather than that of the spark gap circuit and we do not believe they are particularly anxious in regard to the efficiency of an amateur set.

* * *

A. C., Bangor, Me.:

The freak results obtained with your receiving tuner are undoubtedly due to the end turns, i. e., your tuner is too large for the range of wave-lengths you desire to receive. When your receiving transformer is adjusted to the shorter range of wavelength, it is quite probable that the end turns have a natural period of oscillation somewhat near to that of the incoming signal, and hence a considerable amount of the energy of the oscillations is absorbed. This will tend to damp out the oscillations and will give the effects you have observed, namely, amateur stations can be heard regardless of the adjustment of the tuner.

THE N. A. W. A. SERVICE BULLETIN

(*Concluded from page 763*)

It is proposed to begin a country-wide campaign to enlarge the membership of the N. A. W. A. and to further its interest in every way possible.

A State Director of Communications will be appointed in each state who will look after the interests of the Association. The one to be selected to carry out this important work will, of course, be a well known amateur who possesses a first grade equipment and whose ability as a telegraphist is generally recognized.

Form letters will be sent out at a later date which all members are to fill out in detail. These will enable us to obtain highly important data for carrying out the plans of the campaign.

Long distance relay tests appear to appeal to the amateur experimenter both for utility and interest, and it is therefore proposed to organize several standard relay routes across the United States, designed not only to interest experimental workers in general, but to serve as an emergency communication means in case of disaster such as that of several years ago in the flooded Ohio districts.

That amateur stations can be of great assistance in emergency has been fully proven. Several instances can be cited where amateurs have maintained the only means of communication when telegraph and telephone have failed.

Through the columns of this department members of the Association are requested to express themselves freely on Government legislation. Those who have stations which might be of benefit to the Government in the present crisis and others which possess equipment peculiarly located for carrying out such work efficiently should send in full details to Association headquarters. These data will be kept on file, so when they are required we shall be able to present to the Government authorities a complete list of such stations.

Communications are invited from all amateurs on subjects pertaining to the advancement of the Association. Constructive criticism will be particularly welcomed and communications which are considered of importance to the field in general will be published in this department.

It is the purpose of the Association to further the interest of the amateur:

(1) By informing him of the latest developments in respect to the technical application of wireless telegraphy;

(2) By informing him of proposed legislation pro and con to his interests;

(3) By guiding his experimental work along more scientific lines of investigation;

(4) By protecting him from nefarious and unprincipled manufacturers;

(5) By showing him what is true and what is false in the published reports of the day.