June, 1919

20 Cents

The WIRELESS AGE

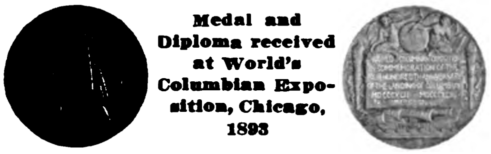
Volume 6

Number 9

Examining the Instruments Prior to an Aerial Overseas Flight

A Full Description of the Marconi Wireless Telephone for Seaplanes

BUY WAR SAVINGS STAMPS



Medal and Diploma received at World's Columbian Exposition, Chicago, 1893

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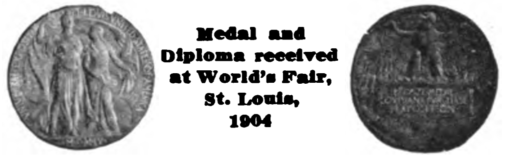

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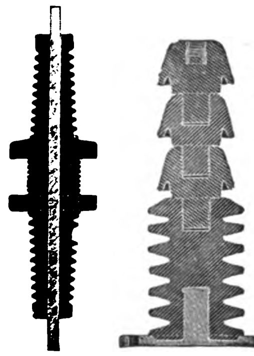

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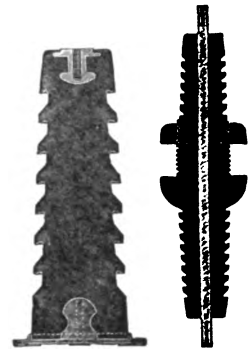

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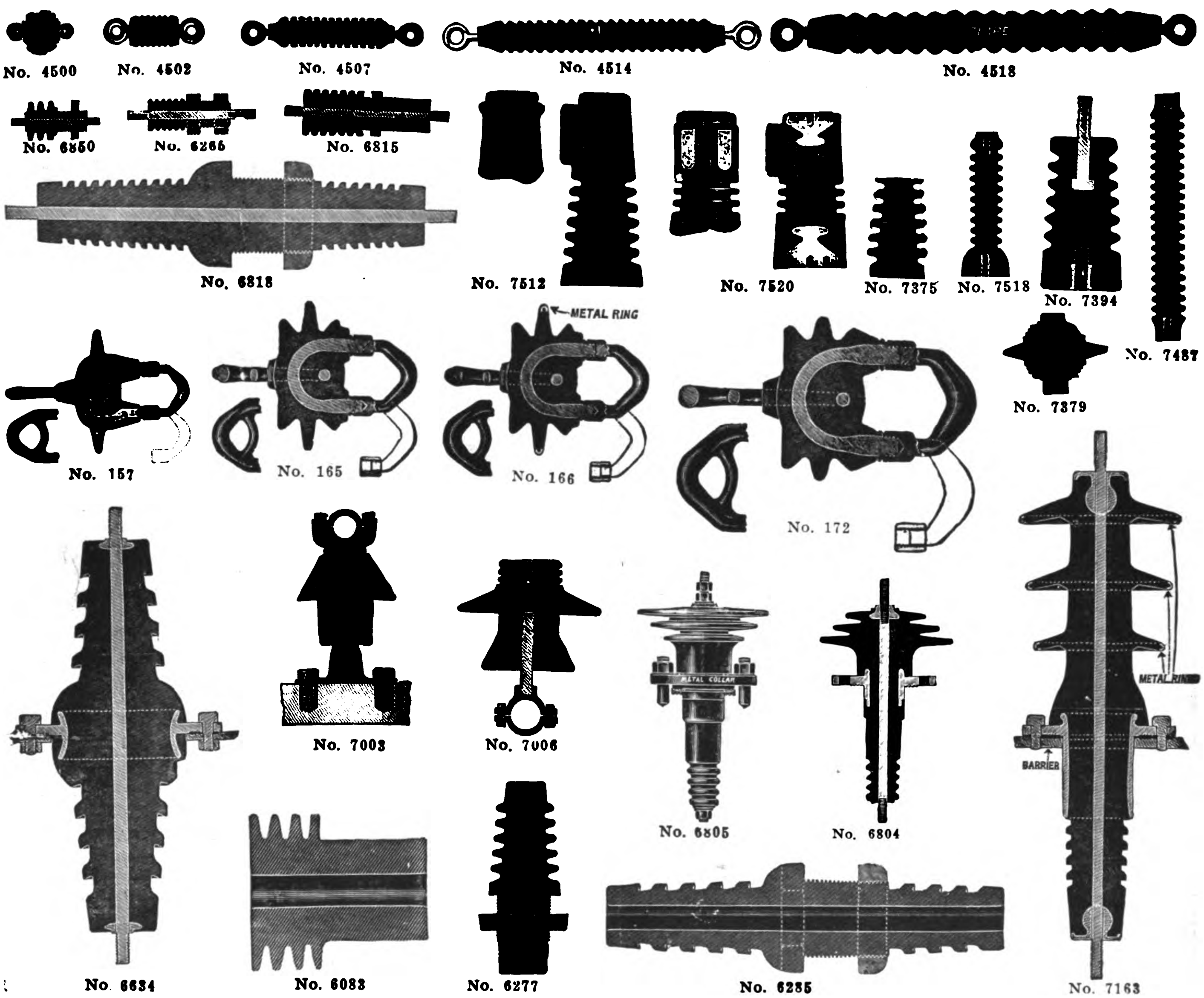

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The Wireless Age

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

Vol. 6 — No. 9

Contents for June, 1919

Index of Equipment

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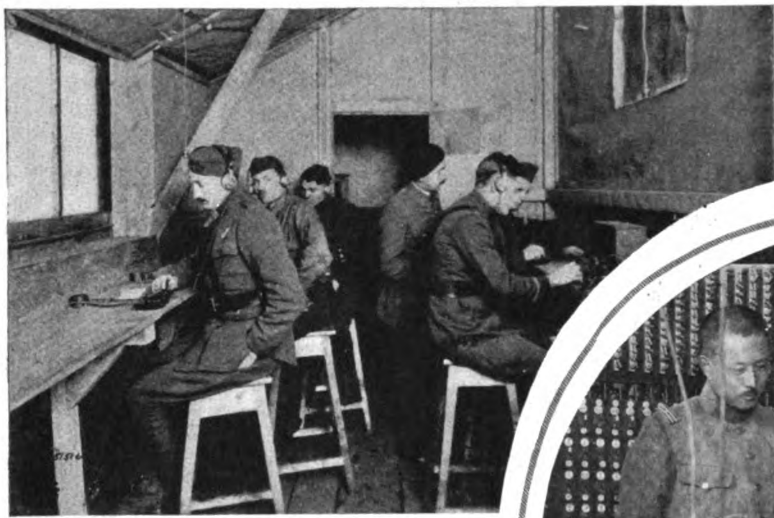
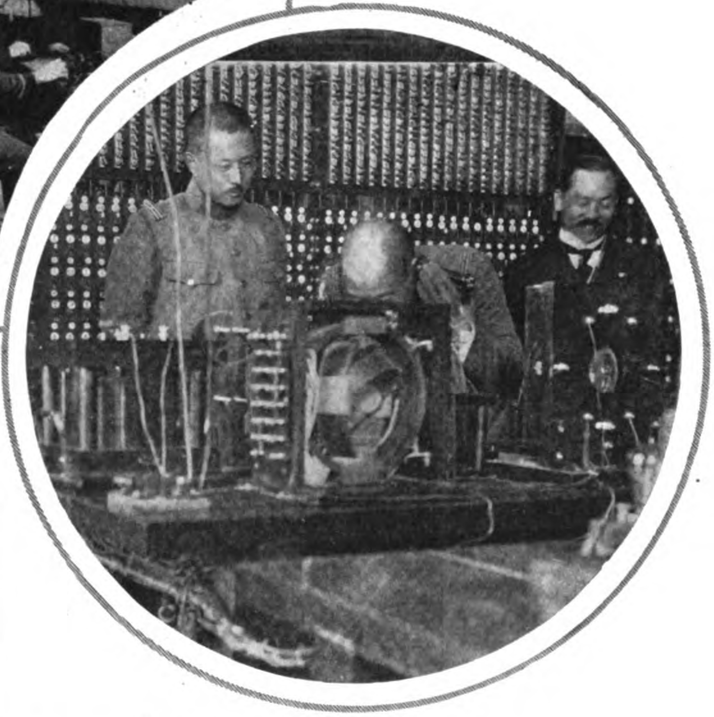


A group of observers at Le Valdahon, Doubs, France, getting in some wireless practice during spare time; novices are thus taught to send and receive, and experienced operators increase their skill

U. S. Official Photo



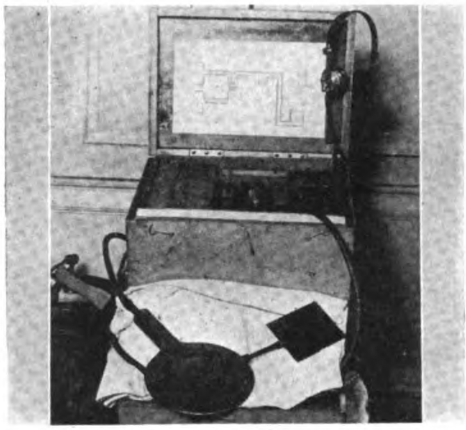
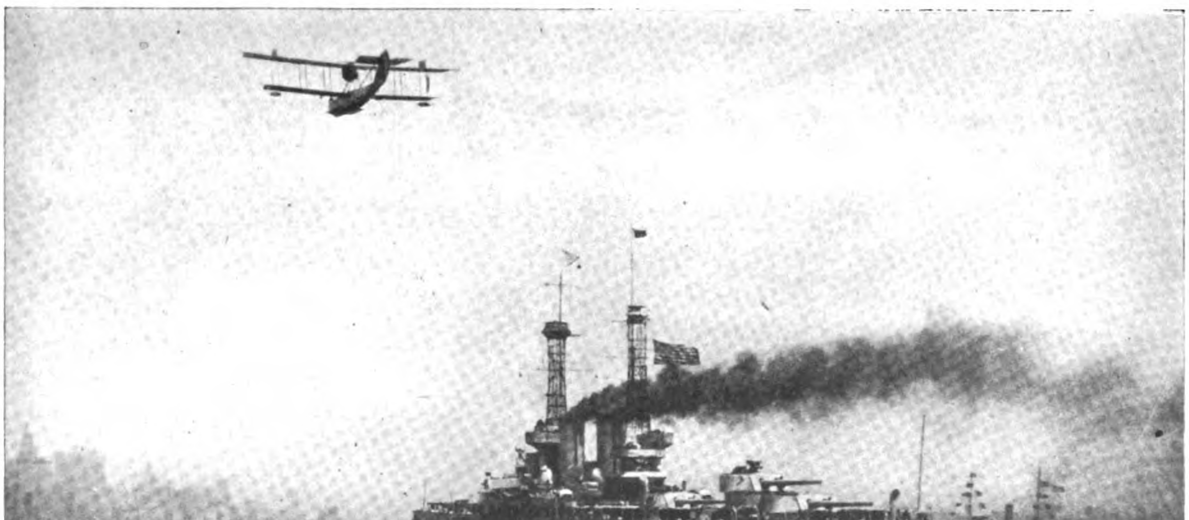


Photo: Press Ill. Svce.

In uniform, standing, in the circle above is H. I. H., Prince Kita-Shirakawa inspecting the wireless apparatus at Tokyo Central Telegraph office, as a complimentary message is being received from Guam

To the left is the hydrophone submarine detector used successfully during the war as a means of detecting the approach of enemy undersea craft



As the homecoming fleet sailed into New York an invitation from the reception committee was transmitted and the plans were approved and accepted by wireless

Photo: Press Ill. Svce.

VOL. 6. No. 9. JUNE, 1919

THE WIRELESS AGE

WORLD WIDE WIRELESS

Growing Importance of Wireless Recognized

THAT the future for wireless is great and a belief that it will play a large part in reconstruction are thoughts expressed in a recent copyrighted dispatch from London to the N. Y. Sun. According to the writer, in a discussion of wireless and reconstruction Guglielmo Marconi noted that the war had done wonders for wireless. Never have so many kindred inventions been made in so brief a period as have sprung up in connection with wireless since the war started. As indicated by the fact that a message recently was sent half around the globe, wireless will have a tremendous role to play in the days of reconstruction.

Only those who know the cost of maintaining a line of telegraph across the wastes of the desert, through the jungle, across the wilds of the tropics, can have any appreciable idea of the saving that wireless will effect.

Tornadoes, even the ants, work havoc among telegraph wires. That this evil will be largely surmounted by wireless goes without saying.

Wireless will have a far greater part to play in connection with the great aerial routes with which the continents are to be linked up.

Wireless will have opportunity to display its powers in linking up those parts of the country intersected by waterways. The money spent in laying cables, in defraying the expense of upkeep and so forth, is amazing.

One thing upon which Marconi lays stress is the part his invention will play in fostering international relationships. He is profoundly grateful for what wireless achieved in the cause of freedom during the war, just as he rejoices over the thousands of lives saved by his invention before the war, to say nothing of the many rescued during the hostilities.

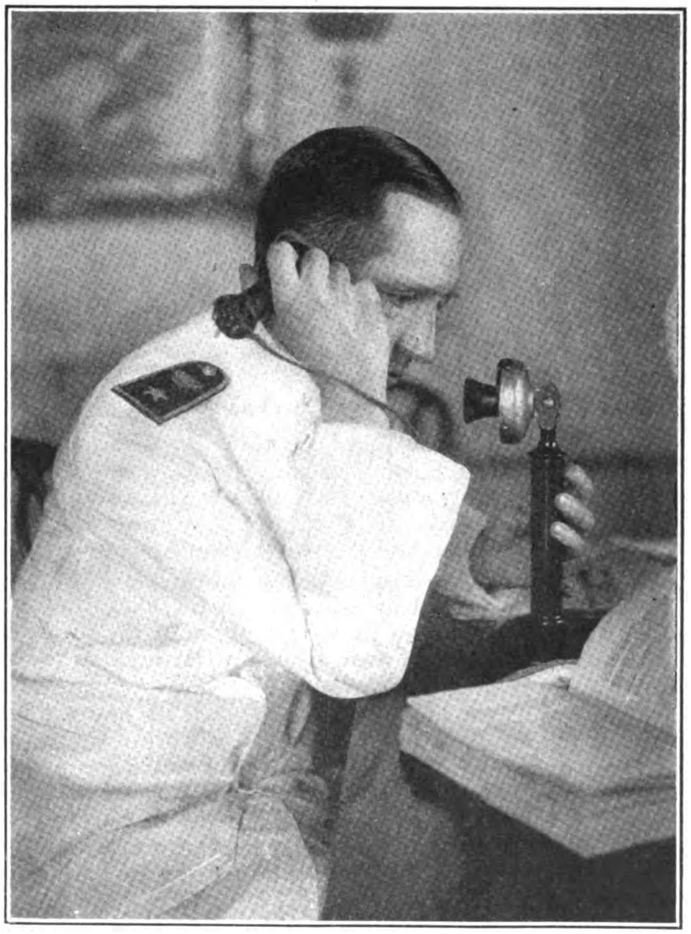
But the part it is to play during the day to be will best accentuate the utility of the invention of Marconi. Shipwreck will be a peril not half so terrible as it was till recent years. Opinions soon will be bandied about the earth in a way that seems incredible. Consultations between the world's statesmen, scientists, business heads, will constantly be in progress; the mountain ranges, the far-flung frontier line, the oceans, will be reduced into the compass of a few leagues.

The development of aircraft will be assisted by wireless in a way that baffles the imagination. Until recently an airplane or an airship enveloped in fog was more or less out of touch with the surface. Especially was this the case at sea, where many an able pilot came to a tragic end. But now lost in a cloud bank the aviator of today by wireless can be as certain of his bearings as if he were the skipper of a paddle steamer.

In the event of a great earthquake the wireless will be of even greater assistance than ever it was. In combination with aircraft, wireless would be the means of summoning assistance on such an occasion with startling promptitude.

And the same holds good in regard to railway collisions.

The telegraph has played the leading part in bringing many a criminal to justice. But an infinitely greater trap for the culprit will be the telegraphy which, independent of the innumerable restrictions of wires, can play a greater part in arresting his flight than telegraphers ever dreamed of.



Press Ill. Service

Recent portrait of Marconi, who sees great expansion in peace-time uses of wireless

German Peace Delegates Use Eiffel Tower Wireless

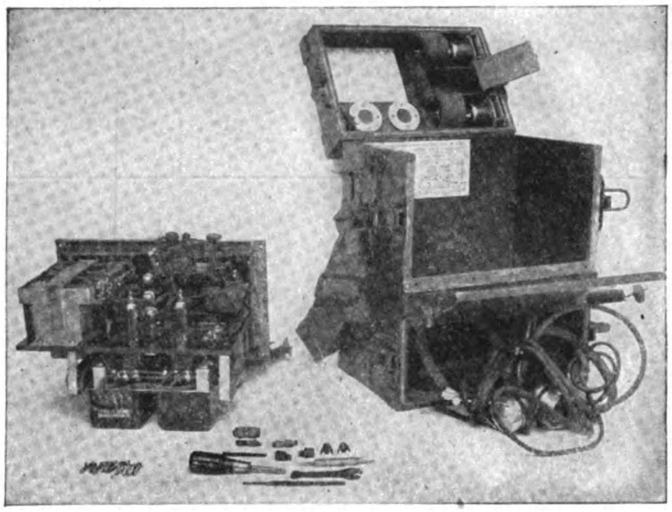
FOLLOWING the news of the presentation of the peace treaty it was stated that the high-power radio equipment in the Eiffel Tower had been reserved for the exclusive use of Count Brockdorff-Rantzau, head of the German peace delegation, at certain hours during the day. The announcement of this arrangement from Versailles added that a direct wire had been established from the Hotel Des Reservoirs to the famous French long-distance station.

International Commission to Distribute Radio Information for Aerial Navigation

THE proposed convention regarding international aerial navigation has been completed by the judicial and military sub-committees of the Aeronautic Commission of the Peace Conference, on which Brig.-Gen. Benjamin D. Foulois, Major Pollock and Capt. Bacon represent the United States.

The convention is composed of forty-one articles, which establish an international agreement on sovereignty of the air, provide for the concession of inoffensive voyages between the contracting states and deal with forbidden zones and also international aerial routes.

An international commission on aerial navigation is to be formed. Its duty will be the gathering and disseminating of radio-telegraphic, meteorological and medical information affecting aerial travel.



Ground telegraph transmitting and receiving apparatus

Voices By Radiophone Urge Purchase of Victory Notes

FROM an airplane flying 2,600 feet overhead an army officer read President Wilson's Victory Liberty Loan message to 15,000 persons assembled at the south steps of the Treasury, in Washington, by the use of the wireless telephone and a newly invented sound amplifier.

The throng of Government employees, dismissed for the capital's opening demonstration for the loan, cheered the President's message as spoken through the air and enunciated distinctly to them by Lieut. H. E. Metcalf, a radio officer in the airplane.

The "sound amplifier," was also given its first public demonstration in Victory Way, in New York.

The external evidences of the instrument were sound distributors, resembling phonograph horns in shape, suspended from wires over the heads of the crowds. The voice of a speaker given in at the central transmitter is amplified and carried with equal force to each of the sound distributors in the system.

Used in conjunction with the wireless telephone, sound was brought from a city wireless station and then reproduced over the overhead wires. Voices and phonograph and piano music were recorded.

Franklin D. Roosevelt, Assistant Secretary of the Navy, was one of those who spoke; his words were received by wireless telephone from Washington.

Visitors also had the official naval time transmitted to them every quarter hour in the same manner as the navy wireless station at Arlington flashes the correct time to ships at sea. Other features included the transmission of a soldier quartet singing at Camp Upton.

Overhead the big navy dirigible C-4 from the Rockaway station sent down a telephone message to the crowd to "buy Victory notes."

Wireless Warning Saved Leviathan from Floating Mine

THAT the transport Leviathan, biggest ship afloat, carrying 14,000 persons including troops, crew and civilians, came within ten yards of striking a mine on her way from Brest became known when the ship docked at Hoboken.

A wireless from the transport Mount Vernon on April 21st reported a floating mine 400 miles southeast of the Grand Banks. The Leviathan swerved southward, but at 10:30 o'clock the next morning her lookout reported a mine so close that when Lieut. Commander Harold Cunningham, the navigator, put the ship hard to port she missed the mine by only thirty feet.

Naval Academy's Electrical Head Takes Charge of French Station

CAPTAIN A. St. Clair Smith, U. S. N., has been ordered from the Naval Academy at Annapolis to take command of the Lafayette Radio station conducted by the U. S. Navy at Croix d'Hins, near Bordeaux, France.

The station, which is nearly completed, has eight towers, each 850 feet in height. The control of the Croix d'Hins station, it is understood, ultimately will pass to France.

Captain Smith has headed the Department of Electrical Engineering and Physics at the academy for two and a half years.

Croix de Guerre for Brooklyn Wireless Man

FOR maintaining his wireless station in the midst of the famous "million dollar barrage," Private Edgar T. Smith, of Brooklyn, has been awarded the Croix de Guerre. Smith was a wireless operator on a New York-Havana liner prior to enlisting May 4, 1917. He was assigned to the Signal Corps as an instructor in wireless signaling at Camp Upton. When the big drive started September 27, Private Smith was in charge of a wireless detail in the second line trenches of the Argonne. Six men were holding a station that invited shelling through the German's use of instruments locating wireless stations. As soon as the drive started and the wireless orders began snapping from the station the detail was located.

German guns were trained on the dugout where the detail was stationed and after a few close shots a direct hit knocked it to bits. Instead of going back the detail moved a half kilometer forward. Private Smith with three men established another station closer to the enemy guns. The other two men went out for food and Smith operated the station for 24 hours alone.

On February 27, at Ballou, the 37th Division, the Ohio National Guard, of which Smith was then a member, was reviewed and presentations of decorations made. With a kiss on each cheek he was given the Croix de Guerre for "distinguished bravery."

Smith was twice gassed and once wounded with shrapnel. He fought in the Vosges, St. Mihiel, Meuse-Argonne and other sectors.

British Admiralty Removes Ship Radio Restrictions

ACCORDING to an announcement from the British Admiralty all restrictions on the use of wireless telegraphy on ships were removed on May 1st except in the North Sea, the English Channel east of the line joining Dungeness and Boulogne, in Baltic Northern Russia, in the waters of the Mediterranean, Black Sea, and Sea of Marmora.

Directional Effect of Radio Useful in Trans-Atlantic Aircraft Flight

PROFESSOR W. I. SLICHTER, of Columbia University, is the author of an interesting article which appeared recently in the New York World, dealing with one of the many cases where the development work in preparation for war may be put to permanent use in the arts of peace.

In transoceanic flight a difficulty will be encountered in that it is impossible to take an observation of the sun from an airplane, as is the universal custom among mariners in order to determine their position at sea. The reason for this difficulty is the mariner measures the angle between the sun and the horizon to determine his position, and the horizon is a definite thing to one located within a few feet of the level of the sea. But to an observer in an airplane the horizon changes with every change in altitude, and in order to make a careful calculation the observer would have to know his height above the sea very accurately and then make very complicated calculations.

That is why radio engineers are so interested in the problem of transoceanic flight; because they have a scheme by which the aviator may determine his position at any time of the day or night, in fog and cloudy weather as well as sunshine. In this it has an advantage over the present practice of the mariner.

To assist the transoceanic flyer it is necessary to have two or three powerful land radio stations, such as at Washington, D. C., Newfoundland, Ireland and France, send out signals of a definite strength at definite intervals, say once an hour. The operator in the airplane could by means of the well known directional effect of the radio direction finder determine the direction of any two of these stations and thus locate himself on the map by finding the intersection of two lines drawn in the proper direction from the two land stations. Two stations are all that are necessary theoretically, but as the plane might be travelling on the straight line connecting them, he would not always be able to tell his distance from his objective without a third.

It is to be hoped that in the two transatlantic flights about to be attempted in the very near future by an English aviator in one direction and an American navy aviator in the eastwardly direction this scheme will be tried. It is still in doubt, as radio engineers have not as yet attempted to reach great distances to airplanes.

Patent Claim Is Basis for Injunction Against Alien Property Custodian

THE General Transmission Company, a New Jersey concern has brought suit in the equity courts to enjoin the Alien Property Custodian and the Secretary of the Navy from paying any money to the Atlantic Communication Company and the New York Patents Exploitation Corporation on account of the use of certain wireless apparatus by the government, the patent on which is said to belong to the General Transmission Company. An accounting is asked for.

Hammond Wireless-Controlled Torpedo to Have Final Test

IT is announced from Washington that Colonel Robert S. Abernathy, a field artillery officer has been ordered to Boston as official representative of Secretary Baker, in connection with preparations for final tests of the wireless-controlled torpedo invented by John Hays Hammond, Jr., which Congress has authorized the War Department to take over if it fulfills expectations.

Selection of Site Made for Dutch Wireless Station

THE site for the wireless station intended for communication between the Netherlands and the Dutch East Indies has finally been decided. The selection made is the Koelberg hill, which is 86 meters high and located in Hoog-Buurlo, near Apeldoorn.

A new railway line will be constructed from Kaatwyk. The station is to have four towers, each 210 meters high, a large power house and building for housing the operatives. The communicating station in India is to be built near Bandoeng in the Preanger, so that the distance between the two stations will be some 11,000 kilometers.

Int'l Film Service
The "Magnavox"—meaning great voice—a device for amplifying wireless telephone speech

Engineers Believe Commercial Radio Telephony Offers No Complications

THE belief that radio telephony will be established commercially as a complement to the wire systems by means of which remote and inaccessible points may be reached, was expressed in a paper prepared by E. B. Craft and E. H. Colpitts of the Western Electric Company, and read at the convention of the American Institute of Electrical Engineers.

The paper described the work accomplished in the development of wireless telephony in the war, and called attention to its advantages and disadvantages as compared with the wire system. One of the principal advantages is that the wireless system would require neither fixed nor accessible channels, and no cost at all for line construction and maintenance.

"It is easy to see," the paper said, "that radio telephony could never compete with wire telephony in densely populated districts, while wire telephony is a physical impossibility at sea and in the air. Connection of a wire system to a radio system is no more complicated than connecting wire lines and therefore these two fields, although distinct, are adjacent."

Harvard Naval Radio School Comes to an End

THE naval radio school established at Harvard University during the war has been closed and the personnel and equipment transferred to the school at the Great Lakes naval training station.

Orders have been published detaching Commander David A. Weaver from duty at the Harvard school and assigning him to the Great Lakes station.

Wireless Service to West Indies Opened

THE Naval Communication Service has opened commercial traffic between St. Thomas, St. Croix, San Juan, Santo Domingo and Port-au-Prince and the United States via the Naval Radio Station at Guantanamo and cable from Guantanamo to the United States. Traffic will be accepted in the United States for West Indian points.

Direction Finder Locates Ship with Great Accuracy

ONE of the best records yet made by radio direction finding stations on the Atlantic coast was hung up by the Hog Island and Cape Henry stations on April 7th when they located the battleship Virginia, inbound with returning troops, several hundred miles off the coast, their estimate being within ¼ mile of the ship's actual position.

According to the navigating officer of the Virginia the big battleship was plowing along through a dense fog, and no bearings had been taken for some time. Then the radio began to click and Cape Henry's position was located. A few minutes later Hog Island broke in and its direction was noted. Then a line drawn on a chart from Hog Island until it met a similar line drawn from Cape Henry pointed to the ship's location. Bearings taken a few minutes later proved the radio had come within a mile of the Virginia's actual position.

The officers of the Virginia, who have had considerable experience with the radio finding plants on the European side were amazed at the accuracy with which Cape Henry and Hog Island located the big transport.

Scene of Early Morse Experiments Now Has Wireless

WITH the installation of powerful U. S. wireless equipment at San Juan for transoceanic service, Porto Ricans are recalling that the electric telegraph had its first tryout in Porto Rico. Morse, the inventor, conducted many of his experiments at Cuatro Calles, in Arroyo. The terminals of his experimental line were the house he occupied and a warehouse in the same village.

Signal Corps Calls for Radio Men

THE Signal Corps, U. S. Army, is urgently in need of radio operators, according to the statement issued simultaneously from various recruiting headquarters. Cable and telegraph operators, telephone and telegraph line men, pigeon fanciers, and a number of other specialists are also required. The men are needed for Alaska, Philippine Islands, Panama, Hawaii, and for service in the United States.

All Canadian Amateur Restrictions Removed

FROM Ottawa, Canada, on May 5th came the long awaited news that the war-time regulations canceling all licenses issued for the operation of amateur wireless stations throughout the Dominion, have been rescinded. This decree frees experimental stations which have been inoperative for more than four and a half years.

Full Scope of German War Plotters' Radio Work Exposed

FRANCIS P. GARVAN, recently appointed Custodian of Enemy Alien Property to succeed A. Mitchell Palmer, designated by President Wilson for United States Attorney General, has made public the latter's report on the work of the office since America entered the war.

Of the wireless seizures, the report says:

It must have been apparent to the Germans that communication with America would be cut upon England's entry into the war, unless some means independent of cable or ship was established.

The war plotters found in a transatlantic wireless station the sole means of overcoming the British control of the seas and of maintaining their touch with America, and from 1910 to 1914 there were begun and completed two high-powered wireless plants, one at Sayville, L. I., and the other at Tuckerton, N. J.

Investigation of the wireless field disclosed that the Telefunken system had been installed on German shipping and on our own coastwise fleets, and had been operating with great success in conjunction with the Sayville plant. German stations had been installed in Cuba, Mexico, Central and South America. A high-powered plant had been erected at Togu, Africa, and China and Dutch East Indies and also the Pacific Islands had been sprinkled with Telefunken ship-to-shore stations.

An American appearance had been given to Telefunken in America by the organization of the Atlantic Communication Company and the naming of a directorate of American citizens. The technical work, however, and the disbursement of moneys were in the hands of German agents. Telefunken engineers came over to install the plant and operate it.

Despite the immediate cutting of the German cables and despite Great Britain's vast preponderance on the sea, Germany was able, while a ship floated, to keep in touch with it, and was able to begin at once the effort to influence American opinion.

Navy Offers Training Course to Experienced Men

AN unusual opportunity is offered by the Navy Department at the radio school in Cambridge, Mass., to men between the ages of eighteen and twenty-five years, who have some knowledge of radio work and who are able to send or receive ten words a minute. Applicants for this course must pass a creditable examination in spelling and penmanship and must understand elementary arithmetic. The course covers a period of six months and the subjects taken up during the course are magnetism, static electricity, current electricity, electromagnetism, alternating current, generators and storage batteries, motors and motor control, radio power circuits, oscillatory circuits, spark transmitters, detectors, service receivers, audions, high frequency measurements, review and examination for specialization. The Navy is offering this course, including all the text books and appliances for practical training, free to young men who meet the requirements for enlistment in this school.

By an order of Rear Admiral Victor Blue of the bureau of navigation, commanding that 160 men be sent from the Atlantic fleet each week to the naval radio school at Cambridge, it is believed that the school will remain at its present location until late this summer. The school was originally scheduled for transfer to the Great Lakes station at Chicago, next April.

Those enrolled at Cambridge in the future will be regularly enlisted members of the navy and will replace operators in the reserves, now serving on United States merchant ships.

Overseas in the Marconi Service

By Gecrge H. Fischer, Jr.

Sailor take care. Sailor beware.
Many brave hearts are asleep in the deep.
So take care, take care . . .

THE little phonograph down below in the gunners' quarters squeaked away. A group on the poop were playing "acey ducey." A crap game was in full sway amidships. Nowhere could be found a less worried bunch of sailors. Most of them just couldn't take this "daw-goned" war at all seriously. Time and again they had crossed the war zone without even seeing a "sub" . . . they reckoned that submarine stuff was all exaggerated anyhow.

The author with machine gun on board the Westwego

But they didn't know they had a jinx with them this trip. A jinx that always worked two ways: brought the trouble, and escaped it, too. The jinx was me.

From the time when Uncle Sam first rolled up his sleeves and entered the war until the day Germany collapsed, I never made a trip to sea without having something happen. Even on my very first trip through the war zone as an enemy of Germany a submarine threw a scare into us. On that occasion there were no torpedoes. The arrival of another ship upon the scene was responsible for that escape.

Now I was on another ship bound for France. It was on board the old Westwego that I had stowed my bag this time. She was a great ship to carry oil; but to carry men—well the men were the last consideration. The reserve coal bunker, aft and just alongside the engine room, had been converted into gunners' quarters. The heat of the month of August was added to that of the engine; the gunner's gloryhole could scarcely be termed a comfy spot. But there never was an American crew of gobs that could stay grouchy no matter what kind of a ship they were on. The usual merchant ship crew of square heads are always grouching. If they aren't they're sick. But all was harmony on our old crab as we nosed eastward through the summer sea.

On all sides were scattered the ships of our convoy: every allied nation was represented. Our consort was H.M.S. Roxborough. Each of the twenty-four vessels in the fleet was bearing a precious cargo to France to feed the machine that was slowly but surely overpowering the Hun. On the other side of the sea were a few hundred submarines. We had no illusions about their manifests; their cargo was a death-dealing one, to be used in an effort to cut off the ever increasing stream of supplies flowing to France. We knew the record. Sinking non-fighting ships without a moment's notice. Murdering crews in cold blood.

As we neared the war zone, radio warnings came in ever increasing numbers. I found an old chart of the North Atlantic and on it recorded the various submarine "position reports" as they were received. On the fourth day of September we were steering due east. Wireless reports received during the night had all been put down on the chart, each sub indicated by a dot. These dots now formed a semicircle, into the very centre of which we were headed. Land's End called the cruiser with a code message that afternoon, and an hour later we were headed west. This maneuver had us all puzzled, and only those on the cruiser knew the truth of the situation.

At noon the next day we once more headed east, and this time we were accompanied by eight large British destroyers which had came up at daybreak from the south'ard.

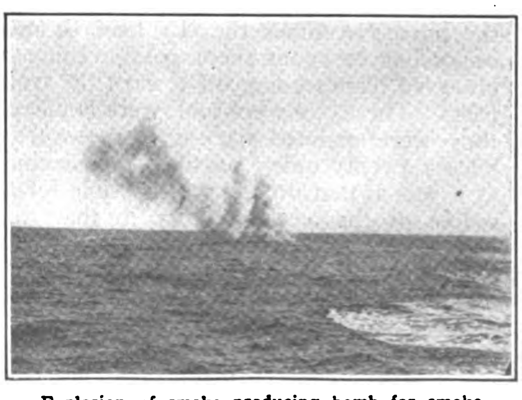
It was wonderful weather for a sea trip. The sea was dead calm and the air not too warm. The afternoon dragged away. The phonograph squeaked worse than ever, for the same needle was still doing duty. Eight bells of the afternoon watch clanked, and died away.

Suddenly, a dull boom sounded from across the water. The cruiser fired an answering shot. Then came a great explosion which shook the whole vessel. We were torpedoed! No; we were safe; it was the ship right off our quarter; the torpedo had passed under our stern.

"General Quarters!" The gunners crowded on the gun platforms eager for a shot at the attacking submarines. A periscope came up for a moment right astern, but our guns were silent; they could not be fired because of the risk of the shell ricochetting and striking a T.N.T. ship which was right behind us. Those of the crew not on watch crowded to the boats and made ready to let go. I was in the radio room and could see only aft, but what I saw was enough to occupy my entire attention. A tanker, the Messina I believe, had been hit in the forward section and was sinking very fast. The torpedo had torn away half her bow; she rose to a vertical position with her propeller churning the air; poised for an instant and then plunged beneath the waves. . . . Two little boats were left bobbing on the surface; many little black

Gun crew at drill. Machine gun in foreground

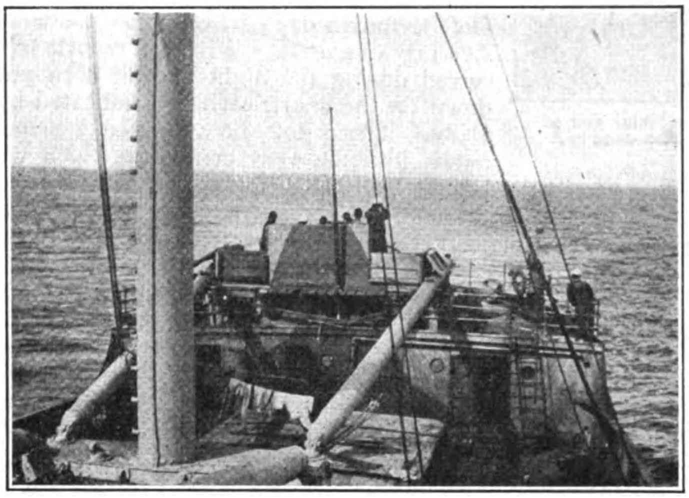
3-inch gun mounted on poop deck



Explosion of smoke producing bomb for smoke screen specks scattered about reminded us that all had not had time to get to the boats. The very smallness of the struggling forms made the great expanse of water seem greater.

Off to the left was another sinking tanker. She was going down by the stern, not so quickly as the Messina. A destroyer dashed past us, headed for a spot of oil on the surface. Three "ashcans" went over her side. The first and second of these depth bombs brought up great columns of water, but the third must have struck home for the water came up black with oil and wreckage.

The official report said there had been six submarines in the attacking force, the first to make a massed attack. There was no confusion. I still do not know positively how many ships were sunk, but there wasn't a very great number in the fleet that proceeded up the channel. We sat up all through the night and drank coffee; it was lukewarm in the cups, but coffee in any form was acceptable to men from whose faces had faded the "I should worry" expression. In its place had appeared the tense fixedness of grim determination to square accounts with Fritz at the first opportunity.



Camouflaged gun platform and crew firing at target

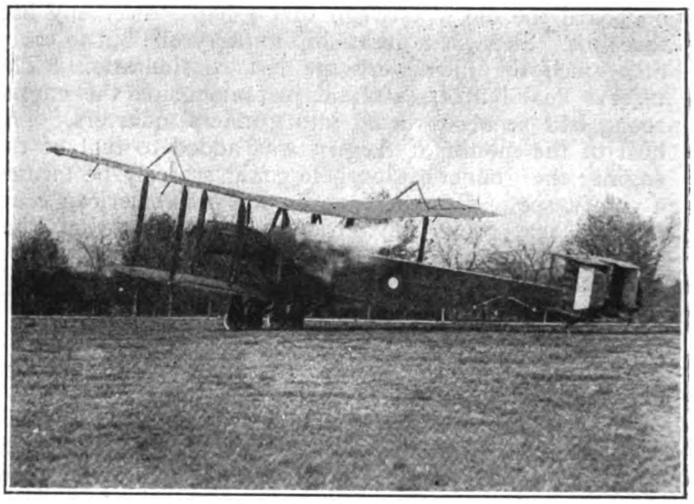
We arrived at Dunkerque, France, two days later, after a short stop-over at Folkstone. Events on our trip across had impressed us with a hatred for the Boche; but that which followed seared that hatred into our souls.

Dunkerque, the one time third port of France, we found a busy military centre. Its devastation lacked the completeness of towns further up the line, but ruined buildings everywhere reminded one that a war was being waged close by. There were two aviation bases at Dunkerque, one French and one English. Our cargo, fuel for the airplanes, was greatly needed. Aerial activity had been unusually great during the past week and frequent raids were taking place. I will endeavor to describe for you one of these raids as it appeared to a merchant mariner.

All day long airplanes had been going and coming from the north; at times the sky held so many that it was impossible to count them. As evening approached, we observed planes going off toward the front lines in small fleets. These, we were told, were bombers. Great giants they were, painted dark grey. As we were approximately twenty miles, possibly less, behind the battle line as it was at that time, it was possible for us to see considerable of the aerial activity in that direction. Along about five o'clock in the afternoon we noticed that a fleet of planes which had left Dunkerque shortly before was being shot at from the German side. Little white puffs of smoke were bursting all about them. Soon the aircraft became mere specks in the sky and we had to use glasses to follow them. Another group of specks—Germans—were seen to be mounting into the sky. In a few moments both groups met and an aerial battle was in progress. It was too far distant to be observed distinctly, but we felt the thrill of each daring maneuver and silently applauded each burst of machine gun fire.

Orders came for us to move. An air raid was expected and there was too much danger of the Westwego being blown up by a bomb from overhead. We were taken out for the night to an anchorage about a mile below the lighthouse. Near by were anchored two British monster monitors, just returned from bombarding the German positions on the Belgian coast. As luck would have it, part of our crew were on liberty and had been left ashore.

The night was mild and the sea dead calm. I was aft, taking an after supper prom on the poop, when we were startled by a dull "kerump!"—the queer and very distinctive sound an aerial torpedo makes when it explodes. We rushed to the other side of the ship and found the show in progress. Searchlight rays were sweeping back and forth across the skies like blades of grass waving in the breeze. Every few seconds there would be a red flash from the ground and the "kerump" which followed told that another bomb had reached its mark. The Germans were by now over the main section of the city and they began dropping flares. These flares were attached to parachutes and gave a very powerful illumination of 400,000 candlepower held suspended in the air, lighting the ground beneath to a circular area more than a mile in diameter. While the flares made it possible for the Hun fliers to observe the activities on the ground and ascertain the location of the important buildings, they also made it more difficult for the anti-aircraft gunners to locate them, as they flew above the lighted area. A barrage was put up all about the city by having the anti-aircraft guns fire shells into the air which were timed to burst at various heights. Each line of guns having a shell bursting at a greater height than the other before it, the air became filled with bursting shrapnel, thus forcing the Boche machines to a greater height than was favorable for their operations.



As evening approached we observed planes going off toward the front lines

Anyone who has ever heard a German airplane motor will be sure to remember its queer tone. It has a regular beat or throb to it instead of the purr that the allied engines have. A Canadian lieutenant at Dunkerque had told me how these Hun machines sounded and I recognized the tone immediately. Louder and louder came the "hum-ahum-ahum" till it was directly over our heads. All the lights aboard were out; we stood there in the darkness and gazed up and cursed. It is almost impossible to express the baffled feeling of rage when you are placed in a position where the enemy can fire on you and

Lights sprung up in the landing fields and the planes which had gone forth to give battle to the raiders came down

you can't fire back. It would have relieved the tension if we could have fired our machine gun, but unfortunately this had been stowed away on our arrival at Dunkerque.

Suddenly, the monitors to our port side began firing their anti-aircraft batteries. The shrapnel exploded with piercing crashes overhead and we ducked for cover to be out of the way of falling pieces, for the scattering fire is almost as dangerous coming down as it is going up. As we stood by, helpless and watching, I became conscious of a succession of sounds that had hitherto been meaningless. Then I realized that all during the noise, the German wireless station KBU could be plainly heard working by those amidships. The signals were audible fully eight or ten feet away from the radio cabin.

A move was made to launch a boat; then we were told to have it in readiness to lower. Our greatest danger lay from shrapnel or in a spark from a flare setting off the gasoline in our tanks. The captain appreciated this a moment later and ordered the boat back into the chocks, accompanying the order with the assurance that should the ship explode we'd need no boat to carry us into a different vicinity.

We were held in suspense through many minutes, each of which seemed hours long. The Germans swept across the city three or four times; then they passed on down the coast to Calais where they also gave a short performance, and returned to us. Machine guns and anti-aircrafts reopened fire, evidently without success. But a red glow had broken out over the northern section of the city, indicating that some of the bombs had taken effect.

After another hour or so the firing gradually ceased and the allied air scouts signaled with Morse lights that all was clear. Lights sprung up in the landing fields and the planes which had gone to give battle to the raiders came down.

I sat out on deck till near morning. All along the front the artillery was active. We could see the flashes and hear the booming of the big guns "up the line" as they pounded away all night. . . .

The next day the communique read: "All quiet on the western front."

Aircraft Maker to Have Wireless Equipped Automobile

WHEN it comes to the matter of equipment it is probable that Glenn Martin's new car is going to be the most completely equipped automobile that ever turned a wheel. The airplane manufacturer recently visited the Los Angeles Stearns-Knight headquarters and gave an order for a 1919 four-cylinder Stearns to be delivered to him at his Cleveland plant.

"It's going to have practically everything that an airplane has on it, including a combination wireless telephone and telegraph outfit," Martin said. "My work is divided between the flying fields and the factory, so that it is of extreme importance to me to be in touch with both places at all times, and it will be a marked convenience as well to be in communication with the aviators in their testing work in the air.

"At present, these wireless outfits cost $2,200, but I can foresee the time when they will not cost more than $500, and will be installed as optional equipment on many high-grade cars. They have a telephonic range of thirty miles, and the simple turning of a switch converts them into a wireless telegraph outfit with a range of 300 miles.

"A red light will flash on the dash of my car when someone wants to get in communication with me, and it will only be necessary to put the receiver to my ear to get the message, if I am within thirty miles of the man who wants to talk to me.

IN THE JULY ISSUE

The concluding instalment of Weagant's invention for eliminating static.

Don't miss this most important article!

Wireless Telephone Transmitter for Seaplanes

Flying Boat Type S. E. 1100, Developed by the American Marconi Company for Navy Use During the War

MARKED progress in the perfection of airplane wireless telegraph and telephone apparatus is a direct result of exhaustive researches in radio communication which have been conducted during the past two years. Light-weight transmitters having a sending range of 150 miles or more have been developed. Spark apparatus has been employed to a considerable extent in airplane communication, but transmitters utilizing the vacuum tube oscillator have the advantage of permitting either speech transmission or telegraphic signals by damped or undamped oscillations, at the will of the operator.

Practical wireless telephone apparatus of the vacuum tube type is disclosed in the following description of the Marconi type S.E. 1100 set—a comparatively high power bulb transmitter—developed by the Marconi Wireless Telegraph Company of America.

The set was designed primarily for the large flying boats, the H-16 class, of the U. S. Navy, and has fully satisfied every test to which it has been put. In one of the earlier tests in flight over Chesapeake Bay, telegraph signals radiated from a trailing antenna on an H-16 boat were heard distinctly in Washington, D. C., over a distance of 120 nautical miles. Subsequent tests with the set used as a wireless telephone permitted the accurate transmission of speech over a distance of 150 miles. The transmitter radiates at two wave lengths, 1600 and 600 meters. For the former wave length a trailing wire antenna of .0004 mfd. is employed; for the latter, an emergency aerial of .00026 mfd.

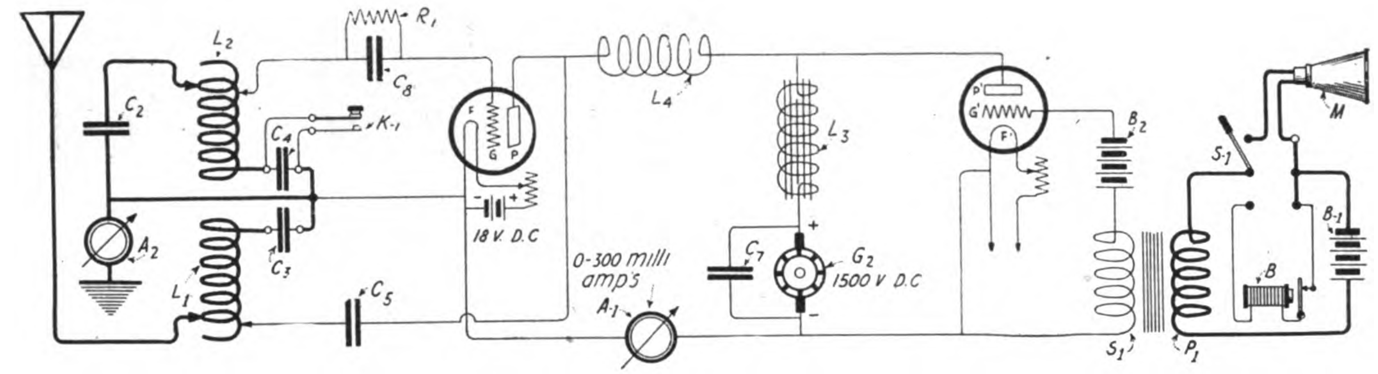


Figure 1—Fundamental circuits of the wireless telephone transmitter for seaplanes

The transmitter is supplied with two 3-electrode tubes of the pliotron type. One tube is employed as an oscillator for the production of radio frequency currents and the other as a modulator and amplifier of the voice currents communicated to it by the microphone.

The fundamental circuits of the set are shown in figure 1, the actual circuit in figure 2, a front view of the transmitter in figure 3, a rear view in figure 4, a side view in figure 5 and a wiring diagram showing the function of the change-over switches in figure 6. An installation sketch is shown in figure 7.

Description of the Circuits

For best understanding of the operation of the apparatus, it should first be appreciated that if the grid and plate circuits of a vacuum tube include radio frequency circuits coupled inductively, conductively or electrostatically, alternating currents of any desired frequency may be generated. This is the first requisite;

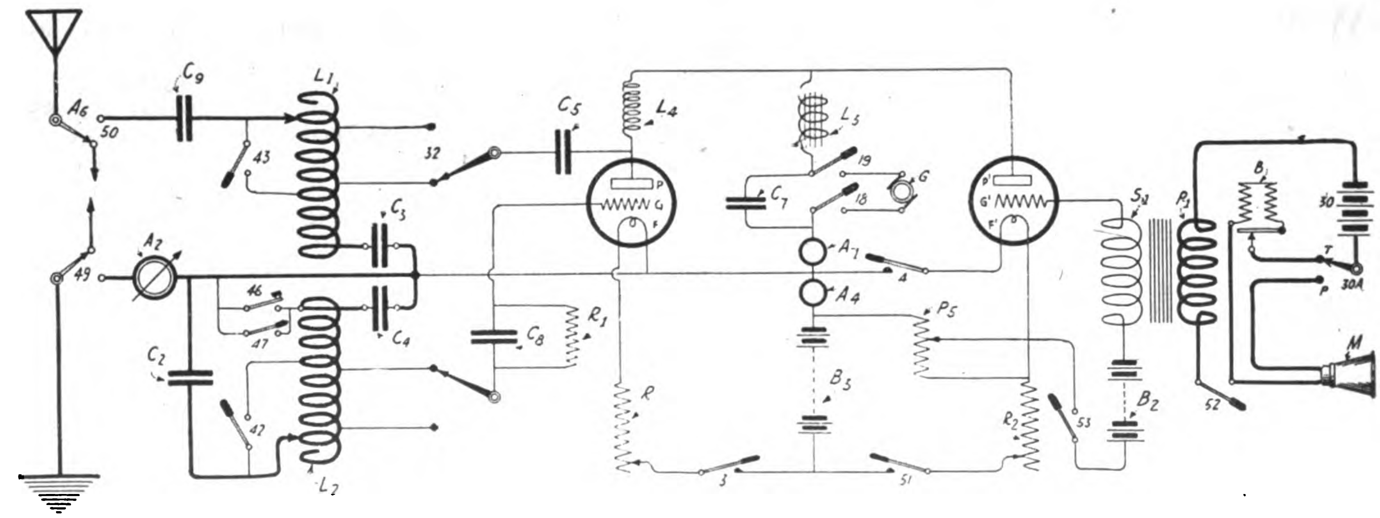


Figure 2—The actual circuit used in practice

other problems, such as rapid change of wave length, satisfactory modulation, and the elimination of disturbing capacities between circuits, arise in the practical set, and are of equal importance. They were satisfactorily solved only after diligent research.

In order to set valve circuits into a state of radio frequency oscillation, it is necessary that the connections be so made that the grid end of the grid inductance will be alternately negative and positive as the plate end of the plate inductance is positive and negative. When the grid and plate radio frequency circuits are coupled with the proper phase relation, any variation of voltage in either the grid or plate circuits will cause minute disturbances in the oscillation circuits, setting them into oscillation at whatever frequency they happen to be adjusted to. For example, a slight variation of voltage in the plate circuit by any means whatsoever, will cause its resonant circuit to oscillate at radio frequency, and the resultant currents will act upon the grid circuit, setting it into oscillation at the same frequency. The resulting radio frequency fluctuations of the grid potential will act upon the plate at the right time to keep the plate resonance circuit in a state of oscillation, and this state of affairs will continue so long as the proper supply of voltage and filament current is maintained, but not otherwise.

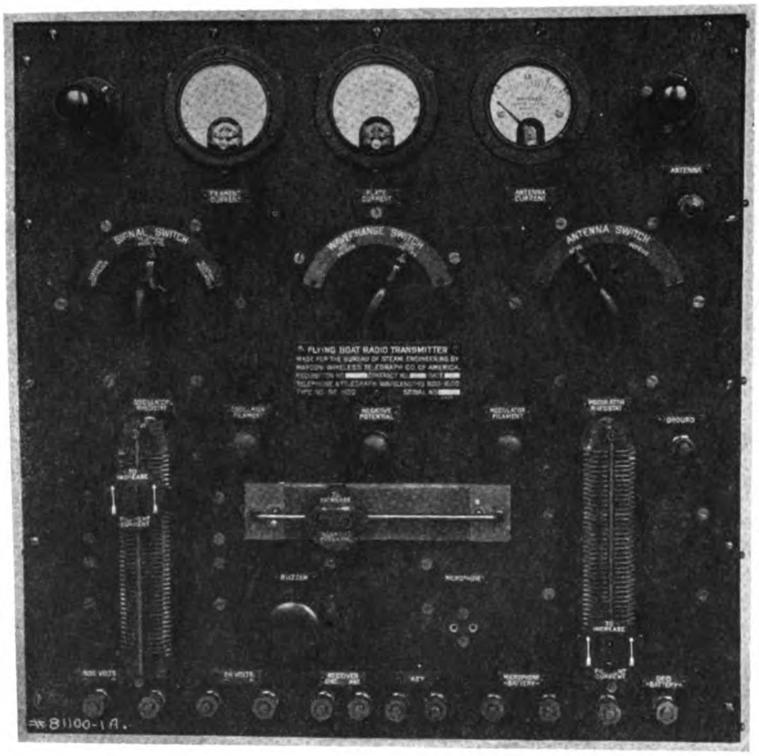


Figure 3—Front view of the Marconi wireless set, SE1100, used in flying boats

The tube is able to generate alternating currents because of its amplifying properties. The energy delivered to the grid circuit in accordance with the actions just outlined will gradually increase in value until a maximum is reached, which is the maximum output the valve is capable of delivering, as may be discerned from the well-known characteristic curve.

Referring to figure 1, it will be observed that the plate and grid circuits of the tube contain the coils L-1 and L-2, in inductive relation, each connected through the condensers C-3 and C-4 to the negative side of the filament. The grid oscillating circuit comprises the coil L-2, the condenser C-2 and a protective condenser C-4. The plate oscillating circuit includes the condenser C-3, a part of the coil L-1 and the series condenser C-5. The antenna and earth connections tapped off from the coil L-1 take the place of the condenser C-2 in the grid oscillating circuit. C-2 is called the balancing condenser. In series with the grid is another condenser C-8 shunted by a leak resistance R-1, which maintains the grid at a negative potential.

The system further includes a three electrode tube F′, G′, P′ which amplifies the output of the microphone circuit and simultaneously modulates the output currents of the oscillating bulb.

It will be noted that the plate circuit is fed by a 1500 volt DC generator G-2, the positive terminal of which connects to the plate P of the oscillating tube through the audio frequency inductance or transformer L-3 and the radio frequency inductance L-4. The negative side of the generator connects through the milli-ammeter A-1 to the negative side of the filament F. The condenser C-5 is the protective condenser which is generally employed in tube oscillating circuits when the source to the plate circuit is connected in shunt to the plate and to the filament, as is the case in this circuit. The modulating circuit shown to the right of the drawing permits either voice transmission or telegraphy by damped oscillations.

CIRCUITS FOR WIRELESS TELEPHONY

For telephony, the microphone M is placed in series with the telephone induction coil P-1, S-1, and the battery B-1, by means of the switch S-1. The coil S-1 is connected to the grid and filament of the modulating tube, and includes in its circuit the battery B-2 through which the grid is held at a suitable negative potential for maximum magnification. The filament and plate of the modulating tube are shunted across the plate circuit of the oscillating tube. The audio frequency choke L-1 may be said to act as a one to one transformer. The radio frequency choke L-4 prevents the radio frequency currents developed by the oscillator from flowing back to the plate circuit generator G. C-7 is a protective condenser for the plate circuit generator.

When the transmitter M is spoken into, speech currents of variable frequencies generated by the microphone are impressed upon the grid circuit of the modulating tube and, through the medium of the auto transformer L-3, alternating currents are superposed upon the plate circuit of the oscillator. This in turn varies the amplitude of the oscillator currents at speech frequencies, and accordingly the amplitude of the radio frequency oscillations flowing in the antenna circuit. It is essential that the key K-1 of figure 1 be closed for the production of undamped oscillations, for when it is open the tube stops oscillating. Manipulation of this key permits telegraphic signaling by the undamped oscillations produced by the tube.

TELEGRAPHY BY DAMPED OSCILLATIONS

When it is desired to telegraph by damped oscillations, the change over switch S-1 is thrown from the microphone to the buzzer B which is energized by the battery B-1. The interrupted currents fed by the buzzer through the primary P-1 of the induction coil produce alternating currents of higher voltages in the coil S-1, which in turn are magnified by the modulating tube, the latter varying the radio frequency currents in the oscillator tube at the frequency of the buzzer. In this way, the antenna radiates *damped oscillations* in groups, the frequency of the groups varying as the number of interruptions of the buzzer.

A more detailed circuit of the Marconi aircraft set appears in figure 2. This diagram not only embraces the fundamental connections of figure 1, but includes all necessary switches for the three different signaling func-

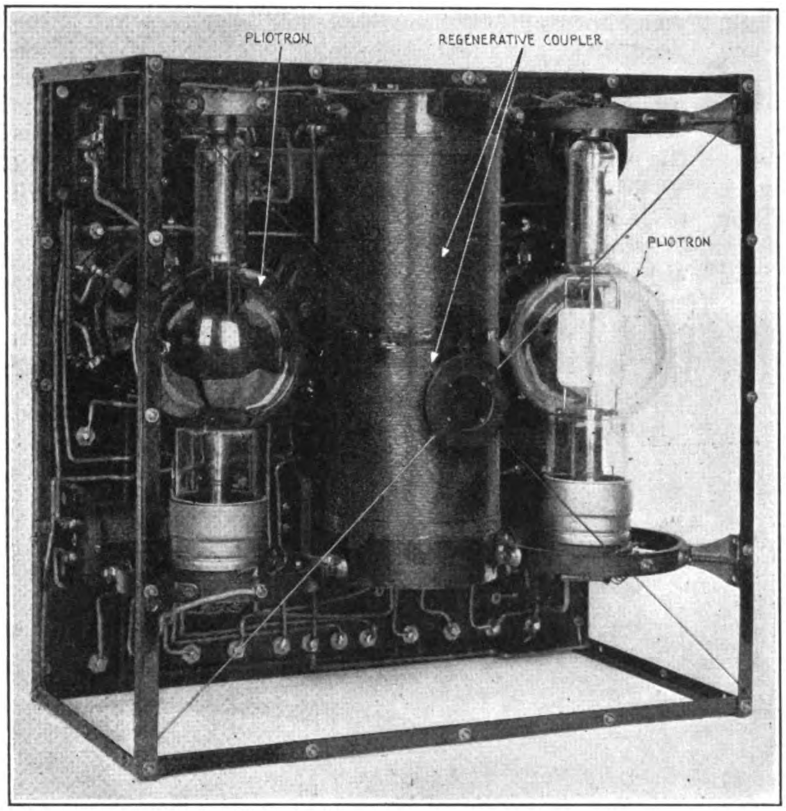


Figure 4—Rear view of the transmitting set with pliotrons in place

tions on the 600 and 1600 meter wave. It includes, moreover, a detailed wiring diagram of the filament circuits.

Details of the Filament Circuit

The filament circuit divides at the positive terminal of the 24 volt storage battery B-3, one branch going through the rheostat R-1 to the filament F of the oscillating valve, and the other going through the rheostat R-2 to the filament F′ of the modulating valve. The negative sides of the two filaments are connected together and to ground. In addition there is provided a potentiometer P-5 connected across the battery B-3 with a tap leading to the negative potential battery B-2 and on through the secondary of the microphone transformer S-1 to the grid G′.

The object of the potentiometer in figure 2 is to compensate for any loss of negative potential in the grid circuit G′, which may be occasioned by the lowering of the voltage of the filament battery B-1.

The switches for shifting the connections from one system of signaling to the other are enclosed in drums, as may be noticed in the left hand part of the photograph of figure 5. The schematic diagram of these is shown in figure 6. The inside and outside rows of jaws on each set are represented by the upper and lower group of dots in figure 6. In that figure the left hand pair constitute the *wave length changing switch,* the middle pair, the *sending and receiving switch* and the right hand pair, the *signal switch.* The first, second and third positions of each switch are indicated by the letters X, Y and Z, these letters being placed between the two points which the blades of the switch short circuit in that position.

Regarding the action of the oscillating valve itself: When the grid is negative in respect to the filament, no current passes between the grid and filament; but when it is positive, considerable current passes which constitutes a loss in the circuit; but if the grid is held at a constant negative potential this energy loss is reduced and a more effective transmitter is obtained. The grid potential may be held at a negative value by the insertion of a grid battery but it can be done in just as effective a way by inserting a condenser in the grid circuit which rectifies the grid currents and holds the grid at a negative potential.

If the leak were not provided, the potential of the grid would rise to such a high negative value that all action would be stopped. A leak of proper value definitely limits the maximum negative potential of the grid and therefore does away with the necessity for a special grid battery.

Change-Over Switches

The numbers on the separate single pole switches in figure 6 correspond with those shown in figure 2. The *outside row* of studs on the wave length changing switch perform the following functions: In the 600 meter position (X at 32 in figure 2) the first tap on the upper section of the loading coil L-1 is connected to the plate series condenser C-5, and at 43 short circuits the end portion of the same coil. In the 1600 meter position Y, it connects at 32 the second tap of the coil to the condenser and opens the short circuit.

The *inside row* of studs on the wave length changing switch performs the same functions for the coil L-2, which is the lower portion of the long single coil mounted in the middle of the rear of the panel in the accompanying photograph. In the schematic diagram, figure 6, the blade marked 35 is shown connecting to the first tap of the lower portion of the coil in the 600 meter position, and to the second tap in the 1600 meter position to the grid condenser C-8 with its leak resistance R-1. The actual wiring of the set differs slightly from this, for it was found that the same tap of the coil was correct for both wave lengths. For this reason, there are but two taps on the lower portion of the coil. The first of these is coupled

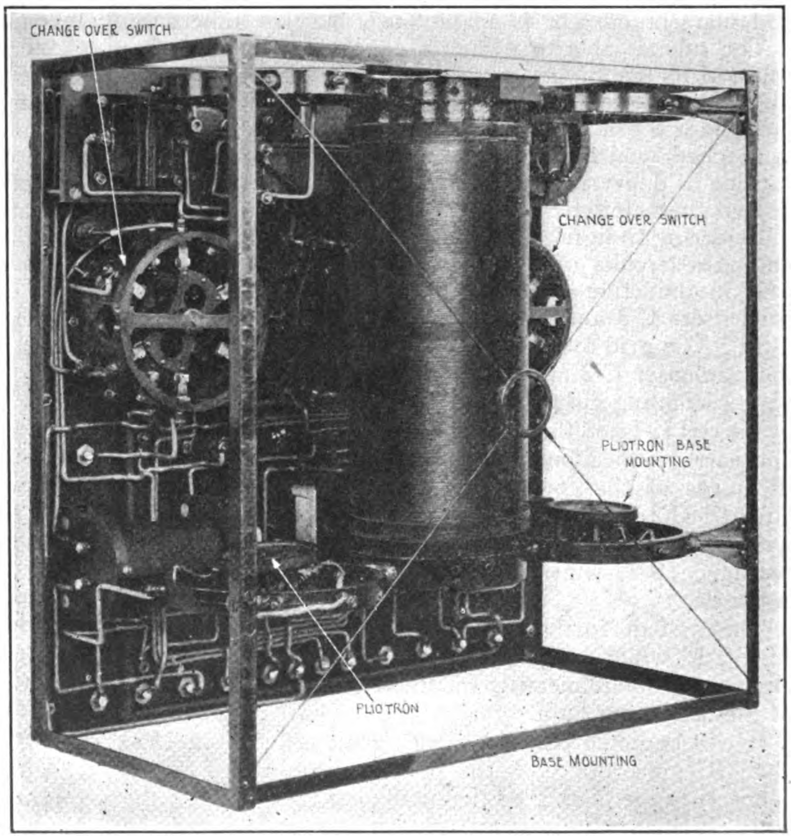


Figure 5—Rear view of Marconi flying boat wireless set with pliotrons removed

directly to the grid condenser C-8 and does not go through the wave length switch. The blade marked 42 short circuits one end of the coil L-2 in the 600 meter position and removes the short circuit in the 1,600 meter position.

The outside portion of the switch marked "send-receive" (in the right hand position of figure 3 and also in the upper central position of figure 6) serves to connect the antenna A-6 to the transmitter in the "send" position (X) and to the receiver in the "receive" position (Y). In the "send" position the circuit of the antenna at 50 is through the series condenser C-9 to the top of the loading coil L-1 and to the ground. The latter is connected at 49 through the antenna ammeter A-2 to the main ground bus of the set which is the frame.

The inside portion of the "send-receive" switch, in the lower part of figure 6, is idle in the receive position Y, but in the "send" position X at 21, it completes the 1500

METERS AND THEIR FUNCTIONS

Space and weight considerations demand the fewest possible measuring instruments. A direct current ammeter A-4 is connected in series with two filaments and reads the total current taken by both of them. The instrument's scale registers from zero to 10 amperes; to read the current in either filament it is merely necessary to cut out the other one. This may be done by means of two small switches marked on the set "oscillator filament" and "modulator filament."

The principal indicator for checking up the proper operating conditions of the set is the plate current drawn by each of the valves from the dynamotor, the voltage of which, as already mentioned, is 1500 volts. This reading is obtained from the plate current ammeter A-1 of figure 2, connected in the ground leg of the supply circuit. This instrument reads from zero to 300 milliamperes and measures the total plate current taken by the oscillator

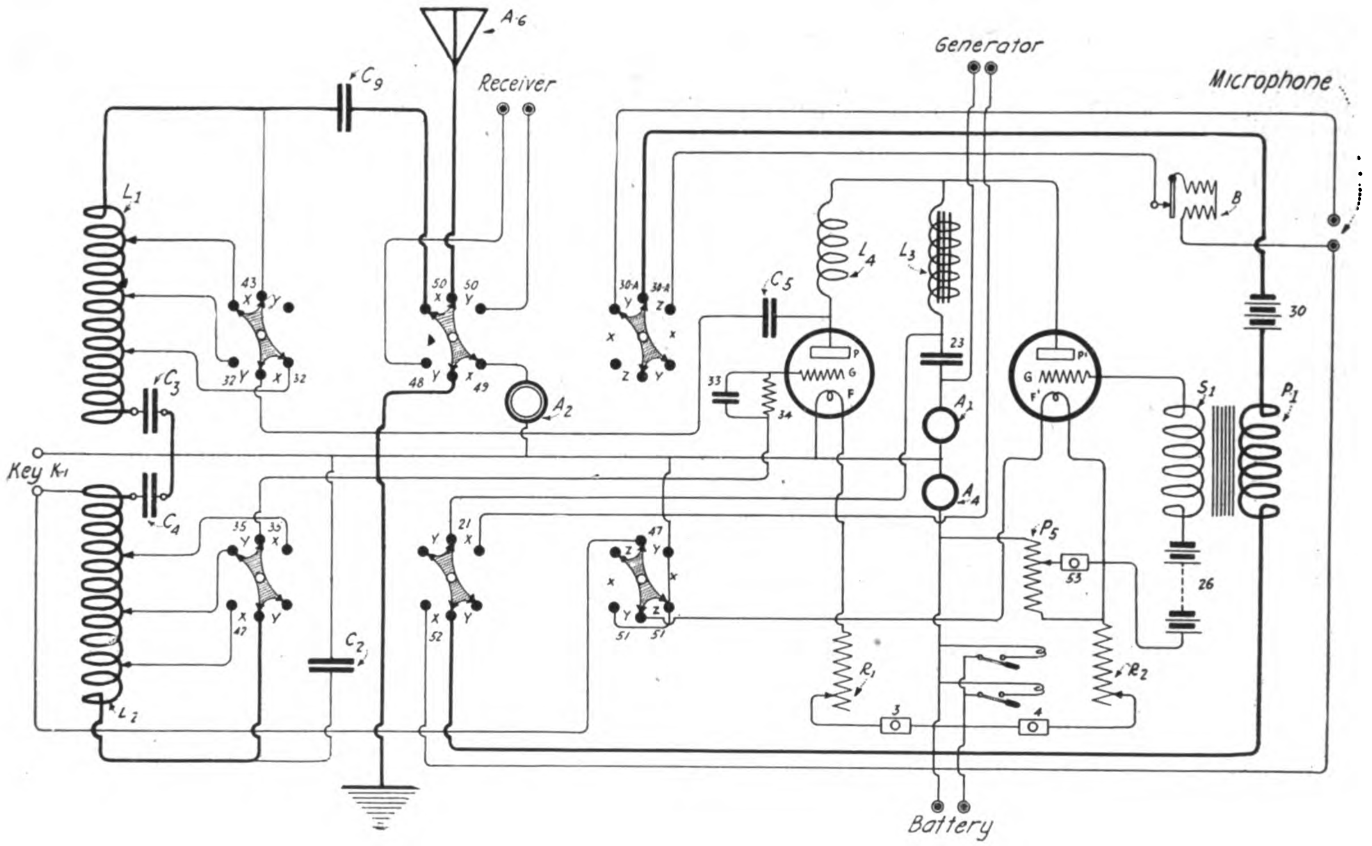


Figure 6—Wiring diagram showing the function of the change-over switches

volt DC supply current to the plates P and P-1 of the pliotrons. At 52 it connects the primary of the microphone transformer P-1 to the microphone terminals 28 and to the buzzer B. These connections are opened in the "receive" position.

There are three positions for the signal switch. The first, X, is for *continuous wave telegraphy*. In this position the connections made in the second and third positions are opened. The second position Y is for telephony; the inside portion of the switch (the upper part in figure 6) connects the microphone to the microphone battery, and at 51 the outside portion (in the lower part of figure 6) completes the filament circuit for the modulating valve and short circuits the key at 47. In the third position, the switch connects at 30 A the buzzer to the microphone battery and at 51 keeps the filament of the modulating valve lighted, removing the short circuit from the key.

The position of the switches in figure 6 does not correspond with their location on the set. All three switches are built to stand a maximum of 10,000 volts high frequency potential, although the potentials developed in the apparatus are considerably lower.

and modulator. The maximum voltage developed by the dynamotor is 1600 volts and the vacuum tube generally will cease to operate when it falls below 1100 volts. The generating tube will oscillate over a wide range of plate voltages if the filament current is kept below a certain critical value. The filaments of the pliotrons are designed to operate on 18 volts.

WIRING

The entire set is wired with No. 12 B & S bare soft copper wire with empire cloth tubing slipped over it as insulation. No terminal lugs are used; the ends of the wires are bent in the shape of an eye which fits the stud terminal and is passed around it in a direction that tends to make the wire grip the stud when the nut is tightened.

The wiring has been so located that small or disturbing capacities between the wires are avoided.

STRUCTURAL CONSIDERATIONS

Owing to the vibration of the airplane every possible precaution has been taken to prevent the fastenings working loose. Special steel lock washers are used throughout the set. The general scheme of construction is such that the main supports and fastenings will bend before they break, wood or any material which splits or fractures, having been eliminated. The steel wire cross braces shown in the photograph make the structure an extremely light and a surprisingly rigid unit.

Power Supply

The primary source of energy is two 12 volt, 50 ampere hour batteries of the Willard lead type similar to those used in automobile starters. The filaments of the two pliotrons are operated through a rheostat directly from the 24-volt storage battery. Since the tubes require a plate E.M.F. of 1,500 volts DC, a small dynamotor, driven by the 24-volt storage battery, is supplied. The armature has two windings in the same slots, one connected to the 24-volt commutator at one end, and the other to the 1,500-volt commutator at the opposite end. It is a two-pole machine excited from the 24-volt source. The armature, which runs on ball bearings at 5,000 r.p.m. and draws about 30 amperes on its full load at 450 watts, weighs approximately 30 pounds.

In addition to the 24-volt storage battery, three other batteries are required; two for the transmitter and one for the receiver. These three sets are known as the *microphone battery, grid battery* and *receiver battery.* The voltage of the first is 5; of the second 60, and of the third 40. The 60- and 40-volt sets consist of 20-volt units connected in series. They are arranged in a wooden box screwed to the operating shelf. A dilecto terminal block is supplied.

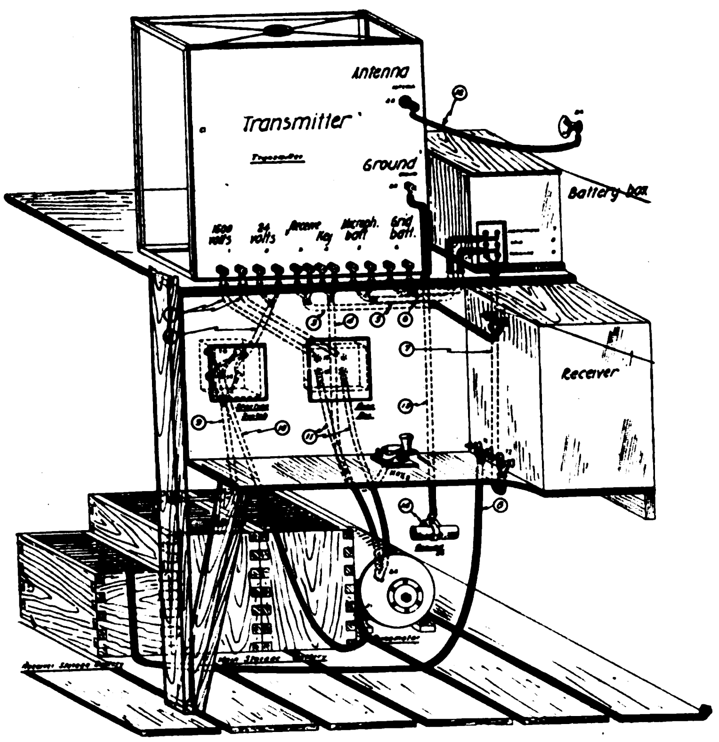


Figure 7—Sketch showing the installation of the complete set

The Support of the Pliotrons

To insure against breakage, the best position for the pliotrons is vertical with the large neck at the bottom. This brings the *plate terminal cap* at the top and the *filament and grid terminal cap* at the bottom. In each of the two dilecto rings shown at the top of the photograph, three spiral springs placed 120 degrees apart support a spring cap which fits over the plate terminal cap of the pliotrons. The springs are held by small machine screws which pass through the insulating ring. One of these serve as a terminal, being connected by a pig-tail to the spring tap. In each of the two bottom dilecto rings, three spiral springs, placed 120 degrees apart support a special jack block made to take the filament and grid terminals. This block is made in two halves, upper and lower, held together by screws; clamping these spring jacks between them, three posts, which project from the bottom of the jack block, take the ends of the three supporting springs, and are electrically connected by a copper pig-tail to the screw-eyes that hold the other end of the spring to the dilecto ring. The two filament terminals of the tube and the grid terminal are brought out to the three screws in the dilecto ring. Thus, each pliotron is supported to the rigid frame of the set by 6 springs which are set so that when the tube is in place the top springs pull down and the bottom springs pull up.

The mechanical period of vibration of the vacuum tubes in this spring mounting is considerably below that of any vibration that will occur in the seaplane itself. Sudden shocks in any but a horizontal direction are not transmitted through these springs with sufficient violence to injure the tubes.

The positions of all controlling appliances on the main panel board are clearly indicated in the photograph, figure 3. The small sub-panel is mounted immediately to the rear of the frame.

Reel Antenna and Accessories

The antenna reel group for this set consists of the reel mechanism, a removable drum with antenna wire and spare drums with complete antennae on them. The wire from the reel runs through a take-off pulley and passes through the lead-in insulator in the side of the hull of the boat. It then passes through either a strut pulley or wing pulley, depending upon the type of the boat.

Reel Mechanism

A cast aluminum plate, clamped to one of the main struts in the hull of the boat, carries a shaft on which the drum turns. On this same shaft, next to the attachment plate, there is a brake drum of cast aluminum, and around this drum a cast iron brake band. The band is sprung over the drum and prevents it from turning except when a cam which is attached to the brake lever springs it open. A pin on the brake drum engages holes in the main drum, when the latter is put on the shaft. The crank by which the main drum is turned has a square hub on which the drum sets. It is slipped onto the shaft, and latches in place. The latch is released by a latch handle just behind the arm of the crank. To remove the drum, to put a new one in place, the operator grasps the arm of the crank, and in so doing also grasps the latch handle and releases the latch. He then pulls the crank and drum off together. One drum may then be slipped off the hub of the crank and a new one put on, and the two slipped back onto the shaft.

Reel Drum and Antenna

The drum is a pressed steel spool, black japanned, and will hold about 600 feet of the standard antenna wire. It has a square hole at its center which fits the hub of the crank. The antenna wire has a ball at the reel end, and this ball is dropped through a hole in the drum face. The other end of the wire is attached to a swivel, and this in turn is attached to the "fish" or weight.

Lead-in Insulator

The lead-in insulator is a moulded "electrose" fitting, with a metal tube running through it, and a wide flare at either end, so that the wire cannot catch on the ends of the tube even if it enters at right angles. The insulator is held by lock-nuts in a hole in the side of the hull. The antenna connection from the set is brought to this insulator. When the antenna is out, the ball on the reel end of the wire rests against the inside flare of the insulator. The wire is thus entirely disconnected from the reel, and the reel is dead. When it becomes necessary to reel up, the ball is grasped, and of course brings the wire with it. The ball is passed through the take-off pulley and dropped through the hole in the drum face, and the crank is turned. The brake mechanism is arranged so that the cam may be left holding the brake off during the reeling-up process.

Figure 7 shows the position of the receiving storage battery, the main storage battery transmitter, transmitting key, receiver, and battery box.

The maximum antenna current is 2.5 amperes, with the antenna supplied with the set. This has been found to satisfy all ordinary distance requirements.

Comprehensive instructions are supplied with each set, enabling the operator to obtain the best adjustment for the three signaling positions with the greatest ease.

Uni-Directional Transmitting System

UTILIZING loop antennae, C. S. Franklin of the English Marconi Company has devised the one-way transmitting system shown diagrammatically in the accompanying figures 1 and 2.

It is common knowledge that a frame such as a rectangular circuit of wire placed in a vertical plane and in which high frequency alternating currents are induced,

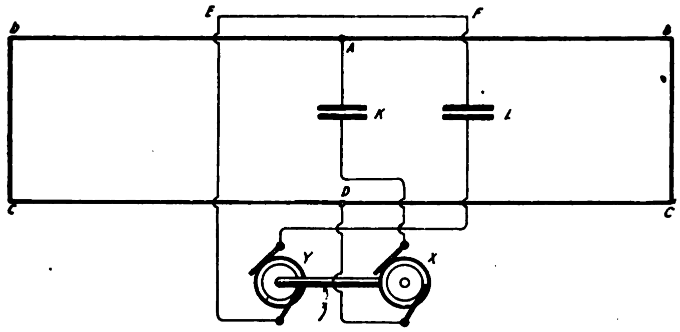


Figure 1—Circuit of the uni-directional transmitting system using two equal frames in parallel

radiates electric waves best in the two directions in the plane of the rectangle, and not at all in the two directions at right angles to this plane. The polar curve of radiation is in fact in the form of the figure 8, consisting of two equal figures which are nearly circles. The waves at any two points equidistant from and one on each side of the rectangle and in its plane are at any instant of time equal and of opposite phase.

As an illustrative example of the working of this system, two equal rectangular or frame circuits may be assumed to be erected in the same vertical plane, either so that they have one vertical edge common to both (in which case they may be considered as being in parallel), or so that they have one vertical edge of one rectangle adjacent to one vertical edge of the other, the two circuits being connected in series so that one is reversed as regards the other. Then if high frequency alternating currents are induced in the two circuits so that the currents traverse them in opposite directions, the combination will as before radiate best in the two directions in the plane of the rectangles, and not at all in the two directions at right angles. The polar curve will again be a figure of 8 made up of two similar figures which are nearly circles. In this case, however, the waves at any two points equidistant from, and one on each side of the rectangles and in their plane, are at any instant of time equal and in phase with each other.

To obtain uni-directional transmission, Mr. Franklin provides a double frame circuit in the same, or substantially the same plane with a simple frame circuit placed symmetrically with respect to the double circuit. The two circuits will have no mutual inductance or coupling effect on one another if they are properly proportioned; that is to say, alternating currents existing in one will not affect alternating currents existing in the other. Under these conditions each circuit tends to produce its own radiation independently of the other circuit.

Before proceeding further with the operating theory, a description of the diagrams will be given.

Figure 1 shows the arrangement of two equal frames in parallel, and figure 2 the arrangement of two frames in series. In figure 1, A,B,C,D, a,b,c,d are two equal rectangular aerials having the vertical side A,D common. In A,D is inserted a tuning condenser K and an oscillation generator X.

E,F,G,H is a simple rectangular aerial having a tuning condenser L and an oscillation generator Y; this aerial is erected in substantially the same plane as the double rectangular aerial and symmetrically with respect to it, so that there is no coupling between the two systems. The two oscillation generators Y and X produce oscillations of the same frequency. It is obvious that the phase of the currents in the two alternators may be varied as desired by changing their relative positions on the common driving shaft z. However, any suitable or known means may be used for producing a desired phase difference. In figure 2, A,B,C,D, a,b,c,d are two equal frames connected in series as shown.

In one direction in the plane of the system of either arrangement (provided that the relative phase of the currents in the two circuits is correct) the magnetic fields from the independent circuits are in phase and produce

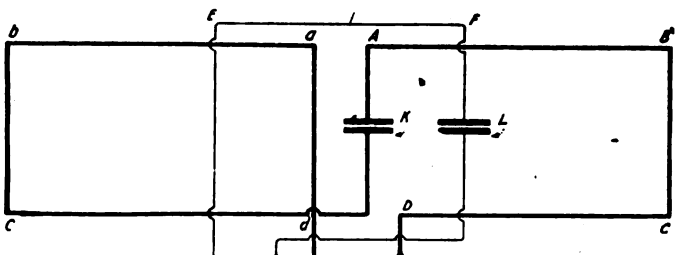


Figure 2—Circuit using two frames in series

a wave with an energy proportional to the square of their sum; while in the other direction the magnetic fields are of opposite phase and produce a wave having an energy proportional to the square of their difference.

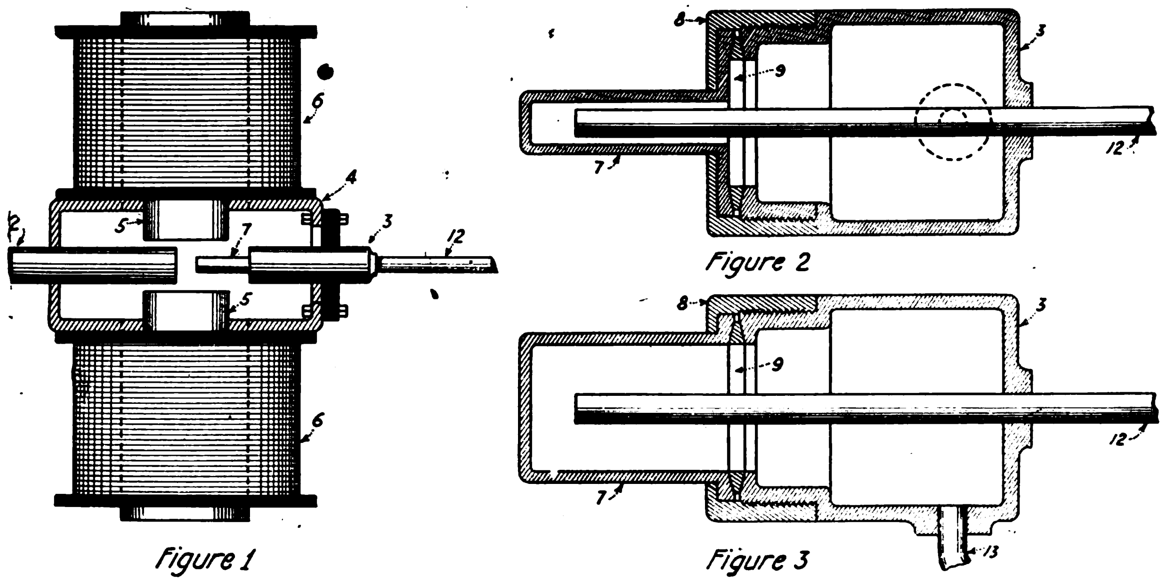
Therefore, if the currents in the two independent circuits are so adjusted that they produce waves of equal strength, the magnetic fields in one direction in their plane will produce a wave with four times the energy of the waves from either circuit separately; in the opposite direction the magnetic fields neutralize each other and no waves are produced. In order that the fields may correctly cancel on the one side, it is necessary that the two sets of oscillations have a phase difference of 90°.

In the two directions at right angles to the plane of the circuits no waves are produced. The result is that practically all the energy is radiated only on one side of the plane, through the system at right angles to its plane. On that side the polar curves of the two frames add; on the other side of the line the two curves practically neutralize each other.

In practice it is necessary to introduce condensers into the circuits which need not necessarily be rectangles, so as to tune them to the frequency employed. To obtain the best directional effects the circuits should be entirely insulated from the earth, but good directional effects may be obtained if the earth be used as part of one or both circuits.

Fuller's Arc Generator

IN the accompanying diagrams, figures 1, 2 and 3, Leonard Fuller discloses the construction of an arc gap applicable to radio telegraphy. Figure 1 is a horizontal section of the generator; figure 2 is a horizontal longitudinal section of the anode; and figure 3 a vertical longitudinal section of the anode. The carbon cathode 2 and the anode 3 are enclosed in a casing 4 so that the arc between the electrodes may be subjected to a hydrogen atmosphere. When the generator is connected in a wireless transmission system the cathode is connected to earth and the anode to the antenna. Powerful magnets are mounted at right angles to the arc to increase the efficiency of conversion. A very small potential difference exists between the magnet poles and cathode, but between the anode and the poles the potential difference is relatively high and, accordingly, in the ordinary construction there must be greater spacing at this point than between the cathode and the poles.



Drawings showing detailed construction of Fuller's arc generator for use in radio telegraphy

It is desirable for maximum flux density that the air gap between the poles be small. This gap cannot be small on account of the potential difference mentioned, unless the construction is in accordance with the drawings. Arranged on opposite sides of the casing, and having their poles 5 extending into the chamber thereby formed, are the electromagnets 6. The anode 3 is provided with a tip 7 of much less width than the cathode, so as to give the requisite spacing between the anode and poles. The anode is a hollow metallic body and the tip is made of copper, which is hollow and is of rectangular cross section. The tip is secured to the anode body by a screw cap 8, the joint between the tip and the body being sealed by a metallic gasket 9.

During the operation of the generator, the temperature of the anode becomes excessive and would rapidly fuse if it were not for a stream of water which is introduced into the anode through the conduit 12.

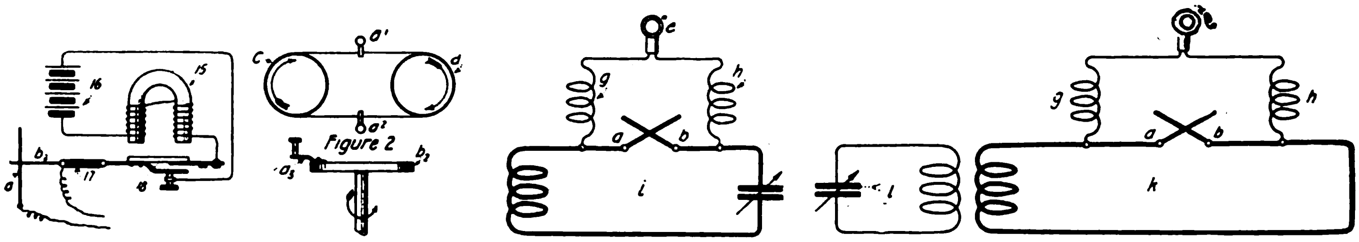
Undamped Wave Detectors

W. SCHLOEMILCH of Berlin has recently been acknowledged the inventor of several forms of the sliding wire ticker, a device which has been used experimentally and commercially for a number of years.

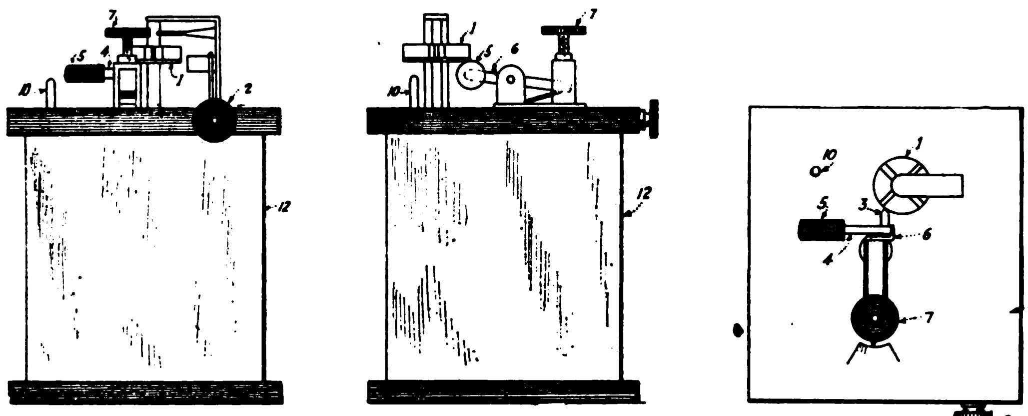
Three different embodiments of the device are shown in figures 1, 2 and 3. Figures 4 and 5 indicate the connections of these detectors in receiving circuits and figures 6, 7 and 8 are a front elevation, side elevation and top plan view, respectively, of a constructional form of the ticker. In figure 1, the silver or gold wire electrodes A and B are in contact, the resistance being changed by the vibrations of the buzzer 15 operated by the battery 16. In the particular construction shown in figure 2, the sliding contact is formed by two springs A-1 and A-2 pressing on an endless wire B-1, which is rotated by the wheels or rollers C and E. In figure 3, the stationary contact piece is an adjustable spring A-3, and the movable contact a revolving disc B-2 which can be driven by a motor.

In figure 4, the wave detector A is connected in series with an oscillatory circuit such as the secondary of the receiving transformer, choke coils G and H being provided to prevent the passage of high frequency oscillations through the telephone. In figure 5, the sliding contact detector A, B is located in an aperiodic circuit K which is coupled to the oscillation circuit I.

In the drawings, figures 6 to 8, the detector comprises the disc 1 provided with vanes which are rotated rapidly by clock-work contained in the casing 12. The point of the fine upwardly bent platinum wire 3, bears against the under side of the disc 1. To obtain maximum signals, the inventor provides a vertical adjustment and the regular adjustment of the sliding point. For the vertical adjustment, the platinum wire is attached to the bushing 4, which can be rotated about a horizontal axis by a handle 5. This bushing is attached to two iron levers 6 which can be rocked about a horizontal axis 8 by means of an adjusting screw 7. The first device permits rough adjustments, and the second, fine adjustments. The entire pressure adjustment is rotatable about a vertical axle 9 so that platinum wire can be adjusted radially relatively to the axis of the disc 1. The relative speed between the wire and the disc may therefore be varied at will.



Diagrams showing three forms of the sliding wire ticker and two types of connections



Diagrams showing in numerical order, the front view, side view, and top plan view, respectively, of a constructional form of the ticker

White's Automatic Radio Telephone System

IT is customary in some radio telephone systems to provide an electromagnetically operated change-over switch to alternately connect the transmitter and receiver to the wireless aerial. This is not always a convenient procedure unless the apparatus is operated by one skilled in its use; for a condition is apt to arise where both parties place their apparatus in a transmitting position, and endeavor to talk to each other simultaneously.

To overcome this objection, William C. White has devised the method of automatically changing from a trans-

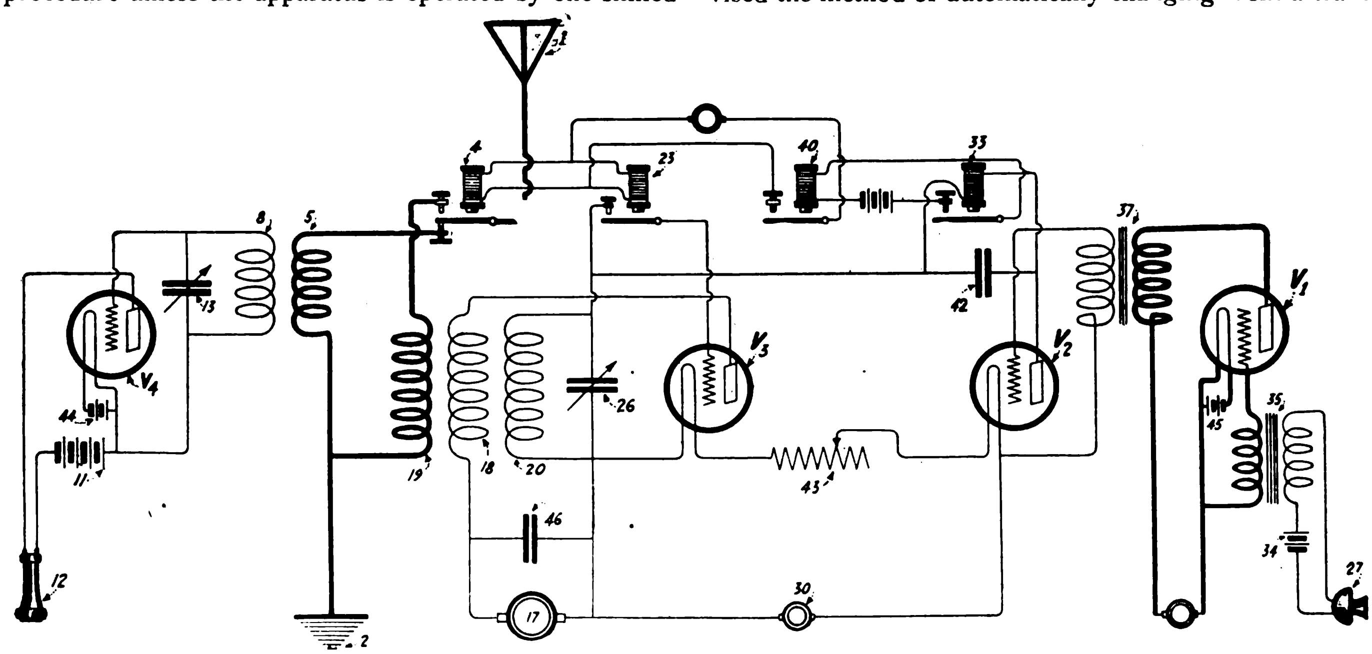


Figure 1—Diagram of White's automatic radio telephone system

mitting to a receiving position shown in the accompanying diagram figure 1, which embraces the complete circuits of a wireless telephone system. In the diagram, the three-electrode tube V-1 amplifies the speech frequency currents generated by the microphone 27. The output circuit of V-1 is coupled to the input circuit of V-2, which is the modulator bulb. The modulator in turn varies the output of the oscillating bulb V-3, which is coupled to generate radio frequency currents at any desired frequency. V-4 is the detecting tube with the usual controlling appliances, including the receiving transformer, 5, 8 and the telephone 12.

A condenser 42 in the plate circuit of the bulb V-2 is shunted by a magnet 33 which opens and closes the relay contacts shown directly underneath. The closing of these contacts energizes the magnet 40, which in turn closes the circuit to the magnets 23 and 24. When relay 4 operates, it breaks contact at 3 and makes a second contact at 25, thus connecting the coil 19 between the antenna and ground and disconnecting the receiving apparatus from the antenna. The relay 23 operates the contact 22 which, when open, prevents the bulb V-3 from generating radio frequency oscillations. When the microphone 27 is spoken into, the transmitter is automatically connected to the antenna as will now be explained.

When the transmitting apparatus is not in operation, the current which flows through the relay winding is not sufficient to operate it, but when the microphone is spoken into the currents thus produced flow through the transformer 37 and reproduce, in the plate circuit of the controlling bulb V-2, variations at speech frequencies, the average value of which will be much greater than the normal current in the plate circuit and will be sufficient to operate relay 33 which in turn operates the other relays previously mentioned. Relays 33 and 40 should be quick acting, and relays 4 and 23 should be quick to close, but should have an appreciable time lag in opening to prevent the transmitting apparatus from being disconnected during a momentary cessation of the sound waves acting upon transmitter 27. The time lag is preferably greater for relay 4 than for relay 23, in order that relay 23 may open and thus stop production of the oscillations before the antenna circuit is broken at 25.

Bellini's Electrostatically Coupled Goniometer

THE Marconi-Bellini-Tosi radio goniometer has been employed in wireless telegraphy for many years. As many of our readers know, the two loop antennae in this device are magnetically coupled through two primaries to a rotating coil which may be revolved on its axis in the resulting magnetic field.

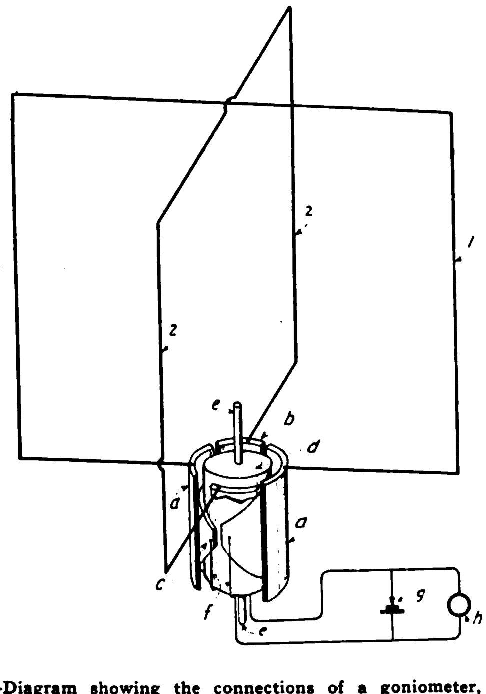


Figure 1—Diagram showing the connections of a goniometer, receiving detector and head telephones

Ettore Bellini, who is a pioneer in directive radio telegraphy, has recently described the capacitively coupled goniometer shown in figure 1. Here two loop antennae 1 and 2 are connected to pairs of stationary plates aa and bb arranged around an axis. On the shaft e is mounted a drum d, upon which are placed the conducting elements c. It is preferable that the conductors have the form shown in figure 2, which when extended in a plane, has the outline formed by two sinusoidal curves, or by the portion of the enclosed surface situated above the axis of the abscissae, s, t. The two plates c (of figure 1 or figure 3) must not touch each other, but must be very close together. The action of the stationary plates is apparently to set up a

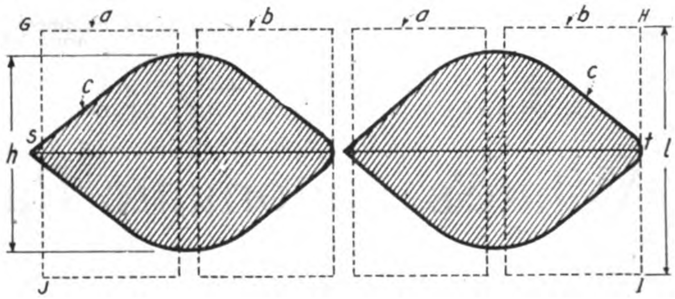


Figure 2—Improved type of conductors

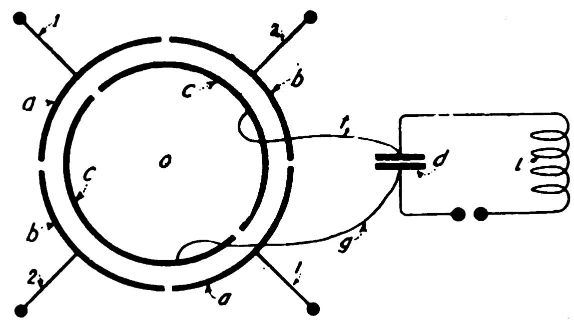


Figure 3—Circuits for directive transmission

resultant electrostatic field, the direction of which in the goniometer varies as the direction of the advancing wave. By rotating the inner drum, it may be placed in a position to receive the maximum induction from the stationary plates.

The diagram figure 1 shows the connections of a receiving detector g with head telephones h in shunt. Figure 3 shows the circuits for directive transmission, the rotating plates cc being connected to a circuit comprising the condenser d, inductance i and the spark gap. In this diagram 1, 1 and 2, 2 are the terminals of the two loop antennae. The rotating element therefore serves to impress high frequency currents from a local generator upon the antenna circuit, and to receive radio frequency currents sent out by the distant transmitter.

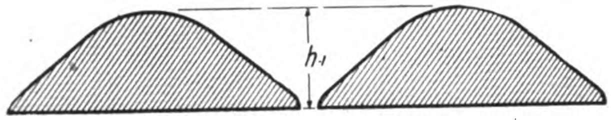


Figure 4—Another form of the improved conductor

Figure 4 shows another type of movable plates which can be used in place of those shown in figure 2. Bellini states that, as with the well-known magnetically coupled goniometer, this system can be employed for directive transmission or reception.

Aviators' Intercommunicating Telephone System

G. M. JENKINS, realizing the difficulty of a pilot and observer in an airplane talking to each other on account of the whir of the propeller, the rush of air and the exhaust of the motor, has devised a telephone system including a transmitter and receiver which are strapped to the aviator's head. Moreover, he has provided a switching arrangement so that when the talker puts his head forward to speak a switch is closed, connecting the transmitter into the circuit. This automatic feature is of considerable value, for it leaves the pilot's hands free

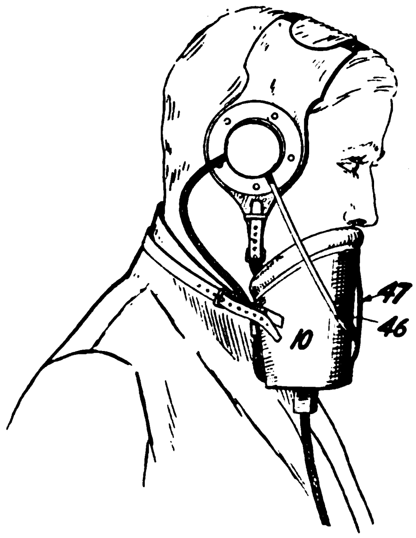


Figure 1

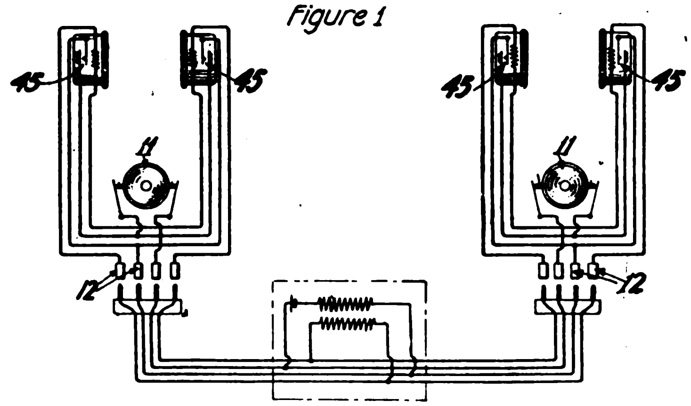


Figure 2

Transmitter and receiver adjusted to operator and diagram of circuit employed

for manipulating his control levers and prevents a drain on the transmitter battery during the period when no conversations are taking place.

Figure 1 shows the transmitter and receiver in position for operation; figure 2 is a diagram of the circuits employed; figure 3 is a front elevation of the transmitter box, a portion of which is cut away to show the mounting in the transmitter. Figure 4 is a side elevation and figure 5 a plan view of the transmitter box in figure 3. Figures 6 and 7 show a head band for holding the receivers, one receiver being shown in position and a portion cut away to show the operation of the transmitter switch.

Each pilot or observer is provided with a transmitter box 10 of leather, adapted for the mounting of the transmitter 11, and a set of four line terminals or jacks 12. The upper portion of the box 10 is provided with a cushion consisting of a soft rubber tube 13 and a soft leather casing 14.

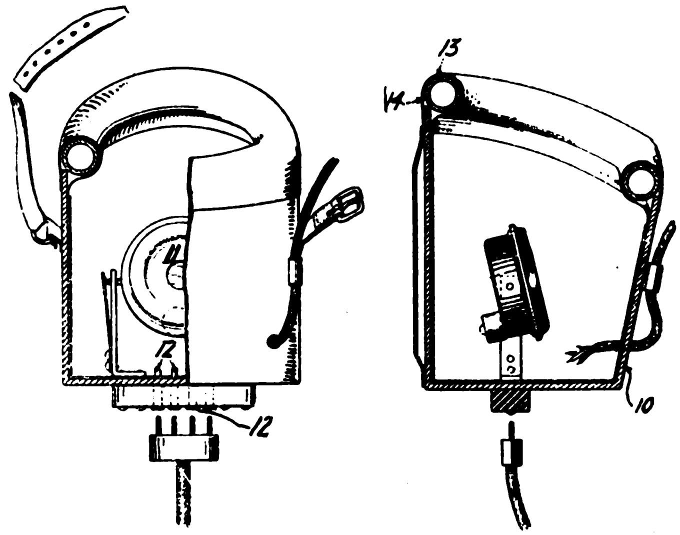
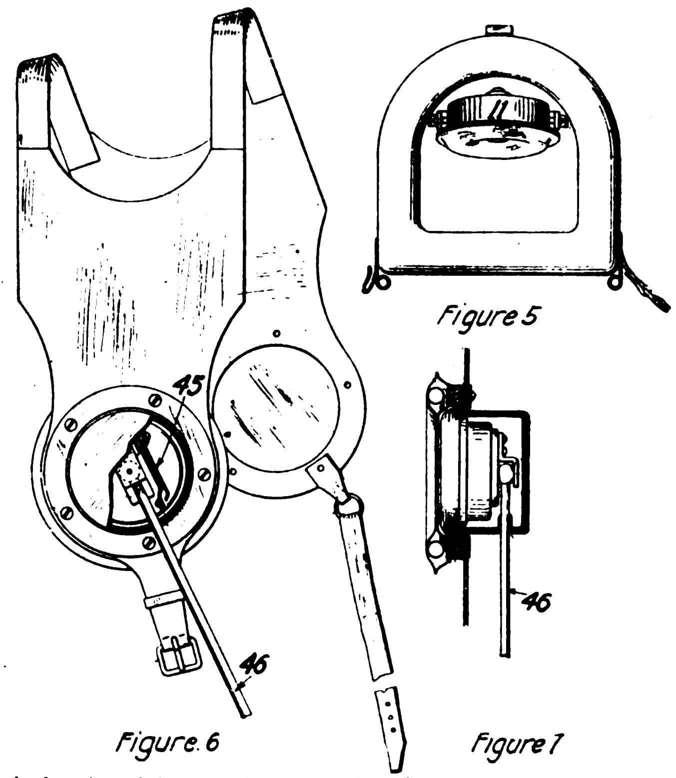


Figure 3 Figure 4

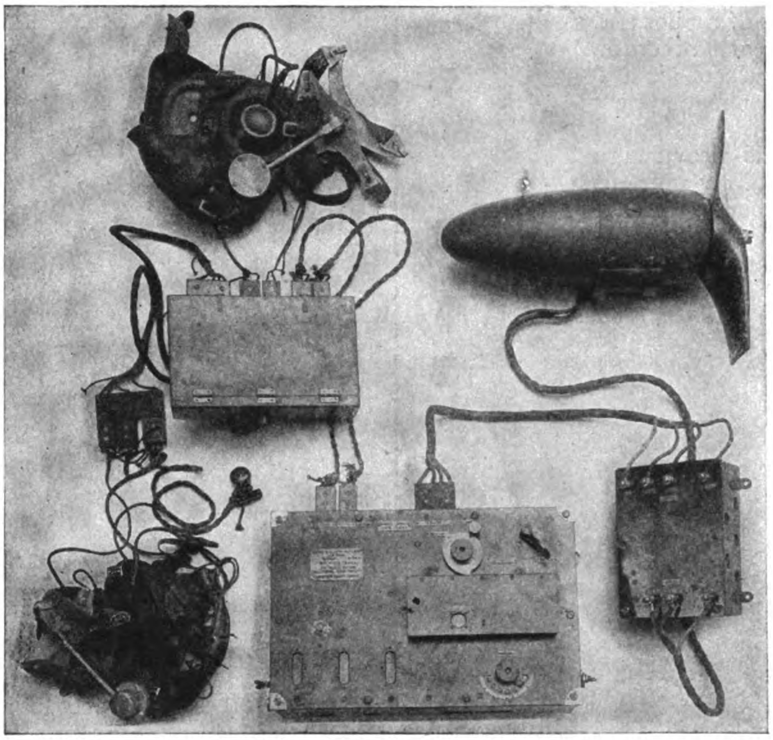
A front and side elevation of the transmitter

On each receiver is a transmitter switch 45 arranged for connecting the transmitter in a circuit automatically when the user lowers his head to transmit. The switch is operated by a wire 46 which extends in a loop from the two head receivers and passes under a strap 47 on the front of the transmitter box 10.

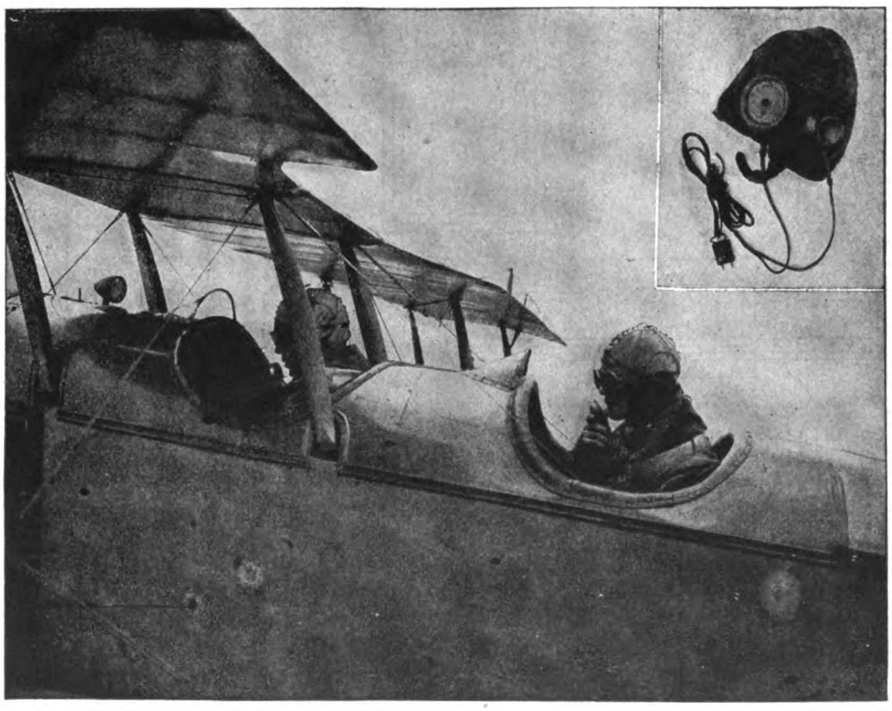


A plan view of the transmitter box and head band for holding thereceiver

Army Airplane Apparatus

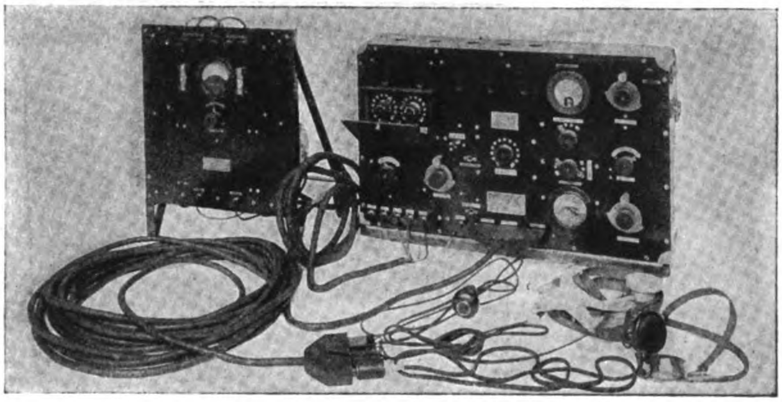


Complete airplane radio telephone set developed for the U. S. Army during the war. This set, known as SCR-68 occupies only one cubic foot of space and weighs 45 pounds. The transmitting circuit includes the antenna capacity as part of the tuned circuit in which a vacuum tube maintains high frequency oscillations, the magnitude of these being controlled by a second tube, which in turn is controlled by the voice currents from the transmitter. The receiving set employs a tuned circuit and a vacuum tube detector, the speech output of which is amplified by two vacuum tubes



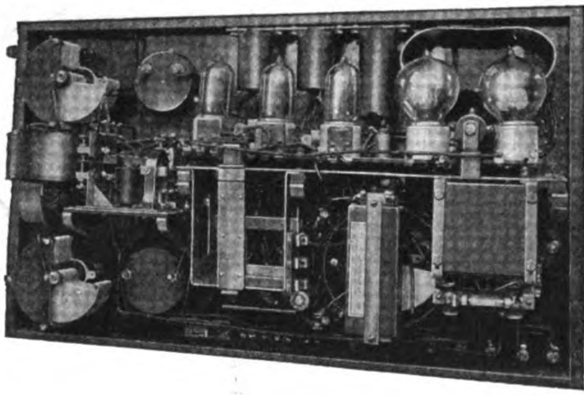
The inset shows the specially designed helmet by which the noise and wind encountered while in flight are overcome and conversation is made possible. In the practical use of the set the observer uses the same telephone equipment for radio and for communication with the pilot

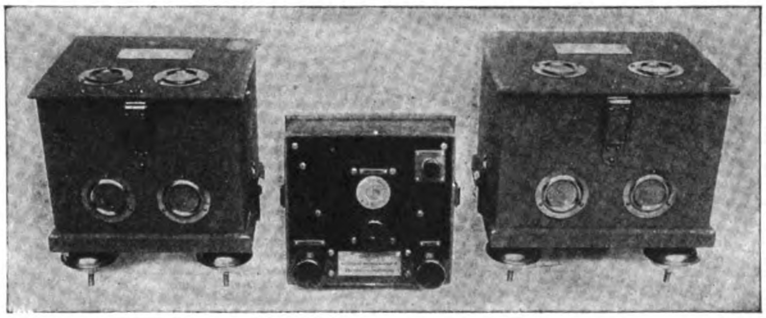
Ground and Short Wave Sets



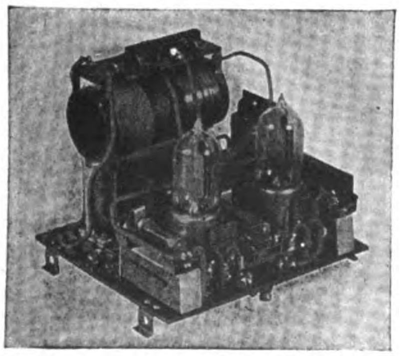
For use on the ground, in talking to observers in airplanes, the U. S. Army used the set illustrated on the left. It is known as type SCR-67 and is similar in principle to the aircraft equipment, but as space and weight are not so restricted, this outfit is designed with a doubly tuned receiving circuit so greater selectivity may be obtained

On the right is an interior view of the ground radio 'phone set illustrated above. A single tuned circuit permits a "stand-by" adjustment for detecting speech, which is transmitted by modulating any one of a wide range of high frequencies. The operator may then quickly adjust for the selective reception of the desired conversation. This equipment also functions under remote control, so that the speaker may make observations of the planes with which he is communicating by standing in the open while the set with which he is connected is protected under cover

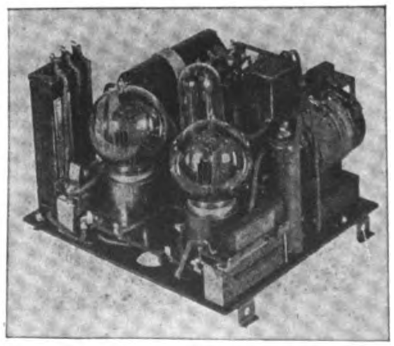




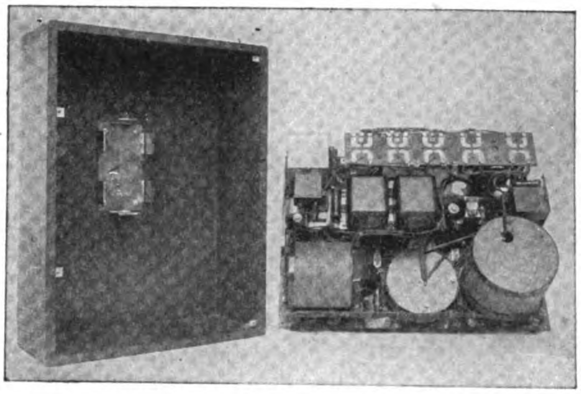
The complete SCR-91 short wave set designed to eliminate the long trailing wire antenna. Its range is from 86 to 116 meters. In the center is a control panel which is mounted before the pilot in the cockpit operating a special set of amplifiers

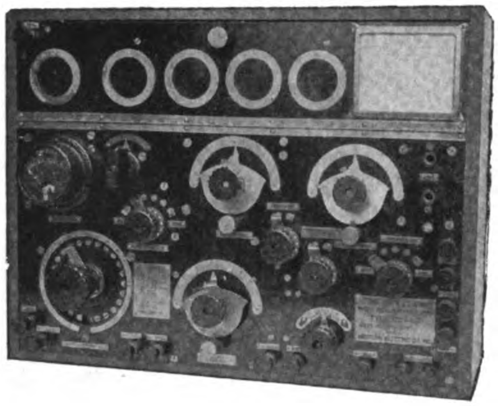


To the right is an interior view of the transmitter, and to the left an interior view of the receiver of the complete set illustrated above. In the receiving equipment space is saved by utilizing a system of amplification whereby the output of the detector tube is successively applied to it as an input until a limiting critical amplification is reached

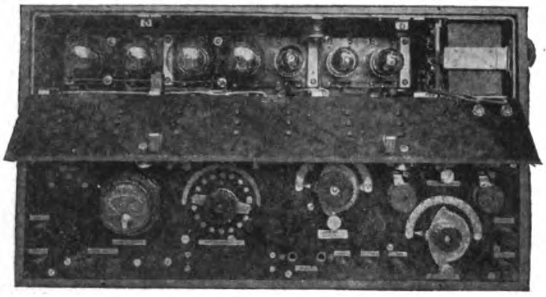


Varied Military Equipment

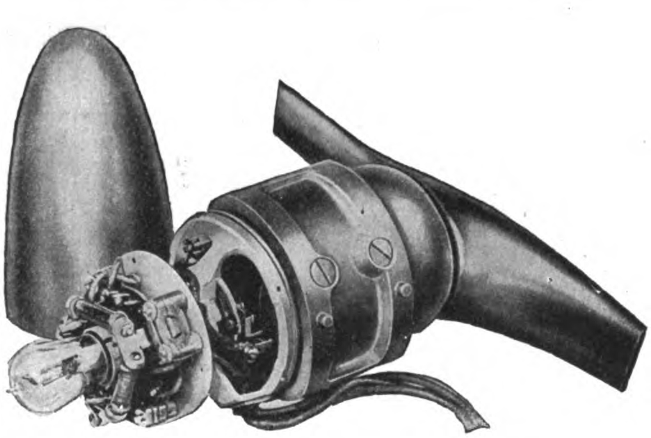




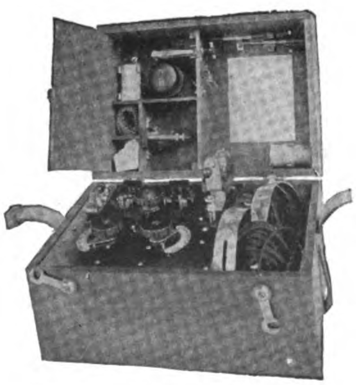
The two illustrations above are interior and exterior views of the radio telegraph set, type SCR-99, for army field use. Two vacuum tubes are used in the oscillating circuit for continuous wave transmission. This equipment is designed for beat reception of continuous wave signals and is also capable of receiving spark set signals



On the left is wireless telegraph set type SCR-78, designed especially for tanks, to enable them to advance as protected signal stations. Only the smallest antenna could be used, and the problem of obtaining the necessary power output was met by using an oscillating circuit involving four vacuum tube amplifiers

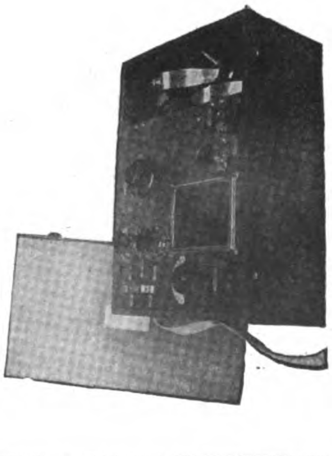


Wind-driven generator for airplane sets, showing regulator which supplies both a 24-volt current for the filaments and a 350-volt current for the plate-filament circuit. The speed of this generator, varying through wide limits, required special means for voltage regulation, found by utilizing characteristic properties of a thermionic vacuum tube, the bulb itself being mounted in the stream line extension of the generator

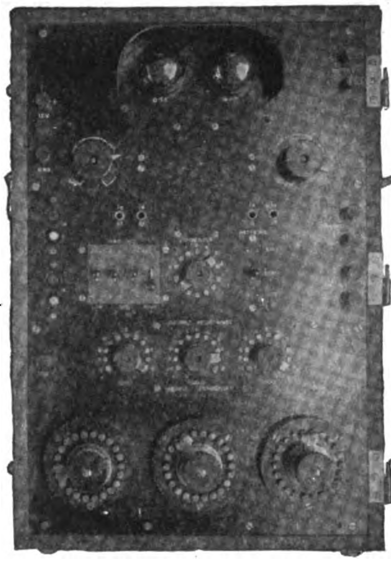


To the left is wireless telegraph receiver SCR-54, using a crystal detector and patterned on sets in use by the French Army in the earlier years of the war

To the right, the familiar SCR-70 special wireless receiving set used in instructing aviators and other radio operators

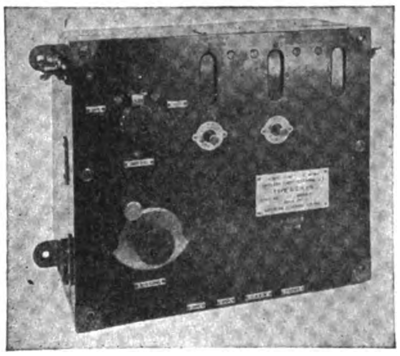


Recently Developed Apparatus

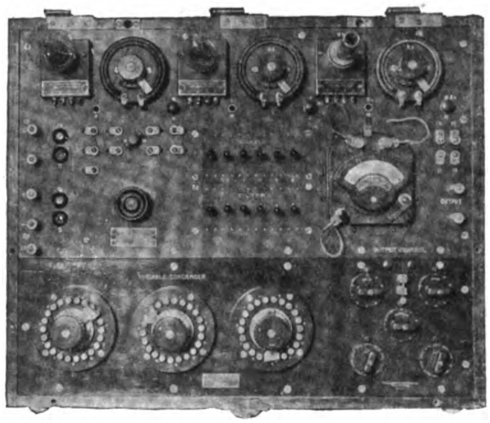


Oscillator for very low frequencies

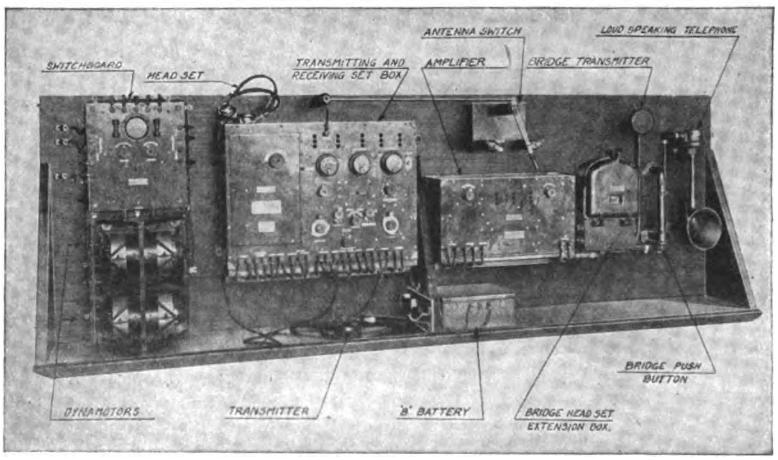
Interior view of SCR-68 wireless telephone set



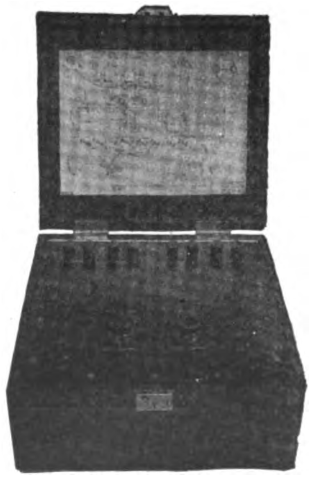
Double tuned ground receiving set SCR-59



Audio frequency oscillator



Navy wireless telephone set designed for use by submarine chasers



Portable 3-stage amplifier

EXPERIMENTERS' WORLD

Views of readers on subjects and specific problems they would like to have discussed in this department will be appreciated by the Editor

A Universal Radio Receiver for Amateur Use

By Morton W. Sterns

IT has been the writer's good fortune to meet many hundreds of radio amateurs since the war began, and it has been his observation that their main concern has been to obtain the details of the design of a receiver that will permit reception over great distances for relay work. Although a variety of opinions and designs have been

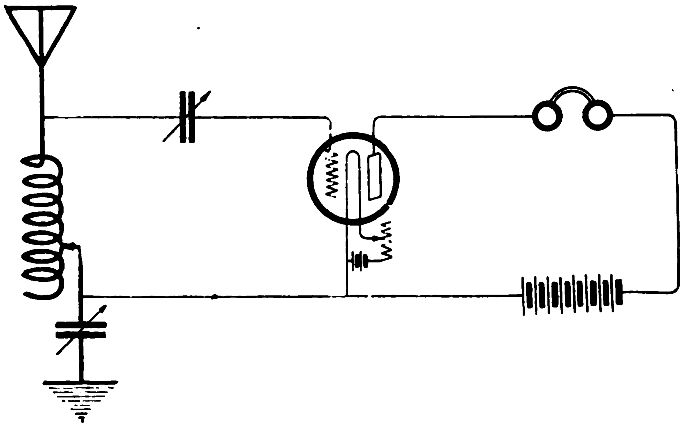


Figure 1—Fundamental circuit showing three-electrode vacuum tube connected across a tuning coil in series with the antenna circuit

set forth as to what constitutes the best all around receiver, the most of them are, in the author's opinion, either too difficult to construct or too expensive for the average amateur's pocket-book.

The writer has given the matter his serious consideration for some time and has finally evolved a set which it is believed possesses many desirable characteristics. Keeping in view the desirability of an efficient receiving set that would occupy a minimum of space, a set was eventually produced that would give a range of tuning

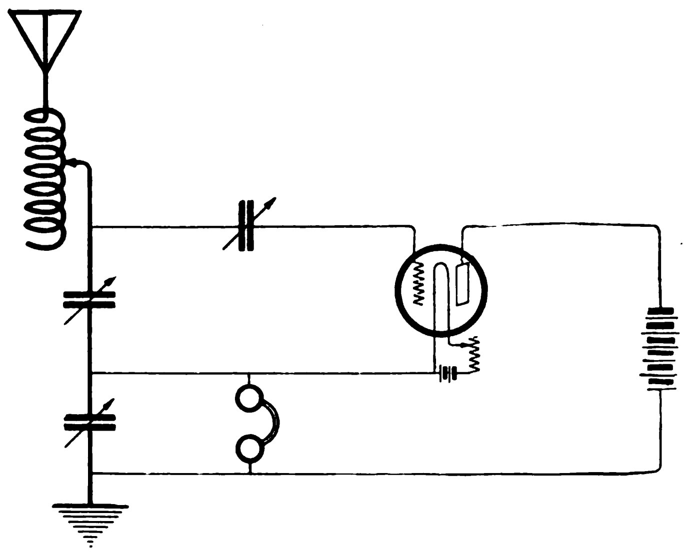


Figure 2—Another circuit using two variable condensers

from 130 to 1850 meters with a small antenna of .0005 mfd. capacity. As will be noted further on, this same set gives a three mile range either as a radio telegraph or radio telephone transmitter. A single bulb is used for all work and the circuit has proved especially efficient on short amateur wave lengths. The entire set occupies a

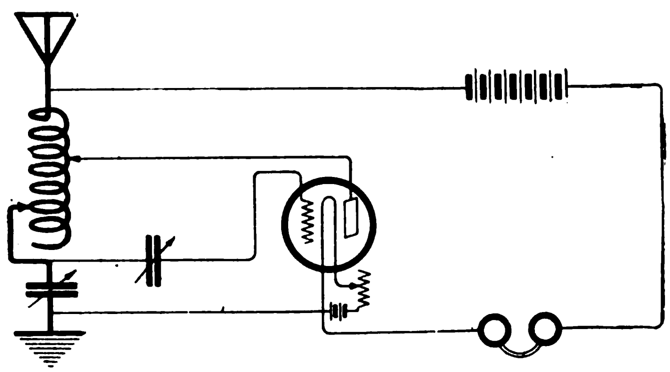


Figure 4—Circuit using one coil and one condenser and employing direct regenerative coupling between the plate and grid circuits

space less than a two foot cube. It is not only feasible for the reception of damped and undamped waves, but it gives regenerative amplification and constitutes a very neat and efficient wireless telephone set.

Fundamental Circuits

A series of exhaustive experiments with various types of circuits have been carried out. Very good results were obtained with the circuit shown in figure 1, where a three electrode vacuum tube is connected across a tuning coil

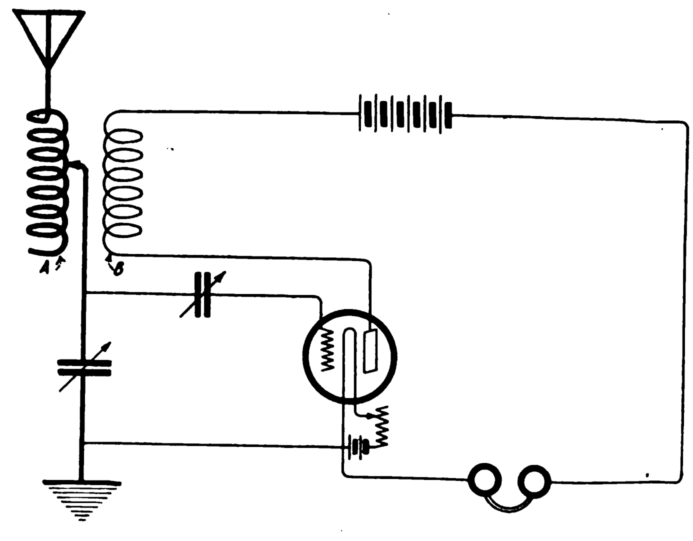


Figure 3—A circuit patented by C. V. Logwood using a regenerative coupling to transfer energy from the plate to the grid circuit

in series with the antenna circuit. The principal objection to this particular circuit was that it was not capable of receiving continuous wave signals.

The circuit of figure 2 was found to give very good results, but the local oscillations were not easily controlled and, furthermore, it necessitated the purchase of two variable condensers as shown.

Very satisfactory results were obtained with the circuit of figure 3 which, it is stated, has been patented by C. V. Logwood. In that diagram coil B is a tickler coil of a comparatively few turns of wire mounted inside of coil A, constituting a regenerative coupling by which energy can be transferred from the plate to the grid circuit. It is a feature of this circuit that the oscillations can be started or stopped simply by moving the coil B in and out of the coil A.

Having determined the good and bad features of the circuits described, I carried out further experiments with the view of obtaining greater simplicity. In fact, I was determined to have one coil and one condenser, and my researches eventually culminated in the circuit shown in figure 4, in which direct regenerative coupling between

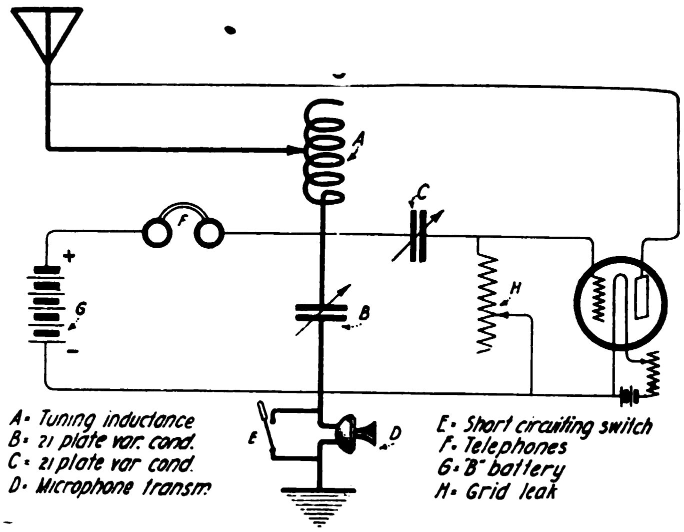


Figure 5—The perfected circuit of simple design and extremely sharp tuning

the plate and grid circuits is employed. Once having discovered a fundamental basis upon which to work, and having observed that the mutual inductance between the plate and grid circuits could be controlled by a single coil, various combinations were tried employing grid leaks, negative grid voltages, etc. Some useful results were obtained, but the experiments finally terminated in the universal circuit shown in figure 5, which it is believed is the acme of simplicity and moreover gives extremely sharp tuning.

The notations in the diagram are explained in the accompanying drawing.

Coil A in the diagram has three taps. The switch is placed on one tap and the condenser B is varied over its range until the desired signal is heard. Since the tuning is exceedingly sharp, care must be taken while adjusting this condenser not to miss the signal. It is understood, of course, that the switch E is closed while receiving, but it is interesting to note that by varying the capacity of the condenser C, the bulb can be made to give regenerative amplification or to generate powerful oscillations, hence the circuit can be used for wireless telephone transmission as well.

By way of further explanation of the circuit, H is a grid leak which is of the order of 60,000 to 100,000 ohms resistance for the audiotron or the round bulb. This leak can be made a pencil mark, between two binding posts of a Ward Leonard porcelain resistance or a graphite potentiometer such as used in the B battery circuit. The latter type is particularly handy, because it is variable. It must be understood that the grid leak is essential for proper working of the system, but once adjusted it need not be touched during the life of any particular bulb. The plate

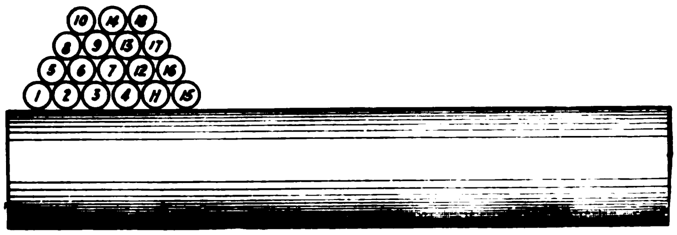


Figure 6—A four-bank winding showing the order in which the turns are placed upon the tube

circuit voltage in this system varies between 60 and 80 volts or even higher if possible.

Use of the Circuit for Wireless Telephony

To engage in wireless telephone conversation, open the switch E and speak into the microphone distinctly, making sure that the bulb is in a state of oscillation. An indicating device of some sort, such as a small ammeter, should be placed in the antenna circuit to determine the maximum antenna current. The plate voltage should be as high as possible without causing the bulb to ionize; that is, to give the characteristic blue glow. And if any amateur possesses a "hard" bulb that proved inoperative in an ordinary receiving circuit, he should now put it into use, because for transmitting purposes, the "harder" the bulb the better will be the results obtained.

In order to telegraph by means of continuous waves, place the key in series with the grid leak. This will cause the bulb to stop oscillating whenever the key is up.

In the construction of this apparatus it is preferable that the receiving cabinet proper contain only the tuning inductance and the 21-plate variable condenser. The vacuum tube control panel is separate, and a sufficient number of binding posts are brought out to allow any desired connection to the tube. The connections from the inductance switch are brought to the binding posts on the receiving panel. Other posts are provided for connection to the antenna and ground. Additional leads are brought out from the variable condenser to binding posts.

The tuning coil is wound with "litzendraht" or No. 18 B & S D.C.C. wire on a tube three inches outside diameter. A four bank winding is employed as shown in figure 6, the numbered circles showing the order in which the turns are placed upon the tube. A section of fifty turns is

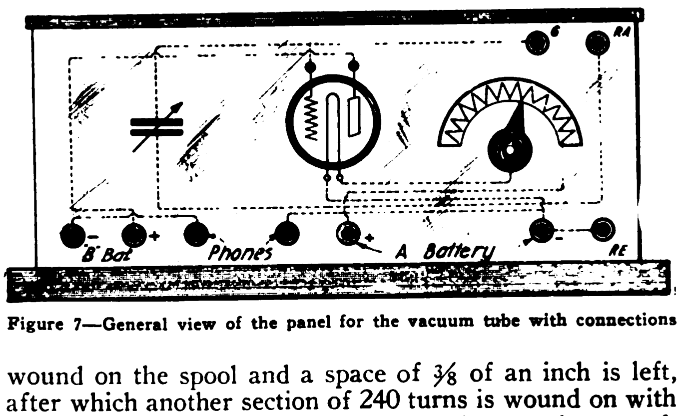


Figure 7—General view of the panel for the vacuum tube with connections

wound on the spool and a space of ⅜ of an inch is left, after which another section of 240 turns is wound on with a tap placed at each 55 turns. The writer employs, preferably, litzendraht cable composed of 42 separate strands of No. 36 B & S enameled wire with a double silk covering.

Figure 7 shows a general outline of the panel for the vacuum tube. It contains a variable condenser, the vacuum tube holder and a filament rheostat, all mounted inside the box. The panel is of 3/8 inch bakelite. The connections are brought out in such a way that any desired hook-up can be employed.

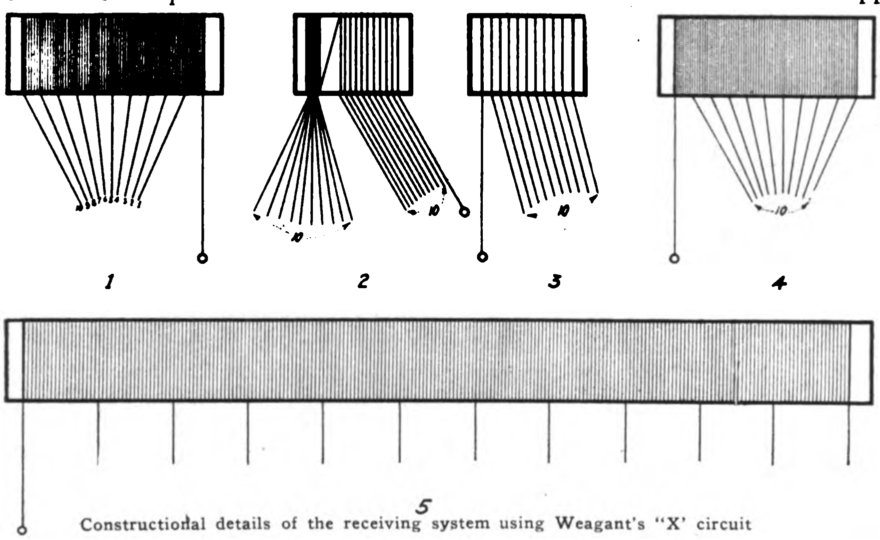
A feature of construction that the average amateur would do well to incorporate in his set is the method of fastening the panels to the box. Several right angles of 1/16 inch brass are made and screwed to the side of the box. The panel is then lowered and rests on the angles as a support, leaving the panels flush with the top of the box. Holes are then drilled through the panel and spotted in the brass angles. The holes are then reamed out to give clearance for a small machine screw; the brass in then drilled and tapped to fit the machine screw. Constructed in this way, the panel can be removed from the box as often as desired without stripping the thread in the wood, as might happen if wood screws are employed.

In closing, it is well to remark that the final circuits shown in this article can be used directly with the Western Electric "E" type tube fed from a 220 volt direct current force of supply. The bulb will give antenna current of 0.8 ampere and telephone conversations with this amount of current have been heard seven miles away. Other types of bulbs I have employed permit transmission over distances of three miles.

Constructional Details of a Wireless Receiving System Involving Weagant's "X" Circuit

By E. T. Jones

I HAVE experimented with many circuits for the reception of damped and undamped waves but the one described here gives better all-around results than any other I have used. The complete circuit acts as a detector, oscillator and amplifier for both long and short damped or undamped waves. An outstanding feature is that but one bulb is required for reception over great distances.



Constructional details of the receiving system using Weagant's "X" circuit

With a circuit of this kind I have copied signals from Nauen and Eilvese, Germany; Canarvon, Wales; Koko Head, Hawaii; Pearl Harbor, Hawaii; not to mention the arc stations located in the United States, the signals from which come in at audibilities of approximately 5,000. Signals have been read from the new high power station in Japan testing with Koko Head. These signals were plainly readable at New Orleans at 8 o'clock in the morning. One point that stands out particularly in connection with the operation of this set is, that by careful variation of the condenser capacity in the grid and plate circuits, adjustments can be obtained whereby the circuits are just on the verge of radio frequency oscillation, causing great amplification of spark signals; and by further adjustment of the condenser capacities, the circuits may be set into oscillation at any desired frequency permitting the reception of undamped waves.

Still another feature of this apparatus which I believe will appeal to the amateur experimenter is that wave lengths ranging from 600 up to 20,000 can be received without having the usual duplex receiving transformer, a multiplicity of change-over switches, etc. In fact, my entire series of experiments leads me to believe that too much praise can not be given this circuit for general experimental work. It is described in pages 102 to 105 of Bucher's "Vacuum Tubes in Wireless Communication," which explains vacuum tube detector circuits in detail.

Constructional details and dimensions of the tuner which I have found very satisfactory under the most exacting conditions follow; the antenna loading coil is wound on a tube 4" in diameter and 12" long covered with one layer of No. 24 S.C.C. magnet wire. Taps are taken off every inch, making a total of 10 taps. The winding is eleven inches in length. A general view is shown in figure 1.

A direct coupled receiving transformer is employed as shown in figure 2. It is wound on a tube 4" in diameter and 6" long covered with one layer of No. 24 S.C.C. wire. Taps are taken off every 10 turns, making a total of 20 taps. Two switches with

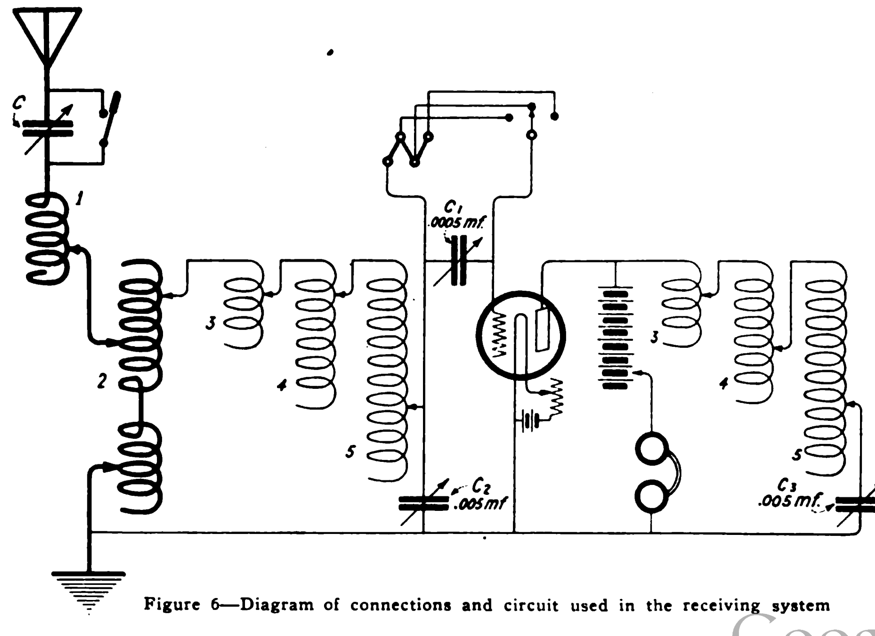


Figure 6—Diagram of connections and circuit used in the receiving system

ten contact points are provided. Each contact point is connected to successive tenth turns. A unit switch is also supplied which connects to the first ten turns, one at a time, as shown.

The short secondary coils shown in figure 3 are made on tubes 4" in diameter, 6" long wound with one layer of No. 24 S.C.C. magnet wire. Taps are taken off every half inch, making ten taps per coil, or a total of 20 taps. The two loading coils of medium length are made of tubes 4" in diameter, 12" long wound with one layer of No. 24 S.C.C. magnet wire. Taps are taken off every inch, making a total of 20 taps for the two coils.

The large loading coils for long wave lengths are made on tubes 4" in diameter, 36" long, wound with one layer of No. 24 S.C.C. magnet wire. Taps are taken off every 3". The details are shown in figure 5.

The variable condensers in the secondary circuit and plate circuits should have a capacity of at least .001 mfd.

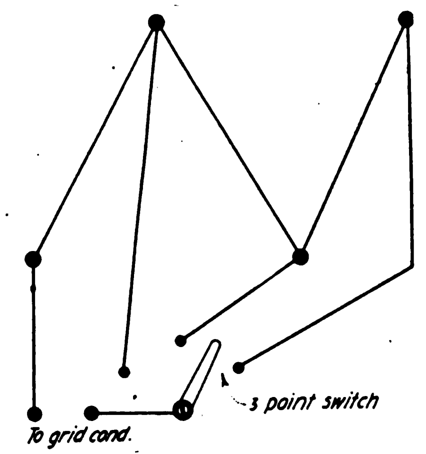


Figure 7—Diagram of connections for the three-point switch

and for the very long wave lengths a capacity of .005 mfd. is desirable. The grid condenser should not exceed a capacity of .0005 mfd. or thereabouts. A grid leak of the type shown in figure 6 is necessary for stable operation. It may be made of high resistance strips of graphite or lead pencil lines drawn in a groove, or of carbon typewriter paper. A three point switch is connected as shown in figure 7.

The receiving system shown in figure 6 is not only exceedingly stable in operation but simple of adjustment and by proper selection of inductance at the antenna loading coil 1, at the tuning transformer 2 and at the loading coils in the grid and plate circuits, a point can be found where simple variation of the capacity of the condensers C-2 and C-3 will be sufficient to cover a wide range of wave lengths. In case near-by local power lines cause interference, the filament may be grounded to earth.

A Combination Spark and Buzzer Transmitter

By William Holladay

It is well known that the buzzer can be used for transmitting over distances up to about two or three miles. As it radiates a wave of the natural frequency of the aerial and of low decrement, and may be adjusted so as to give a 500 cycle tone, it makes a good substitute for the spark transmitter for inter-city communication. But very few amateurs are content to use a buzzer for transmitting and sooner or later they will choose a transformer for long distance communication. A transformer is not, however, well suited for short distances and the buzzer is the logical solution of such a problem. It is quite a job to change all the connections to the key, aerial and ground in order to change from the buzzer to the transformer, so I believe the accompanying circuit is the solution. The panel shows the arrangement of switches.

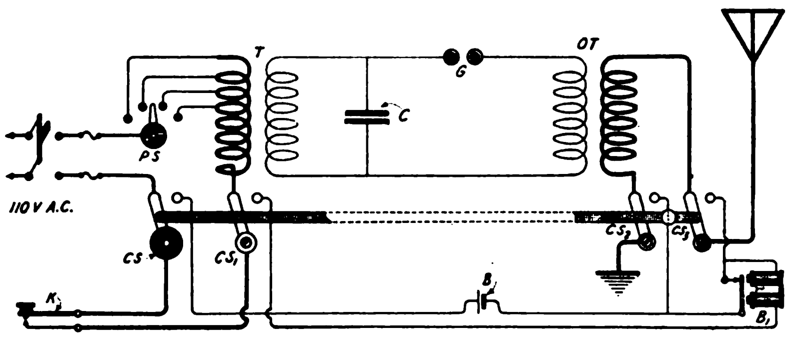


Figure 1—Circuit showing connections of switches in the combination spark and buzzer transmitter

Taking the circuit figure 1 with the switches CS, CS_1, CS_2 and CS_3, in the position shown, the current passes through the fused switch and through the reactance regulator PS, into the primary, through switch CS_1, to the key K and back to the line. The current induced in the transformer secondary charges the usual form of closed circuit, embracing the high potential condenser C, the rotary gap G and the primary of the oscillation transformer. The secondary is connected to the two remaining switches CS_2 and CS_3 to which are soldered leads to aerial and ground.

When the handle of CS is rotated, all the change-over switches are snapped to the right, and the buzzer circuit is used for transmitting. It will be seen that the current passes from the battery through the key by way of the first two switches, and the two contacts of the vibrator are connected to aerial and ground through the two switches on the right.

The switch panel shown in figure 2 should be of marble, bakelite, or other good insulating material, but for low powers well-varnished hardwood will answer the purpose. The two switches on the right, marked "G" and "A" should be about four inches long, made of copper bus-bar, with the contacts at least three inches apart. The two binding posts marked "110" are connected to the line and the "B" posts to the low voltage battery for running the buzzer. The two binding posts K on the lower part of the panel are connected to the key. It will be found better to solder the aerial and ground leads, and also the oscillation transformer leads, directly to the back of the switches. The panel should be about 15 inches long and 11 inches wide.

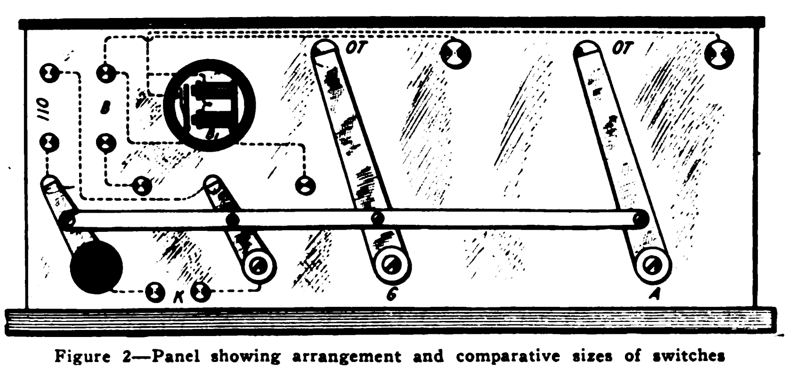


Figure 2—Panel showing arrangement and comparative sizes of switches

An Easily Constructed Oudin Coil

By R. C. Hitchcock

WHILE the amateur is obliged to abandon his radio transmitting set, he can easily construct a high frequency oscillator which may be energized by his transmitting outfit. 18 inches at the other. Two wooden pieces are turned to fit the ends, and the assembly then mounted between lathe centers for winding. No. 26 wire is preferred and the turns should be spaced with a string which may be left on permanently. When the coil has been wound it should be painted with hot paraffine or some good insulating material.

The primary is wound on a six-sided figure about 24 inches outside diameter, depending on the width of the supports. Slots for No. 8 wire are provided, six turns being sufficient for the set under consideration.

An insulator, which may be turned of wood, is mounted on the secondary to support a brass ball from which the sparks are drawn.

The secondary and primary are grounded at one end and the other connections made as shown in figure 2. Sparks drawn into metal objects held in the hand cause no shock whatever.

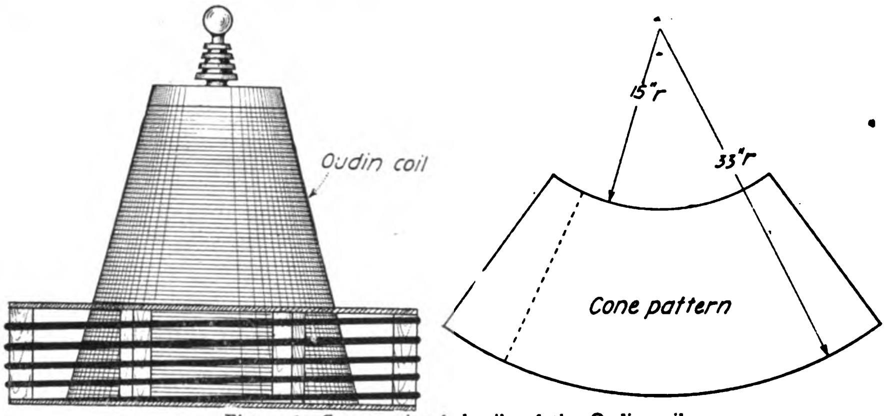


Figure 1—Constructional details of the Oudin coil

Many interesting and startling experiments may be performed.

The coil shown in figure 1 has been successfully operated on a ½ kw. wireless transformer, using a glass condenser and straight gap. The straight gap gave high frequency sparks of greater length than a rotary gap.

The core for the secondary can be made of several pieces of cardboard, cut like the pattern and glued together, making a tube 18 inches long, 9 inches diameter at the small end and

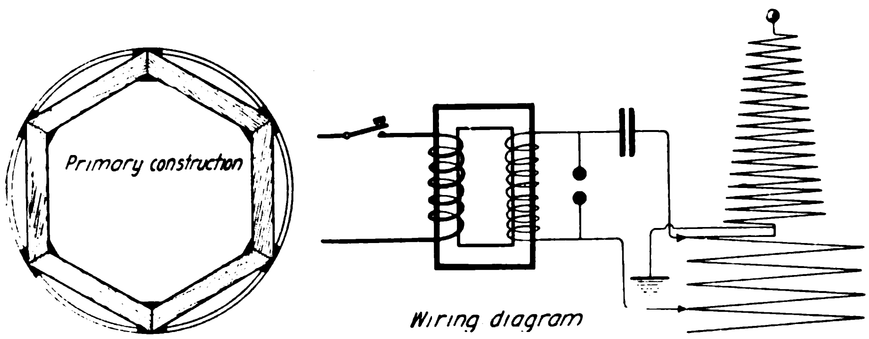


Figure 2—Primary construction and the wiring diagram

Code Practice Alternator for the Amateur

By C. J. Fitch

IT is certain that the amateur cannot expect to obtain genuine pleasure out of his radio apparatus unless he is skilled in sending and receiving. To acquire facility he needs a good code practice set. One particular way of generating artificial radio signals, doing away with the troublesome buzzer, is shown in the accompanying diagram. A small battery motor is rewound and connected in such a way as to produce a buzzing note in the head telephone. The details of construction follow:

The field is wound with No. 28 S.C.C. wire and connected in shunt to the armature. The armature coils are each wound with an equal number of turns of No. 26 S.C.C. wire. It is important that the coils be wound in the direction shown, otherwise the motor will not run. The three terminals connected at O are grounded on the rotor shaft. Connection from the battery to the shaft is made by a bronze spring wire rubbing in the groove of the small pulley mounted on the end of the shaft.

The theory of operation is as follows: When the armature is in the position shown, current flows from the battery to the + brush, through the coil C to the point O, through the coils A and B, which are connected in parallel at this instant, to the — brush and battery. The neutral wire OP will carry no current when both sides of the line are balanced. At the instant shown, however, the line is unbalanced, having two armature coils, A and B on one side and one coil C on the other. Therefore the neutral will carry the difference of current in the two sides and the current, in this case, will flow upward.

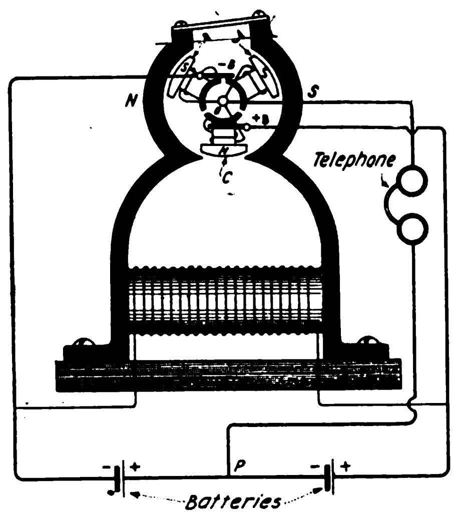


Figure 1—Showing construction and connections of the code practice alternator

The polarity of the armature and field poles when the above takes place is as indicated; the armature will rotate counter clock-wise. After the armature has rotated 60°, if the windings are traced out as before, it will be seen that two armature coils are in parallel on the side of the line which previously had one coil. In this position, the difference of current will flow down through the neutral, instead of up, as in the previous case. These reversals take place every time the armature rotates 60°, giving 6 reversals, or 3 cycles per revolution of the armature in the wire OP.

The object of the shunt field is to keep the system balanced. The series field may be used, but the current in the neutral wire will be a pulsating direct current.

No other equipment besides the motor is made use of.

Timely Advice on the Matter of Interference Between Amateur Stations

By J. E. Law, Jr.

THE amateur wireless enthusiast should exercise every means at his disposal to prevent interference. "Jamming," as wireless operators term it, may be due to any of the following causes: badly tuned transmitters; non-selective receiving apparatus; and non-observance by operators of the government regulations concerning the transmission of radiograms. Interference is not alone caused by transmitters radiating broad waves; the operator himself may lack the necessary operating skill to handle his apparatus intelligently.

One way of reducing the damping of the antenna oscillations is to select a transformer voltage suited to the set under construction, means being provided for careful regulation of its input. Abnormal spark gap voltages prevent quenching with consequent double wave emission.

The high voltage condenser should be immersed in oil to prevent brush discharge, for brush leakage is extremely detrimental to high efficiency and should be corrected before it punctures the dielectric.

The quenched spark gap is being used extensively by commercial and naval stations, and is today probably the most efficient type, since it can quickly quench out the primary oscillations before those in the antenna circuit react appreciably upon the closed circuit. The sparking surfaces of the series gap must be supported in a strictly parallel position and be kept clean. A motor blower or fan, such as is used on the Marconi panel transmitters, is required to keep the temperature at a safe value.

All leads connecting the closed circuit should be as short and as heavy as possible and should have no kinks or bends in them.

An oscillation transformer of the "pancake" type is the handiest for rapid change of wave length, but with all oscillation transformers two waves will usually be radiated if the spark gap does not quench properly and the coupling is too close. Single wave emission may be secured with any gap by reducing the coupling at the oscillation transformer. The antenna current will be reduced by this procedure. But the range of the station may be increased, because all radiation is taking place on one wave length. Careful attention to these details aid one in securing the desired sharp wave, i.e., a decrement of less than 0.2 as prescribed by law.

Nearly as important as the correct tuning of a transmitter is the provision of a selective receiving set. A vacuum tube detector permits sharper tuning than a crystal rectifier, and the use of litzendraht wire in the primary and secondary coils gives a minimum high frequency resistance. The tuning coils should be tapped so that the inductance may be varied one turn at a time. End turn switches should be used in order that turns not in use may be disconnected from those actually in the circuit.

In regard to the interference caused by the operator himself, I know it to be a fact that some operators do not always comply with the government regulations regarding the transmission of messages; when they have a message to transmit they persist in calling for a long period, even though transmission is in progress at the time. This interference is strictly *unnecessary*, with the possible exception of when urgent messages are to be transmitted. If all operators would observe the regulations governing the transmission of messages, such as the permissible wave lengths and the amount of power for a given distance, and moreover make more extensive use of abbreviations, general traffic would be dispatched with greater facility.

There are a few willful "air hogs" who want to get their messages through in a hurry and who have little respect for the other operators waiting for their turn to transmit. Let each operator, "Do unto others as he would have them do unto him," and there will be a change for the better.

An additional source of interference is the "spark coil menace," caused by "hams" disregarding every law concerning tuning, decrement, etc., and acquiring the habit of "sitting on the key."

If the government would amend the Radio Act so as to require all persons owning wireless sending stations of any power whatsoever to obtain licenses for their operation, these beginners would have some pride in their sets and strive to make them efficient. They would then realize that 200 meters means 200 *meters;* no more; no less!

Sometimes, relief may be had by paying them a friendly visit and urging them to join a wireless club where they can be taught the fundamental principles of wireless telegraphy.

Another way to decrease interference among these experimenters is to organize them all and plan out some sort of working schedule for testing periods and small talk, reserving other hours for long distance work and relaying, at which time no other transmission is to be allowed. As amateur organizations increase, doubtless some such schedule will become effective everywhere.

Ground Telegraphy

By Gerald Ehinger

THE theory of the ground telegraph is generally understood but it is not often used by amateurs. The underlying idea is to connect land line wires to earth at two points and utilize a buzzer at the transmitter station to impress variable electromotive forces upon the conducting earth. A fundamental diagram is shown in figure 1, where the transmitter includes a battery, key, and a high toned buzzer. At the receiving station, a telephone receiver is connected between two grounds as shown.

The power for the transmitter may be drawn from dry cells, storage batteries or a step-down transformer. A "break in" system is secured by connecting a condenser in the circuit as in figure 2. The working of the ap-

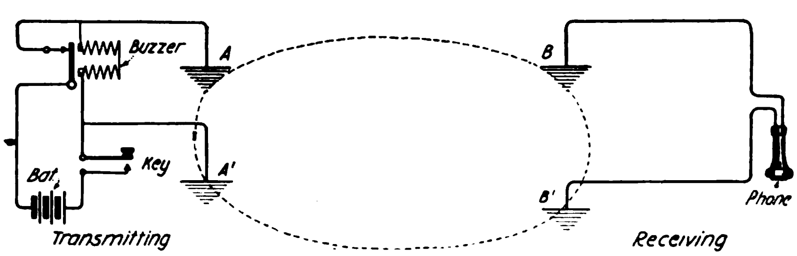


Figure 1—Fundamental circuit for ground telegraphy

paratus should be clear from the drawing.

The receiving telephone should have a low resistance; in fact, the lower the better. High resistance telephones can be used if connected to the secondary of a 1" coil (spark), the primary being connected into the circuit. A small spark coil may be used instead of a buzzer for transmitting purposes, but it is not as efficient.

Connections at the transmitter and receiver could be made to water and gas pipes, but the signals at the receiver will not be so strong as in the arrangement I have described.

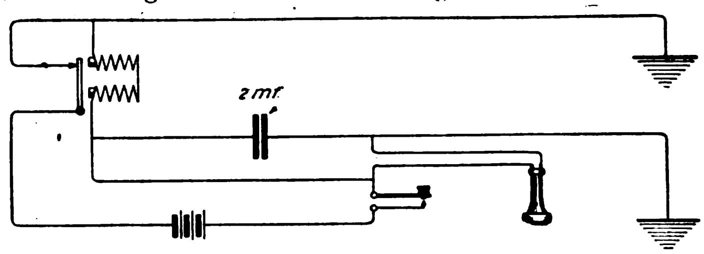


Figure 2—The "Break-in" system with condenser connected in the circuit

A Short Wave Receiver for the Amateur Station

By Carleton Howiler

I BELIEVE that the most efficient type of short wave receiver is that which employs variometers as the primary and secondary inductances.

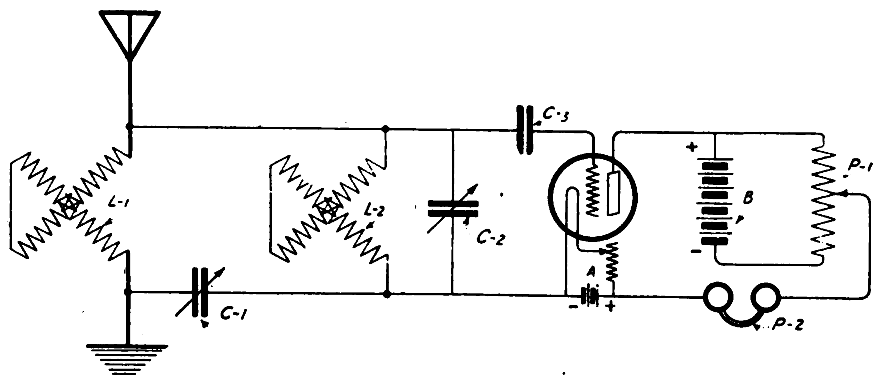


Figure 1—Circuit of the short wave receiver suitable for amateur stations

Hence the amount of inductance required to reach a wave-length of 200 meters is relatively small, and the losses in the variometers themselves are negligible.

The diagram, figure 1, shows the circuit preferred for amateur use. L-1 is the antenna variometer and L-2 the variometer which acts as one of the tuning elements of the secondary circuit. It is shunted by the variable condenser C-2. In series with L-1 and L-2 is the variable condenser C-1 which has the effect of changing the coupling between the antenna and detector circuits. A small grid condenser C-3 of about .0005 mfd. is connected in series as shown. The plate circuit of the vacuum tube is energized by the battery B shunted by the potentiometer P-1, which may be of 3,000 ohms resistance. For additional amplification some part of the plate circuit may be placed in inductive relation to the grid circuit of the tube, but very good results will be obtained with the simple circuit shown.

The variometers are identical in construction. Each consist of two cardboard cylinders 1½ inches wide. The larger cylinder is 4½ inches in diameter and the smaller one 4 inches in diameter. Both are wound with the same number of turns of No. 26 S.C.C. wire.

I prefer to mount the variometers and variable condensers in opposite corners of a cabinet. The panel on which the vacuum tube detectors are mounted can be secured to the top, giving a very neat appearance.

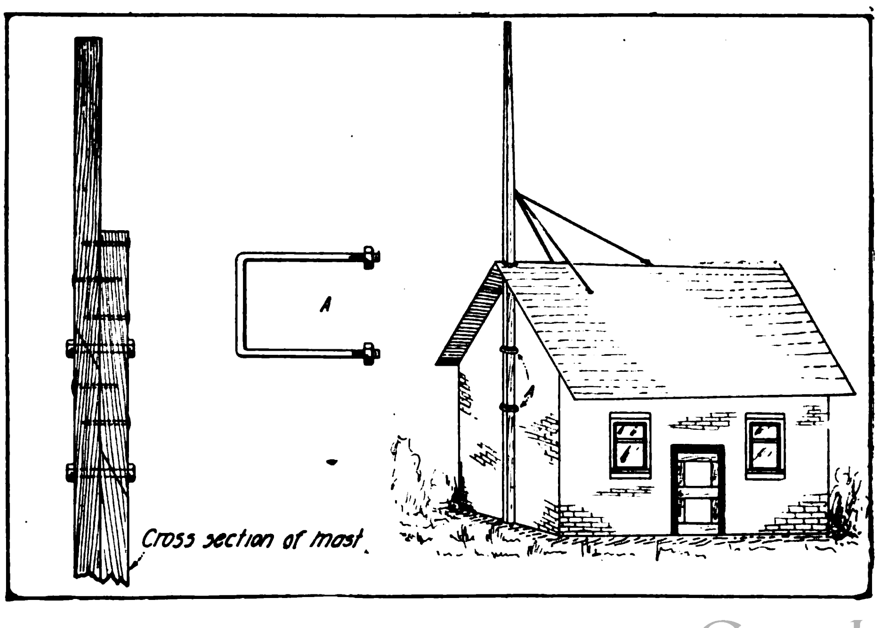
I am sure that with these few constructional details and a careful study of the diagrams, any amateur can readily build a set that will do far better work on short waves than the average amateur equipment.

An Aerial Mast on the Roof

THE amateur located in the country or a small town may be interested in the design of an aerial mast constructed as shown in the accompanying drawings. It will be noted that a hole is cut in the roof of the building through which the mast enters and that the mast is clamped to the side of the building by means of two iron rods of the shape shown in the figure at A, which are threaded at both ends to take a bolt.

The mast may be put together in sections, one at a time, and slid up through the holding clamps. By using pieces of two by four lumber 16 feet long, a very serviceable mast is obtained. Two or three 16 foot pieces will be sufficient for the average amateur aerial mast.

HENRY KLAUS, *Illinois.*



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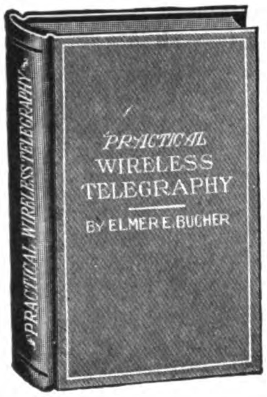

Practical Wireless Telegraphy

BY ELMER E. BUCHER

More than 55,000 copies of this book have been sold to date. It is used in practically every school, college, library and training camp in this country.

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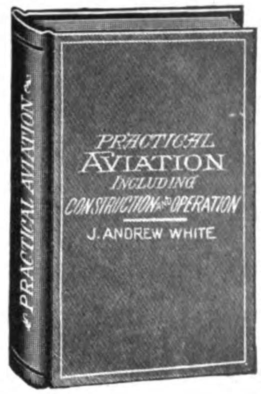

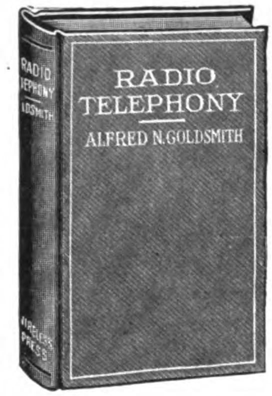

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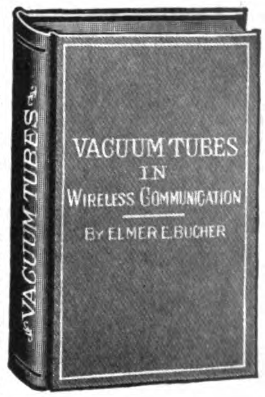

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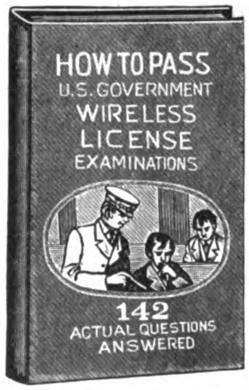

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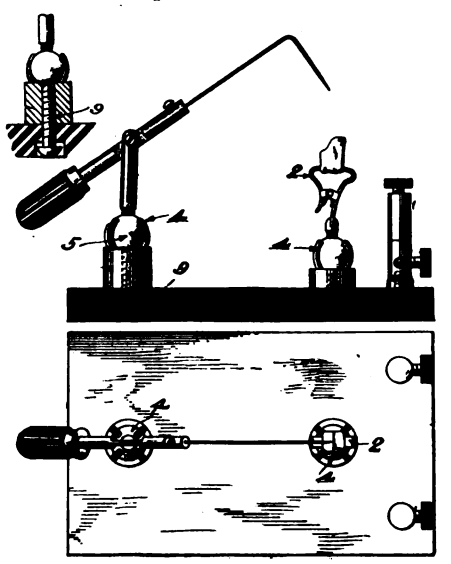


Figure 1—Showing construction and assembly of the cat-whisker detector stand

Amateur War Work

I AM a non-commissioned officer in the radio branch of the U. S. Signal Corps and have had many an opportunity to see the value the radio operator has been to the Army in France. The best of the signal personnel are former, or pre-war, amateurs who operated amateur stations and enlisted like myself when the war broke out.

A little incident in which I took part during the great drive we made against the Hun will show why the radio amateur should be encouraged.

One dark night we could not raise 4 - - -, who was located about a half mile forward of us. After calling several times we decided to go and see what was wrong. Station 4 - - - was manned by radio men who got what radio experience they ever had in the Signal Corps. To reach them we had to drive a motorcycle, another lad and I, over a road which was undergoing the worst shelling by the Huns it ever had. But we arrived O. K. We were using a sustained wave transmitter of the bulb type and the high tension battery was made up of a large number of 40 volt storage batteries. Upon examination of the Station 4 - - - set we found this battery circuit open.

We of course put the station working in short order. The point of the incident—only one of many incidents—is that the amateur radio men have shown themselves far superior to those who were taught wireless in the Service. And while we were still in uniform and not able to make an organized protest against Congressional action, they tried to wipe us off the map. Fine recognition of valuable service well rendered. I am sending these few lines to the N. W. A. by request of the amateurs in our outfit, which number up pretty high.

CORPORAL E. J. ATKINSON *(formerly 1QV), 302nd Field Sig. Bn., A. E. F., France.*

Safeguarding Our President By Radio

EXTRAORDINARY efforts were made by the U. S. Navy Department to maintain continuous radio communication with the U. S. S. George Washington, carrying the President of the United States and his official party to France. As is well known, the vessel was convoyed by the U. S. S. Pennsylvania, which was equipped with powerful wireless transmitting and receiving apparatus. Four high power undamped wave transmitting land stations were employed to transmit to and receive from the George Washington, the Annapolis arc set transmitting on 16,900 meters, the arc set at Tuckerton, N. J., on 9,200 meters and the Marconi radio frequency alternator set at New Brunswick, N. J., on 13,000 meters. The Government high power station at Lyons, France, transmitted on 15,500 meters.

The battleship Pennsylvania's radio equipment consisted of a 30 kw. arc transmitter, which was used for transmitting messages to the United States and France on the wave length of 3,600 meters; also one 10 kw. quenched spark transmitter working on 600 and 952 meters, which was employed for communication with low power land stations; a short range radio telephone transmitter working on 297 meters, and one vacuum tube radio telegraph set transmitting on 450 meters. The latter was used for communicating between the U. S. S. George Washington and her convoy, the Pennsylvania. The Pennsylvania worked United States stations up to 2,500 miles and communication was established with Lyons, France, before the Pennsylvania was out of range with the United States.

The Pennsylvania's radio cabin was fitted with six receiving booths which were able to receive at eight different tunes simultaneously as follows: One booth was on constant watch for the 297 meter telephone signal and another booth guarded the 450 meter vacuum tube transmitting set for communication with the Pennsylvania. Another operator on a separate receiving set stood by on 4,000 meters, which is the standard arc calling tune; the fourth receiver guarded Lyons' wave length of 15,500 meters and the fifth guarded Tuckerton's tune, 9,200 meters. The sixth set was kept on constant watch to pick up signals from Annapolis or the Marconi New Brunswick station at 16,900 and 13,000 meters respectively. Another operator with a distinct receiving set and antenna guarded 600 and 952 meters. The principal receiving station in the United States was that located at Otter Cliffs, Me., but other stations were also kept on watch for the reception of signals. On the other side, the reception of signals was effected at Lyons, France.

The radio equipment on the U. S. S. George Washington consisted of a low power spark transmitting set, a 16,900 meter long wave receiving set, one 600 meter spark receiving set, one short wave radio telephone transmitting and receiving set and one vacuum tube 450 meter telegraph transmitting and receiving set.

The George Washington was able to take down messages transmitted from the Annapolis or New Brunswick station and at the same time keep an efficient watch on the wave length of 600 meters, intercept commercial signals, emergency signals or messages transmitted by radio telephone or vacuum tube transmitters, simultaneously.

The messages intended for the George Washington were received principally on the Pennsylvania and relayed to the George Washington by means of the wireless telephone and vacuum tube telegraph set, simultaneously.

Suggestion for Prize Contest, July Issue Wireless Age

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

"What are the relative merits of the regenerative vacuum tube receiver and the cascade vacuum tube amplifier for radio reception at amateur wave length?"

A Simple Method of Tuning the Amateur Transmitter

SINCE the declaration of peace seems a short time off and the whole tribe of amateurs are looking forward to the day when they will be able to revert to the peaceful pursuit of radio telegraphy, the following method of tuning the transmitting apparatus to the required wave of 200 meters will, because of its simplicity, and because of the fact that no wave meter is required, appeal to many suburbanites and less wealthy experimenters, who are unable to procure the use of a calibrated instrument:

An exploring coil of optional dimensions (six or eight turns of No. 20 wire around a short cardboard tube having a diameter of 3 or 4 inches, is satisfactory) is inserted in series with the secondary of the loose coupler of the ordinary short wave receiving circuit. Using a minimum degree of coupling, the receiving apparatus is tuned to the signals of a station having a known 200 meter wave. When these adjustments have been made as accurately as possible, the loose coupler secondary is moved from inductive relationship with the primary, in order to avoid mutual inductance between the two, which would affect the accuracy of the readings.

The complete secondary circuit of the receiving apparatus now forms a wave meter, permanently adjusted to a wave length of 200 meters, the telephones being employed to find resonance as in a standard wave meter. The transmitting apparatus may now be tuned by any one of the commonly used methods. Perhaps the most satisfactory method for our purpose is to excite the aerial by means of a small buzzer, connecting the buzzer contacts to aerial and ground respectively. The buzzer is set into operation, and the exploring coil of the wave meter is brought into juxtaposition with the secondary of the oscillation transformer, so that the buzzer signals are barely audible. The inductance of the oscillation transformer is changed until maximum response is noted in the telephones. The transmitting set next is put into operation and, using a small value of coupling, the oscillation transformer primary inductance is changed until the aerial ammeter or pilot lamp shows a maximum reading. The critical value of coupling to be employed may be ascertained from the other fellow, who can inform you when your wave becomes too broad.

SGT. MAJ. CHARLES MANLEY—*Amer. Exped. Forces, France.*

Contest Winners for June

The April subject for discussion was: "Which of the two following types of wireless transmitter do you consider to be the most practical for amateur use, namely: the panel type or the isolated instrument type?" Prizes have been awarded to the writers of the following articles.

First Prize—The Panel Transmitter Versus the Isolated Instrument Type

TO my mind, the question as to whether the panel or isolated instrument type of transmitter is the more practical is not difficult to answer. While it cannot be denied that the isolated instrument type has given good results and that some amateurs will continue to use it after the ban is lifted, yet there can be no argument against the superiority of the panel transmitter.

A particular advantage of panel mounting is the reduction of the length of the leads in the oscillation circuits. This is a vital factor when we take into consideration that the maximum capacity of the condenser of the amateur transmitting circuit can not exceed .008 mfd.; for otherwise, the wave length of the closed oscillation circuit will exceed the government restriction. In addition to the lead reduction advantage, the panel transmitter permits centralization of control. This is of especial importance when rapid changes in the circuits are to be made, such as changing the radiated wave length. Then, too, the panel set takes up less space and it presents a much better appearance. Any amateur will agree with the latter conclusion after once having seen some stations in which the various instruments, such as the transformer, condenser and spark gap are scattered around the floor. Such haphazard installation is not only uncalled for, but it displays ignorance on the part of the owner in regard to the fundamental requirements of an efficient station.

It is often argued that the instruments of the isolated type of transmitter are more accessible for repair; but to my way of thinking, if the panel type is properly designed it is just as accessible as any other type.

I like particularly the transmitter

described by Mr. Zahorsky in the April issue of THE WIRELESS AGE, but I am inclined to believe that a neater set would result if the experimenters would mount their apparatus behind the panel as is done in standard Marconi sets. While on this point, I would urge that amateurs study the good points of the Marconi panel transmitters described in "Practical Wireless Telegraphy."

The experimenter should realize that commercial companies have sifted this matter down to the last detail and their panel designs are undoubtedly the result of extended experience. Why not make good use of that experience?

The writer once designed a transmitting set which consumed one-sixteenth kilowatt; the instruments, comprising the complete set, were arranged on a table in as efficient a manner as was possible. Later, these instruments were mounted on a panel and increased range of transmission was secured. This was undoubtedly due to the use of short connecting leads, particularly in the spark gap circuit.

I do not think it advisable to suggest a particular design for an efficient panel set, for I believe it to be impossible to put forth suggestions that would be acceptable to all; besides which, the arrangement of the apparatus on the board would depend upon the type of transmitter used. As far as I am personally concerned, the panel set is the only type to which I would give serious consideration.

N. W. LOCKWOOD, *Pennsylvania.*

Second Prize—Panel Versus Isolated Instrument Type of Amateur Radio Transmitter

UNLIKE radio receiving outfits, the hook-ups for transmitting outfits are limited, and are practically on a par, so far as the efficiency of the set is concerned. The amateur's sending set generally consists of the following instruments: key, step-up transformer, condensers, spark-gap, oscillation transformer, and usually a hot-wire ammeter. There are but two schemes in general use (see figures 1 and 2) for connecting these instruments, and they are practically identical in regard to efficiency.

The first factor for the amateur to consider in the design of his transmitter is to arrange and design the instruments so that the radiated wave length will comply with the laws governing amateur or experimental transmitting stations. To keep the wave length within the restrictions imposed by law, the shortest possible connections should be used. Next in importance is the insulation problem. Leakage is the source of large losses, but it can easily be prevented.

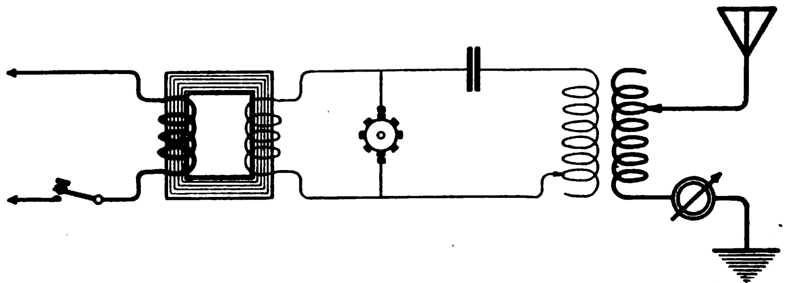


Figure 1—Standard hook-up for amateur panel transmitting set

Now for the particular advantages the panel type possesses over the isolated instrument type: It is not necessary or desirable to isolate the several instruments in order that different hook-ups may be tried, because they have all been tried, and the best ones appear in figures 1 and 2. It is a well known fact that it is a much easier matter to make short connections when the instruments are mounted on a panel. Good insulation can be had in either method. I have

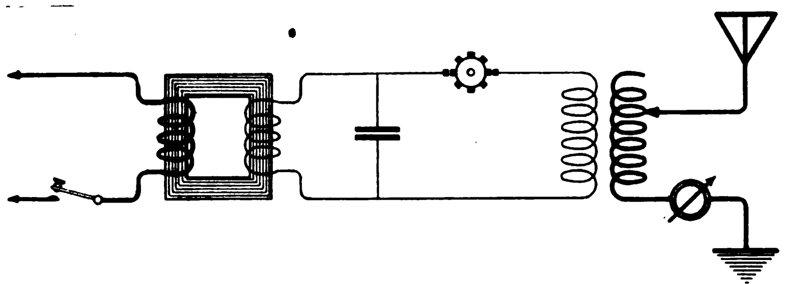


Figure 2—Another form of figure 1

seen panel transmitting sets in which nearly all connecting wires, binding posts, etc., were imbedded in an insulating compound, making them weather and "fool" proof. With regard to the comparative ease of operation of the two types, they are on a par, and depend entirely upon the forethought used in installation.

Finally, I am sure the readers of THE WIRELESS AGE will agree that, as a rule, the panel type amateur transmitter, although slightly more expensive, has a decided advantage in neatness and appearance as compared with the old fashioned, isolated instrument type.

L. W. VAN SLYCK, *Michigan.*

Third Prize—The Panel Transmitter

AMATEUR transmitting sets may be divided into two general classes: The panel type, in which the instruments are arranged in a compact, systematic manner and the isolated instrument type, in which they are scattered about without regard to over-all efficiency. For the amateur who wishes to get the best results from his sending set, the panel type is by far the most desirable of the two. The efficiency of a transmitting set will be remarkably increased by panel mounting, principally because of the reduced length of the leads in the oscillating circuits. In addition, this construction provides better insulation.

Arrangement of the instruments, one above the other, in logical order, permits short leads which need not cross each other and in the matter of insulation each separate instrument has its own rack, thus doing away with leakage or cross induction. Thus the panel transmitter affords a remedy for the two greatest defects of the isolated instrument type.

A most important factor in operating sending apparatus is the assurance of safety to both the operator and instruments. The panel, because of the small floor space it requires, can be placed in a convenient position where it will not injure the receiving instruments. The only wires required to operate the panel at any distance are those leading to the key and to the rotary gap switch. In this set, moreover, the apparatus, situated behind a protecting panel, is in no danger of being jarred, upset, broken, or put out of adjustment as may be the case when the apparatus is spread all over the room. And not only are the instruments and their connecting wires removed from the operator's very elbow, but further, all wires are mounted behind the panel, eliminating the danger of shock to any one while sending.

Compactness, a valuable quality in any set, is a feature of the panel transmitter. The manner of arranging the instruments one over the other naturally makes a compact set. Indeed, a panel equipped with ordinary amateur apparatus can easily be mounted in a space, 4 feet by 3 feet by 2 feet. This compactness facilitates quick adjustment and renders the set portable. In this feature, the panel has a great advantage over the old type, in which the willy-nilly arrangement of the component parts makes adjustment difficult and quick moving impossible.

While not important in respect to efficiency, an always outstanding feature of a transmitting set is its appearance. In a panel transmitter the orderly arrangement of the apparatus gives a pleasing effect. In some types of panels all of the instruments are back of the panel itself, while in others, they are on the front. There are numerous models of each type, which have been described in previous issues of THE WIRELESS AGE, all of which would give a station a distinctive appearance.

Now, as to the objections to the panel transmitter: Many amateurs have the idea that such a set is large, expensive and distinctly professional. Others think that it is difficult to operate. In the first place, a panel set is not big and cumbersome. I have never seen a diagram for a panel which was larger than 5 feet from floor to top, 3 feet across the front and 3 feet from extreme back to front. In fact, one of such dimensions is unusually large. So, if the amateur can stand upright in his wireless room, he has more space than is needed to erect a panel. It would occupy, if of usual dimensions, about 6 square feet, that is, approximately 3 by 2 feet, whereas the old type transmitter requires usually double or triple that amount of space.

The apparatus used in a panel set is exactly the same as that of the ordinary amateur set. To change to a panel set, it is only necessary to transfer the instruments from their present isolated locations to the well-arranged shelves made for them in the panel. The only added expense is in making the panel, an easy task for any amateur handy with tools. This light cost is more than made up for by the efficiency and pleasing appearance of the finished panel.

Backed by the experience and opinions of some of the foremost authorities on wireless in this country, I strongly advise and in fact urge amateurs to discard the old method of isolated arrangement, and to place their apparatus in a vastly more practical form, i.e., build a panel transmitter.

HARRY HEMPHILL, *New Jersey.*

The Monthly Service Bulletin of the

NATIONAL WIRELESS ASSOCIATION

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

Pittsburgh Club Resumes

A CAMPAIGN for membership has been instituted by the Pittsburgh Radio Club, an organization which was formed some time before the war. Regular meetings will be held at stated intervals, where the members can get together and discuss the various problems in which they are interested, arrange relay systems, tests of equipment and other activities. Interesting talks will be scheduled on such subjects as the construction of some particularly efficient piece of apparatus, wave-lengths and tuning, description and explanation of any new and interesting radio apparatus, wireless legislation and amateur experiences in the service during the war.

Another and very important function of this club will be that of teaching the International Morse (Continental) Code to all those who are not now as proficient as they would like to be. Burton Williams, president of the club, was in the Signal Corps, U. S. A., and later was Government instructor at the school for training radio operators installed in the Carnegie Institute of Technology.

It is proposed to install complete sending and receiving equipment in the club rooms for the benefit of all the members, the present plan being to use two aerials; one long one for receiving, and a 200 meter aerial for sending. The equipment will also include an omnigraph and buzzer practice sets for code practice. It is further proposed to subscribe for the leading wireless magazines and endeavor to have a library section.

Invitations to seek membership are issued to all amateurs. C. E. Urban, 26 Watson Boulevard, N. S., Pittsburgh, Pa., is secretary of the club.

Regarding Restrictions on Amateur Stations

THE radio stations of the United States may be classified into three types, namely; commercial (including ship and shore stations), government and amateur stations. The first two types are essential to the nation for commercial and military reasons. The amateur stations are extremely useful to the country largely on account of their educational influence on the future wireless operator.

In the early days, because of the comparatively small number of radio stations in operation, the matter of interference was a negligible factor, but with the rapid increase of stations during the last ten years, interference has become such an important problem as to require regulation. As all radio men are aware, the authority to regulate the wave lengths and power employed has been delegated to the Department of Commerce.

In my opinion, the only way to eliminate interference is to classify stations according to their importance and have them operate in a region of defined wave lengths. The amateur has been allotted any wave length up to 200 meters and in exceptional cases wave lengths in excess of this figure. The principal objection to some amateur stations is, that they are not carefully constructed and properly tuned and as a consequence they radiate what is termed a "broad wave." This, of course, is in violation of the wireless statutes and creates a great deal of unnecessary interference. In some cases the emission of a broad wave is due to the use of the direct aerial connection, that is, the spark gap is placed in series with the antenna. If the authorities would compel the use of coupled circuits, this difficulty would be largely eliminated. In fact, in the writer's opinion, if regulations were enacted restricting the use of broad waves, the actual wave length used by the amateur, particularly in certain localities, would make little difference.

I would suggest that amateur transmitting stations be divided into two classes. In the first class we would place such stations as would do purely local transmission; and in the second class, those who intend to transmit over great distances. I would urge that the amateurs in the first class be permitted to operate in 150 meters and those in the second class on wave lengths up to 250 meters. If this policy was adopted, the local amateurs would not interfere with those doing long distance work. Furthermore, those in the first class might be allowed to operate their apparatus without obtaining a license provided they will conform to the regulations concerning wave length, power, etc.; but those entered in the second class should be required to pass an examination covering their proficiency in the telegraph code, technical knowledge, etc.

Amateurs in the first class would be limited to spark coil transmitters or alternating transmitters of equivalent low power. Those in the second class should be allowed to use power inputs up to 1 kw. Amateur stations in the vicinity of commercial or naval stations should be limited to the same power input as in the past.

It is the moral duty of every amateur wireless operator to do everything in his power to prevent interference with commercial or government stations and there is no reason why he should not take a similar attitude toward amateur stations. The experimenter also should be educated to make use of variable power inputs and to use no more power than is necessary to cover a given distance.

J. C. MORRIS, JR.—*Louisiana.*

Vibration as a Basis of Invention

THE person who would give to the world some great invention must not deceive himself into thinking that he can do it by creative processes. It is not our function to create. It is our province only to adapt the laws and forces already in existence to our needs. The process is really a relative rather than a creative one. The laws and forces are here. It is our work to relate ourselves to them. One cannot build a machine that will do anything. He can only construct a mechanism through which the already existing laws of nature can operate.

Another mistake apt to be made by the amateur, and one which will lead him farther away from instead of nearer to success, is the entertainment of the notion that a wonderful mechanism must necessarily be complex. The wonderful thing about nature, after all, is its simplicity. The mechanism which is to establish a point of contact between us and a force of nature must be as simple in its principle as the force itself.

The notable thing about almost any of our great inventions is the simplicity of their design and operative principle. After observing the action of any of them one is quite apt to turn away and inwardly remark that he could have done the same thing himself if he had only thought of it. Of course, the chief approach to any notable achievement is the matter of thinking of it. Most of us do not think of these things, and the reason is often the fact that we are looking for something complex when the real principle is very simple.

The problem of the would-be inventor or discoverer, then, is not one of adding something to the universe as it stands. His work is to ponder the forces that have long operated and the laws by which they have operated, and then relate his work to some one of them. One of the chief of these, and one upon which some of our notable inventions have been based, is the universal fact of vibration.

The first great inventions which are based upon the vibration theory were made long before any of us were born and each of us has been given a free sample of both. One is named the eye, while the other is known as the ear. So far as that is concerned the work of the actual nerves at the surface of the skin is based upon the same principle.

The other day in a medical laboratory I was examining a dissection of the human head made with a view to showing the nerves in their relation to the spinal trunk and to the brain. The brain had been removed down to where its base rests upon the spinal stem. I was not so much interested in the countless fibers running off from the entire length of the spinal cord nearly so much as the two sets of nerves which have to do with seeing and hearing. Off from the spinal stem, just below the base of the brain, two large nerves ran forward to the eyes, and two other large ones ran aside to the ears. These were the optic and the auditory nerves, respectively.

These are the means which the Ruling Genius of the universe has established by which the person may maintain his contact with the outward world. One of these sets takes up vibrations and reports them in terms of light. The other takes vibrations and reports them in terms of sound. The two sets look almost precisely alike. The means by which they are made to distinguish vibrations into these two different forms of interpretation remains a mystery, unless it be that they are made sensitive only to given lengths and types of waves.

The eye was the first camera, and the inventor of the photographic process necessarily had to base his work on precisely the same principle. A sensitive surface had to be provided; a means had to be established whereby it might receive and be affected by ether vibrations of given lengths; then the result, which in the case of the eye is so temporary, had to be chemically fixed and thereby rendered permanent.

The phonographic process is related to the vibration theory of sound just as the photographic process is based upon the wave theory of light. A phonographic record is simply the photograph of a sound. A surface had to be provided which was capable of receiving the record of the vibrations which make a given sound. The means had to be provided by which they could be permanently recorded there. Then a mechanism capable of reproducing them made the phonograph complete. The same effect was produced upon the ear as would have been produced by the original vibrations themselves. Thereby the thing which is fleeting and temporary to the ear was rendered more or less permanent. These two inventions proved once and for all the truth of the theories on which they were based.

Telegraphy and telephony, both ordinary and wireless, are likewise based upon phases of the vibration principle. Each in its day has been revolutionary. We, are, however, only upon the threshold of achievement in these vibratory means of communication. Each is simple, when once achieved, because each is based on ordinary and everyday laws of nature. Those who are improving upon the processes already established are not those who are trying to find different paths. They are those who are seeking a closer acquaintance with natural laws as they are, and who are seeking better ways of relating ourselves to those laws, can only improve upon their use.

There is a great field for scientific and inventive progress of an intensive nature. As we move forward in the effort to gain a little firmer hold upon natural processes we find ourselves able to throw away today equipment which was very necessary yesterday. First, we could carry communication farther and better with metal media between the communicating points. Now we do it equally well without the artificial media.

A few years ago a scientist announced that he could accumulate, concentrate, and unloose a vibratory force sufficient to wreck the planet on which we live. Should anyone want to do such a thing, and should the rest of the world be willing, there is little doubt that such a thing would be possible. There is probably no limit to the harm that could be done by harnessing up the ever-present vibrations to an evil end. Neither is there any limit to the good they can be made to do when intelligently turned to worthy purposes.

Probably the statement of the scientist mentioned above was, after all, only a part of the truth. Someone has said that one cannot move his finger without displacing the elements of the universe all the way to the farthest star. Vibration is not only here but everywhere. It carries light to us from so far that years are required for the journey. It is not inconceivable that it might be made to do the same with sound.

Certainly it could be made to do the same with ideas if two conditions could be fulfilled. First, there would have to be living and intelligent beings elsewhere in the universe. Second, there would have to be a common code or basis of interpretation between ourselves and them. About the first we do not know. As to the second, no one yet sees how to accomplish such a thing. Archimedes could have moved the world with a lever if he had only had a place to stand, but of course he did not have it, so the possibility was spoiled. The principle of the lever, however, held just as good as though the impossible condition could have been fulfilled. Likewise, the law of vibrations would permit of a system of wireless out into the reaches of space. The difficulty is not with the law.

Nature probably holds some provision for our every want. We need only to establish the means by which she can deliver her gifts to us. The universe thrills with life and action. Out of its heart-throbs we shall be able to gather many a blessing.

CLARENCE E. FLYNN—*Indiana.*

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.

E. B. N., Dallas, Texas:

The use of closed coil or frame aerials is perfectly feasible in amateur radio reception, if an efficient amplifier is provided to bring the signals up to audibility. Frames 4 to 5 feet square can be employed for transatlantic reception with multi-stage amplifiers. The natural wave length of the closed circuit loop should be somewhat near to the wave length to be received. For amateur reception a coil 7 to 9 feet square wound with three turns of wire spaced ½ inch will give very good results, but the plane of the coil must point in the direction of the transmitting station. Twenty or thirty turns of wire, spaced ⅛ inch, wound around the same frame will give good results on the longer wave lengths. For amateur reception, the coils are preferably mounted on the roof of the building and constructed so that it may be rotated through an arc of 180 degrees by some mechanical contrivance within the station. A four-stage resistance coupled amplifier constructed in accordance with the description in the April issue of The Wireless Age, or in accordance with the several circuits shown in the recently revised text book "Vacuum Tubes in Wireless Communication," will permit reception of short wave lengths over considerable distances. The directional characteristics of these frames permit a considerable amount of interference to be eliminated. Such an aerial, in fact, constitutes a direction finder and will indicate the general direction of an advancing wireless telegraph wave.

* * *

J. A., San Juan, Porto Rico:

Perhaps you misunderstood the reply to the query in the September, 1917, issue of The Wireless Age. Loading coils should be connected in both primary and secondary circuits of the long wave receiving tuner mentioned in that query. Unless multi-layered primary and secondary coils are used the tuner would be too clumsy to be manipulated conveniently.

The inductance required in the secondary circuit of a receiving tuner for a given wave length can be readily calculated by Nagaoka's formula, shape factor curves for which are given in the text book "Practical Wireless Telegraphy." To determine the required value of inductance you must first decide on the maximum shunt capacity to be used across the secondary circuit. Then use the following formula:

$$L = \frac{\lambda^2}{3552 \times C}$$

where C = capacity of the condenser in microfarads, λ = wave length in meters and L = inductance in centimeters. The dimensions of a coil to satisfy the inductance found by the above formula may be determined from Nagaoka's formula in "Practical Wireless Telegraphy" or Lorenz's formula in "How to Conduct a Radio Club."

In regard to the condenser of one microfarad capacity: You will find it less expensive to purchase one of this capacity than to construct it. Doubling the area of the surface of the condenser will double its capacity, provided the dielectric remains the same. Any electrical supply house can probably furnish you with one of these condensers.

Galvanized iron wire will function as a receiving antenna, but copper wire is better. Platinum wire can be obtained from any electrical supply house.

Regarding the dimensions of the buzzer coil for exciting the secondary circuit of the receiving tuner: If you desire to employ an aperiodic excitation circuit, a dozen turns of annunciator wire wound on a spool 2 inches in diameter, will be sufficient to set the detector circuit into excitation.

* * *

J. P. S., Buffalo, N. Y.:

If your first inquiry in reference to the best amateur antenna refers to wireless transmission at amateur wave lengths, the flat top portion should not be more than 120 feet in length; otherwise, the fundamental wave length will exceed 200 meters. A "T" aerial of the same dimensions as the "L" type will have a lower fundamental wave length. To change from an "L" to a "T" aerial often proves a very convenient means of reducing the fundamental wave length below 200 meters.

In reply to your second query, regarding the relation between the power of a transmitter and the radiated wave length: You should know that many variable factors enter the case. A high power transmitter necessarily radiates at long wave lengths on account of the large condenser required to absorb the output of the high voltage transformer.

In reply to the third query: When a wireless transmitter radiates waves of high decrement it radiates a wave of such characteristics that it will set into excitation receiving sets which are not sharply tuned to the radiated wave.

The Weagant static eliminator is feasible for amateur working but requires rather large aerials. Each loop should be about 350 feet long and the plane of the antennae should preferably point in the direction of the transmitting station.

* * *

J. W., New York City:

You are quite right in assuming that an undamped wave receiving set which employs the heterodyne principle radiates electromagnetic waves. If one of your amateur friends possesses a similar set there is no reason why you cannot establish wireless telephone communication over one-quarter mile, as you suggest. In fact, the writer, with an 8,000 meter set adjusted for undamped reception has communicated telephonically with another amateur station adjusted to the same wave length over a distance of 1¾ miles. You would obtain far better results with the circuit you have shown by connecting the microphone in some part of the grid circuit. Of course you cannot expect to obtain maximum efficiency in undamped wave transmission with a receiving set because of the resistance of the tuning coils.

In the matter of wireless telephony, your attention is directed to the last chapter of the newly revised edition of "Vacuum Tubes in Wireless Communication." Complete details of oscillating tube wireless telephone transmitters that will prove highly satisfactory for amateur communication are given. Also note the article by M. W. Sterns in this issue of THE WIRELESS AGE.

It is practical to connect several oscillating bulbs in parallel. Good results will be obtained with bulbs of identical operating characteristics.

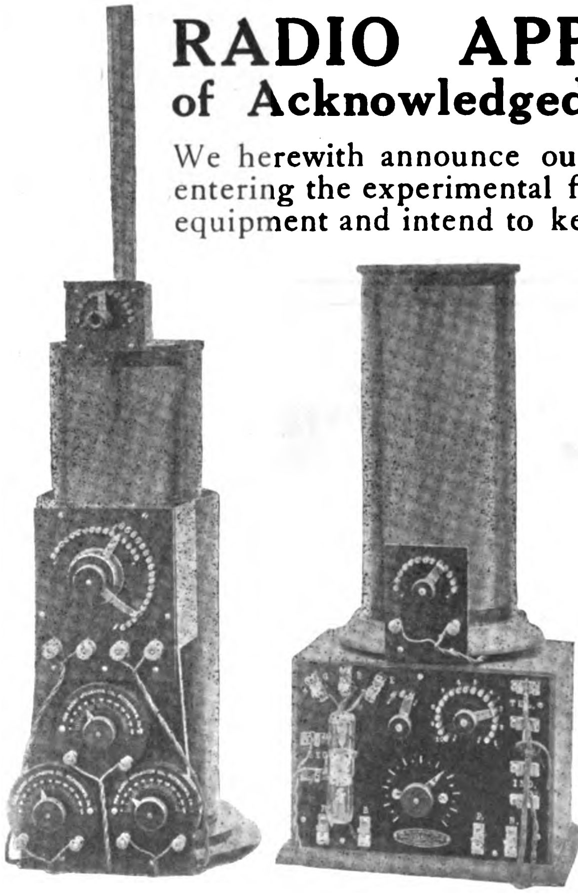
The presence of a ground antenna within 40 feet of your receiving antenna will effect the latter's resonating qualities and change its wave length. Whether or not it will weaken the signal in the receiving antenna is a matter governed by many variable factors and the facts can best be determined by experiment.

The matter of amplification in vacuum tube circuits is an elusive measurement, from the amateur's standpoint. Just how much a set will amplify depends upon a number of conditions which have to be taken into consideration. One thing you will observe in a cascade amplifier is, that its amplifying qualities are most discernible in the reception of weak signals. Strong signals will not be much louder than with a single bulb.

* * *

H. H., Atlantic City, N. J.:

In view of the local conditions surrounding your station, it is believed that an antenna built in accordance with the sketch you have sent in is the best possible design. It is often very difficult to remove the induction from arc light circuits and trolley wires. One method of getting rid of this interference is to erect a single wire aerial 30 or 40 feet high in close inductive relation to the power wires and couple this circuit inductively to the secondary circuit of the receiving transformer. By this means, the the interfering currents in the receiving antenna can sometimes be brought into nearly opposite phase with those induced in the special antenna, resulting in almost complete annullment. The diagram you show for a receiving set is correct. Special advice on this matter is not necessary. THE WIRELESS AGE has published many diagrams applicable to amateur work.



Type 93 Undamped Wave Set