January, 1919 20 Cents

The WIRELESS AGE

Volume 6 Number 4

Protests With a Point—
Varied Views on Government
Ownership of Wireless

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Varied Views on Government Ownership of Wireless

The Wireless Age

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

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Index of Equipment

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AUSTRALIA
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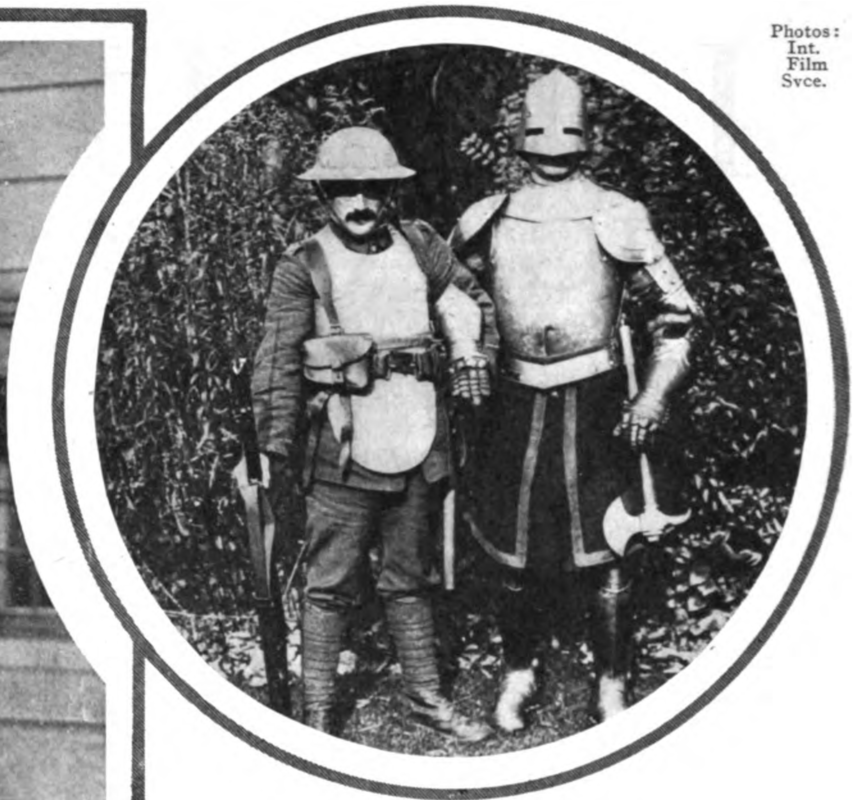


Photos: Int. Film Svce.

Modern Military Armor

Above, in circle, a modern fighting man's dress contrasted with ancient body armor, showing that protective metal covering has not lost its usefulness. The modern doughboy here shown has dispensed with cumbersome steel but is well protected against bayonet and shrapnel

To the left is illustrated the helmet which is capable of stopping a rifle bullet and body armor made of semi-flexible thin spring steel plates sewn together in a canvas sack

A favorite pastime in Flanders, now that the guns are silent, is trying on suits of German armor left behind by the Boche in his flight

VOL. 6. NO. 4. JANUARY, 1919

THE WIRELESS AGE

WORLD WIDE WIRELESS

Weagant's Solution of Static Problem Arouses Controversy

IMMEDIATELY following the announcement that the static problem had been solved by an invention of Roy A. Weagant, reported in the December issue, Newcomb Carlton, president of the Western Union ridiculed the idea, stating that such delusions had been coming up ever since Wireless was discovered.

Mr. E. J. Nally, Vice President and General Manager, Marconi Wireless Telegraph Company of America, being asked for further comment upon President Carlton's statement, said that while he deplored public controversy it was being forced upon him by the animus of the Western Union, adding "science and progress have ever met with the disdain of those who like to follow the lines of least resistance. These non-progressives may be divided into classes. There is the man who says it can't be done, the man who fears it might be done and the man who would like to say it shall not be done. Mr. Carlton is entitled to the distinction of adding another class for himself, in that he, claiming cryptic knowledge of something he has not seen and could not know anything about, empirically condemns it.

"It is not a nice position for the head of a large corporation to take, but he is following historically in the footsteps of some other Western Union presidents, one of whom deflected the genius of Elisha Gray from developing the telephone. Another president of similar 'low visibility' completely failed to encourage the genius of Edison, who was forced to work elsewhere than in the telegraph business, and whose wonderful achievements since are known to all mankind.

"But all of this perhaps accounts for the lack of progress of the science in land line telegraphy, which has advanced very little beyond the days of Morse, and certainly not at all beyond the days of Edison's connection with it. Mr. Carlton's statement that the claim for continuous transatlantic communication through the operation of the Weagant invention is 'humbug' is utterly false. For this is the very thing that has been established beyond a peradventure."

Michael I. Pupin, professor of electro-mechanics at Columbia University, also issued an opposition statement:

"The removal of static interference," said Professor Pupin, "is the great problem of wireless. It may never be discovered. An invention of such tremendous importance should not be announced until it has been tested by disinterested experts.

"There are already a dozen inventions that will remove static under certain conditions. What we want is an invention that will remove static under all conditions. We want to be able to send wireless messages in spite of everything excepting lightning and the will of God."

Professor Pupin, who is inventor of the Pupin coil, explained that he had demonstrated his own inventions before a group of scientists before he made them public.

Complete tests of the invention of Roy A. Weagant, which, it is asserted, eliminated static interference in wireless telegraphy, will be made next Summer, Mr. Weagant immediately announced.

"We are going to make the tests that Professor Pupin calls for during next June, July, and August," Mr. Weagant said. "They cannot be made immediately because nobody would accept tests made in Winter, when there is much less static electricity to contend with than in Summer. I cannot say yet where the tests will be made, but they will be carried out in the presence of disinterested scientists. In all probability Professor Pupin himself will be invited to attend."

"The skepticism was quite natural," he said. "It sounds big to make the announcement that we have perfected wireless after all these years, but I know we are safe. I would like to tell the whole story, but I am restrained until the peace pact is signed. I don't expect people, including scientific men, to believe it until they use it. It is like flying—people would not believe it could be done until they actually saw it done."

President Constantly in Touch with Land on Overseas Trip

SPECIAL arrangements never before used were made for handling President Wilson's wireless messages and to keep him in constant touch with Washington.

This announcement was made by Secretary of the Navy Daniels in connection with a statement that the Navy Department had been in continuous communication with the George Washington and the flagship Pennsylvania since they sailed from New York. He said:

The George Washington and the battleship Pennsylvania are both equipped with the most modern radio apparatus, some of which was installed for this particular trip.

This apparatus includes, on the Pennsylvania, the most powerful transmitting set on any United States naval ship and also special receiving apparatus for receiving from high power stations used ordinarily only for transatlantic messages. The George Washington was also especially equipped with similar receiving apparatus. On board both ships were installed radio telephones and the newest type of low power radio sets, for use only in communicating from ship to ship.

All messages for the President were sent by the new naval high power station at Annapolis, which is five times as powerful as the Arlington station. These messages were received by the George Washington and the Pennsylvania simultaneously. All replies were forwarded from the George Washington to the Pennsylvania and relayed to shore by the Pennsylvania.

At three special naval radio receiving stations, one in Maine, one in New Jersey and one in the Navy Building, Washington, expert operators listened continuously for the Pennsylvania's messages. The messages when received were forwarded with utmost despatch to the transatlantic radio division of the office of the Director of Naval Communications in the Navy Department, and the three copies compared to insure accuracy. All outgoing messages passed through the same office in Washington.

As the Presidential party approached Europe, by arrangement of the Navy Department, special receiving stations in both England and France listened for messages from the Pennsylvania, and one of the French high power stations forwarded messages direct to the ship. The President was thus kept in touch with Washington and Paris or London simultaneously.

Interior of the wireless room on the S. S. George Washington—By means of this apparatus the President was kept informed of the world's doings during his trip to France

N. Y. State Troopers Get Wireless

MEMBERS of the State Constabulary operating in New York City's suburbs, it was announced on November 23, are to be equipped with wireless telegraphy as a means of communication.

The Naval Intelligence Department informed Lieut. John Walton of the troopers that the powerful apparatus with a 5,000-mile radius, which Corporal Daniel Faber of Highland Falls station recently seized from Glen Vanvalkenberg at his home in Westkill and confiscated, is to be presented to the troopers. This is in recognition of the services they have rendered the Navy Department in finding and confiscating many wireless stations during the war. Lieut. Walton will have the apparatus transferred to White Plains and set up there so the police can send and receive messages.

Report That Ex-Kaiser Has Station

WILHELM is reported to be closely in touch with Germany from his Holland domicile. One dispatch from Amsterdam today reported that a wireless station has been installed at the Van Bentinck castle and that German airmen flying over Maarn drop messages for him.

Marconi to Sell and Lease Ship Equipment

EDWARD J. NALLY, Vice President and General Manager, Marconi Wireless Telegraph Company of America, on his return from Washington, where he went for conference with the Navy Department, has made known a change in the policy of the Marconi Company under which it will in future sell as well as lease wireless apparatus. The first result of this change in policy has been the sale to the Government of the apparatus on some three hundred ships now under Government control and all of the small coast stations which the Marconi Company has maintained in the past but which it no longer needs under its new policy.

Mr. Nally stated that the terms of the sale were based upon the earning value of the stations and the apparatus, and added that the Secretary of the Navy had dealt with this question with the utmost fairness and with just consideration of the rights of the company's stockholders.

This transfer does not in any way affect the status of the company's large stations for transoceanic communication, but it is believed that it will have met every need of the Government for the control of domestic wireless and that there will now be no occasion for the Government seeking to secure control or ownership of the large high power stations which were built with the principal object of rendering to the public international transoceanic wireless service in competition with the cables, which is by far the most important part of the Marconi Company's activities.

Progress Announced for Japan's Radiophone

AN exchange to connect wireless and wire telephones is to be established in Kobe, Japan, before the first of the year by the Government Department of Communications, it is reported. A wireless tower 180 feet high is now being erected in front of the largest of the Kobe telephone exchanges. Wireless telephone messages from vessels within 100 miles of the South Japan port will be connected by central operators with the telephones of subscribers in Kobe, Osake, Kyoto and neighboring cities, thus serving the most densely populated section in Japan.

Police Radio Saves Lives and Dollars

ACTING police commissioner, of New York, received on December 5 a report on the work done by the wireless telegraph branch of the police department during the past two years. The wireless tower is on the roof of the police headquarters building, and the seagoing end of the service is aboard the police boat, Patrol, which covers the harbor.

The report shows that merchandise valued at upwards of $400,000 and some twenty-five lives have been saved mainly through information received by wireless. About 2,000 messages have been handled by the service. Headquarters has been able to receive messages from a distance of 1,500 miles, and to transmit them 300. On the Patrol are two operators, John Ward and Russell McKee, both patrolmen, and stationed at headquarters are Charles Goul, John E. Hanley, and William J. Ferrick, also patrolmen.

Marconi Company Opposed to Government Ownership

THAT the Marconi Wireless Telegraphy Company of America is unalterably opposed to Government ownership and operation of the radio stations in the United States which it owns, and which have been under Government control and operation since before this country entered the war, was indicated by a statement issued by Edward J. Nally, Vice-President and General Manager of the company. The statement follows:

The Marconi Wireless Telegraph Company of America, through its Vice-President and General Manager, Edward J. Nally, makes further answer today to the questions raised by the bill which has been introduced by Representative Alexander, Chairman of the Merchant Marine Committee, which seeks to give permanent government ownership of all radio communication through the acquisition and operation by the Navy Department of all wireless stations in the United States used for commercial purposes.

"Mr. Nally wished to particularly point out that the situation with respect to wireless was in no way different from that of communication by telegraph, telephone, and submarine cables. In other words, there is no special reason for Government ownership and operation of radio communication that does not equally apply to other means of communication.

"The fact that the statement prepared by the Navy Department and given out by Judge (Representative) Alexander states that transoceanic radio telegraphy is not a serious competitor of the cables, and that high-power stations are not yet able to receive from one another all day and in all seasons, proves that the Government is not able to make the most of its opportunities and get the best results from transoceanic wireless operation. This statement is a weak attempt to minimize, in the eyes of the public, the importance of wireless competition with the cables.

"As a matter of fact, before the war, the Marconi Wireless Telegraph Company had inaugurated its transpacific service with Japan and was building up a very successful commercial business with the Orient. The cable companies recognized that there was a competitor in the field, because they were forced to reduce their rates and to add new classes of service, which, during all the years they monopolized transpacific communication, they had refused to do.

"The Marconi Company, by reason of its organization and its improved apparatus, particularly with the aid of the Weagant invention, of which wide announcement was recently made, is in position to guarantee to the business public accurate and reliable service at all times and at rates lower than those charged by the cables. Already it is being petitioned by business firms on the Pacific Coast and in New York to resume its service, owing to the congested condition of the cables and the poor service which they are giving.

"It seems a pity, at this time, when transoceanic communication is so important, that commercial wireless companies should not be given the fullest opportunity to meet the public demands."

By way of answer to that part of the statement made public by Representative Alexander as Chairman of the House Merchant Marine Committee, that, except in very special circumstances, wireless telegraph companies have never made any profit, except by the sale of stock, the Marconi Company pointed to the financial showing it made for the years 1914 to 1917, inclusive. The figures, taken from the annual report for the year ended December 31, 1917, show:

Net income for year 1914, after charging reserves, carried to balance sheet, $149,877.47; for 1915, $177,316.51; for 1916, $259,888.80, and for 1917, $617,772.69.

The company has issued and outstanding $10,000,000 of common stock. Since its organization, in 1899, it has paid two dividends, one of 2 per cent. in 1914, and one of 5 per cent. in 1917.

Wireless Beats the Dutch

SOMETIME during the war British naval officers were searching the mail bags of a Dutch liner bound for New York and extracted therefrom about $200,000 in American railroad bonds. In spite of the angry arguments of the purser that the bonds belonged to the Dutch bankers whose names appeared on the envelopes the North Sea skippers took them aboard the cruiser and from thence they found a resting place in the British treasury.

Not long afterwards a delegation of lawyers representing the Dutch and American interests visited the British Embassy and laid the case before a representative of Great Britain.

He listened politely and said: "Gentlemen, you apparently have a good case, but wait a moment." With this he asked the clerk to bring in file No.—.

Taking a few slips of paper from the file he read

Morris for George Matthew Adams Service
Another war decoration

to the lawyers not only the names of the German bankers who had sold the bonds through Dutch banks but the names of the American bankers who were actually to receive said bonds, and also all the wireless messages in regard to the transaction which had been carefully decoded by the British Admiralty experts.

The astonished lawyers politely withdrew.

Sayville Bought by U. S. Is Report

IT was semi-officially announced here on November 26 that the Government had bought the Sayville Wireless Station outright after it was taken over.

The station was owned by a so-called "American syndicate," and the question had arisen whether it will revert to its original private owners.

Boys Congratulated on Rounding Up Spy Stations

A TELEGRAM from Secretary of the Navy Daniels was received by the Boy Scouts of America November 15. It characterized them as "chivalric young crusaders" because of their work during the war. It also disclosed that the Scouts, working on behalf of the Government, had discovered hundreds of illegal wireless plants.

Twenty-six of these plants were found in one day. A German alien operating an underground raido station with a small New England river supplying the motive power, was taken into custody and interned. This plant was said to have been exchanging German Government messages between America and Berlin. Details of these scout activities are expected to be made public later.

Fair Californian Didn't Land Navy Job

THE latest and bravest storming of masculine citadels comes with the entrance of women into the hitherto taboo field of wireless telegraphy. The horrors of higher mathematics have been braved, the difficulties of taking twenty words a minute in the wireless code conquered, by Miss Reavis Hughes, daughter of Mrs. Walter J. Hughes, who in October completed a regular operator's course at the Polytechnic High School, Los Angeles.

But women telegraph operators are still somewhat of a novelty to United States Government officials, as Miss Hughes to her sorrow found out. After taking her regular man-sized course, passing a strenuous all-day examination with all kinds of intricate code tests and other lively matter, she emerged with flying colors and word was sent on to Washington, D. C., that Reavis Hughes was a first-grade operator. A license was sent to her, followed by a telegram notifying her of her appointment to take a special radio course for special work under the War Department, an offer which was as promptly withdrawn when it was made plain that "Reavis" was a woman and not a man. Consequently, Reavis Hughes, first-grade operator, still awaits a job, but feels certain that one soon will be forthcoming.

Britain's King Broadcasts Peace Congratulations

THE White Star liner Megantic, which arrived November 18 from Liverpool, was the first passenger vessel to be signaled from Sandy Hook since the United States entered the war. The Megantic had been used for transporting American troops overseas and will now be used for bringing back the troops to Canada.

When the news of the signing of the armistice was received by wireless late at night Captain F. E. Beadnell ordered all the decklights to be turned on for the first time since early in 1915, when the German submarines became active. All on board were roused at 7 o'clock the following morning by the continuous blowing of the siren and at 8 o'clock the flag was hoisted at the stern, while the band played "God Save the King." At noon Captain Beadnell mustered the crew and the passengers on the forward deck and read a message received by wireless from King George to the captains of all ships flying the Union Jack congratulating them for the part they had taking in assisting to win the war.

Warning Issued About Amateur Licenses

S. W. EDWARDS, United States radio inspector, with offices in the Federal building, Detroit, issues instructions to amateur wireless operators on the procedure to be followed in obtaining permission to use their equipment, warning them, also, that severe penalties may be imposed on any who attempt to use stations without proper authorization. Inspector Edwards says:

"They are advised that applications for station license may be made at once and that all such applications will be filed in the order received.

"The opening of any amateur wireless station and the beginning of amateur activities is forbidden under penalty of arrest and confiscation of all apparatus. They are informed that as soon as the ban has been lifted and all restrictions on this class of station removed, all those who make application now to this office will be individually notified by the proper government authorities. Until such a time, however, they must not use wireless apparatus in any manner or for any purpose, testing included. Should those who make application for license fail to receive any notification within a week after the treaty of peace is signed they may request further information from this office.

"After all restrictions on amateur activities have been raised and if it is the amateur's intention to use any transmitting apparatus whatever regardless of its range, they will be required to secure both an amateur station license and an operator's license for which no fee is charged. In view of the fact that such licenses held and call letters assigned before the outbreak of the war are regarded as canceled, they cannot be renewed and therefore new ones must be secured. Use of transmitting apparatus without such licenses is punishable by a fine of $500 and forfeiture of all apparatus."

Wireless Aid in Breaking Hun Morale

WIRELESS telegraphy, its conquests and achievements during the war, will be one of the alluring chapters soon to be unfolded before the public, now that the veil of secrecy imposed by the universal censorship is being removed. It will be a record of performances that will be equalled, or rather exceeded, only by the plans of development that are in prospect for the world-wide political and commercial expansion of the immediate future.

Since the outbreak of the war, and more particularly since the United States entered it, the wireless has developed a universality of uses that outrun the imagination.

Everything of international interest the President said during the war was distributed through the air. The main purpose of this distribution was to reach the people of the Central Powers, that is to say, Germany, Austria-Hungary, Turkey and Bulgaria. These methods were employed to get the viewpoint of the United States before the people of the Central Powers. First, whatever was to be sent, whether it was something spoken or written by the President, or whether it was a statement as to the number of troops that had been sent to France, was sent by wireless across the Atlantic and put into the air over all Europe.

It is assumed that the German wireless stations picked all this news out of the air and while the officials in charge of those stations did not give it newspaper publicity it did gain much publicity by being passed from mouth to mouth.

How Science Beat the Hun

The Accomplishments of the Trained Man of Science in the War *

By J. S. Ames
Professor, Johns Hopkins University

(*Continued from the December,* 1918, WIRELESS AGE)

BOTH the army and the navy need airplanes for their operations; but after their demands are supplied, there remains the wide expanse of the air through which attacks can be made upon the enemy, far away from the battle-front and the coast. Great Britain has recognized this all-important fact, and has been building a great fleet of airplanes for this new service. In this, new instruments, new types of machines, new guns and bombs are required.

There are two main problems in connection with the submarine, first to locate it, second to destroy it. Methods of destruction are at hand in the shape of depth bombs; but methods of detection so far have not been eminently successful.

From an airplane one can see through water only to a limited depth, never more than twenty feet, and so the main reason why the seaplanes have been so successful in destroying submarines is not due to the fact that the observer in the airplane discovers his' prey, but is that his machine has such great speed, three times that of a destroyer, that when news is flashed that a vessel is being attacked by a submarine it can often reach the spot in time to drop its bomb effectively. The detection of the presence of a submarine is a definite physical problem; and it is not an exaggeration to say that at least one-fourth of the physicists of note in England, France and this country have been engaged in the attempt to solve it.

What lines of attack upon it are open? Not many.

The submarine in motion emits certain sounds; can they be heard? It is a solid body; can one obtain an echo from it? It is made of iron; can this fact help through some magnetic action?

These are the obvious lines of approach, but one should not hastily conclude that there are not others.

Without stating, and I may not, how far successful these efforts of the physicists have been, I may note that the method which is now being tested by our Navy is one elaborated by a distinguished professor of mathematical physics.

In the course of these extremely numerous experiments upon the submarine question several beautiful methods have been developed which in the future will have great scientific importance; one of these, due to a French physicist, is one of the most interesting developments in physics made within a decade.

Another submarine problem, which is by no means of secondary importance, is to develop a method by which one submarine may communicate with another or with the shore. I do not think I am saying too much when I state that this has been solved, even for considerable distances.

I cannot leave the subject of the airplane and the observation balloon without referring to the question of maps and map-making, in connection with which the former are so important.

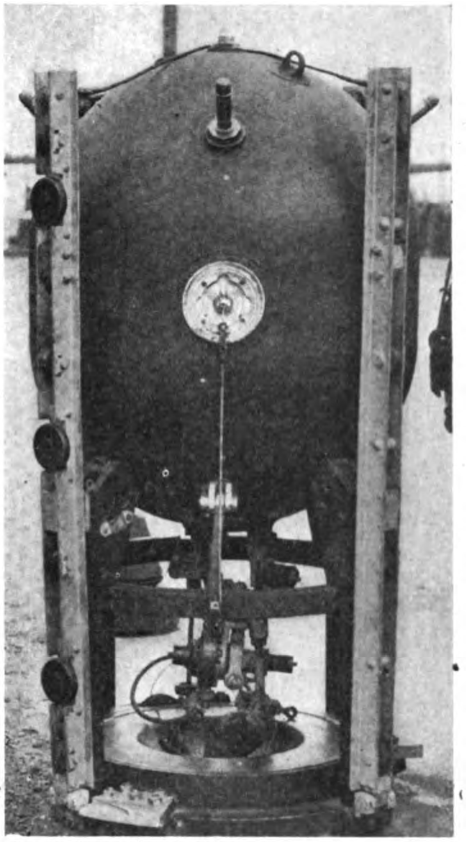
Until one has been at the headquarters of an army, it is not possible to realize the extent to which maps are used, or the various types of maps required. There are maps showing roads, paths and trenches; maps for staff officers, for regimental commanders, for company cap-

Maj. Gen. George O. Squier, Chief Signal Officer, U. S. A.

tains, for sergeants; there are maps showing the position of the enemy's ammunition dumps, aerodromes, signal stations, anti-aircraft guns; there are maps showing the location of the enemy's batteries; there are special maps for the use of the quartermaster, etc., showing where each horse trough, each well, each storehouse is. Map-making has long been a function of engineers; and the most marked improvements have been in the main mechanical, first in introducing quickly on a map the revelations made by aerial photographs, second in increasing the speed of production of a map. In many cases, entirely new sets of maps are made each day, each one containing the information obtained within the preceding twelve hours.

* Abstract of an Address at the University of Virginia.

Another department of science closely connected with airplanes and balloons is meteorology. We associate this word with weather prediction and with uninteresting data; but it must be remembered that these data include



Press Illustrating Service

Mine taken from a captured U-boat now a souvenir on exhibition in England

observations of temperature, of moisture content of the air, of air pressure, of wind direction and velocity at different heights above the earth. A knowledge of all of these is absolutely essential for each day's battle.

Artillery at a long range is useless unless the temperature, the moisture content and the wind are known accurately. Gas attacks are controlled by the knowledge of winds and barometric pressure. The safe strata for airplanes must be known; and for long distance work weather prediction of every description is essential.

So important is the subject that observation stations with competent forecasters and scientific observers dot the battle-front at close intervals; and the home offices send almost hourly reports to the fleets and the coast-stations.

What strikes a layman most forcibly when inspecting a meteorological station near the battle-line is the rapidity of operation. Only minutes lapse between the observations and the deduction of the conclusion. One realizes then how much meteorology has grown into an exact science.

Modern artillery is a good illustration of the application of pure science. All of us are now familiar with the method by which artillery fire is controlled by the aid of airplanes; but you may not realize its wonderful accuracy.

If the enemy's battery is located, by any means, this implies that its position on a topographic map is known to within, say fifty feet, often less. It may be at a distance of ten, fifteen or more miles. Then to hit it, an exact knowledge of the properties of the powder used and of ballistics is required. With this, the target is reached in an astonishingly short time.

I have witnessed myself the destruction of a German battery at a distance of eleven miles by a French battery of three thirteen-inch guns, all done within ten minutes, the exact aim being secured after three salvoes.

The perfection of the mechanism of the French 75 and 37 millimeter guns is known to us all; but we hear much less of the English and American guns. I can assure you that this is only a curious bit of camouflage.

Of all the numerous ways in which physics has been called in to assist artillery, I know none so interesting as is illustrated by anti-aircraft gunnery. The problem is most difficult. An airplane may be traveling at a speed of 100 or 10 miles an hour, it rarely keeps a constant course, it may be at a height above the earth of 20,000 feet, nearly four miles. The man aiming the gun must know the position of the airplane and its speed, and then must make his calculations so that when his shell reaches the immense height, it shall be so timed as to meet the airplane.

It is true that it is rather a question of the airplane meeting some fragment of the shell, than the converse; but the problem is the same. When it is realized that numerous hits are recorded at heights of 20,000 feet, and when one hears the personal experiences of the pilots, it is clear that the problem has been solved fairly well. A former student of mine writing to me a few days ago, after telling how he had "speared his first Hun" on his first day at the front, added that the German shells rarely missed him by more than ten feet, and he was flying a rapid scout machine and was manouvering for position all the time.

I am familiar with the French and British methods of aiming their guns; and, as you can yourself decide from reading the newspapers, they are not inferior to the ones used by the Germans.

One can not speak of artillery without thinking of gas shells and gas attacks. The Germans were the first to use this hideous means of warfare, although it is well known that it was proposed to the British war office many years ago and the decision was reached that it should not be adopted.

When poisonous gases first became a weapon, it was in the form of gas clouds, rolled along the ground by the wind, the gas having been released from cylinders in the front line of trenches. For perfectly obvious reasons this mode of gas attack was soon replaced by the use of large shells filled with the liquefied gas. When the shell was exploded by a contact- or a time-fuse, the gas would escape and work its action in all the neighborhood.

There are two problems associated with this mode of warfare: an offensive and a defensive one. The former is to make a gas which can be liquefied, is not so light as to diffuse upward too rapidly, and which will either kill the man who breathes it or will in some way incapacitate him; the latter is to make a mask or a suit of clothing, if necessary, which will enable the wearer to breath and do his work in the contaminated atmosphere.

We hear most of course about the terrors of the gases used by the Germans; but, if they would only describe to us their feelings about the gases sent them, our point of view would change. Some might even have a feeling of pity.

Both the questions, of defense and offense, are strictly scientific ones, in the main belonging to chemistry. The researches undertaken in Great Britain, France and this country are so numerous that the truth is almost unbelievable. It is safe to say that there are at least 2,000 chemists in America alone working on problems connected with the military use of gas.

We can well be proud of the achievements of our chemists. Among many things which I may say I shall select two: they have devised a mask for use inside a gun turret on our large ships where a particularly dangerous gas is liberated during a battle, and the masks supplied our soldiers are at least 20 per cent. better than either the British or French mask, and they are better than the German model.

As another illustration of the usefulness of chemists in this war, one should state what has been done by them to render the allied countries and our own independent of Germany from an economic standpoint. All I shall do, however, will be to mention two subjects: dye-stuffs and drugs; and you know the rest. It should be remembered, though, that this is not the full story, only an interesting chapter.

One of the most important military questions, which in the end is a purely physical one, is that of signals. Our army is most fortunate in having as its Chief Signal Officer a man who is a doctor of philosophy in physics, from Johns Hopkins University, Major General George O. Squier. He certainly knows his subject from the scientific standpoint as few military officers can know it.

Think for a moment of the variety of signals required. Those to and from airplanes and submarines have been referred to. In addition, each trench, each outpost, each reserve force, each artillery battery must be in unbroken communication with the brigade headquarters, and the division and staff officers. Wireless telegraphy and telephone are used in various ways; ordinary telephones are installed everywhere; carrier pigeons must be bred and trained; signals using both sound and light are most useful. It is not merely a matter of perfecting signals which work satisfactorily; much more is required, safeguards must be devised which make it impossible for the enemy to observe or read them. When I say that all this has been done, and done to a large degree by our American physicists, I am telling only the bare truth. I wish it were permitted to tell more.

Signals as used by the Navy are not as varied as those required by the Army. But there is one special problem which concerns the American Navy more than any other. In sending ships and transports to Europe in large groups, at night no lights are shown by any vessel; the question then arises, how is it possible to maintain relative distances and positions? This sounds as if it were an almost hopeless proposition; but it is not; and I have seen a solution which seems satisfactory, again the ingenious idea of an American physicist.

The demands upon photography are great, largely in connection with airplanes; and the methods elaborated by the British and French scientists are beautiful. There are other phases, though, of almost equal importance. Can we not take photographs of objects which the eye can not see, owing to clouds, haze or distance? This matter is solved in a large degree as a result of our spectroscopic knowledge.

By photographic methods it is possible to discover the location of the enemy's batteries unless they are hidden with the utmost care.

In this last case resort is had, as you know, to what is called sound-ranging. When a gun ejects its shell in the direction of the enemy, the latter hears in succession three sounds; first that due to the passing of the shell through the air, in general a hissing sound; then the proper sound from the gun mouth, a boom; and finally the sound of the explosion of the shell. Sound waves travel through the air with a comparatively slow velocity, slightly over 1,000 feet per second, and so if observing stations are placed at different distances from the gun, any one type of the three sounds, *e. g.*, the boom, will be heard at different instants of time. It is easily seen, then, that methods may be devised by means of a system of triangulation, by which the location of the gun may be determined. The accuracy of the methods in use is so great that now within a few minutes after the firing of a gun its position is known definitely to within limits less than the accuracy of the guns which are responsible for the destruction of the enemy's battery. This last limitation is due to an unavoidable variation in shells and their powder charges, and to variations in the atmosphere.

International Film Service

First aerial ambulance in air service of U. S. Army—Photo shows the ambulance attendants lifting a wounded soldier upon a stretcher into the berth of an airplane

This method of sound-ranging is simple in theory, but extremely difficult in practise, owing to vagaries of the wind and to the confusion caused by simultaneous discharges of guns. The former difficulty has been overcome by a brilliant British physicist; but, as you have probably seen in the papers, one of the ways used by the Germans to conceal the position of its big guns by which they were bombarding Paris was to discharge a dozen other guns simultaneously.

A somewhat similar problem arises in connection with determining the position of an airplane at night, or in cloudy weather. One inherent difficulty here lies in the great speed and great height of the airplane. Rumors have reached us that the British have found a method; but, whether this is true or not, the problem is not hopeless. The airplane in flight emits sounds, loud ones; with that fact as a basis, its detection is therefore certain.

I am not sure that any of you would of your own account think of astronomy as being a practical science; yet there has been found a definite usefulness for the disturbances on the sun, known as sunspots; and astronomers easily turn from calculations of the motions of comets, planets and satellites to those of twelve-inch shells and bombs dropped from airplanes. The instruments used by navigators on the sea and in the air when the flights are long are essentially those invented and adopted by astronomers. In fact an American astronomer has perfected within the past few months an entirely new instrument for the use of navigators, an instrument which will mean a great deal to both our sea and our air force.

Another science which seems remote from war is geology, and yet it has proved not simply useful, but essential. The minute you realize that war is concerned with trenches, dugouts, military mines, tunnels, water-supply, etc., you see that here the geologist must be summoned to help. He alone knows from his maps, made in times of peace, how to plan for any emergency requiring one to go below the surface of the earth.

There is a group of sciences, not physical, which has, in the end, the greatest responsibility in bringing victory to our arms. The men who are directing the work, in the laboratory and in the field, are university men almost without exception. This group includes experimental psychology, medicine and surgery and hygiene.

The function of the first of these is to devise such tests that we may be reasonably sure that a man selected for a certain duty can perform it. As a simple illustration, think of an airplane pilot. It is not difficult to analyze his responsibilities and to state the qualities which he should possess; further it is not impossible to devise experimental tests which may be performed on the ground in order to see if he has these qualities or, if not, to see whether he can acquire them in a short time. Our aviation section of the army has equipped laboratories along these lines, and the results obtained are most interesting. Certain generalizations will undoubtedly be deduced, and the examination of candidates can proceed more rapidly.

As soon as our military departments can be persuaded to recognize the fact that experimental psychology can in many, if not all, cases state definitely that a man with such and such reactions ought not to command a company, a regiment or a ship, our fighting forces will become efficient, not before.

The varied activities of our medical departments are known. When I think of them, what is uppermost in my mind is their progress in combating disease. I may be pardoned for speaking of two illustrations.

The gas-bacillus, the cause of hospital gangrene, has lost its terrors absolutely; first by the Carrel-Dakin treatment of wounds, second by Dr. Bull's discovery of a serum which may be used exactly as diphtheria anti-toxin is used. Dr. Carrel is a Frenchman and Dr. Dakin is an Englishman; but both have lived long in this country; and Dr. Bull perfected his method at the Rockefeller Institute, New York.

My second illustration is the discovery of the means by which trench fever is conveyed from patient to patient. This is not a dangerous disease, but is one which renders soldiers non-combatants for the time being. This discovery has just been made in France by two of our American doctors, both attached in normal times to American universities.

You are probably saying to yourselves, "Yes, this is interesting to hear about the scientific achievements of ourselves and the Allies; but what is the real use of it, when Germany, which leads the world in all branches of science, is our enemy?" No educated man should assert that Germany is the leader of the world of science. It is true that Germany modestly acknowledges it, and every American newspaper supports the claim in ways both direct and insidious. The facts, however, do not support it. Many years ago it undoubtedly was true, but a full generation has passed since then.

The Prussian form of government does not encourage individuality or freedom of thought; and these are essential for scientific discoveries and scientific development. In all seriousness I maintain that Germany has not been fruitful in ideas for many years in any of the experimental sciences, with the exception of medicine. In the fields of physics, of chemistry, of meteorology, of metallurgy, you must look for the leaders in other countries.

It may be true, although I doubt it, that Germany had the best generals, the best guns, the best ships; she certainly had the largest army and the power to bear upon any point the greatest force; but this condition has passed.

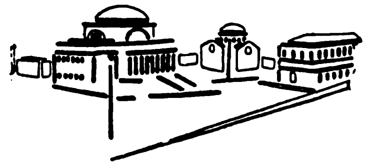
There were two agencies at work in this country which in reality were most powerful sources of German propaganda. One of these was the interpretation given to news from the war by our public journals, and the emphasis placed upon German successes. In part this is due to the lack of realization by the managers of the papers of their responsibility in the matter, but in larger part to that policy of a newspaper office which leaves the writing of the headlines in the hands of inexperienced, comparatively uneducated young men.

The other agency of German propaganda, and a much more vicious one, was the policy adopted by our own government in regard to giving out official information. The whole policy was wrong, and should have been changed. The people have lost confidence in the government agents, and rightly so; they are either optimistic to a ridiculous degree or boastful. What is required is that the government must realize the tremendous responsibility of the office charged with the dissemination of news. There is no man in America too great for this task. He must command the absolute confidence of every one; he must be able to speak the truth and nothing but the truth; he must understand the thousand phases of the war, looked at from a military, a medical, a scientific, a social standpoint; above all he must be allowed to give the American people real information in regard to the efficiency, the achievements of our people and of the Allies.

It is one of the real tragedies that the American people are so often deceived and are not told the truth about so many matters which concern them so vitally. If our people could only have realized the exact situation, Germany would have lost half her power, because in fact the American people were afraid of her, a condition which is absurd.

The time has come for America to recognize the usefulness of the scholar, the thinker, the investigator of science. All the other countries of the world have done so long since. It is only in regard to such experimental sciences as physics and chemistry that there is this failure in this country to appreciate the services of its experts.

Progress In Radio Science



Langmuir's Beat Receiver Circuits

SEVERAL circuits have been patented by Irving Langmuir for the reception of undamped waves by the beat phenomenon. They are shown in the accompanying drawings figures 1, 2 and 3. In figure 1 there is coupled to the plate circuit of the vacuum tube the alternator 12 through the inductance 13 which acts inductively on the plate circuit at coil 11. In the diagram of figure 2, a cascade amplifier is shown where the plate and grid circuits of the first and second valve respectively are coupled through a high resistance 13 shunted by a variable condenser 14. In figure 3 the radio frequency alternator is coupled directly to the antenna through the inductance 22 and 23 and the amplitude of the locally generated current is regulated by the resistance R. This is distinctly necessary for maximum amplification.

Langmuir's explanation for the operation of these circuits is as follows:

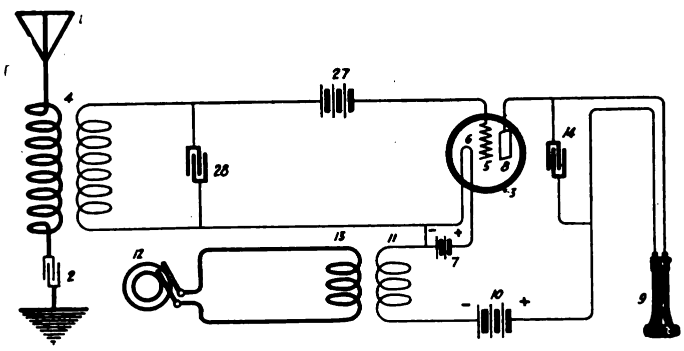


Figure 1—Showing plate circuit of the vacuum tube coupled to alternator

When the frequency of the received waves and of the locally generated waves differ there will be periods when the anode 8 is positive and the grid 5 is positive at the same time. The length of these periods will of course depend upon how near the two sets of waves approach phase opposition. There will also be similar periods when the anode is positive and the grid negative, when the anode is negative and the grid positive, and when the anode is negative and the grid negative. Current will flow freely through the plate circuit, however, only during those periods when the anode is positive and the grid positive. The length of these periods and the amplitude of the current flow will increase from zero when the two waves are in phase, to a maximum when the two sets of waves are directly opposite in phase and will then decrease to zero again. Inasmuch as these periods during which current will flow are of very high frequency, each individual impulse of current will have no effect on the telephone receiver. In combination, however, the impulses will have the effect of a continuous current which gradually increases in amplitude from zero to a maximum value and then decreases again to zero and as a result beats will be heard in the telephone, the frequency of the beats being dependent upon the group frequency of the current impulses set up in the plate circuit and this group frequency in turn being equal to the difference in frequency of the two sets of waves.

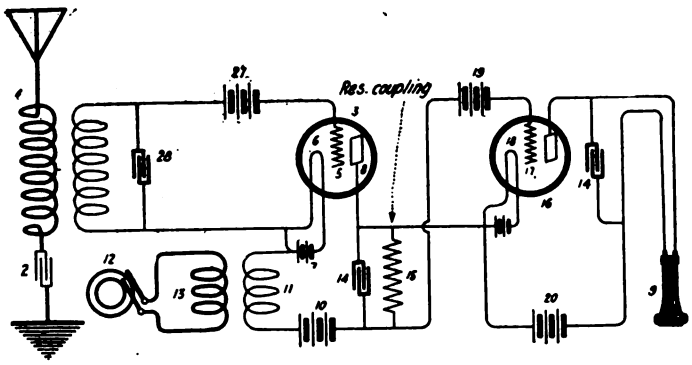


Figure 2—Showing a cascade amplifier

With this arrangement the only signals which can be received are those which are transmitted by means of waves which differ in frequency from those produced by the local source by an amount which is within the range of audibility of an ordinary telephone receiver. Waves which differ in frequency from the locally produced waves by a greater or less amount than the audible frequency of the receiver will produce no effect.

In some cases it may be desirable that the positive half wave of the local source which is impressed upon the anode be made greater than the negative half wave. To provide for this a battery 10 may be employed having its positive pole connected to the anode. The successive impulses of current which flow in the plate circuit, having a high frequency, would be choked back by the inductance of the telephone receiver. To prevent this a condenser 14 may be shunted across the terminals of the receiver. In some cases it will be found desirable also to employ a battery 27 in order that the numerical value of the negative potential imposed upon the grids 5 and 24 may be greater than that of the positive potential. It may even be found advantageous in some cases to make the battery so large that the potential of the grid will always be negative. On the other hand, it may be found desirable in some cases to so connect the battery that a positive potential will be imposed on the grid. It will of course be understood that other suitable forms of current operated devices than a telephone receiver may be used for receiving the signals.

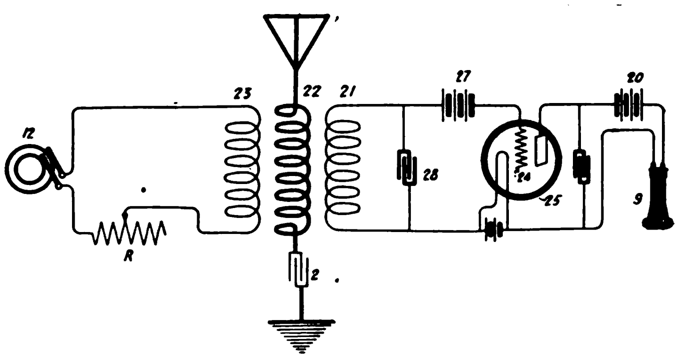


Figure 3—Circuit showing radio frequency alternator coupled directly to antenna

In some cases the energy of the received waves may be so small that the amount of energy which may be controlled thereby in the plate circuit of the tube will be too small to give an easily audible signal in the telephone receiver. In such cases, however, the current fluctuations produced may be easily amplified by the arrangement shown in figure 2. In place of the telephone receiver in the plate circuit in this case we may use a high resistance 15 which is also connected in the grid circuit of a second electron discharge tube 16. This circuit in addition to the grid 17 and the cathode 18 may also include a battery 19. This battery may be so connected that normally the grid 17 has a positive charge. In this case current from the local battery 20 will always flow in the plate circuit of the second tube in which the receiver 9 is included. When current flows through the plate circuit of the first tube the drop of potential in the plate circuit will principally take place in the high resistance 15, and this will cut down the positive charge on the grid 17 due to the battery 19. This will decrease the current flow through the plate circuit of the second tube and the current fluctuations set up in this manner will produce beats in the telephone receiver in a similar manner to that described in connection with figure 1.

The Thermic Telephone as an Oscillation Detector

PROF. DR. HENDRIK ZWAARDEMAKER of Utrecht, Netherlands, has shown a circuit for the reception of electrical oscillations wherein the thermic

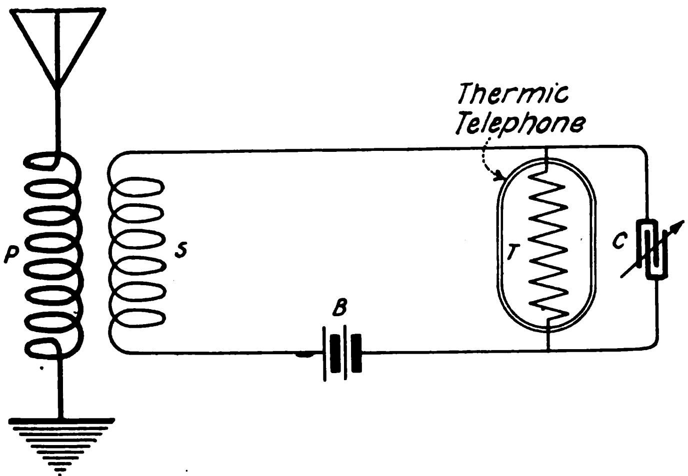


Figure 1—Thermic telephone used as an oscillation detector

telephone is employed as a detector. He has observed that the sensitiveness of the thermic telephone when used as an oscillation detector can be considerably increased when it is polarized, for example, by pre-heating it with a direct current.

In accordance with his invention he corrects the apparatus as shown in the diagram of figure 1 where the primary of an oscillation transformer is indicated at P and the secondary at S, the thermic telephone at T shunted by a variable condenser C. The source of direct current, B, is included in series with secondary winding of the receiving transformer and the telephone T.

Prof. Zwaardemaker insists that the circuit shown in this diagram is sensitive and the apparatus will respond to very weak signals. There must, however, be a certain relation between the resistance of the thermic telephone and that of the secondary coil S. The air space within the thermic telephone should be as small as possible and, in general, its resistance should be rather high.

Dubilier Vibrator Transmitting Sets

A NOVEL apparatus for the production of electrical oscillations has recently been shown by William Dubilier in which a vibrating contact constitutes the spark discharge gap of a closed oscillation circuit. The method of using is shown in the accompanying drawings figures 1, 2, 3 and 4.

The construction of the vibrator is shown in figure 1, where a vibrating element O carries a contact D-1 which makes contact with a stationary electrode D-2. The electromagnetic winding A serves to open and close the contacts D-1 and D-2.

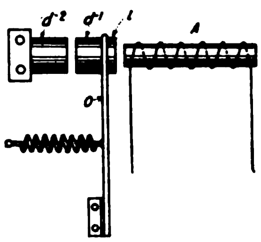


Figure 1—The construction of the vibrator transmitting set

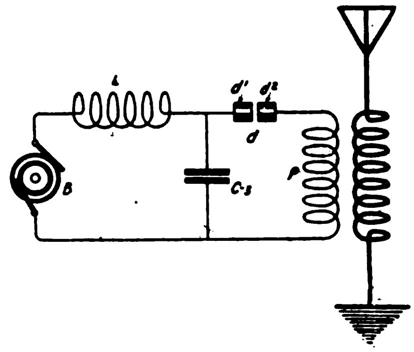


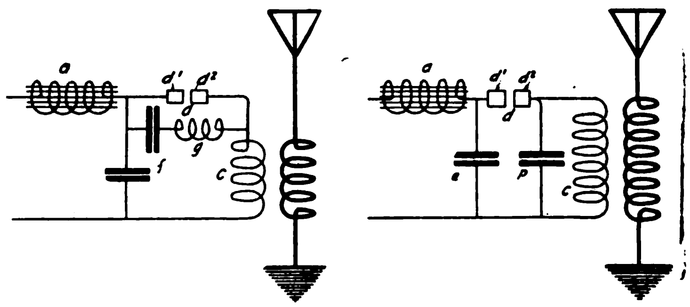
Figure 2—The interrupter spark gap

In the diagram of figure 2, the interrupter spark gap is shown at D, a source of energy at B which may be direct or alternating current, an inductance at L in series with the spark gap and generator, and the primary of the oscillation transformer at P. The complete radio frequency closed circuit comprises the spark gap D, the variable condenser C-3 and the primary P.

The operation of the apparatus has been explained as follows: The current passing from the generator B through the inductance L, through the transformer primary P is broken at contacts D-1 and D-2. The condenser E is in parallel with the gap D and is charged by the action of the arc across the gap. Inductance L prevents the high frequency current set up in a circuit D, C-3, P from traveling back through the generator and also assists in charging the condenser due to its self-induction when the circuit is broken at D.

The inventor declares that the apparatus operates efficiently when the period of vibration of the spring in the vibrator has a selected ratio to the natural frequency of the oscillating circuit D, C-3, P, that is, when its period of vibration is either equal to, or a harmonic of, the natural frequency of the oscillating circuit.

Modified circuits are shown in figures 3 and 4 where a capacity F and an inductance G are placed in parallel with the interrupter D (figure 3). In figure 4, the con-



Figures 3, 4—Modified circuits of the vibrator transmitting set

denser P is placed across the primary of the oscillation transformer C. Inasmuch as a simple electromagnetic vibrator is used to produce oscillations, the cost of manufacture is correspondingly less; and moreover because a closed circuit is obtained in starting the oscillations, a high primary potential is not necessary. A direct current source at low voltage is sufficient to operate the apparatus efficiently, the potential of the oscillating circuit being raised by the opening of the gap D-1 and D-2 and the inductance A. The inventor states that the apparatus is particularly useful for airplane work. He gives us no information concerning the constants of the circuits employed nor any formula by which the proper proportion of the inductances and capacity are secured.

The inventor mentioned that the circuit produces oscillations having the characteristics of undamped currents for a certain period and a damped or quenched characteristic for a further period.

It would seem from the explanation given that the radio frequency oscillations take place, for example, in circuit D, C-3, P of figure 2 at the time that an arc occurs between the electrodes D-1 and D-2 and at further opening of the electrodes, the arc is extinguished and the oscillations then cease.

Valve Circuits for Radio Reception and the Generation of Sustained Oscillations

IMPROVED circuits for the use of the vacuum valve as a detector of damped and undamped oscillations have been devised by Roy A. Weagant, Chief Engineer of the Marconi Wireless Telegraph Company, as shown in the accompanying figures 1 and 3. Figure 2 is a circuit

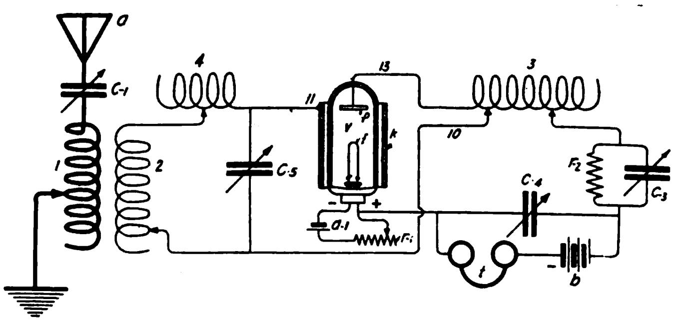


Figure 1—Weagant's circuit for the use of the vacuum valve as a detector of damped and undamped oscillations

which may be utilized for the production of sustained oscillations for transmitting purposes, but which is also applicable for radio reception. The construction of the vacuum tube is shown in figure 4, being an improvement on the well-known Fleming valve patented in 1905. It contains a plate P and a filament F surrounded by a copper sheath K and which is preferably electroplated to the glass. The sheath is of sufficient area to practically enclose both electrodes.

The circuit in figure 3 can be made to generate oscillations in groups at frequencies above or below audibility and therefore can be employed for wireless reception by the beat phenomenon. Generally speaking, the vacuum of the tube when used as in figure 3 is such that the application of 100 volts or less between the plate and filament will produce a visible blue glow or arc like effect. The apparatus shown in figure 1 will generate sinusoidal currents at any frequency and not in groups as the apparatus in figure 3.

An important addition to these circuits is the use of resistance R-2 in the plate circuit, shunted by the variable condenser C-3. When this resistance is very high and of the order of that of the internal resistance of the valve itself, it permits the plate voltage to be adjusted to a higher value than is desirable without its use, enabling the operator to get a critical adjustment of gas ionization so that minute electrical disturbances impressed upon the tube causes a great increase of current through the telephone T. The resistance contributes materially in obtaining the adjustment whereby automatic interruption of the local plate current is obtained enabling the valve to generate alternating currents in groups of damped oscillations.

The inductance 3 in the plate circuit of figure 1 performs several novel and important functions. By careful adjustment of its value, marked amplifications of the incoming signal are obtained. The maximum amplification is usually secured when the frequency of the plate

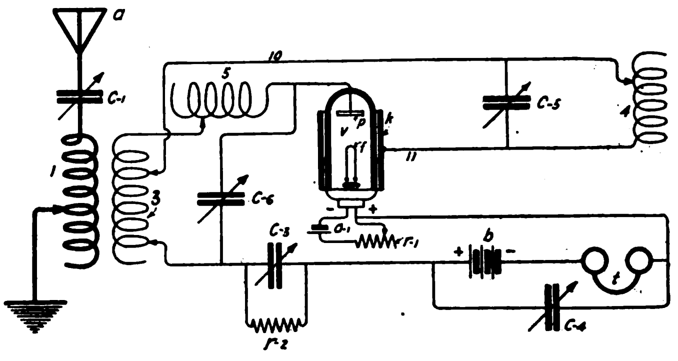


Figure 2—Circuit for producing sustained oscillations for transmitting—is also applicable for radio reception

circuit corresponds closely to that of the associated circuits to which the sheath is connected. By the use of this inductance the valve becomes a generator of sinusoidal oscillations without depending upon any particular critical value of ionization within the bulb. As a matter of fact in contrast to the circuit in which this inductance is not employed, better results are obtained with a tube in which the vacuum is as perfect as possible.

When the apparatus shown in these diagrams is used as a receiver of spark signals, the circuits are tuned so that the valve is just on the verge of oscillation; on the other hand for the reception of undamped waves, the valve is made to oscillate at a frequency slightly different from that of the incoming signal producing a beat current. Another advantage of the inductance element 3 in figure 1 is that it will amplify weak signals whereas with the circuit of figure 3 wherein this inductance is eliminated, there is a minimum strength of signal below which the circuit will not amplify.

The inventor remarks that with the circuit in figure 1 it is possible to start with a signal which is below the low limit of the device when the inductance is not present and amplify it considerably. Added to this, we may have the amplification due to the critical gas ionization within the valve. The combined effects bring about an enormous increase in the original strength of the signals.

Still better signals can be obtained from certain types of valves by providing coupling between plate and secondary windings of the circuit as shown in figure 1 where a wire 10 is tapped off inductance 3. Direct coupling is thus obtained, but inductive or electrostatic coupling might be used as well. In the diagram of figure 2, the

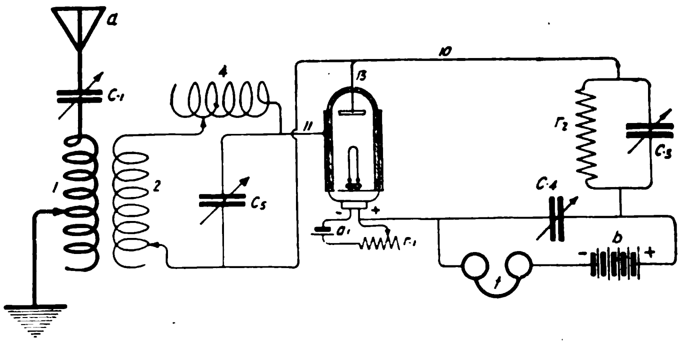


Figure 3—Another form of Weagant's improved circuit

antenna circuit is coupled to the plate circuit inductance 3, the grid circuit being tapped off 3 by wire 10. This circuit also includes inductance 4, shunt condenser C-5 and the sheath K. This circuit constitutes a powerful oscillation generator but may be used for beat reception as well.

Practical Wireless Instruction

A Practical Course for Radio Operators

By Elmer E. Bucher

Director of Instruction, Marconi Institute

PART II—ARTICLE III, OF WARTIME WIRELESS INSTRUCTION

EDITOR'S NOTE—Part 1 of this series of lessons began in the May, 1917, issue of THE WIRELESS AGE. Successive installments were devoted to the fundamental actions of radio transmitting and receiving apparatus for the production and reception of damped oscillations.

Part 2, the present series, will deal with undamped wave generators, including bulb transmitters and receivers for the reception of undamped oscillations. The direction finder and other special appliances employed in radio telegraph work will be treated fundamentally. A discussion of the basic principles of wireless telephony will terminate the series.

The outstanding feature of the lessons has been the absence of cumbersome detail. The course will contain only the essentials required to obtain a government *first grade commercial license certificate* and to supply the knowledge necessary to become a first rate *radio mechanic.*

REFLECTOR ALTERNATORS

(1) In the radio frequency alternators previously described, **radio frequency currents were generated by providing the dynamo rotor with a great number of teeth, the rotating** member being driven at very high velocities. Some of the mechanical and electrical problems involved in such design have been dealt with briefly in the previous issue.

(2) Alexanderson has developed a special radio frequency alternator which we have not described, wherein frequencies up to 200,000 cycles per second were secured by providing **an armature with two-thirds as many slots as the effective number of field poles. Acting on the vernier principle, the frequency of such a machine is equal to the number of field poles on one side multiplied by the speed of the armature per second.**

(3) In the **reflector type** of alternator here to be described, frequencies are multiplied within the same machine. By the use of a relatively low speed armature, radio frequencies up to 60,000 or 80,000 cycles per second can readily be obtained. It is more usual, however, to design such machines for frequencies around 40,000 cycles per second, corresponding to wave lengths between 7,000 and 8,000 meters.

FUNDAMENTAL PRINCIPLE OF THE FREQUENCY MULTIPLYING ALTERNATOR

(1) The student familiar with the operating principle of the **induction motor** is aware that it consists of a **stator** and **rotor.** In the stator a group of fixed windings are so arranged that a two phase current, for example, produces a magnetic field which rotates at an angular velocity determined by the frequency of the alternating current. The **rotor** or **armature** consists of coils wound in slots, which are short circuited and in which the changing flux generated by the field poles induce a current. The flux generated by the armature current reacts upon the field poles and the armature is set in rotation in a definite direction.

(2) A **rotating magnetic field** can be produced by a polyphase (two or more phases) current or by a single phase current provided that, in the latter case, two field windings are supplied and are so designed that the two resulting magnetic fields **generated thereby are out of phase.**

(3) A single phase current flowing in a single set of field coils of an induction motor does not, however, produce a unidirectional rotating magnetic field, but a field which alternates in direction and changes in intensity. In the case of the induction motor the field would have a tendency to turn the armature first in one direction and then in the opposite direction with no resulting motion. However, the magnetic field resulting from an alternating current flowing in the stator winding may be thought of as **two equal and oppositely rotating fields** which can be put to account in the **multiplication of radio frequencies** within a radio frequency alternator. This is done in the Goldschmidt reflector alternator.

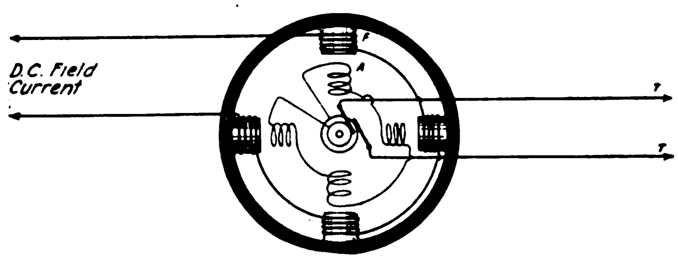


Figure 193

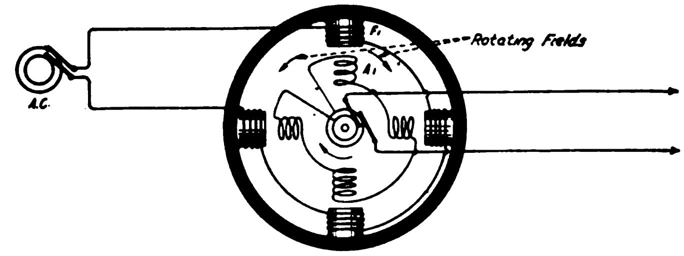


Figure 194

OBJECT OF THE DIAGRAM

To show how an alternating current may be doubled in a generator, the field coils of which are excited by alternating current.

DESCRIPTION OF THE DRAWINGS

Figure 193 represents a simple alternator, with four field poles F, fed by DC current from an external source. The armature coils are indicated at A, the collector rings at N and the external circuit at T. The speed of armature, for purposes of illustration, is assumed to be 1800 revolutions per minute.

Figure 194 is a similar diagram, but in this case the field windings are excited by alternating current of the frequency that would be obtained in figure 193, with DC excitation current, and an armature speed of 1800 R.P.M.

OPERATION

The speed of the armature is 30 revolutions per second and therefore in one complete revolution there will be 4 x 30 or 120 changes of flux through its windings. This will induce 120 alternations of current in the armature coils, giving a frequency of 60 cycles per second.

The terminals of this armature T are assumed to be connected to the terminals of the field coils in figure 194. Current of a frequency of 60 cycles will flow in the field circuit and the resulting magnetic field can be thought of as **two equal magnetic fields rotating in opposite directions.**

If, for example, the armature turns clock-wise, at a speed of 30 revolutions per second, no cutting will result in respect to the component of the field which rotates clock-wise and therefore no current will be induced in the armature coils A', but in respect to the field which rotates in the opposite direction it is clear that the relative motion is **twice the velocity** of the armature, because the **field rotates in one direction at a given velocity and the armature rotates in the opposite direc-**

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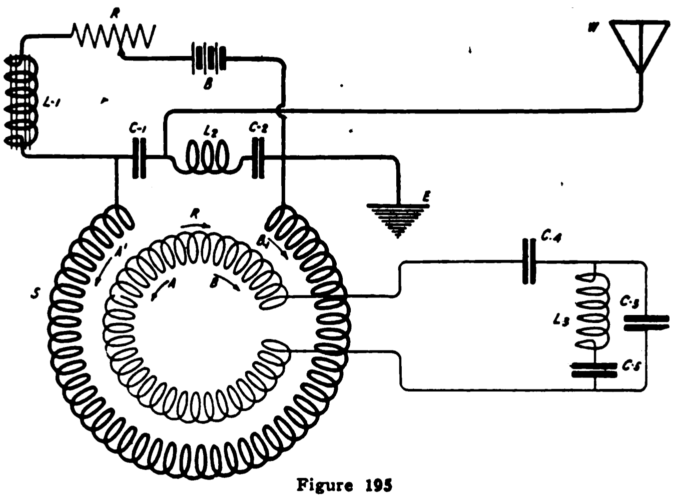


Figure 195

OBJECT OF THE DIAGRAM

To indicate the fundamental principle of circuits of Goldschmidt's radio frequency alternator.

DESCRIPTION OF THE DRAWING

A stationary DC field winding known as the **stator** is indicated at S and the **rotor** or **armature** at R.

Winding S is set into excitation by a DC source B in series with which is the **rheostat** R and the **impedance** L-1.

Since the impedance of the rotor and stator circuits of the alternator must be reduced to a minimum for four frequencies, the rotor and stator terminals are short circuited by the inductances and capacities shown. For example:

In the case of the rotor:

Condenser C-4, inductance L-3, condenser C-5 short circuit the rotor R for the frequency of 15,000 cycles. (That is, inductance L-3 and condenser C-5, short circuit R and C-4).

Condensers C-4 and C-3 short circuit the rotor for 45,000 cycles.

In the case of the stator:

Condenser C-1, inductance L-2 and condenser C-2 short circuit the stator S for the frequency of 30,000 cycles.

Condenser C-1 and the electrostatic capacity of the antenna to earth, short circuit stator S for 60,000 cycles—the desired antenna frequency.

It is to be noted that condenser C-4 alone would short circuit the rotor, but in order that a separate path may be supplied for the current of 45,000 cycles, a second circuit of the same magnitude as R, C-4, namely L-3, C-5 is connected in series. By this connection we have doubled the inductance and halved the capacity, making no change in the fundamental frequency of the circuit. The rotor remains on short circuit to the fundamental frequency of 15,000 cycles per second and another path through C-3 is provided for the frequency of 45,000 cycles without changing the tuning for the other frequency.

The same explanation applies to the stator, the product of S and C-1 equalling the product of L-2 and C-2.

OPERATION

For purposes of illustration we have indicated the two oppositely rotating magnetic fields of the stator and the rotor by the arrows A' and B' for the stator, and A and B for the rotor.

The stator S is provided with the correct number of poles so that the initial frequency of the current generated in the rotor R is 15,000 cycles per second. This current flows through C-4, L-3 and C-5.

The magnetic field of the rotor resulting from this current can be thought of as two oppositely rotating fields represented by the devices A and B. If the armature be assumed to rotate clock-wise, component A (since it is opposite to the direction of rotation) will produce no effect upon the stator winding because the velocity of the rotating field and the armature are the same and in opposite directions, but the component B rotates in the same direction as the armature and at the same velocity. We may therefore consider the field of the rotor to be produced by an alternating current of a frequency N rotating at a frequency N and the component B will cut the stator S at a frequency of 2N or 30,000 cycles. This current is increased in magnitude by short circuiting the armature with condenser C-1, inductance L-2 and condenser C-2.

With reference to the stator S, the current of 2N produces oppositely rotating fields indicated by the devices A' B'. The rotor R cuts through B' at one-half the velocity of B' (which is equal to 2N) inducing in R a frequency of 15,000 cycles or N, which frequency neutralizes the former frequency of N. In respect to component A' the relative motion is obviously 3N, for the armature rotates in one direction at a velocity equal to the frequency N and the component A' in the opposite direction at a velocity equal to 2N. The resulting frequency is therefore 3N (or 45,000 cycles per second) which flows through condensers C-4 and C-3.

We may now resolve the current of 3N in the rotor R, into two oppositely rotating fields, using again the devices A and B. We must keep in mind that the armature rotates clockwise at a velocity equal to the frequency N. In respect to component A the relative cutting upon the stator is 3N—N or 2N (30,000 cycles per second) which current neutralizes the former current of 2N in the stator.

In respect to component B, we may consider it as a field of 3N rotating at a frequency N and its velocity in respect to the stator is 4N or 60,000 cycles. This current flows through C-1, the circuit being completed by the electrostatic capacity of the antenna.

SPECIAL REMARKS

(1) Reflector alternators of 200 kw. output have been constructed and placed in actual operation. They are driven at speeds between 3,000 and 4,000 revolutions per minute and are supplied with 360 field poles.

(2) The rotor is made of fine iron laminations .002 inch in thickness; the laminations being insulated from one another by thin sheets of paper. In fact, the rotor of the machine is one-third paper. The air gap clearance between the rotor and stator is .03 inches, which requires very accurate design throughout.

(3) The stator and rotor windings are similar in design, consisting of one conductor per pole. As in other radio frequency alternators U shaped windings are employed. In order to prevent excessive rises of potential in the alternator circuits, the rotor and stator windings are wound in sections permitting either a series or a parallel connection. The conductor of the rotor and stator is made up of a number of very fine wires in the form of a cable, the wires being insulated from one another by an enamel coating.

(4) **Signaling** is accomplished either **by change of inductance** in the antenna circuit, as in the arc system, thereby tuning and detuning the antenna circuit each time the key is pressed, or the key may be inserted in series with DC excitation circuit. Special precautions had to be taken in the latter method of signaling for each time the field windings were demagnetized, the load was taken off the driving motor, causing a great variation in speed, throwing the machine out of resonance with the antenna circuit. To offset this, a double contact telegraph key is provided which, when the DC excitation circuit 's closed, inserts a resistance in series with the field circuit of the driving motor. The reduction of field current increases the driving force just sufficiently to maintain normal speed under change of load.

(5) The reflector alternator is not suitable for radio transmission at variable wave lengths. It is evident that a rapid change from one frequency to another cannot be obtained and beyond this the best efficiency is obtained at some constant speed. Alternators of this type are only applicable to transmission between land stations, operated at fixed wave lengths. Viewed from all standpoints, it is doubtful whether they will have any considerable commercial application.

(6) Complete resonance between the antenna circuit and the desired alternator frequency is established by an aerial tuning inductance.

(*Continued from page* 18)

tion at the same velocity. There will, therefore, flow in the armature of figure 194 a current of **double frequency.** This current can be fed to the field windings of another generator and the frequency again doubled, but as will be shown this multiplication can take place within the same machine.

SPECIAL REMARKS

(1) In figure 194 the armature A' is rotated at synchronous speed. If it revolves out of synchronism with the two magnetic components of the stationary field coils, it can be shown that two frequencies will be generated in the armature; that is, if the frequency of the field current is N_1, and the speed of armature is such that if the field windings were excited by DC current, its frequency would be of different value N_2, then the frequencies of the two resulting currents in the armature circuit will be N_1+N_2, and $N_1—N_2$.

(2) In the Goldschmidt reflector alternator, owing to the fact that the generation of radio frequency currents is involved, tuned circuits must be provided in order to reduce the impedance of the armature and field circuits for several frequencies. The phenomenon of rotating fields is employed as in the above illustration and the armature is driven at such speeds as will permit the desired multiplication of frequencies to take place.

Radio Frequency Changers

Reported Progress in Their Application to Radio-Telegraphic and Telephonic Communication

By E. E. Bucher

Director of Instruction, Marconi Institute

(*Continued from the December,* 1918, *issue of* THE WIRELESS AGE)

Control of Antenna Currents

IN order to control the antenna current in the Arco-Meissner frequency changer system, it has been found of advantage to divide the auxiliary magnetizing circuits as in figure 17. Here the last group of frequency changers is indicated at C with the primary windings P, S, and the secondary windings P′, S′. A source of direct current B through the windings EE nearly saturates the core of the yokes Y and Y′. The circuits are arranged so that with the degree of magnetization afforded by this circuit, the antenna circuit including the secondaries P′ and S′ is slightly off resonance with the radio frequency changers. Then by closing the key K, the yokes

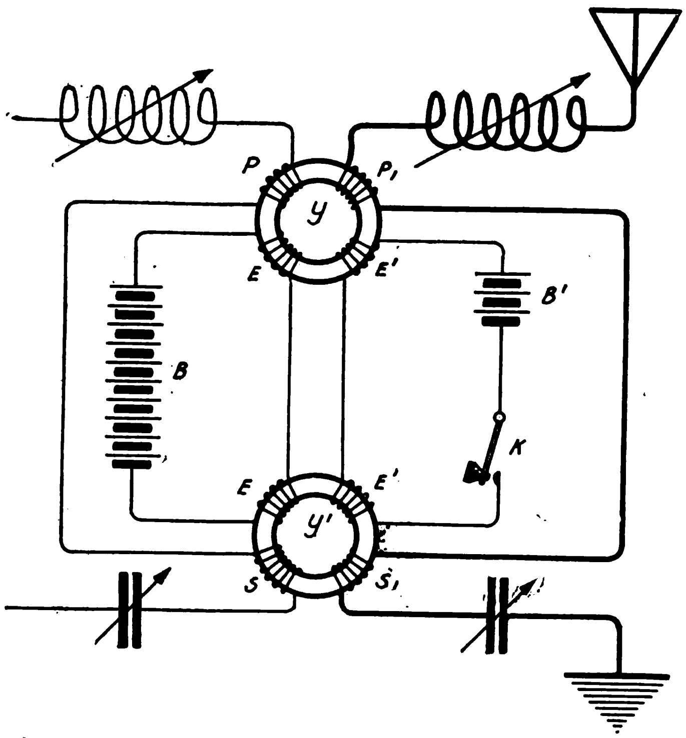


Figure 17—Split key control circuit of the Arco-Meissner system

are further magnetized from a separate source of direct current B′ thereby establishing complete resonance with the antenna system. The coils E′ E′ are therefore designed to provide the additional magnetizing force required to saturate the core. This connection gives the advantage that the electrical control of the saturation circuit and the signaling circuit are separate.

Signaling at tone frequencies may be accomplished by substituting for the key K a magnetic interrupter or for wireless telephony a microphone for the transmission of speech. The inventors' remark that this separation of two magnetizing circuits is of particular advantage in case tone frequencies are secured by means of alternating current at audible frequencies circulating through excitation windings E′.

UNIVERSAL TYPE OF TRANSMITTER

We have shown in the previous article, the circuits of a complete station provided with means for the production of undamped oscillations for telegraphy or telephony, or for the production of groups of damped oscillations all from the same source of current—a radio frequency generator. The diagram which reappears in figure 18 will now be described more in detail. All these arrangements are confined to the same piece of apparatus and by means of a selective switch, not shown, the connections can be shifted from one system to the other as desired. For example, in figure 18 the yokes Y-1 and Y-2 constituting the last step of a radio frequency changer system carry the excitation windings E′ fed by the source of direct current B in series with which are the choking inductances I, the regulating resistance R, the shunt key resistance R-3, a telegraphic signaling key K-4, a separate telegraphic signaling key K-5 in series with which is the buzzer B-2. A special load circuit or dummy aerial is provided by windings S-5 and S-6, inductance L-1, the ballast R the variable condenser C-1, and the switch K-3. Several telephonic microphones M connected in series parallel and each group in series with an inductive resistance R-4 are shown. The source of direct current is the battery B-3. It is further to be observed that the primary winding of the telephone transformer P-7 is connected to each group of microphones through a condenser C-7 so that the speech current flowing through P-7 acting upon secondary S-8 contains no DC component but only the speech variation component.

If it is now desired to telegraph with undamped oscillations, the circuit from the DC source B to the coils E′ is closed. The strength of the excitation current is regulated by the resistance R to the desired degree of core saturation. If then the key K-4 is manipulated so as to cut resistance R-3 in and out of the circuit, the desired signals are produced by alternately tuning and detuning the alternator and antenna circuits in the way explained heretofore.

If at the same time the constants of the load circuit including the ballast R, are properly adjusted and the switch K-2 is closed, the load on the generator remains constant for it is automatically shifted from the artificial aerial to the antenna proper; that is, the constants of the circuit are so selected that when the antenna circuit including windings S-4 and S-3 is in resonance with the impressed radio frequency, the inductance of S-5 and S-6 is changed to throw the dummy circuits out of resonance and vice-versa. This tuning and detuning, may it be repeated, is accomplished by changes of flux through the iron cores. The provision of such means for maintaining a constant load on the generator is particularly essential in the use of high powers but in transmitters involving the use of small amounts of energy, satisfactory

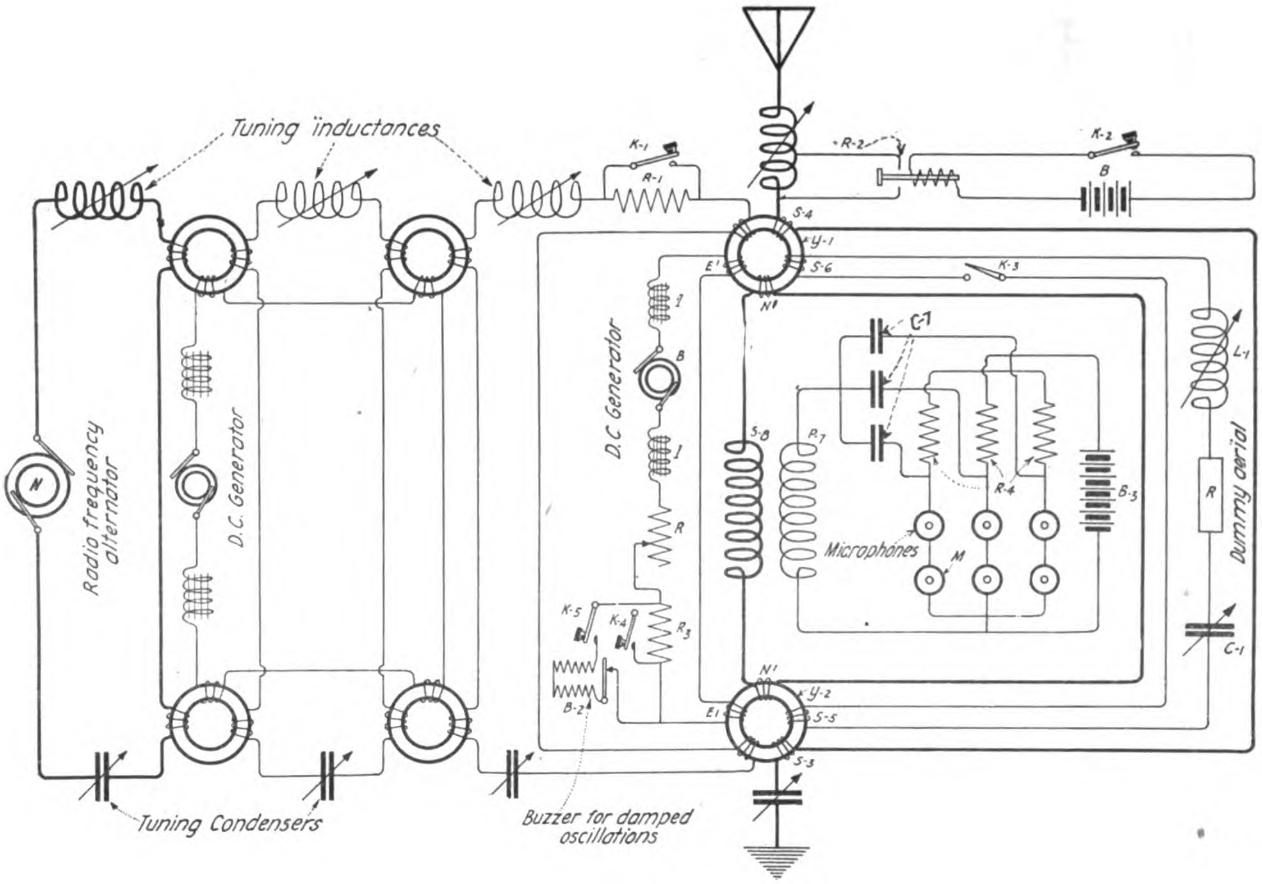


Figure 18—Frequency changer transmitting system for wireless telephony, or telegraphy by damped or undamped oscillations

signaling may be accomplished by opening and closing the keys K-1 and K-2 as described in the previous article. Moreover it is desirable to provide both means of signaling so that in case one becomes inoperative an alternative arrangement is available.

If it is desired to generate damped oscillations at an audio frequency, key K-5 is opened and closed causing the buzzer B-2 to be set in operation. The resulting variation of the excitation current through the coils E' through the operation of the buzzer, causes sufficient change of impedance in the radio frequency changers to vary greatly the antenna current. Thus the antenna will radiate oscillations which can be detected by detectors suitable to the translation of damped oscillations only. In place of the buzzer, alternating current may be superimposed on the winding E' to produce damped oscillations at audible frequencies.

The Circuits for Wireless Telephony

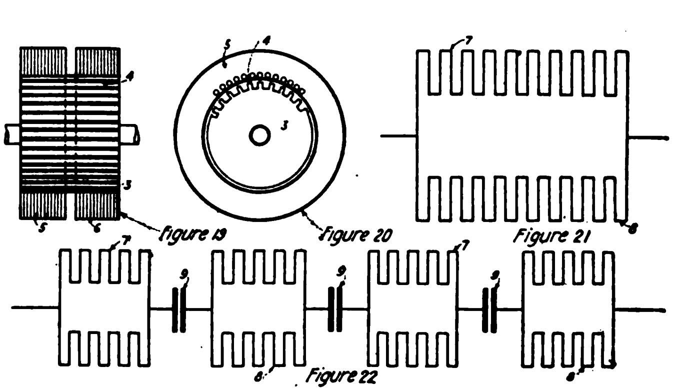
To use this apparatus for speech transmission, the resistance R is first adjusted to a suitable value, and then the microphones M, connected to the transformer P-7, S-8, are put into operation. R is adjusted to a critical point on the characteristic magnetization curve so that the speech currents through the primary P-7 set up similar currents in the secondary windings S-8 and the coils N, N. The resulting change in flux through the yokes Y-1 and Y-2 will cause a relatively great change in the strength of the antenna current.

A close survey of the microphone circuit will show that in each branch two microphones are connected in series but three branches are connected in parallel. Each of the three banks is fed from the source B-3, through their individual resistances R-4. Across each microphone is shunted the primary P-7 of the telephone transformer P-7, S-8 each branch including one of the condensers C-7.

The operation of the microphonic control is as follows: Whenever the microphone resistance increases, the current through its series resistance remains nearly constant, but the current through the microphone diminishes. The excess current resulting therefrom flows through the primary winding P-7 and the corresponding condenser.

Regarding the Design of the Radio Frequency Alternators

After many experiments Arco and Meissner have found that a type of radio frequency alternator having



Figures 19, 20, 21, 22—Constructional details of the dynamo rotor

an air gap the longitudinal axis of which has the direction of the axis of the rotor gives the greatest efficiency. This construction permits the use of a small air gap which is a matter of importance on account of the large number of field poles. It has the further advantage of increasing the output of the machine.

The rotor indicated at 3 in figures 19 and 20 consists of a toothed wheel without windings driven at a very high speed. The poles which are formed by the teeth are of equal polarity and the generation of radio frequency currents is secured by an undulation of flux and not by a reversal thereof which is the case of any ordinary alternator.

It has been found of particular advantage to divide the generator symmetrically in the middle at right-angles to the rotor axis so that equal stator halves 5 and 6 as in figure 19 are obtained.

The continous wave windings of the two winding halves 7 and 8 of figure 21 are preferably arranged in parallel so as to maintain the generator's self-induction and the generator voltage developed by resonance within the winding at a low value. This precaution is particularly necessary because on account of the large number of poles in high frequency generators it is difficult to insulate the armature windings.

In order to further reduce the difficulties of insulation due to high voltages, each stator half in generators of high power is divided into an equal number of sections and the two corresponding sections of the two armature halves are in each case arranged in parallel as a group as shown in figure 22.

The resulting groups are preferably arranged in series with condensers 9 placed between each group as indicated in the drawing. This arrangement reduces materially the equalizing currents which occur in the parallel arrangement of the armature halves, due to inequalities in the winding. Beyond this the maximum voltage between the entire winding and the stator is no greater than the voltage between an individual partial winding and the stator.

It is also advisable in the case of large energy outputs to provide means for conducting cooling water through the iron and stator. This has been provided for in the latest types of equipment.

Valve Arrangements of the Radio Frequency Changers

Finally it may be mentioned that it is possible to use the well-known valve connections for the radio frequency changers shown in figure 23. They are symmetrically inserted into the four branches of a Wheatstone bridge. In the middle branch of the bridge of the group A, is inserted the primary winding of a transformer P acting on the secondary S the complete circuit of which is tuned to currents of double frequency. The current in S may be fed to a further group of radio frequency changers the secondaries of which are directly connected to the antenna.

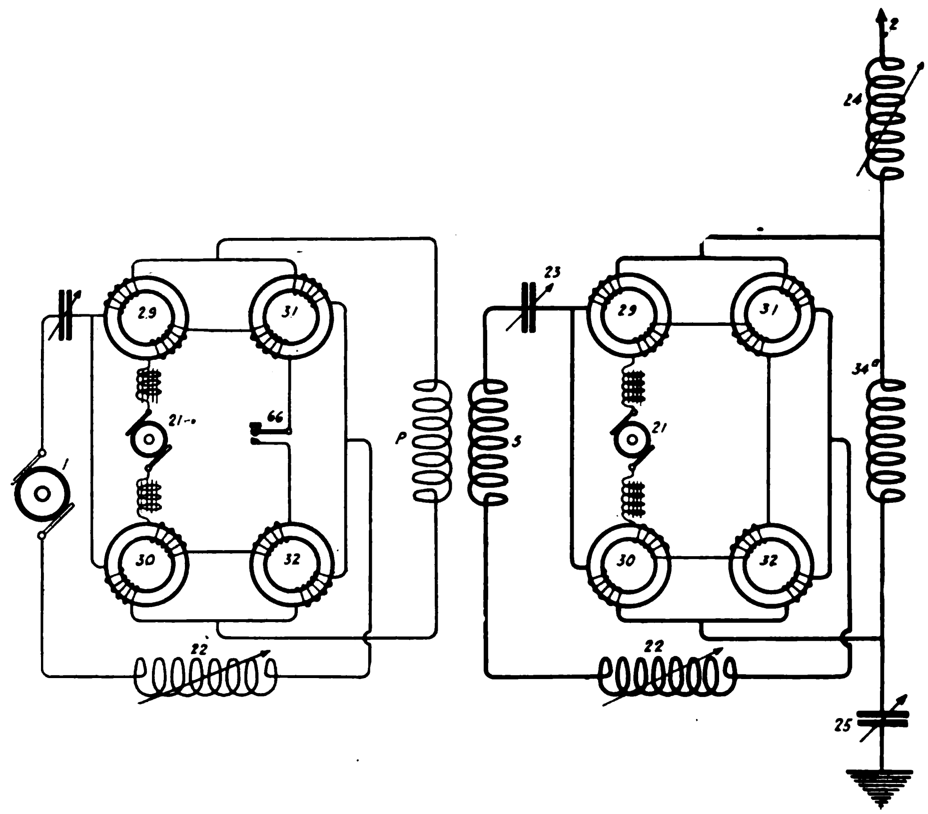


Figure 23—Valve connection of frequency changers

As an alternative arrangement two of these mono-inductive resistances may be substituted by an induction coil from the middle of which a third conductor is branched off as shown in figure 24. Here the middle conductor P is connected to the middle of the armature winding of the generator 1. In this case the two remaining mono-inductive resistances or rather the windings A and B are arranged on one yoke, Y-1, which also carries the two direct current windings D-1 and D-2.

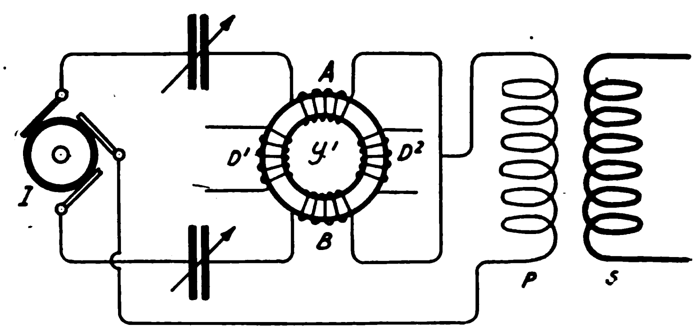


Figure 24—Alternative method of frequency doubling

The Monthly Service Bulletin of the NATIONAL WIRELESS ASSOCIATION

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

In Memory of "9YA."

ACCORDING to word received from the War Department, Lieut. Lyman (Pete) Case has been missing in action since August 14. Later advices report that he was in a bombing airplane squadron and met in collision with a German machine in the neighborhood of Metz. His airplane was seen to crash to the ground from an altitude of 12,000 feet.

Lieut. Lyman Case, reported missing in action, a former well-known N. W. A. member

Lieut. Case will be well remembered by members of the N. W. A. and other amateurs of the United States as the former operator of 9YA, of the State University of Iowa, Iowa City. He was one of the most able assistants in all of the national relay programs which were executed prior to the declaration of war. He could see the handwriting on the wall and knew that sooner or later the Government would need a great number of young men, skilled in the radio art, and devoted nearly all of his spare time in teaching everyone within signaling distance of 9YA, the wireless code. Regularly, he sent out baseball, football and boat race results by wireless. These bulletins were copied as far east as Pittsburgh.

Lieut. Case was born August 7, 1896, in Nokomis, Ill. His parents live in Lamoni, Iowa, one brother being Dr. M. W. Case of Davenport, Iowa. He was one of the first Iowa boys to enter the Officer's Training School at Fort Snelling, in May, 1917. While there, he volunteered for the Aviation Section, Signal Corps, and was sent to Toronto, Canada, in July. From there he was sent to Camp Borden, Texas, at which place, in November, he did his first flying. He was transferred to Garden City the 1st of January and sailed for England January 31. In Scotland, for several weeks Lieut. Case engaged in daily flying. He wrote numerous letters explaining how valuable his training as an amateur had been to him. He was later sent to France and was one of the American aviators who were organized with the Royal Flying Corps. It has not been possible to secure information as to where Lieut. Case was buried.

It will be appreciated if all the wireless amateurs of the country will join with the writer in sending letters of condolence to his family in their bereavement. WM. H. KIRWAN.

VICTORY!
Get Ready for Re-Opening of Stations

Washington, D. C., Dec. 14, 1918.

WIRELESS PRESS:
Hold up publication of "Age" for insertion of following notice:

To All Members:

From all indications the bill in Congress to blot out the amateur has failed. The amazing war record of American amateurs has been openly recognized before the Congressional Committee and an amendment to the bill has been introduced permitting amateur stations to reopen on approximately the same basis as before the war. The hearings on the bill will not close for some days, but it appears that the Government ownership proposals are doomed. Amateur communication will probably be resumed on conclusion of peace as before, under the present law, the act of August, 1912.

The victory is cause for mutual congratulation among all amateurs and best wishes to the field at large are extended for the new year.

Special Committee, N. W. A.
J. ANDREW WHITE,
ALONZO FOGAL, JR.,
E. E. BUCHER,

RADIO STATION, 24 BALLOON CO.
FRANCE.

The Editor, WIRELESS AGE—Kindly pub ish this in your valuable magazine:

Radio men in the U. S. service "over there" are dying to receive your last month's WIRELESS AGE. What do you say, old man? Send yours soon. The last one I saw over here was last March. Hoping to hear from someone in regard to this soon, I am Yours,

JOSEPH E. ENGSTROM,
Radio Station, 24 Balloon Co., A.E.F. Air Service.

Antenna, Radiation and Ground Resistance

I SUBMIT herewith a table prepared from actual tests showing the relation of antenna resistance, radiation resistance and ground resistance of a particular aerial over a change of wave length from 400 to 2,000 meters. The antenna had a capacity of .00126 microfarads, inductance of 43 microhenrys and a fundamental wave length of 440 meters.

Wave Length	Antenna Resistance	Radiation Resistance	Ground Resistance
400	26.0	14.0	6.5
500	19.0	9.0	7.5
600	16.0	6.7	9.0
700	14.9	4.9	10.1
800	15.0	3.5	12.0
900	15.8	3.0	13.5
1000	16.9	2.5	14.8
1100	18.0	2.0	16.0
1200	19.0	1.8	17.5
1300	20.2	1.7	19.0
1400	21.5	1.6	20.2
1500	22.5	1.5	21.9
1600	24.0	1.4	23.0
1700	25.5	1.3	24.6
1800	27.0	1.2	26.0
1900	28.4	1.1	27.8
2000	30.0	1.0	28.7

This table indicates that the ground resistance increases gradually for each increase in wave length, but the radiation and antenna resistance drop around 700 meters. The antenna resistance then increases again. The radiation resistance decreases gradually until the wave length of 1100 meters is reached, whereupon it decreases more slowly and at a more uniform rate. The most effective radiation would take place at wave lengths between 600 and 700 meters, with this particular aerial.—

E. T. JONES—*Louisiana*.

Protests With a Point

Evils of a Legislative Boomerang

THE bill, H. R. 13159, introduced by Congressman Alexander and referred to his committee, calls for outspoken protest from every amateur wireless man in the United States. Senate bill, S. 5036, which appears to be a duplicate, equally calls for vigorous opposition.

These bills make wireless an out-and-out Government monopoly. The Navy would, by the bills' provisions, come into possession and operation of the whole American radio communication system.

A provision is made for experiment and technical training school stations. No mention is made of amateur stations. That the omission was intentional is clear, because the present law distinctly classifies these as: general amateur stations, special amateur stations and restricted amateur stations.

Perhaps some genius might design an amateur station that would not transmit signals outside his state boundaries or receive outside signals—and be permitted to operate. But this is a ridiculous and valueless assumption. Yet that is the only opportunity the present bill offers. It frankly and unreservedly gives the Government permanent possession of radio and its unrestricted operation.

Two conclusions are reached by reading the Alexander bill. First, that the Navy expects by throwing the sop permitting experiment and technical schools to operate, to overcome the objections of leading scientists that experimental progress in an infant art would be killed off by Government monopoly. Second, that the Navy considers amateur wireless of no real or potential value, so purposes to wipe it out.

Against the opinion of the framers of this bill is arrayed a sizable body of serious students in the art, to which the Government is under great obligations. The officers of the National Wireless Association, with a membership of representative character and proportions, feel qualified to speak the unanimous sentiment of this great body of amateurs succinctly as follows:

The Alexander bill is a high-handed and unjustified attempt to trespass on the rights of American citizens and a legislative boomerang that will do incalculable damage to its undoubted exponents, the Navy itself.

On behalf of its membership, the officers of the Association call for complete rejection of the provisions of H. R. 13159 and S. 5036, on the grounds that enactment will absolutely stifle amateur radio communication and thereby bring to a permanent end the development of an experimental group under which have been conducted activities of proved value to the nation.

President Wilson approves this measure, according to newspaper reports. The reasons for the alleged approval are not given. Wherefore it is inconceivable to amateur radio men that he has a true appreciation of the deliberate intention to end amateur work in wireless. The President's views on this subject are on record in this office. On March 1, 1916, he wrote to the Association an endorsement of its activities, the organization of amateurs in his opinion, being "undoubtedly a valuable asset to the nation." Further on the same subject, he wrote: "The value of such an organization in co-ordinating the activities of a large number of specially qualified young men along carefully planned lines will be of great benefit not only in an educational way to the young men themselves but also to the country at large when the necessity for their employment, individually or as an organization, may develop."

That is the substance of the letter. The necessity for employment which President Wilson anticipated, came a year later, in the emergency of war. And the amateurs made good—away beyond the most sanguine expectations.

In return for which service and fulfillment of promise, we are given to understand that their stations in which they prepared for the emergency, are to be permanently silenced and the pursuit of their studies in radio brought to an end!

Such an attitude is inconceivable from the world's leading exponent of freedom for all peoples. American amateurs will not be satisfied that the President's endorsement of the Alexander bill was given with the full understanding that it killed off amateur activities unless the proponents of the bill can introduce indisputable evidence to that effect.

Amateur Wireless Station Constructed by Alfred Henry Grebe

It is difficult also to recognize the obvious truth that the bill provides for the Navy to monopolize radio communication. Amateurs have been led to believe that the Navy looked upon them as useful. Captain Bullard, the first officer who administered the high office of directing naval radio communications, is on record, before the hearings in committee in January, 1917, with a statement that the amateurs should be left alone, that, to quote his exact words: "As far as the Navy is concerned, its activities are toward the uplift of the amateurs and not to destroy them in any way." Captain Bullard accepted honorary vice-presidency in this association, too, and in other ways indicated the sincerity of this viewpoint. His successor, Captain Todd, also in a letter to the Association, in October, 1916, protested against a member's view that proposed legislation "endangered our right to operate our wireless stations," stating this statement was ill-timed and misleading.

Secretary of the Navy Daniels also called in December, 1915, for the names and addresses of members, stating then that the need might arise in the Navy for many more men. It is an historical fact, now, that the need did arise and that the amateurs responded to the call.

In fact, during the war period, and preceding it, repeated requests were received for publication of appeals to secure the enlistment of amateurs, urgently needed for both Army and Navy.

Now that these amateurs have served their useful purpose, it is proposed that as a class they be exterminated. This presupposes a viewpoint that the emergency having passed, a future need will not arise. Blot out the amateur, therefore; he has served; cast him aside now.

It does not appear to enter into the question that the stimulus of wireless telegraphy as an art has a foundation and a source of personnel supply in those who begin their investigation by the home-study and experiment method. The provisions of the bill ignore the potential value of thus continuing to expand the field. It is sought, rather, that all future activity center about the radio establishment of the Government—that the development of a communication method still in a transitory state from an art to a science, be committed to the hands of a few workers on the Government payroll or in technical schools or professional laboratories. The individual worker, in a phrase, is to be suppressed. No opportunity is to be given for independent investigation and possible invention by the youth of the nation—in spite of the fact that the discovery of wireless telegraphy was made by Marconi when a boy just out of his 'teens!

The amateur of America is not typified, as many would like to have the lay public believe, by an irresponsible boy tinkering with tin-can apparatus in a backyard. As a class, the amateur is better represented by a number of commissioned Army and Navy officers called to the colors from civilian pursuits and engaged in designing administration work, and duties of the line of great responsibility. In all cases he is not wearing a uniform; but is serving also as inspector or expert radio aide. It follows, then, that the skill of these amateurs in radio is considerable. It is indisputable, also, that this skill was acquired over a long period of individual experimenting, not through the intensive training facilities offered by the Government in emergency.

The amateur who, for physical reasons or because of dependents, couldn't don olive drab or navy blue, has also served. A generous response followed the appeal to this Association to supply instructors for radio and buzzer operators, 20,000 being required by the Signal Corps. Men who volunteered for this work, conducted by the Federal Board for Vocational Education, included graduate electrical engineers, power plant superintendents and commercial wire chiefs—men in their early forties—and all amateurs in wireless.

As a further illustration of how the amateur was viewed by the military establishment, appeals were made to this Association for highly skilled men for the radio intelligence section, it being specifically stated that students in schools and beginners would not do. Men of the requisite qualifications were supplied from amateur ranks.

These special duties proved beyond question that in wartime the nation could not properly function in radio without men of experience. The experience dealt with in the instances cited is 100 per cent. amateur. Yet it is now proposed that the work of these men in radio be stopped short, that no more amateurs be developed or present ones be permitted to continue their experimental work!

A monopoly of the air, as this bill conceives it, is preposterous. No student of the radio art will concede that scientific development is feasible if left solely to employes of this Government, or any other. Nor does the cry of "interference" awaken any supporting response. It is in every way as ridiculous to forbid vehicular traffic on highways because Government business is being transported over them, as it is to forbid freedom of the air because of Government communication.

As a war measure, silencing and shutting down amateurs was right and proper. There was no protest. But in time of peace, such autocratic proceedings will meet with nation-wide protest.

The matter of so-called interference has been discussed at length many times. **The broad statement that what little interference existed was caused by improper adjustment of receivers and transmitters and poor operation, covers the whole argument. The present law provides, by fine and revocation of license, adequate protection from this annoyance, which, as a matter of fact, exists in infinitesimal quantity.**

It will probably be argued that amateur wireless must be killed off so secrecy may be maintained. Technical advancements insure the reduction of unintentional eavesdropping to an unimportant minimum. The present law provides fine and imprisonment for divulging the contents of a message. What more can be accomplished? Deliberate interception of wireless messages can be carried on secretly no matter what restrictions the law may provide.

It is impossible to insure entire secrecy in any field of communication. All wireless messages in transmission are not easily available to any who care to listen. And it is wholly unfair to the radio art to deliberately foster that opinion in the public mind. The true situation is simply this: Telephone, telegraph and cable lines can be tapped just as readily as wireless can be intercepted. The party-line telephone and the telegraph sounder exactly illustrate the conditions.

Pertinent to the subject of wilfully disclosing the contents of messages, there is another consideration. If the Alexander bill becomes a law 100 per cent. of the radio communications of commerce are placed in the hands of naval operators. These men are citizens of the United States and of course subject to its laws. Should the inference be drawn that they are less susceptible to temptation in disclosing commercial secrets than are other citizens—the amateurs? There are laws against crime, but crime is committed. Is it a fair assumption that Government employes are immune, and the only potential lawbreakers are private citizens?

The matter of secrecy appears from any angle, unimportant, if not irrelevant, in a discussion of reasons for legislating the amateur out of existence.

While not a single valid reason appears why the amateur field should be wiped out, it is clearly demonstrable that the attainments of these individual workers are an appreciable contribution.

Prior to the war the advances in radio which were contributed by Navy men were negligible. All improvements of basic character originated entirely outside the Governmental establishment. The naval achievements consist entirely of detailed variations in

design of apparatus to suit military needs. Wartime improvements are another matter entirely; the amateurs, scientists and commercial engineers and the Government experts all became a unit working to a common end. Whatever developments followed only serve to emphasize the importance of the civilian radio man. Thus the contributions to the art from Government sources must stand examination on progress before the war. And, it is repeated, not a single basic achievement can be presented, whereas the broad field of experimental workers, by invention, incontestably builded the art to a highly efficient state.

The assumption that with Government ownership in force, a hand-picked personnel of experts can be drawn into the ranks of official radio will not stand the test. There is no profit in inventing where there is federal domination, comparable to the reward which commercial industry offers. There is no future for the amateur in production engineering where commercial companies will have but one customer, the U. S. Government, and prices thus become arbitrary. Patents will have a solely speculative value because the Government uses any invention it requires—and refers the inventor to the Court of Claims to await its award, if any.

Naturally, the experimental field will dwindle down to minute proportions. And the United States—the promoter of freedom—will face the sad spectacle of having repressed by official action a great body of earnest, thinking young men from continuing a self-determined course of educational study. It cannot be argued that this form of education will be adequately provided for by technical institutions of learning. The incentive to gain having been removed, or woefully restricted, professions other than radio engineering will appear vastly more enticing to the student.

It is a fact that in the senior engineering class at the Columbia University, at the outbreak of the war, 50 per cent. of the student body were former radio amateurs. Their amateur work had induced them to follow electrical engineering as an eventual profession.

All educational institutions are required to appeal for students; they must be attracted; they do not come to the higher halls of learning unless they are encouraged. And it is submitted that amateur wireless is an extremely valuable means of introduction to the study of electrical science.

The demolition of the amateur field in radio with one legislative blow is a serious matter. As near as can be ascertained there were, prior to the war, 175,000 amateurs in the United States. The figures are based upon the sales records of manufacturers of electrical supplies which show that the purchases of receiving equipment were about in the proportion of 25 receivers to 1 transmitter. Transmitting stations only requiring licenses, and 7,000 of these having been issued, it is evident that the total in round numbers represents 175,000 amateurs. Since these stations will show a fair average investment of $50 each, there is an aggregate investment involved of something like eight and three-quarter million dollars.

But that sizable sum of money represents more than a loss in dollars and cents. The assembly of these stations necessitated a stupendous amount of labor. And with this labor came a still greater acquirement of technical knowledge—that expensive commodity, education—gained by first hand familiarity in assembling and constructing intricate electrical devices.

Is it to be abandoned by a non-advantageous legislative act? Can the future of the existing amateur field be cut off short without due consideration of its claims of valuable achievement?

In the war just ended, amateur wireless saved the Government several million dollars. It has been established that the cost of training men for military service in radio was about $1,000 per man. In the case of the amateur the training period was materially shortened, the per capita cost being reduced perhaps two-thirds. And it is also of interest that the total facilities available in universities and technical schools could provide for but 150,000 men. The existing amateur field was larger by 25,000.

Utility is another consideration worthy of note. The achievement of Mr. Apgar, an amateur, in disclosing to the Department of Justice the unneutral messages sent out by the Sayville station—resulting in its seizure—calls for recognition. It has never been denied that Texas and California amateurs detected the same type of communication over the Mexican border. Nor can the credit be placed anywhere but in the amateur's hands for the maintenance of communication during the floods in the Middle West in 1914 and 1915. It is indisputable also that an amateur saved the situation in Hamilton, Ohio, in 1913. During that flood Mr. Swain, an amateur, was the only man available for communication. He connected up a key and sounder and supplied the only means of communication from the east side of the city, thus securing food, clothing and other supplies urgently needed. Mr. Swain's interest in amateur wireless qualified him to accomplish the feat. The work in flooded districts did not end there. Up to the date of our entry into the war, the station of the Doron brothers in the same city was employed in reporting the stages of river rise whenever the possibility of a flood was imminent. Throughout the entire country drained by the Miami River this station was regularly consulted for reports whenever the river began to rise.

Amateur wireless has a distinctly recognized place in agricultural areas also. Regular distribution of weather reports has been a voluntary service rendered in outlying districts where six to twenty-four hours are required for the mail to arrive from the nearest office of the Weather Bureau. That farming districts require and appreciate this service of amateurs needs no further comment when one reflects upon the problematical value of reports arriving by mail six to twenty-four hours after issuance.

It is also well known that nearly every big ranch in the West had its amateur station for the same reason.

In summary, therefore, it is contended that irreparable damage will be done to the interests of the nation at large if the Alexander bill becomes a law. It is also advanced that the radio art will stagnate under a policy of Government ownership and imperialistic domination of radio communication with all powers vested in a department organized basically for making war.

This Association knows that it voices the full sentiments of the amateurs of the United States in expressing this protest. Thousands of amateurs are still in uniform and are thus effectively silenced. But the protest is supported by the large majority of these patriots also, the Association is confident, for many have been consulted and the desire for permitting amateur radio communication to re-open under the present law (the Act of August 13, 1912) has been unanimously expressed.

NATIONAL WIRELESS ASSOCIATION,

J. ANDREW WHITE,
Acting President.

Some Technical Aspects of Government Wireless Ownership

A FAVORED argument of the proponents of Government ownership to enlist legislative support is the assumption that because a wireless telegram has no guiding wire but employs the all-pervading ether as a conducting medium, it is entirely beyond the control of the sender; therefore it will set up interference to the operation of other stations. The impression is fostered that such messages find their way into the apparatus of stations for which they are not intended, setting up a veritable bedlam which nothing but Government ownership can still. Only through Government proprietorship, the argument continues, can these cross currents be prevented, because federal authorities can then dictate to the last detail the daily operation and acts of every radio station in the nation.

To the lay mind these statements may be impressive, but they fail in the true light of the engineering facts. The ether carries myriads of vibrations simultaneously without interference. It is generally accepted today by leading scientists that heat, light, X-rays and the electric waves of wireless telegraphy are nothing more than different rates of vibration of the ether. The radio engineer may select one of several thousand rates of vibration and employ his choice in communicating between a given set of stations without interfering with the operation of other stations. It should be made clear that the frequency of vibration of the wave motion sent out by a wireless transmitter has a certain definite value, and the receiving instrument must be adjusted or tuned for exactly the same rate of vibration in order that communication may be established.

This is exactly the method by which mutual interference between wireless stations is prevented. There is no reason to believe that the Government radio men are better qualified for selecting and using frequencies of vibration than are the experts of commercial or amateur radio.

There is no objection to Government regulation and supervision, but there are innumerable objections to sole Government ownership. Under the existing laws, Government, commercial and amateur stations are provided with standard wave lengths, which in themselves eliminate the basic problems of interference. Everyday wireless operation has demonstrated that by wisely selecting the wave lengths to be employed, hundreds upon hundreds of wireless stations may be operated without any interference whatsoever.

Before enacting any drastic statutes eliminating the amateur from the program, Congress should investigate and value the benefits which our Government derived in the recent war from the services of the amateur wireless operator. It should be known that experimentation in this art is the best promoter of scientific education of the day. The degree of skill required to operate wireless apparatus should be appreciated, as well as the value of the amateurs' experience in continuing the art of wireless telegraphy through the past few years.

A second so-called argument advanced by Government ownership advocates, is that the amateur wireless operator can, if he chooses, copy down commercial and Government messages, thereby coming into possession of confidential communications which might be employed in a harmful manner.

It is this committee's purpose to prove that the amateur wireless experimenter, obeying existing laws, will not interfere with official or commercial message traffic.

The pre-war regulations were sufficiently stringent to meet all technical requirements for the prevention of interference. Under the existing law amateur wireless transmitting sets are restricted to the wave length of 200 meters, and power input of one-half kilowatt for stations within five miles of a Government station, and to one kilowatt for stations outside a prescribed zone. A further requirement is that the decrement of the radiated wave be no greater than 0.2 per complete cycle, the latter being a precaution to ensure a sharp wave, thus decreasing the possibility of interference or cross currents at any Government receiving station.

The greater proportion of official and commercial communications are dispatched at wave lengths above 600 meters. Certain stations are operated at lower wave lengths—down to 300 meters—but since electric wave radiation at the shorter wave lengths has not proven as effective as at 600 meters and above, the use is not general.

Receiving apparatus at Government stations is ordinarily tuned to wave lengths of 600 meters or greater; the amateur operates on a wave length of 200 meters. With the improvements that have been effected in wireless transmitting and receiving apparatus during the past few years, the possibility of experimental stations interfering with the operation of Government stations is so small that it is negligible.

This committee's contentions are based on the following facts:

It is a comparatively simple matter to design an amateur transmitting set to radiate waves with a decrement as low as .05 per complete cycle. Add to this sharpness of radiation the selectivity obtainable with modern vacuum tube detectors and associated circuits, and it will be found that between stations with wave lengths having the 400 meter difference between 200 and 600 meters (or even a lesser difference) the possibility of interference is reduced to a minimum.

Two types of receiving circuits have recently been developed that further reduce interference at the receiving station:—the **regenerative beat receiver** and the **cascade radio frequency amplifier.** Either system installed in a Government station will eliminate cross currents. In fact, the selectivity of the cascade circuit is so fine that it requires very precise adjustment on the part of the receiving operator to pick out the desired signal.

If, under all circumstances, it is necessary that amateur transmitting stations comply in every detail with the law in respect to the sharpness and purity of the wave radiated from transmitters, no complaint, then, can arise from Government stations. With a pure wave emission a one-half kilowatt amateur station may be operated within a mile of a Government station equipped with modern receiving apparatus of the type aforementioned and not cause the slightest interference. To insure this freedom from interference it is only necessary for the Government to exercise its authority under the present law; viz., see to it that the amateur station radiates a pure wave.

In support of the statement that a 200 meter amateur station will not interfere with the operation of Government stations, is an exact knowledge of radio engineering principles and a series of actual tests made under practical conditions. It follows that if a Government station is interfered with by a 200 meter amateur transmitting set, the apparatus at the Government station is poorly designed or improperly handled.

It must be admitted that the damped wave spark transmitter adjusted for low decrements afford sharpness of tuning nearly equal to continuous wave generators, but if the decrement of the spark transmitter is still employed as an argument, the amateur may resort to more modern types of undamped wave transmitters, thereby removing the last vestige of justifiable complaint about interference.

Greatly improved apparatus has been developed during the war. The vacuum tube transmitting set, for example, has been highly perfected and is one which amateurs may employ to the greatest advantage. It is possible to operate these transmitters at the wave length of 200 meters with a power output of a fractional amount of a kilowatt of energy. Because with such transmitters genuine undamped waves will be radiated, the factor of selectivity will be vastly increased over the old type of transmitter, removing to the lowest degree the possibility of setting up interference with a Government station. It is unquestioned that vacuum tube transmitters will be adopted by amateur experimenters in increasing numbers and within a short time pre-war types of spark transmitters will be in minority use.

The United States Government already has had through previous legislation control of the operation of amateur wireless stations. In the event that any of them did not comply with the law they were reported and the regulations were enforced by the Government's local inspector operating under the Department of Commerce. Violations of the law in pre-war times were limited to a few instances, and were entirely unintentional. A reminder from the Government inspector proved sufficient to place the offending experimenter on the straight and narrow path. There is no reason to believe that the amateur will in the future get out of the control of the Government authorities.

Now, on the subject of a supposed second argument: What possible harm can be occasioned by the presence of the amateur eavesdropper? What confidential information would he by chance be likely to hear in carrying on his experimental work? A few Government orders, many commercial messages and ship position reports! But he is already enjoined by Government legislation from divulging the contents of such communications, and any one whose interests might be injured by his disclosures would have full recourse to the courts of law for damages. To the best of this committee's knowledge, not a single instance of the kind occurred during five years of regulated amateur operation.

It does not appear that there is any danger to business interests through the reception of messages by the eavesdropper; business men do not send confidential communications in plain English over the telephone, cable or wireless. It cannot be said that the wires or cables are strictly secret and it should be known that long distance wireless telegraphy in the immediate future will be conducted at speeds of 200 words or more per minute. Apparatus has already been perfected that will permit such rapid transmission and reception. Ear reception is limited to 30 or 40 words per minute. So the amateur has little chance of ascertaining the contents of high speed messages, unless he is provided with a mechanically elaborate—very costly—high speed recorder capable of taking down these signals.

With long distance radio communication carried on at 200 words per minute and important business messages from ship to shore or shore to ship transmitted in cipher or code, about the only messages that the eavesdropper will be likely to hear would be somewhat to this effect:

MARY SMITH, ALTOONA: SHIP DOCKS AT TEN O'CLOCK. MEET ME.—JOHN.

Inadvertent disclosure of the contents of such a communication would be somewhat analogous to the immensely harmful practice of country postmasters reading incoming postcards.

What benefits would a Government monopoly give to the nation at large? None whatsoever. It would invest the powers of control in the hands of a favored few. It would destroy all incentive for the inventive genius of our country to conduct research towards improvement of wireless communication. Forfeited would be the hundred-and-one commercial applications of the art which would naturally follow under private ownership and freedom of operation. It would give the Government the power to say, "thus far and no further." The advance of the individual would not rest on merit, but upon bureaucratic favoritism. It would destroy the enthusiasm characteristic of American enterprise to develop a new art. It would completely wipe out a branch of experimentation that has done more to further the interests of technical education than any other discovery heretofore made. Such a procedure on the part of our Government is utterly un-American and contrary to all precedent.

Who is responsible for the great inventions in wireless telegraphy in the United States? Surely they cannot be credited to Government initiative. Who, it may well be asked, perfected the Radio Frequency Alternator, the Poulsen Arc Generator, the Vacuum Tube Transmitter, the Regenerative Beat Receiver, the Vacuum Tube Wireless Telephone Transmitter, the Direction Finder, the Weagant Static Eliminator, and numerous other appliances which have advanced the art in the past few years? Every single one of these inventions were perfected by private citizens. Many of these men were former amateurs, and in many cases it was the observations of these men as amateurs which spurred them on to make deeper investigations resulting in the solution of some difficult scientific problem. Who knows but that some amateur wireless experimenter will bring forth a new idea that will revolutionize the art?

Of all the inventions of the past half century, none has created such universal interest as wireless telegraphy. Resulting experiments have been of immense benefit to mankind because they have tended to promote technical education, a matter of paramount importance to America's industrial future.

Amateur radio operation requires a study of fundamental principles of electricity. An insight into the electrical and mechanical sciences is thus gained that most likely would not be induced by any other line of experimentation. It has been demonstrated that the amateur's keenness in manipulating wireless telegraphy equipment was of untold benefit to the Government in the recent war. Through his experience the amateur relieved the Government instructor of a great deal of unnecessary delay in training enlisted men to operate the Government's wireless apparatus.

We have shown ourselves to be a resourceful nation in the event of a national crisis such as arose in the recent war. Our shops, our laboratories, colleges and universities were turned into a united war machine to carry out the plans of the military establishment. Where would we have stood had not the amateur experimenter and the scientist responded so wholeheartedly to the call? Whatever argument may be presented that the amateur's small wireless station might prove detrimental to our peace-time naval and military program, fails before the more forceful one that a small army of amateur wireless operators will again be of inestimable advantage in possible future emergencies. The amateur wireless experimenter should be left alone. Our country may be only too glad to utilize his services at a most unexpected moment.

TECHNICAL COMMITTEE, N.W.A.

A Plea for the Radio Amateur

IT is greatly to be hoped and urgently to be desired that the bill now pending in Congress for the control of radio communication during peace times, and tending to prohibit amateur wireless communication, should be defeated.

No government created the art of radio communication. The art and science of radio communication were both brought into existence by the efforts of amateurs, amateur electricians and physicists. It ill-becomes representatives of a government like ours that they should seek now to confiscate from the amateurs of the country that facility which amateurs produced.

The right to use the air we breathe for talking by sound-waves is unchallenged to all citizens of our globe. Why should the right to talk through the air by invisible electro-magnetic moves be denied!

Everyone will agree that when an amateur abuses his privilege of free speech by radio, through the ether, so as to interfere objectionably with the rights of others, the offending amateur should be proceeded against according to law; but within the proper limits, the amateur should be encouraged and aided by the government, not discouraged and repressed. During the last fifteen years, a number of improvements in radio communication have come about through the enthusiasm and studies of amateur radio operators. Now that the government is able to utilize these improvements, the proponents of this bill will seek to confiscate them, to the exclusion of all future amateurs.

The privilege of listening in, and also, within reasonable limits, of joining in the world's conversation through the all-pervading ether is a godsend to our race and time. No one but an amateur, or person who has practiced radio communication, can fully appreciate the magnitude of that privilege—the opportunity of listening in succession to all the multitude of messages borne upon the ocean of electromagnetic waves. **To destroy that privilege would be one of the most cruel acts of history, worthy only of the Bolsheviki.** During war time, there has been no noticeable complaint on the part of the amateurs of the country, at being debarred from use of the radio apparatus that, in many cases, they had built up with great pains by their own hands. Now that peace is being restored, it should be allowed to restore its blessings to the radio amateur.

The cultivating and civilizing influence on all our people, especially our young amateurs, of putting themselves into intellectual communion with fellow radio telegraphists all over the world, is a great asset to the country. The privilege of entering into the great electromagnetic ocean of intellectual exchange is of the greatest educative value. Anyone who has enjoyed the installation and operation of an amateur radio station, knows that this is a free education in itself. It is an occupation that not only develops the soul of the individual by giving him an insight into the mysteries of electromagnetics and the mysteries of long-distance transmission of ideas; but also tends to make him or her a more useful individual by becoming conversant with the international code of Morse signals. During the war we have trained, at great expense, thousands of young men to become operators, in order to perform more usefully the military tasks assigned to them. This training in signaling will be, also, of great value to those who have acquired it, in times of peace. By excluding the radio amateur from his natural rights and privileges as a dweller in the universal atmosphere, a relatively large number of self-trained Morse operators will be lost.

Radio communication is still a very young art, although it has been developing by leaps and bounds. There is an enormous amount of work yet to be done, in order to perfect and simplify the art of radio communication by telegraph and telephone. Every encouragement should be offered to all the young amateurs throughout the world to help in this development work. If they are excluded by force of government authority, the work of development will be confined to a mere handful of government selected men. Even on the assumption that the best men are employed in the selected group, it is evident that with the aid of all the amateurs in addition, they will be able to accomplish much more.

The great boon of radio communication should be left, as far as possible, free to all, under suitable legal restrictions against abuse of the privilege. Only in that way will inventors be stimulated to work at the various problems presented by the art. If the entire business of radio communication is vested in the hands of the government, the market for the sale of improvements by the work of inventors will be so restricted that very few will have the courage to persevere.

Experience during the recent war has abundantly shown that there will be no difficulty in the immediate acquisition by the military authorities of all the radio plants of the country, amateur or professional, when the emergency arises. Because, for that reason, the government is properly entitled to lay its hands upon all radio communication in war, it owes to the public the right of free communication in times of peace.

A world in which the voice of the radio amateur is hushed by the power of the law, and in which no one has the right to speech except the army or the navy, would be a world no longer free.

A. E. KENNELLY, Sc.D., A.M.,
Vice-President, N. W. A.,
Professor of Electrical Engineering,
Massachusetts Institute of Technology.
Past President, Institute of Radio Engineers.
Past President, American Institute of Electrical Engineers,
Former Principal Electrical Assistant to Thomas A. Edison.

Radio Amateur Work as a Scientific Mind Builder

PRESUMABLY the chief reason why men no longer burrow holes in the sides of hills to serve as their permanent residences is because it is one of the finer human traits to question and experiment. To make a shelter out of boughs proves the possession not only of a spirit of inquiry as to the possibility of improving on the muddy cave, but also a marked tendency to try something which may turn out to be a real improvement.

One of the most personally pleasant survivals of the cave man's attitude to question and try is the experimental attitude of the modern radio amateur.

Presumably (and fortunately) there never has been an amateur who was not a human question mark, or who was ever satisfied with his knowledge of what was going on in the apparatus used by him. The continual series of changes made by the up-to-date amateur show how alive he has been and also his need for verifying experimentally any point concerning which he is in doubt.

Since a questioning and experimental attitude is a real national asset, particularly in a free nation like ours, it is encouraging to note how widely the activities of the amateur have spread. An occasional word of caution is necessary, however. To question even thoroughly demonstrated facts is destructive. To change and experiment with equipment until all its usefulness is destroyed is absurd. The amount of experimental work carried out by the amateur necessarily should be limited by his discreet and reasonable use of apparatus and by the guard which he must set on himself in avoiding interference with other amateurs. Above all, he must bear in mind the grimly serious nature of the traffic handled by commercial and governmental stations, and use every means to avoid interfering, for his pleasure, with what is in their case a life-and-death or, at least, a bread-and-butter matter.

There is a personal aspect of the work of the amateur which has considerable attractiveness. Chatting with one's friends by radio certainly promotes a sort of broad neighborliness. A man's point of view cannot fail to be broadened by having in his circle of acquaintances a number of equally enthusiastic amateurs, centered not only in neighboring towns but even in adjacent states or further. The "small town" attitude melts away at the touch of the radio key and the amateur's world broadens out with the increasing range of his transmitter.

On the other hand, this increased range of the amateur may, and unfortunately sometimes does, bring him within the ken of commercial receiving stations in his neighborhood. A proper amateur code of ethics will at once prompt him to reduce power rather than to risk interference with important commercial or governmental messages.

America has always been proud of Yankee ingenuity and manual skill. Dexterous handling is surely fostered by radio experiments. Aside from the delicate and accurate touch on the key required for careful sending, there is a great amount of delicate adjustment of couplings, of variable condensers, of crystal points, and similar equipment. All of these help toward the development of the observing eye and a careful and dependable hand. The amateur develops a pride in the neat workmanship and excellent finish of his set and in its careful lay-out and business-like appearance. He develops ingenuity in meeting unusual experimental difficulties, in improvising new equipment even out of discarded odds and ends. Such resourcefulness is well worth while.

The amateur may purposely or inadvertently become a listener-in on private communications from ship to shore. This unusual privilege obviously carries with it a proper obligation to maintain a generously co-operative spirit, calling for the exercise of proper caution that there be no interruption of this traffic or annoyance caused to its dispatchers. It is a grave question whether indiscriminate listening-in to private communications will last indefinitely. High speed or code transmission may play a part in the communication of the future.

The amateur of the United States will therefore do well to raise the standard of what may be called his "profession" by joining the leading engineering institute in the field and affiliating himself with local amateur socities as well. He will thus keep in touch with all modern improvements and through the medium of the higher grade radio magazines, know exactly what is going on. In this way he will not lag behind the times, nor unconsciously cause trouble to the commercial stations.

We may hope under these conditions to have a steady stream of radio engineering recruits drawn from the ranks of the amateur with a resulting advantage to the entire field.

Alfred N. Goldsmith, Ph.D.,
Vice-President, N. W. A.
Director of Radiotelegraphic and Radiotelephonic Laboratory, College of the City of New York;
Editor, Proceedings of the Institute of Radio Engineers.

From the American Radio Relay League

A VERY serious situation has arisen. Unless all of us amateurs act quickly, a law will be passed in Washington which will wipe amateur wireless completely out.

I know you will find this hard to believe, **BUT IT IS SO.** A bill has been introduced in both the House and the Senate which may prohibit amateur wireless. It is **GOVERNMENT OWNERSHIP APPLIED EVEN TO OUR AMATEUR WIRELESS,** and whoever introduced it is guilty of gross lack of appreciation of the patriotism of those amateurs who, not waiting to be drafted, **VOLUNTEERED** in those first dangerous days of unpreparedness when our Army and Navy were in desperate need of young men who knew wireless. Not only are these young men ignored, but the bill is likely to be pushed through while they are absent in their country's service and rendered mute by military regulations, and forbidden to appeal on their own behalf.

Our American Radio Relay League officers are fighting hard, but we are only a handful. Alone, we cannot make the Congressmen in Washington appreciate the importance of amateur wireless. You must help us. You positively must write a letter immediately, and see that it is mailed before the sun goes down tonight to your Representative and also your Senator in Congress. You should say something like this:

We protest against the injury that will be done many young men of this country if House Bill 13159 and Senate Bill 5036, which may prohibit amateur wireless, are passed without a full and free hearing. It will take time for the amateurs to present their case because most of them are in the Army or Navy and away from home. The Bills should be held up until the amateurs can be informed of what threatens them.

If you do not know the name and address of your Representative or Senator, your Postmaster will tell you. You must help, and today, or good-bye to all amateur wireless and the valuable experience and education that comes with it. Who knows but what a future Edison, Westinghouse or Marconi is in the making in your very house if he is allowed to continue his amateur wireless work.

THE AMERICAN RADIO RELAY LEAGUE, INC.

Hiram Percy Maxim,
President.

The Amateur as an Army and Navy Expert

YOUR attention is seriously called to a bill, H. R. 13159, "To further regulate radio communication," introduced by Mr. Alexander on Nov. 21, 1918, which was referred to the Committee on the Merchant Marine and Fisheries.

From articles which have appeared in the press, this bill was interpreted by many concerned to merely give the Secretary of the Navy the power to operate or maintain all commercial radio stations on land or on permanently moored vessels now in existence within the jurisdiction of the United States or any of its possessions, and that the commonly-called **"radio amateur"** would still be allowed to erect, maintain or operate for experimental and private use a radio station—if properly licensed, as provided by the Act to Regulate Radio Communication, approved August 13, 1912.

A glance at an official copy of Mr. Alexander's bill shows that the **"radio amateur"** was not even mentioned.

In the Act of 1912 a distinction was made between different classes of land stations as follows:

(1) Public Service Station (a) general (b) limited.
(2) Limited Commercial Stations.
(3) Experimental Stations for the development of radio communication.
(4) Technical and Training School Stations.
(5) General Amateur Stations.
(6) Special Amateur Stations.
(7) Restricted Amateur Stations.

On the present bill, H. R. 13159, the amateur station is ignored. Evidently Mr. Alexander does not know the important part which the "radio amateurs" have played in the war for democracy.

After the United States declared war on Germany our Government sent out a call for several thousand **trained radio operators** which were needed at once in various branches of the Army and the Navy. The result was that more than five thousand radio **amateurs**, skilled in the operation of modern radio apparatus, enlisted or accepted civilian positions in the Army or the Navy.

If Mr. Alexander had excluded the radio amateur from his bill of 1912, this radio personnel would not have been available for the great emergency. Dependable radio operators and radio experts capable of operating and erecting modern complicated radio apparatus cannot be trained over night; their skill rested on years of constant study and experimenting.

Statistics compiled two years ago showed that there were over 100,000 radio **amateurs** in the United States, not taking into account the boys and others who were merely playing with radio. Amateurs, as they are called, are the real experts, for they work at wireless for the love of it; they are building new apparatus all the time, experimenting with improvements in materials and in methods, spending the greater portion of their leisure time at the work. They are the enthusiasts.

It was a New York amateur, Edwin Howard Armstrong, president of the Radio Club of America, who invented the regenerative action of the vacuum tube detector which has made possible many recent evolutions in the radio art. Mr. Armstrong is now a Captain in the Signal Corps, U. S. Army, and has been in France for over a year as radio expert.

Below is a list of a few New York radio AMATEURS who have been in the U. S. Government service since we declared war on Germany, stationed in Washington, helping to solve the many radio problems from their knowledge obtained through experimenting with their own home-made amateur apparatus:

Mr. T. Johnson, Jr., Expert Radio Aide in charge of Aircraft Radio, U. S. Navy.

Lieut. H. Sadenwater, U. S. Navy, Radio Officer, Aircraft Radio.

Lieut. W. S. Lemmon, U. S. Navy, Radio Officer, General Radio.

Mr. B. R. Cummings, Expert Radio Aide, General Radio, U. S. Navy.

Mr. F. W. L. Horle, Expert Radio Aide, General Radio, U. S. Navy.

Mr. T. A. Hart, Expert Radio Aide, General Radio, U. S. Navy.

Mr. A. Allen, Expert Radio Aide, General Radio, U. S. Navy.

Mr. L. Spangerberg, Radio Inspector, Aircraft Radio, U. S. Navy.

Mr. J. A. Fried, Chief Radio Draftsman, Radio Division, U. S. Navy.

Ensign T. J. Styles, U. S. Navy, Aircraft Radio.

Capt. D. C. McCoy, Radio Officer, Division of Military Aeronautics.

Mr. J. O. Smith, Radio Expert, Division of Military Aeronautics.

With restrictions under the existing law of 1912, and using modern apparatus of the continuous wave type, the radio amateur cannot cause interference with naval stations. In my estimation, instead of eliminating the amateur, he should be encouraged to experiment more than ever, so that if the emergency should again arise, the Government will have at its disposal many thousand radio stations needed on airplanes, tanks, balloons, warships, torpedo boats, troopships, land stations ot any type, etc.

If this bill becomes a law, it means that the "radio amateur" will be completely ignored and only "scientists" will be allowed to experiment with radio apparatus of any description—receiving stations included. By a scientist, I mean a professor, or highly technical engineer, actually considered such by the Secretary of the Navy.

You are requested to take immediate action against the approval of this bill without an amendment authorizing the "radio amateur" to operate or maintain a radio station for experimental purposes.

LOUIS GERARD PACENT,
Radio Club of America.

Genuine Preparedness

THE lamentable unpreparedness of our country at the time of entering the war was complete in every respect but one—radio operators. The immediate response of some twenty-five odd thousand amateurs, trained to the minute in radio operation, was the one conspicuous exception to our otherwise total unreadiness. It seems unbelievable that the Government would countenance the loss of thousands of men in constant training for one of the most important branches of warfare, as would result by the passage of the Alexander bill in its present form.

Let the Amateur still be under the regulation of the Government as in the past, and this army of specialists will be ready day and night for the country's call.

H. E. RAWSON,
Station 7ZR, Rawson Ranches,
Kuna, Idaho.

Unjust Legislation

THERE is now pending before the House a Bill, H. R. 13159, proposed by Mr. Alexander to "Further Regulate Radio Communication."

I would strongly urge your opposition to the passage of this bill, as it aims to suppress the development of radio communication by private individuals.

Among the many reasons why the "radio amateur" should be encouraged rather than suppress, are the following:

Immediately after our entry into the war, FIVE THOUSAND RADIO AMATEURS placed themselves at the disposal of the Military and Civil Departments of the Government. This would have been entirely impossible were it not for the fact that, before the war, there were many thousands of radio amateurs experimenting and maintaining their own stations, built by themselves and used for developing the art. Moreover, the present high stage of development is largely due to the efforts of radio amateurs. Pre-eminently among these is Mr. Edwin H. Armstrong, who through the development of the oscillating audion made possible the practical use of long distance communication and the possibility of directing, by means of the radiotelephone, Aircraft in battle.

Many high positions are now held in the Military and Civil Governmental Departments by men who just recently were radio amateurs.

Any legislation which ignores the radio amateur is fundamentally unjust and should be relentlessly opposed.

A. H. GREBE.

QRM from Washington

THE eighth wonder of the world is the activity of Congressmen in and about a number of things that are useless, and in some cases, pernicious. One of the most startling examples of this proclivity has been manifested recently in the House of Representatives by the introduction of a bill in the 65th Congress by Representative Alexander for the ostensible purpose of regulating radio communication, which in reality is a bill calculated to wipe out the radio amateur in the United States and take away from the people at large all right to have wireless apparatus or to become proficient in the use and management of an amateur wireless station.

How serious such a prohibition would be to the interests of the country at large is revealed when we consider the part that the so-called "radio amateur" has played in the War for Freedom just closed. At the outbreak of the war the Government of the United States sent out a call for all the "trained radio operators" who would volunteer to serve the Government during the period of the emergency. More than 5,000 patriotic Americans, who had acquired skill in the operation of radio through the amateur wireless stations which they conducted, responded and made themselves available for the uses of the Army and Navy. Without amateur radio operators, the Government would have been obliged to take raw recruits, unfamiliar with wireless, and given them months of intensive training before the required personnel could have been added to the Signal Corps for wartime uses.

How important this was will be appreciated when we recall that a great modern General said, "The difference between good and bad communication on the battle line is the difference between life and death." The worst part of the introduction of this bill is that it is not the first time that Congress has felt called upon to attempt legislation against the radio amateur. In 1912 a bill was introduced in the House, somewhat similar in its provisions to the present one, which also contained no permission for "radio amateurs" to operate.

A wave of indignation swept the country at that time from the Atlantic to the Pacific, and so strong a protest was made that the bill was defeated; and a lucky thing for Uncle Sam it was, too, as otherwise there would have been no operators upon whom he could call to do the most urgent work of the war, except the mere handful of paid commercial operators. Now that Congress has been busy for the past year and a half taking over control of private enterprises on behalf of the Government, it undoubtedly feels that the time is ripe to take away from the people the privilege of using and maintaining wireless stations, and the bill is submitted once more to Congress with the hope of passing it under the cloak of an "emergency measure" which no one will have the courage to assail at a time like this.

The American people are fully awake and alive to the situation, however, and every organization, firm, magazine, and man in this country with the interest of amateur radio work at heart has taken up the gage of battle against a bill designed to deprive our country of its only source of supply of radio men in time of trouble. Everyone who has had any experience in radio work has had experiences with young men who have taken up wireless as an amusement at first, and who have afterward developed into first class radio operators and experts. The writer, in his long experience in conducting an amateur radio station has had opportunity to observe countless young men starting out in the amateur field, and has watched them grow into A1 technical men, better equipped even than the professionals, by reason of the fact that general amateurs by Governmental regulation must contend with the difficulty of operation with wave lengths of not over 200 meters. In addition, most of them use home-made apparatus, which is of great aid to them in teaching them the construction and design of apparatus for wireless use.

Short waves were almost universally used in the war for trench work, and by reason of the fact that amateurs had, by the Government restriction, been obliged to work on those wave lengths, they attained a skill which the Government experts had previously thought impossible. This was wholly due to the fact that the amateur had been forced to experiment with a spark transmitter tuned to 200 meters, until he was able to transmit and receive with any degree of accuracy, since the year 1912.

A similar bill to the Alexander Bill (H. R. No. 13159) has been introduced in the United States Senate (S. No. 5036) by Senator Fletcher in conjunction with the bill in the Lower House. Both of these bills must be killed if the radio amateur is to live. Whether it is worth while keeping the radio amateur alive is amply demonstrated by his use in the great war.

Congress should be made to understand that amateur stations are not cheap toys. I have personal acquaintance with at least fifty amateur equipments that are on a par with coastal stations in point of efficiency. My own station, 2 PM, cost about $500 in cash and a great deal of labor to construct. It could not be duplicated for $1,500. There are many other amateur plants of equal value.

Man to man, is it right for any Congressman or Senator to attempt by legislation to stifle the spirit of inventiveness and ingenuity in this line of work, especially in view of the noble and patriotic service just recently rendered to the country by the, now, despised amateur? It is not to the interest of the people in the perpetuation of republican institutions, to allow such laws to be passed!

JOHN F. GRINAN,
Owner of Radio Station 2 PM.

Experimenters' World

Langmuir's Circuit and Apparatus for Operation of the Vacuum Tube

A PATENT recently granted to Dr. Irving Langmuir of the General Electric Company shows a vacuum tube of unusual construction connected in a receiving set circuit for the detection of electrical oscillations.

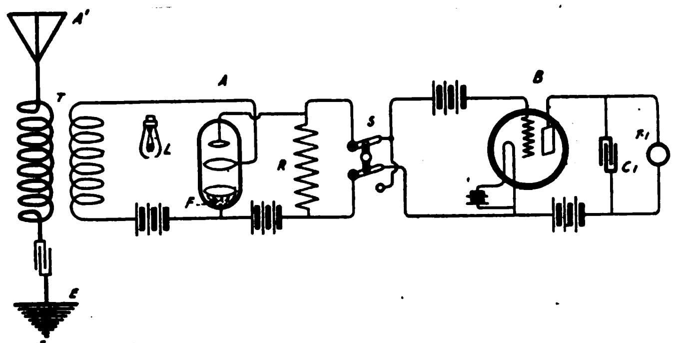


Figure 1—Langmuir's circuit and apparatus for amplifying variable currents

Figure 1 indicates a cascade system where the plate or output circuit of tube A is coupled to the grid or input circuit of tube B, through a resistance R. This usually has a value of 20,000 ohms.

The filament F is not heated by a battery as in the usual tube but it consists of potassium, sodium or other metal which emits electrons when illuminated by the source L.

A monochromatic source of light such as a mercury vapor arc in a quartz or glass envelope has been found to give off electrons of uniform velocity. The anode or plate preferably consists of tungsten and the bulb is exhausted of gas by electron bombardment during the exhausting process. The pressure in the envelope is reduced to a value at which no appreciable gas ionization can occur.

A two-way switch S is provided between the plate and grid circuit of figure 1 and when it is placed so as to connect the positive terminal of the resistance R to the grid circuit of the second tube, which contains a battery for making the grid negative, an increase of plate current in the circuit of the tube A will produce an increase in the plate current of the circuit of the tube B. When the connections are reversed the converse is the case. As in the usual receiving circuit the receiving transformer with its primary and secondary windings is indicated at A, the aerial at A′ and the earth connection E. The current translator is the telephone T-1, which is connected in the plate circuit and shunted by the variable condenser C-1.

The apparatus shown in figure 2 is the usual cascade radio frequency amplifier—a circuit applicable to the reception of damped oscillations. Through the tubes A and B, the incoming radio frequency currents are progressively amplified, the transformers T-1, T-2 and T-3 being air core radio frequency transformers of the necessary dimensions for tuning to an incoming signal. The secondary of the three transformers are shunted by variable condensers as usual. It is to be noted that the vacuum tube C

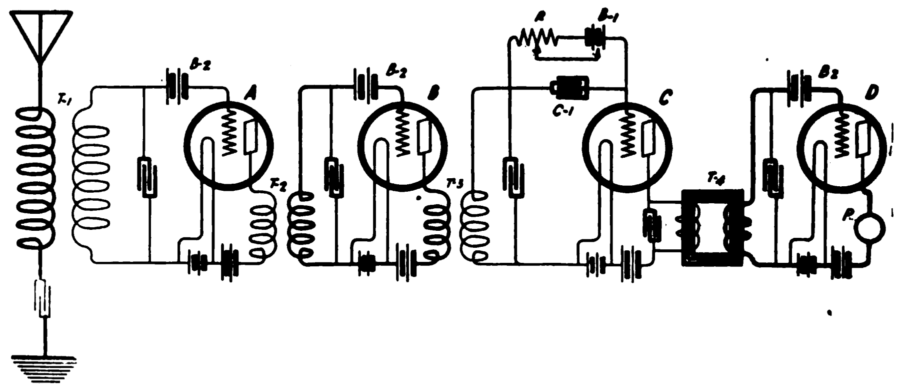


Figure 2—Usual cascade radio frequency amplifier

includes in its grid circuit a series grid condenser C-1 which is shunted by the battery B-1 and the resistance R connected in series. The object of the condenser C-1 is to secure an integral effect of each group of incoming oscillations so that the effect in the plate circuit of the vacuum tube B is to produce an audio frequency pulse of current—one pulse for each spark at the transmitter.

The operation of this part of the circuit is well understood by the field at large, the amplified incoming radio frequency currents being rectified, accumulating a change in the condenser C-1 over the duration of a wave train which makes the grid increasingly negative, reducing the plate current. At the termination of the wave train the charge leaks out, the condenser C-1 being assisted in discharging by the battery B-1. Thus the grid potential of the valve is restored to normal value between each group of oscillations and consequently the maximum effect is obtained in the plate circuit.

Tuning to audio frequency or, in other words, to the spark frequency of the transmitter is accomplished through the transformer T-4, which contains an iron core and is of the necessary dimensions to be resonant to frequencies around a thousand per second. The secondary terminals of T-4 are connected to the grid circuit of the tube D, the plate circuit of which contains the telephone transmitter P.

Both tubes have a source of grid potential—the special grid battery B-2—the object of which is to adjust the potential of the grid in respect to the filament to a slightly negative value, for this has been found to give the best signals.

The effect of the series condenser in the grid circuit of the tube C in figure 2 is shown by the graph in figure 3 where the successive cycles indicate how the potential of the grid to filament varies during the passage of a group of radio frequency cur-

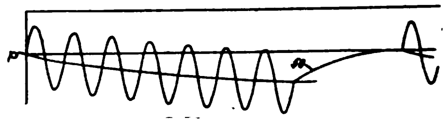


Figure 3—Graph showing how the potential of grid to filament varies

rents. It will be noticed that the effect of the first half cycle is to make the grid slightly positive but as rectification occurs and a charge piles up in the grid condenser C-1, the grid

(*Continued on page 34*)

Vreeland's Selective Wireless Telegraph System

FREDERICK VREELAND believes he has solved the problem of selective and secretive wireless signaling by use of the apparatus shown in figures 1 and 2. The fundamental circuits admittedly are simple, the only unexplained device being the recording instrument to take down the signals. As a novelty of this system it is to be noted that in figure 1 a mercury vapor arc is employed to generate radio frequency currents, and at the receiver a small mercury arc generator is employed for similar purposes to form beat currents, the only thing of importance missing being the recording device, which the inventor remarks may be a telephone, a vibration galvanometer or a mechanically tuned relay. If the reader understands the working of the well-known beat receiver, little attention need be paid to the diagram.

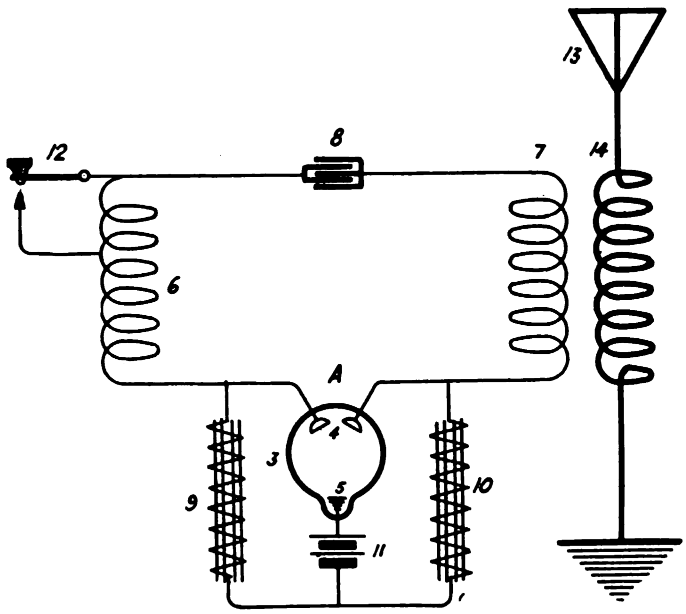


Figure 1—Circuit employing mercury vapor arc to generate radio frequency currents

As a fundamental working basis of the apparatus it may be said that when a local radio frequency generator at a receiving station is adjusted to the correct frequency for the production of audible beats, the difference in frequency between the local generator and that of the incoming signal is practically insufficient, in the inventor's opinion, to require separate tuning for the two currents. It is also evident that in a receiving system of this kind, adjusted for beats, the slightest change in frequency at the transmitter will produce a corresponding change in the beat note. This, in fact, is one method by which the inventor accomplishes radiotelegraphic signaling. For example, if the receiving apparatus in figure 2 is adjusted so that the frequency of the local generator is slightly different from that of the incoming signal, a continuous beat note will result in a telephone provided the transmitter is in constant operation. If then the transmitting operator presses the key 12 in figure 1, the slight detuning of the transmitting circuit occasioned thereby will cause a sufficient change in frequency to either increase or decrease the pitch of the beat current at the receiver.

The operator will then translate the signal heard when the transmitting key is pressed and he may select as a normal pitch for the continuous note at the receiver, any frequency that will make clear the superimposed note.

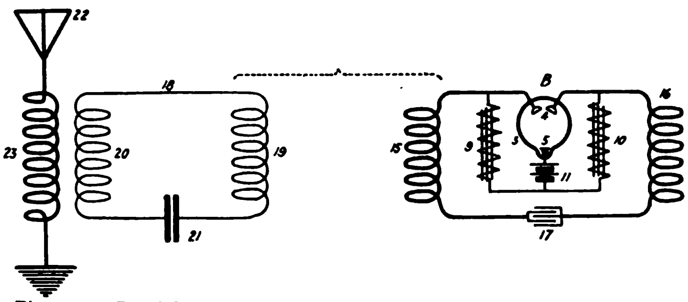


Figure 2—Receiving apparatus of Vreeland's selective wireless system

Assume again that the frequency of the local generator at the receiver is the same as that of the transmitter: No beat note will result but when the transmitting operator presses the key 12 detuning the transmitting circuit an audible note occurs in the receiver.

A vibration galvanometer or a relay or other mechanically tuned receiving device may be adjusted to record the beats. Again the recording device may be such as gives no indication from the audio beat but responds to the intervals of silence in this case. It is evident that unless a spying station was provided with a similar receiver it would be unable to record the signals.

It is obvious that the beats need not be of an audible frequency, provided a receiver is employed capable of discriminating between the beat frequencies corresponding to the signal and no-signal conditions, such as a vibration galvanometer or relay, in which case the signals may be visually displayed or be recorded or both.

A numerical example will illustrate the very small change of frequency required at the transmitter to produce readily distinguishable audible tones. Suppose the frequency of the sending oscillator be 100,000 cycles per second and that of the receiving oscillator be 99,500 cycles per second, or one-half per cent less. Then the beat frequency will be 100,000 — 99,500 = 500 beats (cycles) per second, a rather high pitched musical note. If now the sender frequency be changed to 100,050 cycles per second (one-twentieth per cent higher) the beat frequency will become 550 cycles per second, a change of 10%, or nearly a whole tone of the musical scale, a marked interval easily observed. If the sender frequency be 100,000 and the receiver frequency be 99,900 (one-tenth per cent below sender) the beat frequency will be 100 (cycles) per second (a fairly low note) and a difference of only 10 oscillations or 1 in 10,000 will produce a 10% change in the beat frequency. A minute change in the sender frequency will therefore produce a relatively large change in the beat frequency.

LANGMUIR'S CIRCUIT AND APPARATUS FOR OPERATION OF THE VACUUM TUBE

(*Continued from page* 33)

becomes increasingly negative; at the termination of the wave train the grid potential returns to its normal value as indicated at P.

A feature of the cascade amplifier is, that by tuning successive circuits, the undesired oscillations are reduced in each case in geometric proportion. The additional selectivity occasioned by the use of the group frequency tuner, reduces the problem of interference to a minimum.

Construction and Operation of the Field Telephone and Buzzer

IN a previous article, I informed your readers of certain ideas which I developed in connection with field signaling work applicable to junior military organizations. In this article I present data for the construction and operation of a portable field telephone and buzzer set.

The portable station consists of the instrument case and carrying case. The carrying case has a compartment to hold two No. 6 dry cell batteries, which supply the power to the portable set.

The instrument case is made from the following pieces of kiln dried ¼-inch wood, preferably hard:

2 pieces 4¼" x 3" top and bottom
2 pieces 4 " x 3" sides
1 piece 3¾" x 3" front
1 piece 3½" x 3" back

Before assembling the case, mount the triple pole double throw switch on one of the sides, using two binding posts on the two arms to which the telephones are connected. The binding posts are used in place of the screws which hold the switch arm to the side. Connecting in this manner does away with complicated inside wiring. Fasten the buzzer to the base of the case, mount the strap key and two binding posts to the inside of the front so that, when the cover is opened, the key will be on the inside. The general assembly is shown in figure 1.

Mounting of the Transmitter

The transmitter, as I stated in the first installment, should work on three volts, and be of very light weight. The Crown Telephone Company make the best transmitter that I know of. It is light in weight and works remarkably well on three volts.

As to the mounting of the transmitter there are several satisfactory methods. The first is to make an arm which is fastened to the back of the receiver, and has the transmitter mounted on the other end. The second method is to employ the mounting used for switchboard operators. I am unable here to give the exact dimensions for either method, as it depends upon the size and style of transmitter to be used. Probably the best style is the one used by telephone repairmen throughout the country.

It is my advice that the builder go to the telephone company in his city or town and obtain actual measurements of the style of apparatus he has decided to use. By so doing he will save a great amount of time and trouble. There are so many styles and types of receivers and transmitters that it is useless to consider any one type here. I might take a certain type as standard, which could not be obtained; therefore, I have left the matter for the judgment of the maker.

Operation of the Portable Set

If the two sets after completion are not to be used through an exchange, or the exchange is not completed, be sure that the polarity of the battery of one set is reversed, in respect to the other set, for it is impossible to operate otherwise.

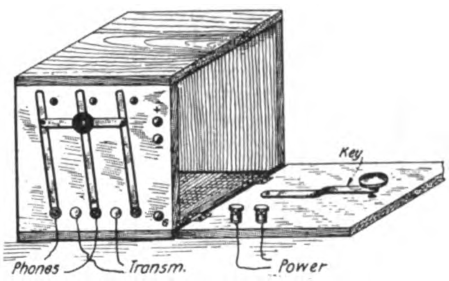


Figure 1—Portable station assembled and ready for use

In the portable set a small one-point switch must be employed so that the arm of the switch connected to the side of the batteries goes to the lower contact of the key, the other side to the line side of the circuit.

When the switch is closed the call light on the exchange will light up, notifying the operator that you wish to communicate with another station.

After finishing transmission, close the switch for at least five seconds. During that time the exchange operator will withdraw the plug connections.

Before calling a station—either the exchange or another portable set—have the T.P.D.T. switch on the buzzer side. Always have the switch on this side for calling, making sure to change back again after using the telephone circuit.

A copper rod 6 inches long must be carried with each portable set. This rod is connected by a wire and driven into the ground. The wire is connected to the ground side of the buzzer.

The following list of "Do Nots" if adhered to will save a lot of time and trouble:

DO NOT call the exchange by means of the telephone.

DO NOT leave the T.P.D.T. switch on the telephone circuit after using this means of communication.

DO NOT forget to see that the lines and batteries are connected up according to the diagrams.

DO NOT forget to notify the switchboard when you have finished transmitting your message.

DO NOT send anything unnecessary, as there may be important business for your commanding officer from headquarters.

DO NOT forget to make ground connections.

DO NOT fail to notify your repairman if the set fails to work.

Wiring of Switchboard

The switchboard described in this article has a capacity of six stations; four line and two headquarters, or company and battalion.

A switchboard to be used for military organizations must have these requirements:

(a) Simplicity.
(b) Ability to send from one headquarters to all line stations.
(c) Calling and finish lights.

The switchboard in figure 2 has 17 binding posts, used as follows:

No. 1 through 12—To which the lines are connected.

No. 44 and 45—For power connections.

No. 46 and 47—For the telephones.

No. 47—Ground wire connections.

Six three-volt bulbs, Nos. 38 through 43.

Twelve plug receptacles for receiving the plugs Nos. 13 through 24.

Thirteen plugs, Nos. 25 through 36 and B.P.X. (Switchboard plug).

The reason for connecting together two plugs and two receptacles and one lamp follows:

If a station desires to communicate with another station, there must be some means of connecting them together. By connecting the plugs and receptacles of each set together, that is, when the plugs of one set are pushed into the receptacles of another set, a complete circuit is made.

In the set a buzzer and key are placed so that when the lights show that a station is calling, the exchange will have a means of answering and calling.

Construction of the Switchboard

The switchboard shown in detail in figure 3 is made of wood which is ¼" thick.

The following pieces must be cut accurately if a neat switchboard is desired:

2 pieces 7½" x 13½"—sides, cut as per figure 3
2 pieces 6 " x 6 "—upper front & back (A & B)
1 piece 7½" x 6 "—lower front (C)
1 piece 7½" x 6 "—lower back (D)
1 piece 8 " x 6 "—bottom (E)
1 piece 5 " x 6 "—plug board (F)
1 piece 1½" x 6 "—back mount (G)
1 piece 1½" x 6 "—top (H)

The pieces were designed so that the back is entirely removable in order that the wiring may be done in a neat manner and yet permit free access to all parts.

Take the two sides and mount front C on them, then set on bottom E and fasten with screws. Take the back mount G and mark off 10 holes as shown in figure 3, part A, and drill with a 1/8" drill; then mount 10 binding posts with a base diameter not to exceed 1/4". Slightly smaller posts would perhaps be preferable. Next put on the top H.

On the upper front A mark off and drill as per figure 3, part B. Cut twelve strips of copper 1/4" wide and 1½" long. Bend each strip ½" from one of the ends; mount one over each hole as shown in figure 3, part C.

After drilling all holes, including those for the lamps, (the size of these holes depends upon the size and style of bulb), and the copper strips are in place, mount the board and proceed with the wiring. From each set of contact arms run two wires, one to each arm to the lamp corresponding to the contact arms above as per the wiring diagram figure 2. There are ten binding posts, 1 through 10 starting at the right when the back is toward you. Numbers 2, 4, 6, 8 and 10 are marked (+) and the others (—). The even numbers are connected to the upper row of receptacles No. 2 to No. 13, etc. The uneven numbers are connected to the lower row No. 1 to No. 14, etc.

Take five pieces of flexible wire each 14½" long and fasten one end of each to binding posts Nos. 1, 3, 5, 7 and 9.

Take five pieces of the same wire each 17" long and fasten one to each of the remaining posts.

Drill the plug board (F) as shown in figure 3 and mount as shown. Drill the short leads through the holes nearest the front A. Pull the longer leads through the remaining holes.

Cut two wires, one 14½" and the other 17" long, and connect to the two headquarters binding posts on the side. Also connect plug receptacle No. 23 to post No. 12 and No. 24 to No. 11, being sure to connect the lights at the same time. Pull the two leads through the remaining holes.

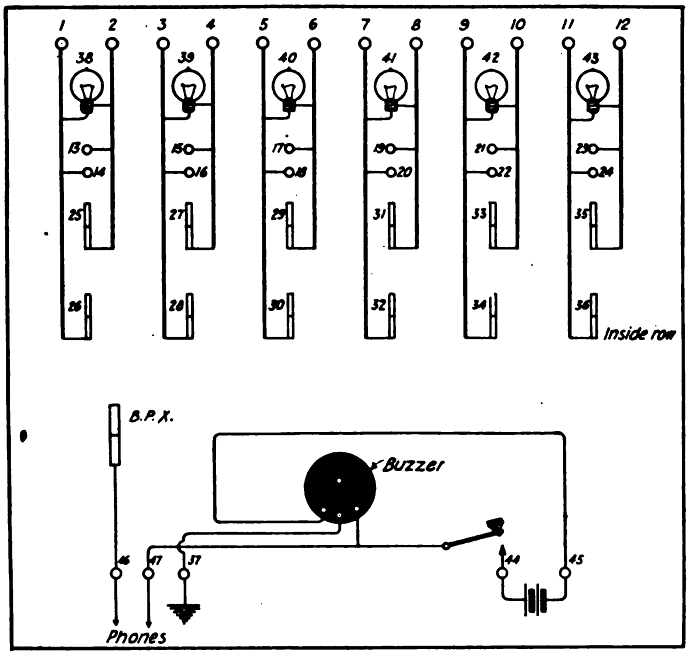


Figure 2—Showing wiring for switchboard

Make thirteen weights of lead each 1" square and drill a hole through the center. Fasten one to each of the leads, on the short leads 5" from the end joined to the binding posts, and on the long leads 6" away. These weights will be heavy enough to hold the wires in place when not in use, and are heavy enough to cause the wires to return to their original position, when released from the plug receptacle. Connect regular telephone plugs on the end of the wires coming through the mount and make the final adjustment on the weights. I offer the following suggestions: Use six black and six red plugs, the inside row of plugs black and the outside row red, the exchange plug red also. Paint a small red ring around the upper row of plug receptacles and black on the lower ones. By doing this, many a mistake will be avoided. Mount a buzzer inside the case and connect to the binding posts marked on figures 2 and 3. Cut a flexible wire 17" long and connect one end to the binding post No. 46, pull the other end through the hole provided for it, fasten a plug and a lead weight. Make the adjustment so that the plug will fit into any one of the plug receptacles. Then mount key and finish the remainder of the assembly.

Testing

After the switchboard is connected it must be tested, not with a portable station, but with a quicker method. Take two dry cells and connect together. Connect the two wires to binding posts No. 1 and No. 2. If properly wired, the light No. 38 should burn. Push plugs 25 and 26 into the plug receptacles of each set and if the lights burn they are correctly connected.

The next step is to see that all the plugs and plug receptacles are connected properly. Take the two batteries and connect one side to binding post No. 1. The other side to one side of a bell, and from the other side of the bell a long wire is attached so that it can be connected to Nos. 3, 5, 7, 9 and 11 in rotation. Connect to No. 3, and push plug 26 into receptacle 16; if the bells ring the circuit to this point is correct. Change the bell wire to No. 5 and plug 26 to 18. Do this to Nos. 7, 9 and 11, being sure to use plug 26 in all cases. If the bell rings each time you change the wire and push the plug into the corresponding receptacle, the circuit is O.K. If it does not ring immediately change the wires of the binding posts. It will then ring. By making these simple tests you will know whether you have done your work properly.

Operation of the Switchboard

When the switchboard and stations are ready for use, connect the lines from the portable station to their respective binding posts on the switchboard. Be sure to have the line side from the portable set connecting to the (+) binding post on the switchboard, the other wire connected to the (—) side.

When the call switch at the portable station is closed, the light across the two binding posts to which that station is connected will burn. Push the exchange plug into the upper row (+) of the receptacles into the one corresponding to the station calling. Send RK, which means "All right, go ahead." The station calling will then send the call letter of the station wanted, which is acknowledged by repeating the call letter or letters once. Now push the plug or plugs of the station calling into the plug receptacle (s) wanted and press the key once. This is to notify the other station he is wanted; then remove your plug. When I say plugs, I mean this: when the buzzer is to be used you only need one plug. On the wiring diagram of the switchboard they are the plugs with the uneven numbers, No. 25, etc.

When the telephone is to be used, the calling station will signify by sending the call letter of the station wanted twice, followed by the letter T twice.

Push the + plug into the — receptacle and the — plug into the + receptacle of the station wanted.

The reason for crossing the lines is that all stations are wired up in the same way, all plug sides of the batteries on each set being joined to the same instruments. When the buzzer is in use it makes no difference whether the power is the same or not. With the telephone the batteries must be in series. That is, the positive side of the batteries on one set must be connected to the negative side of the batteries on the other set. That is why two leads are used, and why they are reversed when the telephone is used.

If headquarters wishes to communicate with one station, the preceding methods are true, but when a communication is desired with all stations at the same time, it is changed to this extent:

If the buzzer is to be used push plug No. 35 (which is one of the two regimental plugs) into plug receptacle No. 21, plug No. 33 into No. 19, No. 31 into No. 17, No. 29 into No. 15, No. 27 into No. 13 and plug 25 will remain. There is one left over because the receptacles and plugs of each set are connected together. Connected in this manner all stations are in series. Send a long dash followed by R.

When using the telephone both plugs must be used. Plug 35 into 22, 36 into 21. Proceed in the same manner as in the buzzer, being sure to reverse the plugs. Hold down your key for at least five seconds, then send RT, which will tell the operators that headquarters is about to transmit by means of the telephones.

The preceding feature is of great use and I am safe to say, original, in allowing direct or selective communication from the commanding officer and all officers of the line.

HEADQUARTERS STATION

The headquarters station may be of two different styles: either a portable set, or a switchboard of the type used by the exchanges. An exchange is the proper thing to install, if possible, for the advantages are obvious.

When an exchange is used at headquarters, three portable sets are employed, each set connecting with one set of binding posts. The other three sets have the lines from the exchange connected to them. The following shows the number of intercommunications possible:

1—Transmission to one or all stations of one company.

2—To one or all of two companies.

3—To one or all of three companies.

4—Working three different stations at the same time.

WHO PAYS FOR THE APPARATUS

Each company or battery will furnish a portable set, to be kept by that company. They will also have two men trained as operators.

The companies making up a battalion will each contribute an equal amount of money for the cost of constructing an exchange. The Signal Corps will furnish the operators.

All companies will bear the expense of equipping headquarters with a portable set or exchange, to be kept by the Signal Corps. All operators for headquarters to be drawn from the Signal Corps.

The wire to connect up the apparatus will be furnished in the same way, excepting that the Signal Corps will supply the wire to go from each exchange to headquarters.

INSTRUCTIONS FOR OFFICERS

1—An instruction school to be conducted by the Signal Corps in operation, maintenance, and construction of the apparatus.

2—Have three trained men who are to be expert repairmen and "trouble shooters," trained on both the portable set and switchboard.

3—Hold an examination for appointment to the grade of Master Signal Electrician. If you already have one, detail this sergeant to study this apparatus.

4—Each man should become a specialist, either as an operator, lineman or repairman.

5—Buzzer practice should be continued until every operator is able to copy at least fifteen words per minute.

If this advice is followed a great deal of unnecessary trouble will be avoided and a "crack" Signal Corps will be the result.

LIEUT. R. D. GREENMAN, U.B.B.A.

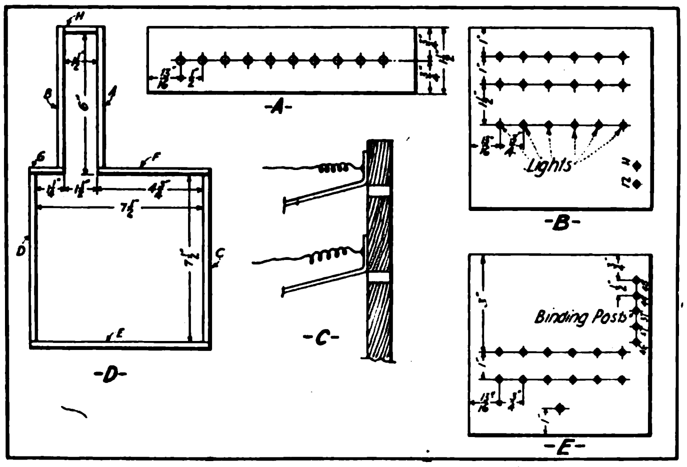


Figure 3—Plan of construction for switchboard

Multi-plate Spark Dischargers for Quenching Effects

A QUENCHING spark gap designed by E. J. Simon is shown in the accompanying figures 1 and 2, where two discharge gaps are in series to form the unit of a complete gap.

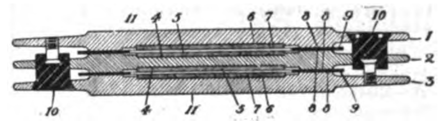


Figure 1—The Simon quenching spark gap

Figure 2 is a plan of a single plate showing the recesses 10 for the insulating bushing.

In figure 1 the intermediate plate 2 is provided with a seat or recess 4 of circular outline. The sparking plate 5 is preferably of electrolytic copper secured to the face of the plate 2. Copper plates 1 and 3 are constructed as plate 2 except that they are grooved on one side only. An insulating gasket 9 is interposed between the plate and it is made of special material such as will insure an air-tight joint.

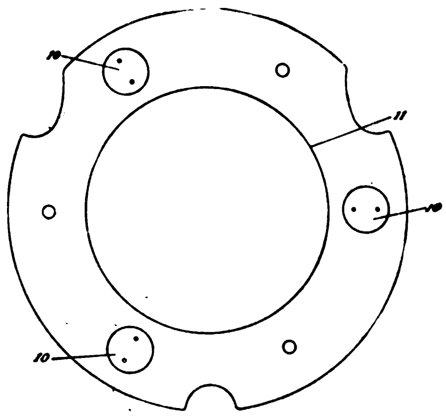


Figure 2—Showing plan of a single plate

At the points where the circumference of the plate makes contact with the insulating gaskets a series of circular grooves are cut in order to insure air-tightness.

The plates are tightly clamped together by the insulating bushings 10, which are drawn up by a small machine screw.

Contest for the January 1919 Issue Wireless Age

In response to the call in the November issue for manuscripts concerning the prevention of interference in amateur radio communication, prizes have been awarded to the writers of the following contributions. The subject upon which the contest was based was: "WHAT IN YOUR OPINION IS THE BEST METHOD TO PURSUE TO PREVENT UNNECESSARY INTERFERENCE IN THE EVERY-DAY USE OF WIRELESS TELEGRAPH APPARATUS?"

First Prize—Some Technical Aspects of Wireless Interference

IT is clear that if all amateur transmitting stations are to operate on the same wave length, and moreover they have been adjusted so that the radiated wave complies with the U. S. laws, a certain amount of interference is bound to result.

It would, therefore, seem highly desirable that the range of wave lengths allotted to amateurs be increased to, say, 300 meters, in order that different wave lengths may be designated to various localities. Committees selected by amateurs throughout the United States should designate the range of wave lengths to be employed in various districts, and these should be adhered to. If the use of such wave lengths is enforced, a great amount of interference heretofore experienced will be prevented, irrespective of the type of apparatus in use.

It is quite probable that vacuum tube transmitters and receivers will play an important part in future operations of the amateur, for the reason that they can be employed for the generation of continuous oscillations at wave lengths as low as 200 meters. Then by the employment of the heterodyne receiver a remarkable degree of selectivity will be secured, owing to the beat phenomenon itself. Whether or not the vacuum tube transmitter will be supplied to the amateur field at a price within the range of its financial resources is at this writing problematical, but it is certain that the only part of the vacuum tube transmitter that the experimenter will actually need to purchase will be the bulb, for all other apparatus connected therewith can readily be constructed by any experimenter handy with tools.

In order that the wireless experimenter may derive the benefits to be expected from the use of such apparatus a campaign of education regarding its use must be inaugurated. We will rely upon THE WIRELESS AGE to do this, but once the operation of the vacuum tube is understood, the amateur with most elementary knowledge will be able to adjust such a vacuum tube set for its maximum efficiency.

Even in the use of damped wave transmitters, increased selectivity can be obtained by employing a regenerative vacuum tube circuit. Any experimenter who has employed this apparatus has immediately observed that the use of regenerative coupling increases the factor of selectivity because it has the effect of reducing the total damping of the receiving circuits.

Many experimenters have not obtained good results from the regenerative amplifier because they have not been given proper constructional details, but I am sure that loads of amateurs—readers of THE WIRELESS AGE—have designed good circuits and will be glad to inform others through the columns of this department concerning the details of their design.

Experimenters have observed that the vacuum tube oscillation detector itself increases the factor of selectivity. This is accounted for by the fact that if the grid of the tube is held at a negative potential, the tube does not absorb energy from the oscillation circuits. The damping is therefore reduced and the sharpness of tuning accordingly increases.

For short distance amateur communication, that is, between stations within the same city, there is not a particle of doubt that the buzzer transmitters which have been so effectively employed in government communication will be adopted by the radio experimenter. This transmitter is of simple construction and inexpensive.

Regarding the lawless amateur, the fellow who jams the atmosphere promiscuously without regard to what is going on; he should be dealt with by police committees of local radio organizations. On top of this the government restrictions should be such that this type of experimenter will not be permitted to operate his equipment until he passes a fairly rigid technical examination and is able to receive and transmit in the International telegraph code at speeds between 15 to 20 words per minute.

I am very optimistic regarding the future of the wireless amateur. I believe that the new inventions brought out during the war will aid him in every way and make his work more interesting, as compared with the types of apparatus used in the pre-war period. Constructional details of sets incorporating the results of recent research will undoubtedly be presented to the field at the proper time.

A. J. HOLBORN, *New York.*

* * *

Second Prize—Interference

IN discussing this subject it would perhaps be well to first apply a bit of analysis. Interference is an effect and there is necessarily a cause to every effect. We must therefore investigate the various causes of interference before we can prescribe a remedy. Briefly stated, all interference may be placed under one or another of two general classifications: Static, arc lights, trolley cars, etc., may be placed under one head; and as these offenders are purely physical, they follow certain well defined laws of nature which can be accurately determined by careful study, and eventually a scientific means of nullifying their effects will be evolved.

The offenders who come under the other head are beings who follow undefined laws of human nature; they can never be controlled by any physical means but must be handled by moral suasion

For the offenders in the first class various remedies have been applied from time to time by many of the foremost authorities on radio, with some success. This topic is one of the chief subjects of research by all investigators, and the fellow who is actually successful in discovering a perfect cure for "static" will win fame and fortune immediately.

The following suggestions bear solely on the control of interference from offenders of the second class:

In reviewing operating conditions in the amateur field up to the time the stations were closed, certain facts become evident. Before the sinking of the Titanic, when the amateurs were free and unrestrained, you could listen in any evening to as fine an imitation of a jazz band as one could desire. No matter where you paused in your tuning, amateur stations with most every known and unknown tone and volume of spark could be heard asking each other "how they came in"—this was ever the chief topic of conversation. When the restrictive radio laws were put into effect, it was thought the death knell of amateur radio had been sounded, as very few supposed any distance could be covered with such small power inputs. However, on the contrary, it proved to be beneficial instead of disastrous in its effects. It took the joy out of life for many triflers and they dropped out of the game. It taught the amateur the value of efficiency, however, as this was the only path left open for increasing his range. It also furnished incentive for serious attempts to advance his work, as it gained him public recognition. And last, but not least, it taught a lesson in respecting the rights of others. All this is established fact and is ample proof of what can be accomplished by proper legislation when justly enforced.

Now let us consider what resulted from this incentive for betterment among amateurs:

The theory of radio was more seriously investigated and applied in the construction and operation of his instruments, and manufacturers had to supply better and more efficient apparatus to suit his requirements. With this better equipment came a natural desire to use it to better advantage, and the standards of operating were raised. At this point the possibility of extending operations into adjoining states was seriously considered, and it was soon realized that in order to accomplish this some definite system would have to be adopted that would enable the efforts of the various individual stations to be brought into harmony, prevent misunderstandings and allow all to pull in one direction. This led to organization of a body of serious minded amateurs, and lines of communication were established throughout the country over which messages were routed. The results obtained exceeded the fondest hopes of the past, and amateur radio was given a new lease of life. All this is likewise established fact and proves what organization can accomplish.

Retrospect is always pleasant, but in this I have an object, and that is to remind you by way of example, of the power *proper legislation and organization* can exert in the amateur field to accomplish a purpose. It is by these means that I believe the evil of unnecessary interference can be eventually cured. It cannot be hoped to make much headway in this direction by the scattered efforts of a few individuals or small groups. The problem is such that it will require the concentrated labor of practically all the amateurs, united in the common cause and working in harmony in a persistent effort to solve it. It is suggested that after stations are opened, the N. W. A. and other bodies representing the interests of amateur radio, co-operate in a nation-wide movement to eliminate unnecessary interference. A joint conference should be held for the discussion of ways and means. Some definite plan should be agreed upon, such as arranging a time schedule and rules of operation that will give every one a chance, by dividing the twenty-four hours of each day into appropriate periods of time and allotting same to the various classes of radio traffic, the most advantageous periods for the most important work, etc. Then these official rules and regulations should be declared broadcast to all stations through every available channel. By adopting an appropriate slogan and pushing the campaign with enthusiasm, it is bound to reach all concerned with gratifying results. And legislation of the amateurs by the amateurs and for the amateurs is most likely to be respected by all.

J. A. WEVER, *Maryland.*

Third Prize—It Rests with the Amateur

I THOROUGHLY believe that the prevention of interference amongst amateur radio stations lies within control of amateurs themselves.

Technical considerations have been avoided in the following suggestions, for my long experience shows me that it is up to the amateurs to apply the "Golden Rule" to as great an extent as possible. There are enough publications devoted to the amateur to supply him with the necessary knowledge to build a transmitting and receiving set that will give a large factor of selectivity, and since it is perfectly obvious that when a number of transmitting stations operate at the same wave length, interference must result, the whole matter resolves itself back into my former suggestion, namely, we must apply the "Golden Rule." Consideration for our fellow worker above all else will solve the problem of interference, even though it may be argued that as long as we comply with the laws laid down for us we are entitled to have the free use of the air. It is only fair that we keep our hands off the transmitting key once in a while and just sit in and listen, giving the other fellow a chance. Messages of importance should always have preference over mere idle chatter.

Frequently, I have listened in and heard more than a dozen amateurs within a given vicinity, trying to use the air at once. It reminded me of a stock exchange where you find perhaps a hundred men yelling at the top of their lungs, something they wanted you to understand. Perhaps you have seen them waving their arms, dodging back and forth frantically with no real result, until silence was enforced.

Although I believe we must appeal largely to the good sense of the amateur to prevent interference, we must not forget the necessity of having our transmitters properly tuned, so as to emit a pure wave and get the maximum efficiency therefrom. It seems feasible to train an amateur in the operation of adjusting his apparatus to such an extent that he can pre-determine its efficiency without unnecessary and constant querying from his fellow worker, "how do you get me?"

My opinion, in brief, is that the first consideration is to have a transmitting and receiving apparatus adjusted for maximum efficiency, and second to have the amateur use his good sense—not to act as if he were the sole owner of the space surrounding him.

H. B. NORDSTROM, *Minnesota.*

Locking Device for a Variable Condenser

WHEN variable condensers are employed in wireless telegraph apparatus subjected to jar and strain such as the equipment installed on an airplane, it is essential that they be provided with a locking device that to vibration. Also during shipment it is desirable to have these plates locked in position to prevent the apparatus from damage due to rough handling. If there is but a slight separation between the movable plates and the fixed

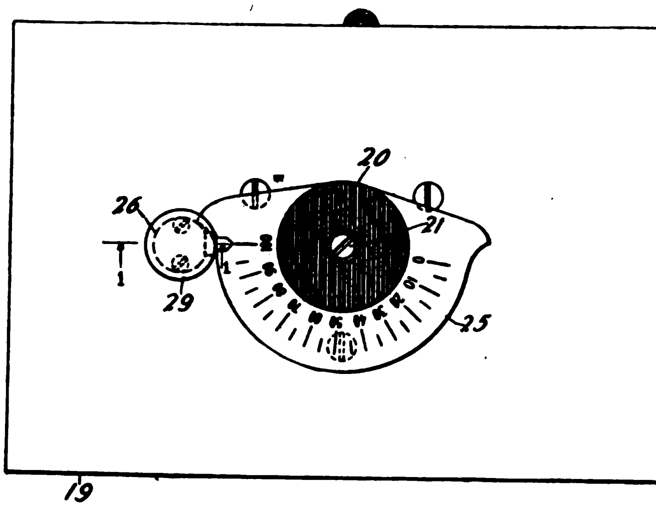


Figure 1—Plan view Gargan locking device

will prevent the movable plates from rotating without putting a severe strain on the condenser mechanism itself.

The movable plates of the average variable condenser are not balanced with respect to the rotating shaft and a tendency therefore exists for them to work out of position when subjected plates, it is highly desirable that the locking device employed be constructed so as to prevent any possibility of the strain changing the separation between the two sets of plates.

John Gargan of Brooklyn, New York, has recently shown a design for a variable condenser embodying this construction as shown in the accompanying figures 1, 2 and 3, figure 1 being a plan view, figure 2 a side elevation, and figure 3 a detail of the locking device.

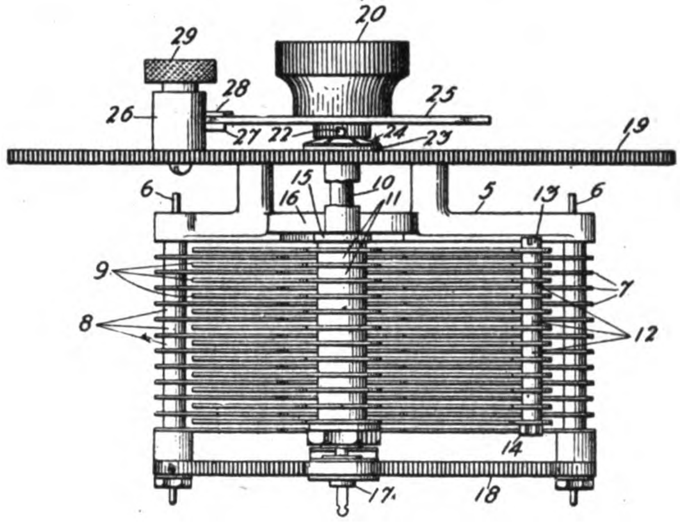


Figure 2—Side elevation Gargan locking device

In the detail of figure 3 the locking device comprises the clamps 27 and 28 which grips the plate 25 attached to

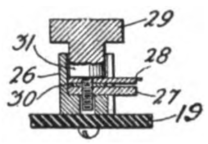


Figure 3—Showing a detail

the handle of the variable condenser. It consists of a hollow post 26 rigidly secured to the mounting plate 19 and provided with a longitudinal slot through which extends a pair of floating jaws 27 and 28. The jaw 27 is assembled to lie in a plane below that of the indicating plate 25 and its inner end is provided with a threaded opening adapted to engage corresponding threads in the knurled head screw 29. The inner end of jaw 28 is provided with an opening through which the threaded portion of screw 29 passes freely and its outer end is pointed to serve as a pointer for the indicating plate 25. Between the jaws 27 and 28 within the post 26 is located a washer 30 of a thickness somewhat less than that of the plate 25. Upon turning the screw 29, the shoulder portion 31 of the screw engages jaw 28, thereby clamping the indicating plate 25 firmly in position.

Coolidge's X-Ray Tubes

THE exhaustive researches of William D. Coolidge in the X-ray field are well known to readers of THE WIRELESS AGE. He has recently shown the design of two complicated structures as per the accompanying drawings figures 1 and 2.

The tube in figure 1 comprises an envelope consisting of an inclosure 1 of metal such as copper and an inclosure 2 of insulating material, preferably glass. A section of platinum 3 is welded or soldered to the copper wall at 4 and is sealed to the glass wall at 5. A copper tube 6 is welded or joined to the tube 1 at 4 and extends into the insulating part 2 of the envelope at the joint 5.

The cathode is a coiled filamentary conductor 7 consisting preferably of tungsten. In this diagram it is shown on edge. Surrounding the filament is tube 8 of molybdenum or other suitable conductive material which acts as a focusing device. One end of the cathode filament is joined to the focusing device and the other end to the conductor 9. Two wires 10 and 11 are joined to the tube 8. They are secured to a split tube 12 of molybdenum or iron. The wires 9, 10 and 11 are bound together by bridge 13, suitable insulation being used if the bridge consists of conducting material. The wires 9 and 10 are sealed into the closed end of the tube section 2. The cathode structure is carried by tube 14 of glass or a suitable insulating material.

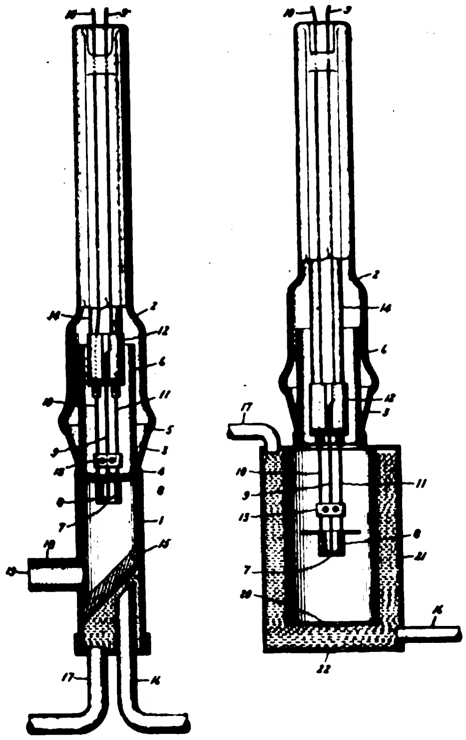
An anode plate or target 15 is applied within the metal end 1. It consists of tungsten or other suitable refractory metal. The target is cooled by water, air or other suitable cooling fluid circulating through a chamber back of the anode into the wall of which are sealed tubes 16 and 17 for supplying and withdrawing the cooling fluid. Opposite the anode is a tube 18 closed with a window 19 of thin metal, glass or other material relatively transparent to X-rays.

The tube is exhausted of gas to a pressure so low that the conduction of electricity can occur between the cathode and anode across the vacuous space independent of positive gas ionization.

During the exhausting process, traces of oxids which are apt to give off gas during the operation of the tube may be removed by introducing hydrogen gas, heating the walls of the tube externally and then re-exhausting to the required low pressure, say, below .05 of a micron of mercury pressure.

To place the tube in operation the cathode 7 is heated to incandescence by passage of current and a source of current of suitable voltage is connected at its negative terminal to the cathode and at its positive terminal to the anode housing 1 with which the target plate 15 is in electrical contact. The electrons emitted by the cathode travel under the influence of the electrical field to the anode where X-rays are produced by their impact. The cathode rays are focused by the electrostatic field of the ring 8 to strike a spot of limited area on the target. Some of the X-rays are permitted to leave the tube through the window 19 so as to be available for use.

The tube shown in figure 2 is similar to that in figure 1 with the exception of the anode construction. The cathode rays strike an anode plate 20 consisting of thin metal such as platinum or silver where X-rays are generated which pass through the cooling fluid contained in an outer housing 21 and out through a window 22 which may consist of thin metal, for example, aluminum. If the plates 20 and 21



Figures 1 and 2—Coolidge electron discharge device

are made very thin, some of the cathode rays will pass through the same and will be emitted from the tube so as to be available for therapeutic or other purposes.

Suggestions for the Experimenters' World

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

WHAT RESTRICTIONS SHOULD BE IMPOSED UPON AMATEUR TRANSMITTING SETS IN RESPECT TO POWER INPUT AND WAVE LENGTH?

Limit your manuscript to 800 words.

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.

L. W., Seattle, Wash.:

Ques.—(1) Referring to the book "Vacuum Tubes in Wireless Communication" which of the two circuits give the best results—figure 69 on page 103 or figure 80 on page 119?

Ans.—(1) These circuits are practically identical. The only difference is that figure 69 has a sensitizing circuit, L-6, C-6. Identical results are obtained from direct or inductive coupling, but as you well understand it is less difficult to adjust the coupling in a two circuit tuner than in a two slide coil. You are also aware that the coupling in figure 80 may be adjusted in the following manner—the sliding contact in the lower end of coil L-1 is moved towards the earth lead and sufficient inductance is added at L-2 with the other contact attached to the antenna until actual resonance is secured. The coupling can thus be gradually reduced to any desired value. From the standpoint of simplicity, figure 80 is recommended.

Ques.—(2) Would it be of any value to substitute variometers for inductances L-4 and L-5, figure 69?

Ans.—(2) If variometers were employed they would have to be of unusual dimensions, for these coils, if of the single layer type for the reception of long wave lengths, are from 24 to 30 inches in length and 4½ to 6 inches in diameter wound with No. 30 or No. 32 wire. The necessary closeness of adjustment for resonance can be secured by condenser C-2 for the plate circuit and C-1 for the grid circuit.

Ques.—(3) Would the addition of an audio frequency transformer in the secondary circuit, figure 69, be of any value in receiving damped waves?

Ans.—(3) Your query is not thoroughly understood. We do not know whether you refer to an audio frequency regenerative transformer or whether you propose to attach an audio frequency transformer in the plate circuit of the valve for cascade amplification.

Ques.—(4) Can such a circuit as figure 69 discloses be operated with two or three valves in cascade? If so, please give diagram and state capacities of condensers and size of inductances.

Ans.—(4) There are sufficient diagrams in this text-book to cover every possible requirement, and if you will study carefully the text, you will be able to devise a diagram entirely satisfactory for your use. An audio frequency cascade amplifier could be connected in the telephone circuit of this valve, using iron core transformers between the plate and grid circuits of successive tubes.

Ques.—(5) Will the circuits of figures 68, 69 and 80 operate equally well with either damped or undamped oscillations?

Ans.—(5) The circuit is applicable for the reception of signals from either type of transmitter. For the reception of damped oscillations, the apparatus should be adjusted just to the verge of oscillation, but for undamped oscillations the circuit should be set to oscillate at a radio frequency slightly different from that of the incoming signal. The beat phenomenon may be employed in the reception of damped oscillations with marked amplifications of the incoming signal, but the normal note of the spark transmitter will be distorted.

* * *

K. K. K., Elizabeth City, N. C.:

Ans.—(1) The wiring diagram for the receiving set shown in your recent communication is in error at two points. The secondary loading inductance L-2 is not connected in the circuit. It is merely attached to one end of the secondary coils of the loose coupler. It is also evident that you propose to regulate the plate voltage by a series rheostat. If you will stop to think over the conditions present in this circuit, you will see that a series rheostat of an extraordinary value of resistance would be required to get the proper voltage regulation. What you require in this circuit is either a multipoint switch which will connect the cells of the circuits in groups or a shunt potentiometer of about 3,000 ohms resistance. A semi-circular piece of graphite is usually employed to act as the potentiometer. In all other respects the diagram is correct, but for the reception of undamped waves you should have a certain amount of coupling between coils L-2 and L-3.

* * *

T. B., Freehold, N. J.:

Questions 1 and 2 in your recent communication are fully answered in the text-book "How to Conduct a Radio Club," on sale by the Wireless Press, Inc., 25 Elm Street, New York City.

Your third query in respect to providing means for varying the frequency of a "howler": The natural frequency of such a circuit is largely governed by the dimensions of the diaphragm. The frequency can be changed somewhat by adjusting the spacing between the magnets and the diaphragm or by proper design of the associated circuits. If you will send us a diagram of the particular "howler" you employ, we can then supply more definite data.

* * *

A. S., East Watertown, Mass.:

A number of diagrams have appeared in past issues of the WIRELESS AGE covering combination apparatus suitable for the reception of damped and undamped oscillations.

The natural wave length of the 125 foot aerial you propose to erect, after the ban is lifted, will have a natural wave length in excess of 200 meters. The flat top portion should not be more than 100 feet in length.

* * *

A gentleman who forgot to sign his name and address inquires:

Ques.—(1) Explain in simple terms, the construction and functioning of ampere hour meter.

Ans.—(1) A detailed explanation appears on pages 72 and 73 of "Practical Wireless Telegraphy" and no more simple explanation can be given. It is nothing more than a small motor which rotates in one direction as the storage battery discharges and the opposite direction as it charges. The motor is geared so that the scale indications are proportional to the ampere-hours of current flowing.

Ques.—(2) On page 187 of "Practical Wireless Telegraphy" it says that as a proper diagram for the government operator's examination figure 209 added to figure 207 will be satisfactory. Explain just how the connections are made.

Ans.—(2) You should have no difficulty in working out details of this diagram yourself. You will observe in figure 209, 8 connections for the volt meter. The terminals 3 and 4, for example, marked "battery unit A," should be connected across the terminals at battery A in figure 207 and so on with the remaining connections. In the Government examination you do not need to show the motor generator with automatic starter indicated in figure 207, but the terminals 5 and 6 in figure 207 should be connected to the "110 volts, DC" connections in the upper left hand corner of figure 111, page 98, of "Practical Wireless Telegraphy."

Ques.—(3) What is the function of the shunt condenser of the secondary receiving transformer?

Ans.—(3) The function of this condenser is to adjust the secondary or closed oscillation circuit to resonance with the incoming signal. By properly adjusting the inductance and capacity for a given wave length, the damping of the secondary circuit is thereby changed, permitting an adjustment favorable to the maximum strength of the signals.

When the coupling between the primary and secondary circuits is relatively loose, marked selectivity can be secured by the use of fairly large values of secondary capacity, but with loose coupling, smaller values of capacity will give the loudest signals.

Ques.—(4) What apparatus do you advise for the detection of undamped waves?

Ans.—(4) The best results are undoubtedly secured with the vacuum tube circuits, known otherwise as the self-heterodyne or "Autodyne." These circuits are completely described in the text-book "Practical Wireless Telegraphy" and "Vacuum Tubes in Wireless Communication."

Ques.—(5) I desire to join the N. W. A. To whom shall I apply?

Ans.—(5) Place your application with Headquarters at 25 Elm Street, New York City.

Electrical Digest

Reconstruction After the War

IF we have correctly sensed the attitude of our contemporary The Electrical Review, there will be no room after the war for the industrial leader with pessimistic ideas. An inevitable readjustment of industrial affairs must follow, but if we believe that unsurmountable chaotic conditions will prevail, we are following a line of argument that will lead into just the condition which is to be avoided.

Business men must make an extraordinary effort to maintain a mental poise during this period. They should not be over optimistic or over pessimistic. Such well-known men as Otto Kahn, the great New York banker, believes that although "the immediate sequence of the ending of the war is bound to be an interval of confusion and readjustment, during which certain industries will be favorably or unfavorably affected, at the completion of the process there should be for a few years at least an immensity of opportunity and a corresponding prosperity producing activity such as even this country has rarely experienced."

We are urged to recognize and respect the demands of the new day, which is a day of progress and social justice and of the searching and testing for the right.

In a recent editorial, the Electrical Review urges that Congress should take up a definitely charged body with the numerous problems involved and the drafting of the most practical solutions thereof. One of the conditions on which a satisfactory solution is based, is the establishment of goodwill between employers and employes.

The Review states editorially:

"Relations between employers and employes must be determined on the basis of mutual fair play and enlightened goodwill; there must be an adjustment of occupations to care for the returning of soldiers and at the same time accord adequate recognition of female labor in our industries; there must be a readjustment of tariff schedules to guard against an influx of hoarded goods from present enemy countries; the thousands of plants now busily engaged in the production of munitions of war must be adapted or readapted to their normal or newly developed peaceful pursuits. These are just a few of the hundreds of equally insistent questions that must be considered and on which the future permanent prosperity of this country must depend.

In approaching the problems of the reconstruction period we should not be carried away by optimistic hopes that they will not be of great importance or will somehow automatically solve themselves. Preparedness for post-war conditions is as important as for war. Nor must we work at cross purposes. We must co-ordinate our efforts as we now are doing, in order that we may achieve the greatest good for the greatest number. This evidently calls for a definite program of action on broad national lines and it is to lay down the groundwork for this that a national reconstruction commission is desirable.

The details of any national program must, however, be worked out by the industries themselves and in this connection the task of the electrical industry is a stupendous one.

The Naval Psychiatric Unit

ARE you temperamentally or otherwise unfit to become a wireless expert? Possibly so, but if uncertain on this point, you will soon ascertain your standing after joining the Naval radio school at Great Lakes, Ill., for they have inaugurated a Psychiatric Unit, the sole purpose of which is to determine the education, mental alertness and all-around qualifications of their students.

The examinations are under the supervision of Chief Yeoman Johnson and his specially trained staff of assistants, who give their students a thorough drilling on such general subjects as, reading, writing, arithmetic, ability to take dictation, the translation of their notes into long-hand, and such other general questions as seem applicable to a well-balanced radiotelegraphic expert. Of course, the primary object of the test is to eliminate men who apparently could not progress rapidly enough for the requirements of the government service.

The examinations of the Unit were evidently of great value, for it was found, after a sufficient number of cases had been investigated to determine fully the accuracy of the Psychiatric tests, that 95 per cent. of the men examined either progressed or failed in accordance with their previous judgment. Quoting a recent article in the school publication Radio Sparks:

"It was found that in practically all cases where the men were examined the men themselves were satisfied with the finding of the psychiatric unit and fully agreed to the transfer if it was suggested. In a few cases, however, individuals insisted that they were able to learn radio and requested that they be allowed to continue for a sufficient length of time to determine whether or not they could make satisfactory progress. In a number of these special cases the men actually did make good, but the great majority of them finally agreed with the examiner that they were not fitted for radio work.

"When it is evident that a man is not fitted for radio work, the psychiatric unit takes special pains to determine in what branch of the service the man belongs, and arrangements were made with the various departments needing specially qualified men, to transfer to them such men as seemed especially fitted for work in their department. This gave such good results that in quite a number of instances the heads of these departments informed the officer in charge of the Radio School that the Radio School was able to select better men for their departments than they were themselves, and this feature also added considerably to the good feeling existing among the men assigned to duty in the Radio School. They were thus assured of what is commonly called a 'square deal' and took the examination fairly and even enthusiastically."

Close to 25 per cent. of the men assigned to duty at this radio school are in this manner eliminated, the tests showing that they were inapt for radio work.

In fact, the success obtained at this training school has in no small measure been credited to the correct selection of the personnel by the Psychiatric Unit.

A similar procedure has been employed by the Marconi Institute for some years past. The students being queried on such general questions as "How far is the sun from the earth?" "What is the average time to take a train trip from New York to San Francisco?" "Name the seasons of the year in the zone in which your school is located and the approximate dates of their beginning and ending."

This test is followed by simple questions in arithmetic—division, decimal fractions and such other arithmetical problems as were deemed necessary to insure the students' progress. Such tests show to the student how little he retains in mind of the actual and fundamental facts of matters pertaining to every day occurrences and to say the least, they tend to sharpen his wits.

Our good wishes go forward to the Psychiatric Unit of Great Lakes for they undoubtedly have performed a great work for the government.

Book Reviews

Aero Engines, Magnetos and Carburetors. By Lieut. Harold Pollard. Cloth binding, 4½x5¾ inches, 84 pages. Macmillan. Price $1.00 net.

Those to whom the mere mention of the various parts of a gasoline engine are bewildering may learn from this little pocket volume what they are and how they function. While the book does not reach the proportions of a technical work on aero engines, it will serve adequately to introduce the subject in a reader's spare hour. In every sense it is a text for a beginner; easily understandable explanations of the general considerations are adequately illustrated by thirty-one diagrams.

Obtainable through the Book Dept., THE WIRELESS AGE.

Aeroplane Construction and Operation. By John B. Rathbun. Cloth binding, 5¼x8 inches, 415 pages. Stanton & Van Vliet. Price $2.00 net.

A compromise between the layman's books and highly technical airplane treatise has been arrived at in the preparation of this volume. Its principal feature is the text on calculations for surface, power and weight, although the aerodynamic principles and construction details are given considerable attention and are well illustrated. The volume follows the usual textbook form, first defining and classifying airplane types, applying aerodynamic principles to wing sections, discussing construction of these in detail and considering quite exhaustively fuselage and chassis construction. The factors of weight, balance and stability and head resistance are valued and power calculations made. A chapter is devoted to operation and training methods followed by a brief one on the characteristics of aeronautic motors.

Those who have had some technical education and are interested in the engineering phases of aviation will find the book of value. The trained mechanic and future designer are adequately served on the subjects of wing and body structure, and the author's expressed hope that "the book will serve to inspire the technical reader to deeper interest and practical research" in aeronautics should be fully realized.

Obtainable through the Book Dept., THE WIRELESS AGE.

Aeroplane Construction and Assembly. By J. T. King and N. W. Leslie. Cloth binding, ox9¼ inches, 115 pages. Dunwoody Institute.

As its title implies, this book specializes in airplane rigging. The Curtiss machine is used to explain the principles of assembly and alignment, and is progressively considered from the time it arrives in a packing case until the running gear, wing and control surfaces have been assembled, attached, adjusted and aligned. The required inspection and preparation of engine and propeller prior to flight is then detailed and cautions and instructions for general inspection given. Materials and functions of the various structural parts are considered in detail and a final chapter co-relates the individual rigging problems by a concise explanation of the theory of flight.

As a means to a practical understanding of the work of the aviation mechanic concerned with the airplane structure's erection and assembly, the book is assured a distinct place in aviation literature.

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Practical Flying. By Flight-Commander W. G. McMinnies, R.N. Cloth binding, 5½x8¾ inches, 246 pages. Doran. Price $1.50 net.

As the three volumes just reviewed are concerned with the mechanics' problems in aviation, this book is almost entirely designed for the aviator. The practical considerations of flight is the author's subject, beginning with qualifications and causes of engine trouble, preliminary to a chapter on the governing principles which make for success during the first lesson in the air. Solo flights and the use of the instruments are then described, completing the preliminary stage. Map reading, preparation and airmanship in cross-country flying, successively follow. Advanced flying is then considered in many aspects: high altitude, acrobacy and air navigation at night being the principal divisions. A chapter on growth of confidence, from both instructor's and pupil's viewpoints concludes with a supplementary discussion of medical aspects and provision of suitable clothing. An appendix carries a glossary of terms and condensed hints for flying efficiency through elementary and advanced stages.

Sound advice and valuable hints on personal flying efficiency both for the beginner and the flier still under instruction but in more advanced stages are contained in generous profusion throughout the pages. Careful reading of the volume will undoubtedly improve the airmanship of nine out of ten pilots and certainly will enable the beginner to avoid the mistakes commonly made.

Obtainable through the Book Dept., The Wireless Age.

The Shipbuilders' Blue Book. By Walter Kay Crawford. Cloth binding, 4x6 inches, 79 pages. Ocean Pub. Co. Price $1.50 net.

The definite announcements of the colossal shipbuilding program to be continued by the United States, adds special interest to this book. The men who are to engage in this industry have little to guide them on the assembly of the various steel plates of which a ship is constructed, and it is to the definition and explanation of the work of the shipfitter that this handbook is devoted. The special rules and requirements of this planning and assembly work are given, the problems of riveting and the approved methods are shown, the basic principles of ship construction being graphically presented by twenty drawings and simplified supporting text. It condenses the thirty years of Mr. Crawford's experience as a shipbuilder and, as information from a thoroughly practical man, will find a ready welcome among those who will engage in the construction of the new American merchant marine.

Obtainable through the Book Dept., The Wireless Age.

Mahan on Naval Warfare. Edited by Allan Westcott, Ph.D. Cloth binding, 5½x8 inches, 372 pages. Little, Brown. Price $2.00 net.

One does not attempt to gild the lily by saying anything in praise of the works on naval warfare of Rear Admiral Alfred T. Mahan; his writings are not only standard on the subject, but the leading expressions in that difficult field. It but remains, then, to note on the present edition that the editor, an instructor at the U. S. Naval Academy, has accomplished to entire satisfaction the concentration in one book of the basic opinions of the world's authority on sea power and naval strategy. Mr. Westcott has not condensed; he has selected from the many Mahan writings the best that value the influence of sea power, define the principles of naval warfare and apply the lessons of the past to the present and future. Thus the compact volume brings to the seafaring man a book easily termed indispensable to a full understanding of his task of assisting in safeguarding the shores of his country and his function on the wide reaches of the sea.

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Winning and Wearing Shoulder Straps. By Lieut. Col. Charles F. Martin. Cloth binding, 4½x5½ inches, 105 pages. Macmillan. Price $1.00 net.

Colonel Martin's little book is a study of the art of command, responsibilities of the army officer, the required efficiency and the psychology of leadership. The advice throughout is sound, and it is of a character that is perhaps best termed advisory. The heart-to-heart talk style of presentation give each point emphasized a "sticking" quality that may serve an officer through many trials long after the source of the knowledge is forgotten. To men still abroad who have the guidance of troops on irksome police duty its direct psychological analysis of the soldier should prove invaluable; and to the many officers who will return to civilian life but still remain on the reserve list, it will concrete experiences and analyze any errors in administration the source of which may not yet be clear.

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Do's and Don'ts for New Soldiers. By Major Harlow Brooks. Cloth binding, 4½x5½ inches, 83 pages. Macmillan. Price $1.00 net.

Another handy pocket book for soldiers on duty overseas during the aftermath period is met with in Major Brooks' text. Pertinent subjects are: police duty, care of the body, what to do when sick or wounded, what to study and remember, the attitude of the soldier toward civilians and when in conquered territory, military courtesy and customs of the service.

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A General's Letters to His Son on Minor Tactics. Cloth binding, 4½x7 inches, 95 pages. Doran. Price $1.00 net.

The anonymous author of this handbook observes a fact well known to officers of the regular establishment: that many men who are in other ways excellent instructors have not the facility for constructing problems with a point. So for officers following civilian pursuits except in emergency, he has done a distinct service in his twelve problems in minor tactics; with these as a basis, proper reformation may be looked for in the method of conducting officers' schools in the militia. The problems have a new pattern, and a very useful one because of entire applicability to actual combat. Too much stress, it may well be said, has in the past been given to the maneuver type of tactical exercise. Lamentably little time has been devoted to ranging for rifle fire, the importance of which is well emphasized in this work.

To illustrate the value of the text it might be remarked that the writer of this review, a typical civilian officer, set out to solve the problems before consulting the answers, with the following result: seven were solved correctly; four solutions were partially correct; one solution was entirely wrong. Yet the author's answers were obviously correct and led the reviewer to wonder how he could have failed of 100 per cent. correct solution. The obvious reason is that the type of problem was unfamiliar, just as would be the case in at least 90 per cent. of reserve officers otherwise well qualified for leadership.

The little volume is a necessity to militia officers who take their responsibilities seriously.

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