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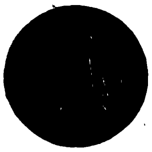
The WIRELESS AGE

Volume 6 Number 10

The Amateur Gets Busy Again

Exclusive Description of the Greatest Invention of All: Weagant's Discovery Eliminating Static Interference

BUY WAR SAVINGS STAMPS



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

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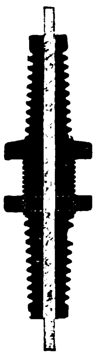
LOUIS STEINBERGER'S PATENTS

Medal and Diploma received at World's Fair, St. Louis, 1904



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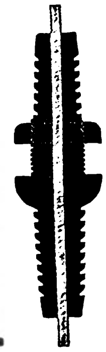

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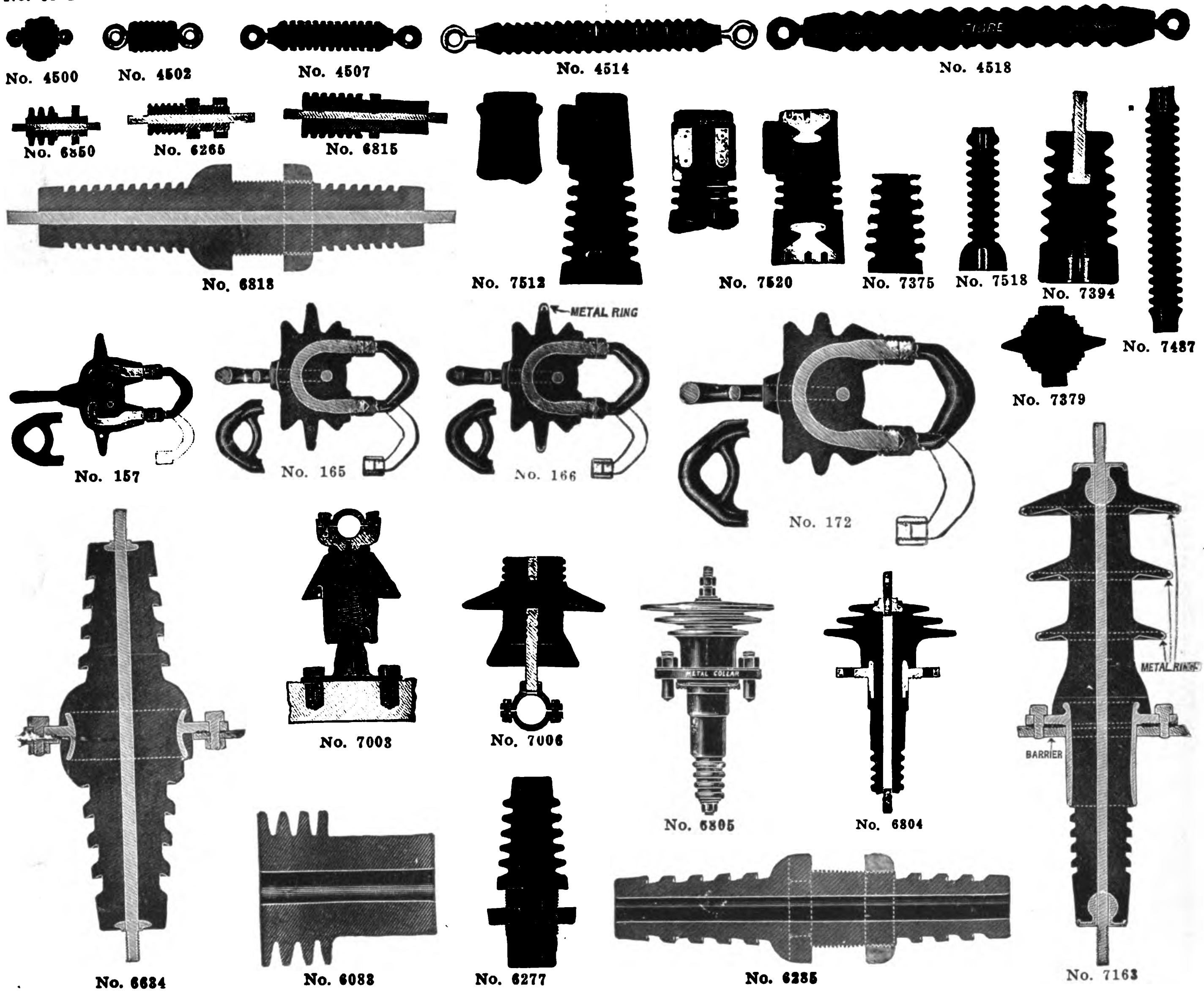

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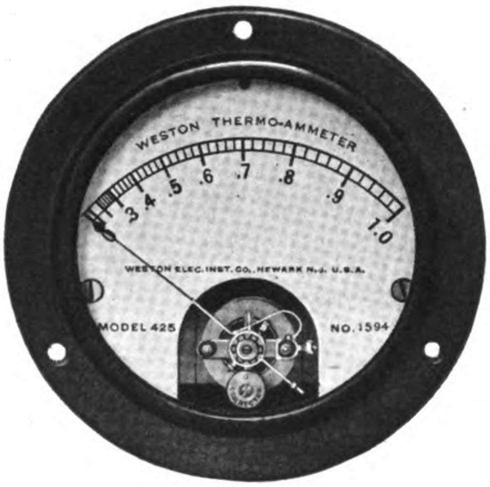

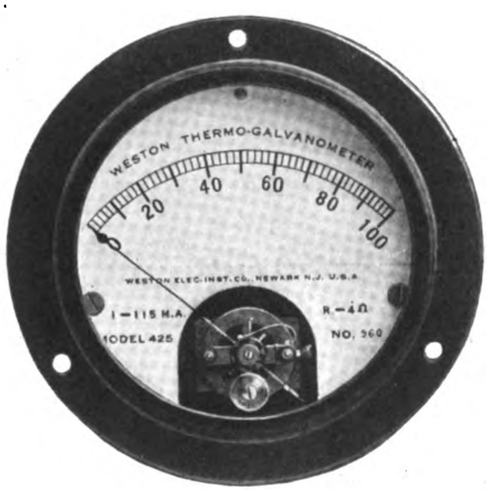

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The Wireless Age

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

Vol. 6 — No. 10

Contents for July, 1919

Index of Equipment

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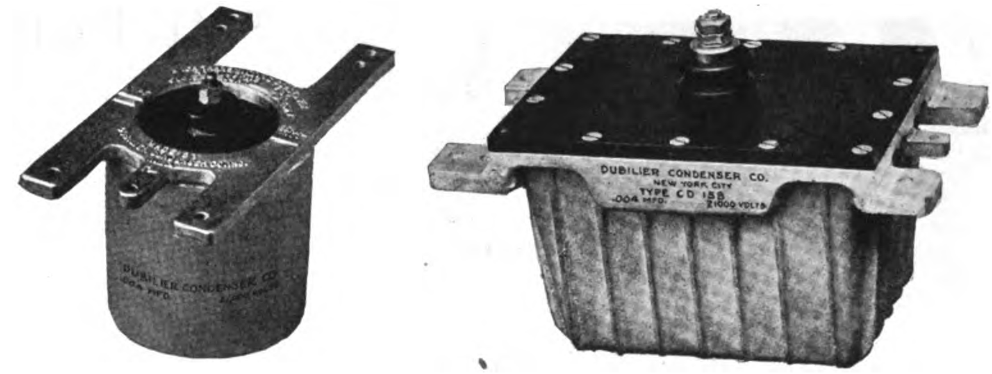

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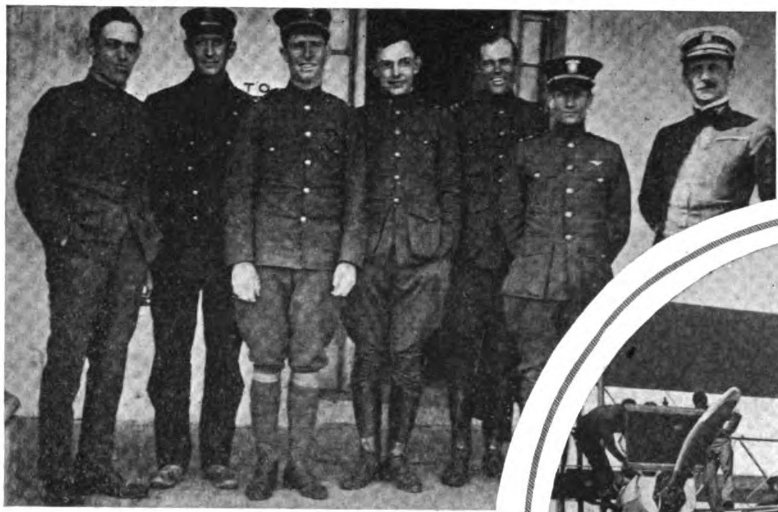
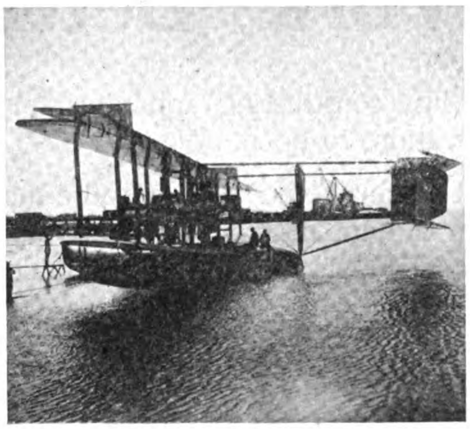


THE FLIGHT OF THE NC-4

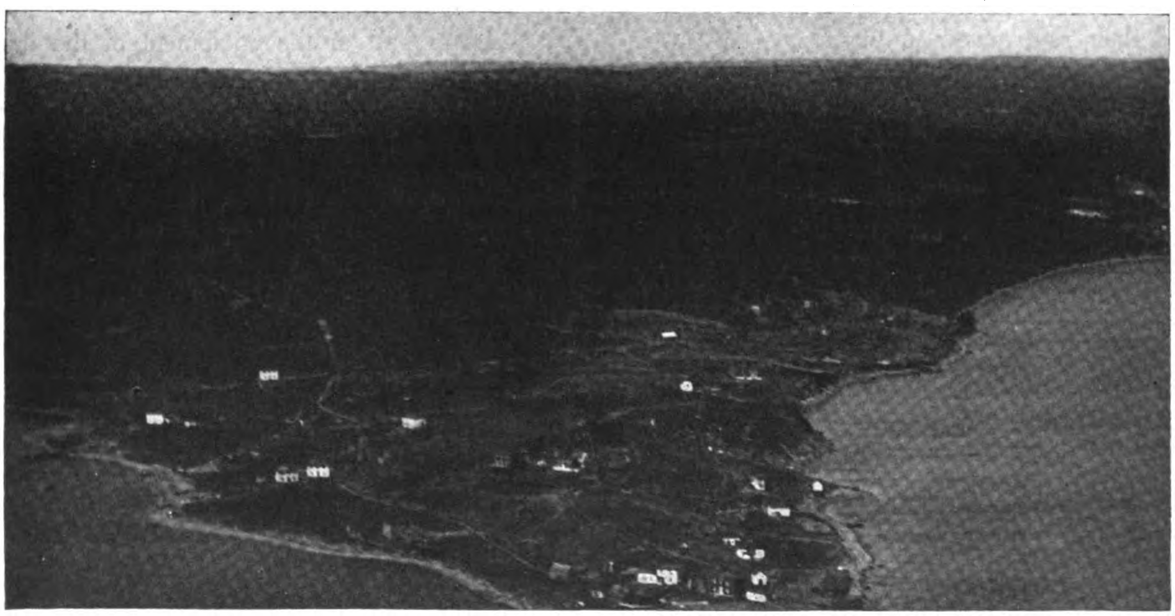
Members of the pioneer cross-ocean air crew as they appeared when they landed at the Azores



Above, in the circle, a view of the final preparations and inspection prior to making the first overseas flight in history

On the left, the NC-4 just before leaving Rockaway Beach for the trans-Atlantic "hop"

Press Ill. Svce.



As Trepassey Bay looked as the three naval flying boats headed off across the ocean

VOL. 6. No. 10. JULY, 1919

THE WIRELESS AGE

WORLD WIDE WIRELESS

Wireless Telephony at Atlantic City

DEMONSTRATIONS of wireless telephony as applied to airplane movements, were among the features of the work of the second Pan-American Aeronautic Congress held recently at Atlantic City.

Many visitors and delegates had their first actual experience with this adjunct to aviation through the apparatus which was installed at the ocean ends of the Steel pier and Young's million dollar pier, and which established and maintained easy communication by the speaking voice with a seaplane in full flight about twenty miles off the New Jersey coast.

As used in the seaplane the apparatus clearly demonstrated the remarkable progress that has been made in constructing complicated instruments in a compact yet accessible manner. Formerly a radio telegraph outfit for sending and receiving occupied a large space, was bulky and cumbersome. Now one small table holds all the needed devices for either telephoning or telegraphing through the air.

National Radio School for Navy

GREAT LAKES has been chosen by the Bureau of Navigation as the site for the new radio school which is to be founded at this station. The first real information came through Lieutenant Mason, district communication superintendent and temporarily in charge of the radio school.

Plans beyond the tentative stage have placed the personnel in the new school at five thousand and there are possibilities of it assuming larger proportions. Commander Weaver in charge of all naval radio work in the United States will take command of this largest and only school of its kind in this country.

The school will be the center of all naval radio telegraph and radio telephone instruction work. Officers are firm in their belief that it will be one of the greatest educational institutions that the navy ever has afforded.

Tribute Paid to Wireless Heroes

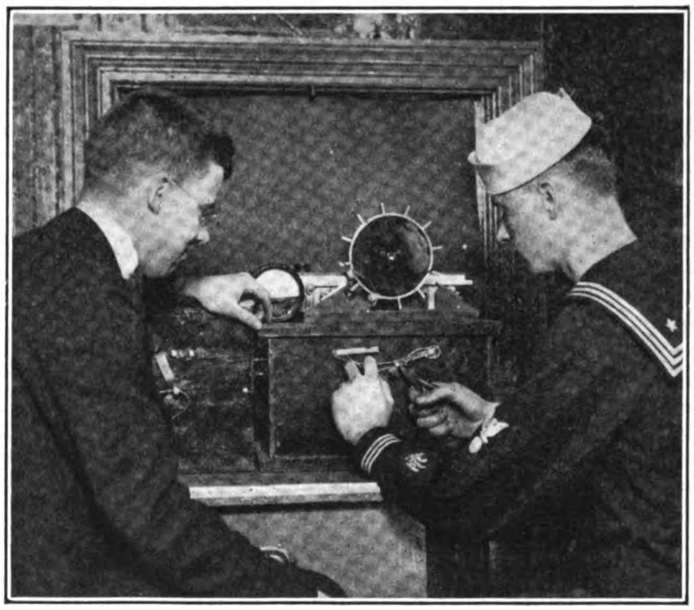
ON Memorial Day a wreath was placed on the monument erected in Battery Park, New York, in memory of wireless operators lost at sea. For the fourth successive year a committee of officials of the Marconi Wireless Telegraph Company of America visited the memorial fountain and with a simple ceremony paid tribute to the wireless men who have given their lives in the service of the merchant marine.

The monument was erected in 1915 by popular subscription during the time when the world was recovering from the shock of the Titanic tragedy.

Commercial Wireless Company for China

AN agreement has been signed between Marconi's Wireless Telegraph Company, Ltd., and the Chinese Government for the formation of the Chinese National Wireless Telegraph Company, with a capital of $3,500,000, half the amount to be subscribed by the Government and half by the Marconi company.

The Marconi company will manufacture wireless apparatus in China and also maintain existing and future wireless installations.



Press Ill. Svce.

A happy moment for the amateur for the naval man is breaking the seal of an amateur wireless apparatus silenced during the war

Wireless Aids Victim of Mysterious Shooting on Shipboard

IN answer to a wireless call from the steamship Makanda of the United States Shipping Board, lying off Sixty-fourth street, Brooklyn, Capt. John Smith of the police marine division responded in a police launch. He found John O'Donnell, 39, a fireman, suffering from a gunshot wound in the left arm.

O'Donnell said that when working on the deck he suddenly felt a stinging sensation and discovered that he had been wounded. He heard no gun report and said that the shot must have been fired from shore or from a passing vessel. He was treated and taken to Kings County Hospital.

Radio Service between Australia and Britain Under Consideration

A COMMERCIAL radio service between Australia and the British Isles is being considered by the Australian Government. It is estimated the cost of wireless transmission would be only one-third of cable messages. If the plan goes through, the cables still will carry the bulk of the code traffic.

The British War Cabinet has appointed a telegraphic communications commission, headed by Lord Milner, to consider the establishment of State-owned wireless stations throughout the Empire.

Wireless Telephone Discovered by Accident

THE wireless telephone was the accidental result of a search for something quite different—the wireless transmission of power. This was the opinion advanced at a recent meeting of the Institution of Radio Engineers in the Engineers' Building by E. F. W. Alexanderson, when accepting the gold medal of the institution in recognition of his original research and invention in the radio field.

"Radio telephony," he said, "is a by-product of the sustained radio waves as a method of alternating current power telegraphy to reproduce speech from the transmission. With the previous system of spark telegraphy it was no more possible to transmit the modulations of the human voice than it would be in land dots and dashes of the Morse code."

Marconi Company Wins Important Patent Litigation

IN a decree recently signed by Federal Judge Mayer, the Marconi Wireless Telegraph Company of America has again been successful in patent litigation under the Fleming Patent No. 803684 granted November 7, 1905 to Prof. John Ambrose Fleming of England, the famous Marconi wireless expert. This patent owned by the Marconi Company, covers the audion—known as one of the most sensitive instruments for use in wireless telegraphy and telephony—and the decree obtained by the Marconi Company is directed against the Atlantic Communication Company, which operated the high power wireless station at Sayville, Long Island, prior to the war in connection with German interests.

The Sayville station was built before the war and was finally taken over by the United States Government, so that no injunction could issue in this suit, but now the Federal Court has held that the receiving apparatus employing audions infringes the Marconi Company's Fleming patent and the decree excludes the Atlantic Communication Company from all rights in the invention.

The Court has appointed Judge E. Henry Lacombe, a special master to ascertain the amount of damages to be assessed against the defendant company, the assets of which are all in the hands of the Government.

International Company Begins Radio Phone Suit

A PATENT infringement suit has been started in the Federal District Court by the International Radio Company of Wilmington, Del., against the Western Electric Company of New York. The complaint alleges that the International Company owns six patents granted to Reginald A. Fessenden and that the apparatus covered by the patents is being used by the Western Electric in making radio-telephones which are being sold to the Government.

The plaintiff asks for triple damages if the defendant continues to manufacture and market the telephones.

The Armistice Preliminaries Hastened Through Use of Wireless

WHEN the Huns last fall somewhat feverishly indicated the desirability of cessation of hostilities it was the judicious use of wireless by Uncle Sam, in direct communication with the enemy on his own stamping-grounds which hastened the armistice preliminaries and brought the fighting to an end Nov. 11. It wasn't exactly according to Hoyle. In fact, communicating in such a forthwith and extemporaneous manner in that sort of situation "isn't done" in well-regulated diplomatic circles, or it hadn't been until your Uncle Samuel did it.

The story of how it was done was told in the New York Evening Post.

It was 12 o'clock noon—one day about Oct. 20, last—when every government wireless operator on duty in the allied countries was startled out of his wits by a signal-call from the radio-station at New Brunswick, N. J. The operators of the wireless stations of the central powers could not have been more surprised.

"P O Z—P O Z—P O Z—de N F F," buzzed the wireless. The allied radio operators saw immediately visions of brazen treachery or equally brazen German spy operations in the United States. They saw visions of an American war-scandal, such as the world had never known, court-martials and firing squads and possible revolution in America.

For P O Z is the radio call for the German government wireless station of Nauen, a suburb of Berlin, and N F F is the radio address of the United States naval sending station at New Brunswick, and the two had not been on speaking terms for a long time.

There must have been a real Prussian at the Nauen switchboard, for within two or three minutes, he responded patronizingly: "Your signals are fine, old man."

Whereupon the "old man" in New Brunswick proceeded to dispatch through ether a message which was not so fine as it was clear. No code was used. The message was in plain English. It was the first of President Wilson's statements to the German people carrying the suggestion that the allies would conduct no negotiations for an armistice and peace with the German government as then constituted.

Thereafter Washington was in constant communication with Berlin. Wireless was making history at a faster pace than all the engines of destruction on the battle-fronts had ever been able to set up. Wireless was saving thousands of lives, perhaps millions. The negotiations between Washington and Berlin continued till the day the armistice was signed.

Japanese Ships Have New Wireless 'Phones

TOKIO papers state that wireless telephones are to be installed on the Toyo Kisen Kaisha passenger liners operating across the Pacific from San Francisco to Yokohama.

The department of communication of Japan, it is stated, is completing arrangements to connect the steamers at sea with public telephone centrals at Tokio and Yokohama by means of wireless telephone apparatus.

New York Manufacturer to Use Wireless

A PROMINENT electrical and radio manufacturing concern of New York City will install, as soon as the ban on sending is lifted, a complete Radio Telephone System between their factory and several branch stores, so as to relieve a greater portion of the land telephone traffic between these units of the organization.

Speed Record Made in Broadcasting Wireless Communication

THE navy in its effort to establish a world's record with a flight across the Atlantic, also set up a new mark in wireless communication.

With the seaplane NC-4 zipping up the North Atlantic coast to join its fellow fliers in cross-sea flight, Acting Secretary Roosevelt grew anxious as to Commander Read's progress. A wireless telegraph message to the NC-4 was transmitted as follows:

"What is your position? All keenly interested in your progress.

"ROOSEVELT."

Two minutes later the radio operator took the following reply by wireless telephone from Commander Read of the NC-4 on the desk at the Navy Department:

"Roosevelt, Washington. Thank you for good wishes. NC-4 is twenty miles southwest Seal Island, making eighty-five miles per hour.

"READ."

In three minutes the high power wireless stations had flashed the news to Paris, London, Panama, San Diego, Cal., and all ships at sea.

Fort Cliff Wireless Compass Station Burns

THE Coast Guard and Radio Compass Station at Fort Cliff, Mass., has been destroyed by fire together with practically all of the life saving apparatus except a small surf boat. Members of the crew escaped by jumping from second story windows. The station was in charge of Capt. Matthew Hoar.

Wireless Messages Received Inside Steel-Concrete Vault

A WIRELESS telephone message from the station at New Brunswick, N. J., has been received at Asbury Park inside a steel and concrete vault under-ground by W. Harold Warren of New Brunswick. He had a portable receiving set, carried in one hand, and neither aerial nor ground connection.

Two sets of head receivers were used; a wireless telephone speech from the New Brunswick radio station was heard distinctly.

The main dining room of the Hotel Klein, New Brunswick, was connected with the local radio station by regular telephone and a relay connection made by wireless telephone. The music of the hotel's orchestra was clearly heard by Mr. Warren inside the vault at Asbury Park.

The commandant of the naval station said that on the last trip of the steamer George Washington to France with President Wilson, the orchestra of the hotel was connected by wireless telephone with the vessel and the music was clearly heard when the ship was 600 miles at sea.

Canadian Forest Fires Fought by Wireless Telephone

CANADA is employing the wireless telephone and airplane in forest-protection service. Two machines have been installed in the Quebec district, and they operate in conjunction with patrol stations, with which the machines are in communication by wireless telephone. Such a system assures prompt discovery of forest fires and early effort at extinguishing the blaze may result in saving great quantities of valuable timber.

New Transatlantic Station at Montreal

THE Marconi Company will erect a long distance wireless station at Montreal to handle some of its transatlantic business. The station will work directly with Paris according to the announcement.

A fine aerial for a hot summer day when signals are coming in bad

Audio Frequency Signals for Aviators' Use in Fog

THE Navy Department has adopted an audio frequency signal for aviators which will enable them to land with safety in a dense fog or in the dark.

This system of audio transmission which has been perfected has played a conspicuous part in the war and is now being applied to the uses of peace. It will be of advantage to navigators finding their way through fog into port, as well as to navigators in the air.

The difficulties encountered because of fog in the recent transatlantic flights of the NC-4's and the Vickers-Vimy airplane demonstrates the need of just such a device.

Mobile Station Gets Two New Towers

TWO new towers for the wireless station of the former Marconi station at Mobile, Ala., on top of the Battle House are being erected. This station is under the direction of the government at the present time. The towers were blown down in the storm of July 5, 1916, and were never restored except in a small way. The towers will be about 40 feet in height.

Nauen and Eiffel Tower Communication Resumed

WIRELESS communication between Nauen and the Eiffel Tower in Paris has been resumed so that the German peace delegation can keep in close touch with Berlin.

British wireless men of the 11th Corps stationed at Weisdorf, Cologne. The building in the background is a part of the great German chemical works at Weisdorf

Two Laymen's Views on Radio

If wireless is going to be the means of communication in the future, why have any argument over the German cables?—*Buffalo Commercial.*

Now that the wireless telephone between America and Europe has been established successfully, one would love to hear what Richard Strauss is saying at being ousted from his conductorship and directorship of the Berlin (no longer Royal) Opera.—*Philadelphia Record.*

Wireless Outfit on Roof of Flying Club in New York

THE American Flying Club, 11 East Thirty-eighth street, New York, has now a radio outfit with which the members hope to keep in touch with aircraft flights at a great distance.

Advantages pointed out at the clubhouse are that the club will be able to promote public interest in the operations of aircraft by disseminating such information as may be received. The members, most of whom served as pilots in the European war, feel generally that it will be a help to their craft in many ways if they can educate the public regarding it. They believe that at present too little is known about the doings of the fliers.

Recently, it was stated at the clubhouse, many flying clubs of other cities have written to this organization suggesting affiliation.

The club's president is Lawrence L. Driggs and its honorary president Gen. Charles T. Menoher, head of the army air service. Many noted air fighters are among the members. It has no connection with any other organization.

Americans Ably Assist a German Station in Africa

AS late as the middle of January a German wireless station was operating in Africa. How this station was discovered and the amusing incident which accompanied the discovery is reported by Gordon Stiles, Chicago News correspondent. It appears that the officers of one of the giant radio plants conducted by the American army of occupation had their suspicions aroused by the nature of the messages which were being sent out from the Nauen tower near Berlin, and after a long investigation they came to the conclusion that the German government was communicating with some foreign station.

Working on that theory, they finally discovered that in the mass of news and propaganda emanating from Nauen was a code. Further, it developed that these code messages were addressed to a station in Africa. Once the Americans had worked out the code it was easy to decipher the messages, which really were harmless, but the German government had been steeped in intrigue for so long that it was second nature to go the longest way around if there was an element of secrecy in such a course.

At any rate, having the messages in their possession, the American wireless men sat down to await the reply. This came in due course and was easily received by the American operators. Not so with the Nauen tower. It seems that the waves were very weak and also that the German amplifiers have been surpassed by those of the American radio service. The result was that the Germans never received the message.

The officer in charge of the American station is a bit of a wag. He held up the message three days and then sent it through in perfectly good German to the Nauen tower, adding, "So sorry, old man, your amplifiers are not up to the Yankee ones," and the Nauen tower operator was a good enough sport to acknowledge the message. Nothing has been heard of the African station since.

New England's Compass Stations Installed

ONE of the most helpful uses of wireless has been inaugurated in the radio compass stations now being installed at harbor entrances and at dangerous headlands around the New England coast. On the Rhode Island shore, there is one at Prices Neck and another is under construction at Watch Hill. The arrangement enables a vessel, by wireless communication with the stations to get its compass bearings with respect to the coast, or find out its position at sea. The stations will furnish positions to ships within thirty miles of the entrance to the outer channel of a harbor, and bearings to within one hundred miles.

Within the radius of the operation of these stations there should be no repetition of such miscalculation as resulted in the stranding of one of our transports from Europe on Fire Island, while feeling its way in a fog toward New York. There are various methods of finding the position of a ship on approaching land, but only one, taking soundings, is available in weather thick enough to shut out the shore line; and the lead is of little use until the ship is in dangerous proximity to the land. In the case of the stranded transport the navigating officer had been tracing his course by dead reckoning, after some days of fog. Had he been able to call a compass station he could have obtained his position and true bearings as soon as he approached the New England coast, and been guided safely to New York by repeated communications. For ships on the sea not looking for a harbor entrance, the service should prove equally valuable where the latitude and longtitude have become uncertain owing to encounters with storm or fog.

Weagant's Anti-Static Invention

Details of a Great Discovery That Has Revolutionized Long Distance Wireless Communication*

An abstract of a paper read before a joint meeting of the New York Electrical Society and the Institute of Radio Engineers at a monthly meeting, Wednesday, March 5th, 1919.

Part II

Repo ted by Elmer E. Bucher

Director of Instruction, Marconi Institute

IT was mentioned in the preceding article that Mr. Weagant observed the necessity for local tuning of each loop in all arrangements employing two widely separated closed circuit loops or cages connected to a central receiving station by long low horizontal leads. This required placing an operator at each cage and informing him by telephone just what adjustments were to be made in order to change the wave length or to obtain a good static balance. Obviously, this was not a convenient arrangement, and an added objection previously mentioned, was that the long, low horizontal leads acted as aerials, picking up both static and signals. Although this particular structure gave a marked reduction in static currents while retaining useful amounts of the signal currents, it cannot be said to have fully satisfied the requirements of modern radio engineering and commercial practice.

In an effort to overcome the troubles incident to the use of the loops with long low leads, Mr. Weagant and Mr. Waterman, jointly, conceived the idea of making the loop and lead-in wires, one; and accordingly experiments were conducted with two loops, each of which consisted of a single turn of wire extending out from the station and back again. This arrangement was free from points where abrupt changes in the circuit constants took place, which was not the case with the cage aerials which made use of the long horizontal leads.

A particular form of the Weagant-Waterman antennae is shown diagrammatically in figure 18. In figures 19 to 33 other structures are illustrated, showing experimental steps with various loops consisting of a plurality of turns, or single turns with different spacings and other modifications. In the practical installation of the system of figure 18 at Lakewood, N. J., in the spring of 1918, the spacing between the upper and lower wires was 15 feet. The poles were 30 feet high and each loop was about three miles in length.

One of the first discoveries made in connection with the enlarged single-turn loops, was that they could not be tuned to sharp resonance with any particular incoming frequency; in fact, the insertion of inductances and capacities in the loops to establish resonance at different wave lengths had seemingly no effect upon their frequency of oscillation.

It was believed that this result was due to a current distribution in the loops of such a nature that a current node existed at the point of insertion of the tuning devices. This distribution was successfully altered by the insertion of inductances at suitable points. A coil of 30 millihenries was inserted, successively, in the upper wire at points between the receiving station and the other end of the loop; it was found that the tuning improved constantly as the coil was moved from one end toward the middle, but it became poorer as the coil was moved from the middle toward the end.

It is interesting also to note that when an inductance was inserted in the lower wire it produced no result. When coils were inserted in the middle points of both lower and upper wire at the same time, the effect of the latter was annulled. Experiments showed that 30 millihenries was about right for a wave length of 12,000 meters and 5 millihenries for 6,000 meters, but either value was sufficiently acceptable for both wave lengths, with loops each three miles long.

After this definite method of tuning had been determined, the results secured in balancing out static and retaining the signal were most satisfactory. The over-all results obtained were better than those secured with smaller loops spaced far apart and connected to the receiving apparatus with long low horizontal lead wires, because in that arrangement the leads had acted as aerials and reduced the effective spacing of the two end loops or cages. The most effective spacing of two such loops was found to be one-half wave length between the centers, which is in agreement with the theory previously outlined.

Special Forms of the Weagant Antennae

An exhaustive series of experiments with enlarged loops of various types were carried on at Lakewood, N. J. Various modifications such as shown in figures 19 to 33 were put under observation. In most of these drawings, the antenna structures are self-explanatory. All those used were found effective in eliminating static interference.

It was believed that the construction shown in figure 31 would give greater effective wave length separation if the receiving aerial extracted energy from passing electromagnetic waves in accordance with the usually accepted theory. But the experiment proved quite conclusively that the loops did not behave in accordance with this assumption and, as Mr. Weagant stated, his whole work has demonstrated that existing ideas of the mechanism by which the loop aerial extracts energy from a passing electromagnetic wave will have to be considerably modified.

In explanation of the special constructions shown in figures 19 to 33: In figure 19 the two ends of the loop are left open at point 3. This arrangement was found to operate quite as effectively as when the circuit was closed. In figure 30, the loops are closed at the ends 4 by variable condensers. In figure 21, the loops are open at the upper conductors 6. Figures 22 and 23 show loops with different spacings between wires, figure 23 particularly showing the loops supported a greater distance above the earth than in the preceding figures. Figures 24 to 29 show loops containing a plurality of turns, while in figures 30 to 33 forms of loops having graded constants are indicated. In the circuit shown in figure 24, the localized inductance 15 is included in the construction of the loop itself; it may be located at any desired point in the length. In all these arrangements the lead-in wires extending from the end of the loops nearest the receiving

* Several of the drawings included in this abstract were not disclosed at the Institute meeting. Special permission to publish them in the Wireless Age has been granted by Mr. Weagant.

Weagant's Low Horizontal Loop Antennae

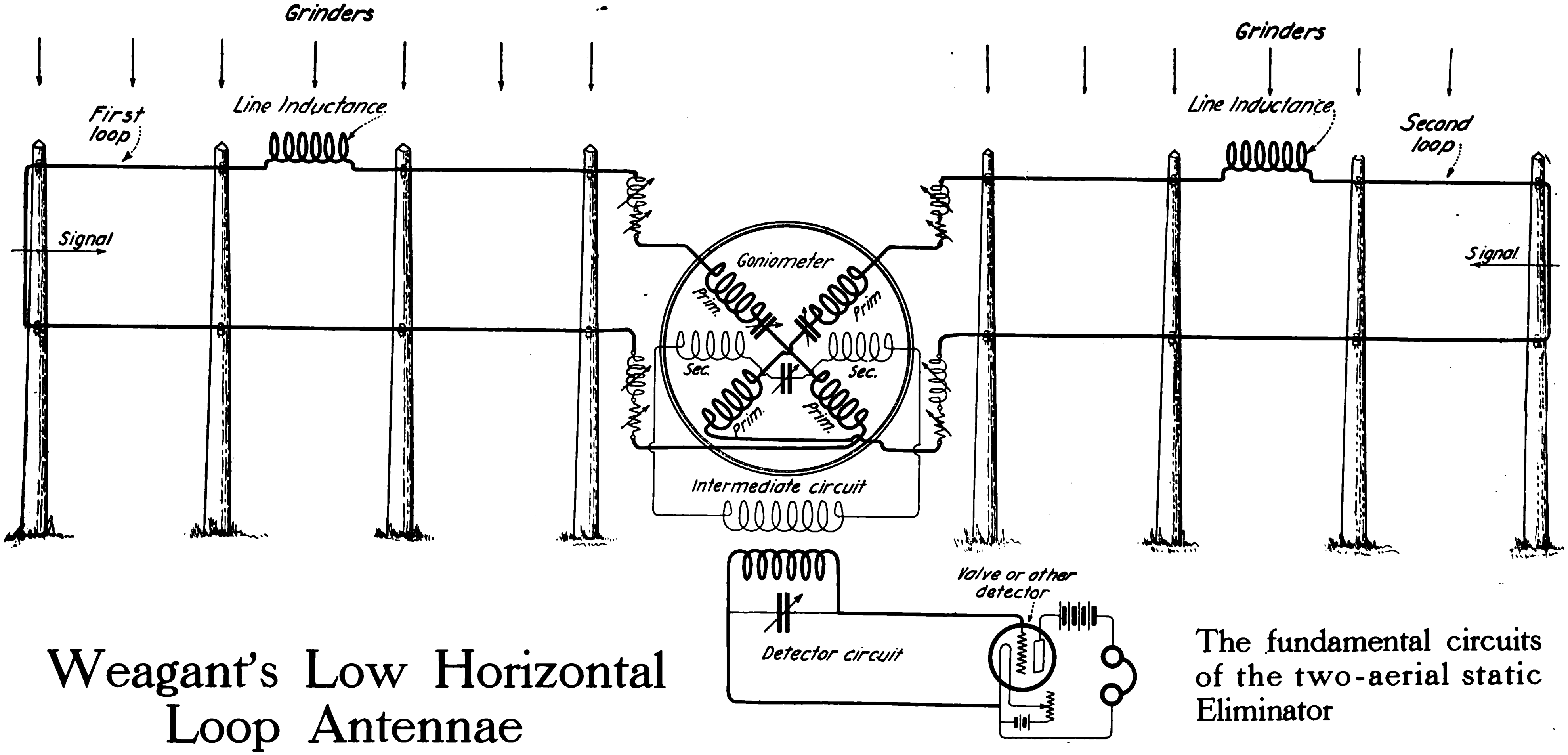


Figure 18

The fundamental circuits of the two-aerial static Eliminator

This diagram shows the fundamental circuits of the two-aerial Weagant system permitting continuous reception of long distance wireless telegraph signals through "static" interference which ordinarily would render the wireless signals unintelligible.

Mr. Weagant, having discovered that the dominant type of static termed "grinders," is apparently propagated vertically in respect to the earth, made use of the two loop antennae as here shown, to balance out static currents, while retaining the signal currents. In practice, the antennae are spaced any distance from center to center, the most efficient separation being one-half wave length. The terminals of both loops are connected to the two primary coils of a radio goniometer. The secondary coil of the goniometer is connected to a detector circuit which, in this diagram, includes a three-electrode vacuum tube. Appropriate loading inductances and variable resistances are connected in series with the leads of each loop to obtain the desired operating characteristic. A line inductance is inserted at the center point in series with the upper wire of each loop. Since the vertically propagated static waves act upon both loops simultaneously, the resulting E.M.F.'s are in phase and may be made to neutralize in the goniometer. Wireless signals on the other hand advancing either from the right or from the left, strike the two aerials at different times and the resulting currents are out of phase and their E.M.F.'s combine vectorially; that is, at any particular instant, the static currents and the signal currents in one loop flow in the same direction and in the other loop in opposite directions. Since the goniometer coils are coupled to the detector circuit in such a way that the static currents oppose and neutralize, the signal currents add their E.M.F.'s according to the effective separation of the loops. Experiments have been made with loops of various lengths up to three miles each, that is, with a complete antenna system six miles in length. In every case, it was possible to balance out the static currents and retain a useful amount of the signaling currents, thus proving Weagant's theory that static waves act perpendicularly in respect to the earth. This discovery represents the greatest progress in the art of radio communication since Marconi's original disclosures.

Not only does the Weagant system permit continuous reception through the severest types of static interference, but it has done away with the necessity for high towers, allows great distances to be covered with less power at the transmitting station and for the first time makes possible the use of an automatic recorder.

station are passed into the receiving apparatus through metallic covered cable.

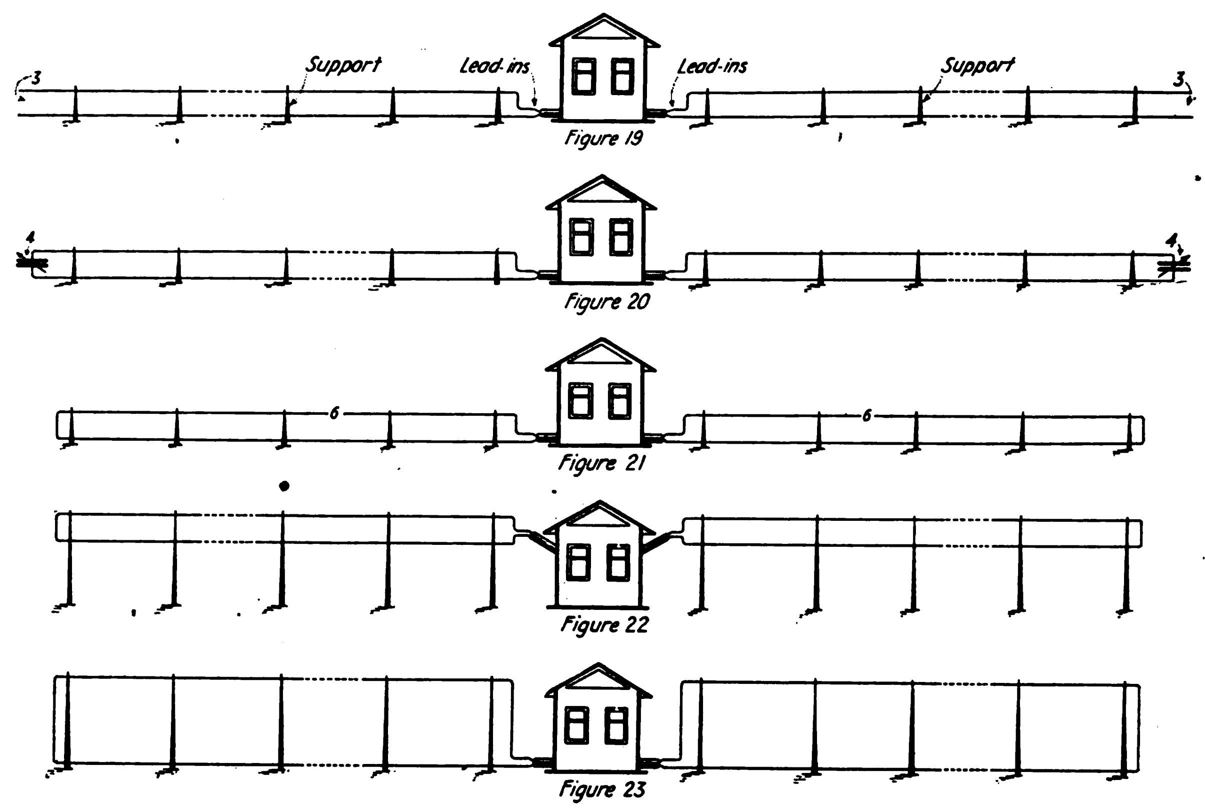
PRACTICAL CIRCUITS

Detailed working circuits of the Weagant two aerial system for static elimination may now prove of interest. Figure 34 shows more fully the station house circuits disclosed fundamentally in figure 18, with the exception that the centrally located line inductances are not shown. Loading coils L-6 and L-7 are inserted in the lower lead of each loop and reversing switches S-1 and S-2 are placed between the loops and stationary goniometer coils, to obtain the most effective working. Variable condensers C-1, C-2 and C-3 are inserted in the center of each goniometer coil. Another reversing switch S-3 is placed in the intermediate tuning circuit which includes the rotating coil of the goniometer L-3, the load inductance L-4 and the coupling coil L-5 acting upon L-6 which in turn actuates the oscillation detector V-3.

series tuning, the single blade switches S-5 and S-6 are opened, S-3 and S-4 being closed to the top set of contacts. For parallel tuning, S-5 and S-6 are closed, S-3 and S-4 being closed to the bottom set of contacts.

Loading inductances L-11, L-12, L-13 and L-14 are placed between the leads and the goniometer coils so that either one or two loadings may be cut in each loop. The reversing switch S-7 permits the most favorable connection to the detector circuits to establish a satisfactory static balance.

In all of the foregoing arrangements, the general procedure to balance out static and retain the signal is, in brief, as follows: The rotary coil of the goniometer is placed in inductive relation to one of the two loops; the circuits are then tuned until the maximum signal strength is obtained. A similar procedure is carried out in respect to the other loop. Both loops are then connected to the goniometer and the third coil is rotated to a position giv-



Figures 19 to 23—Various forms of the Weagant antennae system utilizing two single turn loops separated at an appreciable fraction of a wave length

This particular diagram shows an oscillating vacuum tube, the plate circuit being shunted by an inductance and capacity in series, but any type of detector and circuit suitable for damped or undamped wave reception may be employed.

Because the variable condensers are connected in series with the stationary goniometer coils, the circuit of figure 34 is said to employ *series* tuning in contrast to figure 35 where the same condensers are connected in *parallel* with the stationary coils. The diagram, figure 36, on the other hand, includes a set of switches which permit either *series or parallel* tuning, at the will of the operator.

In the improved circuit, figure 35, line inductances L-9 and L-10 are inserted at approximately the center of the upper wire of each loop, the lower wire of each loop containing the loading coils L-6 and L-7. In the universal circuit for the two aerial arrangement shown in figure 36, S-1 and S-2 are reversing switches inserted between the leads and the goniometer; S-3 and S-4 permit the variable condensers C-1 and C-2 to be placed in series or in parallel with the stationary goniometer coils. For

ing maximum signals and minimum static. A finer balance is then obtained by adjusting the inductance, capacity and resistance in both loops.

One particular modification of the Weagant system for the elimination of static is shown in figure 36-A, a circuit which was employed in very early experiments at Belmar, N. J. Fundamentally, it consists of a loop antenna A-1, grounded to earth through the tuning inductance L-1 and the variable condenser C-1. The coil L-1 acts inductively on the secondary coil L-3, the terminals of which are extended to a detecting circuit as usual. A closed circuit loop A-2 of the early type, with long low horizontal leads was connected to the coil L-2 with the variable condenser C-3 in series; this coil also acts inductively on the secondary L-3.

It was possible with this arrangement to take advantage of the relative flow of currents and the inherent differences of phase between the currents in the grounded antenna and in the closed circuit loop, to balance out static currents and retain the signal currents.

Commenting upon the results obtained with the two aerial system as installed at the Lakewood, N. J., station, Mr. Weagant said:

"This station was operated continuously from the middle of July until the end of September with a force of three operators, each working eight hours, copying messages sent out by Lyons, Carnarvon, and Nauen, regularly, and occasionally other stations. This continued operation was undertaken to determine the capabilities of the system in a practical, commercial way, during the worst period of the summer and at all hours of the day. The results secured were most gratifying, the total interruptions experienced being of no greater total duration than those of good cable working between the same points and at the same time of year.

"It was found that when the signal from the European stations was of normal intensity the heaviest static experienced at any time was unable to interfere in the slightest, but that on the contrary, it might have been very much more severe without causing trouble. Reception under this condition was almost invariably good enough for high speed automatic reception.

"A few thunderstorms occurred during this time and some, but not all of them, prevented reception while they lasted. There were also periods recurring regularly every day between four and six o'clock in the afternoon and between twelve and two o'clock in the morning when the intensity of the received signals from Carnarvon and Nauen fell off enormously, on some occasions falling as low as 1/100th of their normal intensity. During a few of these fading periods, interruptions were experienced varying from five to ten minutes, to perhaps one hour. The worst of these periods was usually—but not always—the midnight to two a.m. period when, although the static was generally lighter than during the afternoon fading period, at which time its maximum intensity occurred, the decrease of signal strength was rather greater. A careful study of the conditions during these fading periods, convinced me that the difficulty was due to the fact that when the signal weakened greatly the click type of static was present in sufficient quantities to cause the trouble, and that when the signal intensity was greatly amplified in order to be heard, the amplification also brought up this disturbance with its ratio to the signal unaltered."

Continued experimenting eventually culminated in the perfection of a three aerial system which eliminated most effectively both the grinders and the click type of static and moreover gave signals of sufficient audibility for continuous reception from European stations of a much lower power than required to give response with the two aerial arrangement. The three aerial arrangement permitted reception through the worst fading periods without interruption.

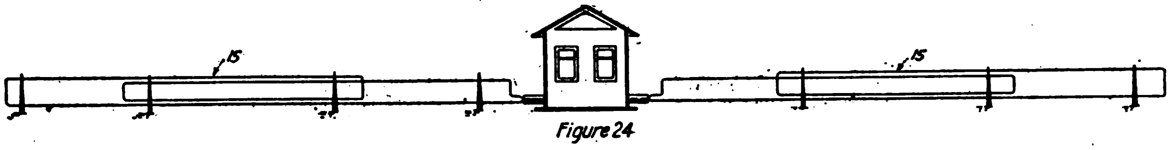


Figure 24

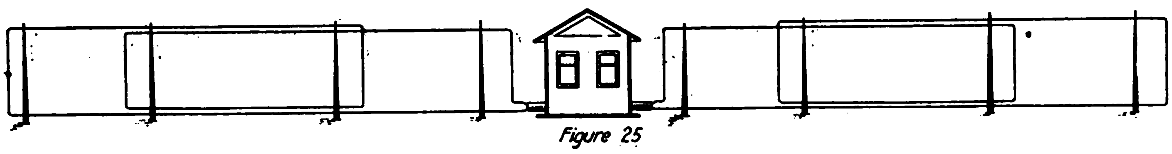


Figure 25

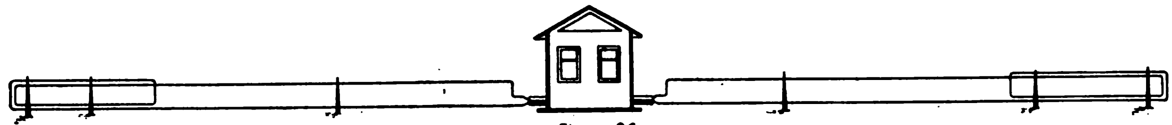


Figure 26

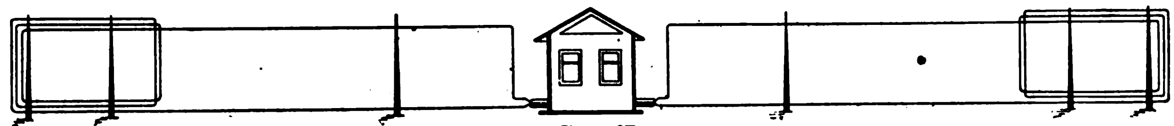


Figure 27

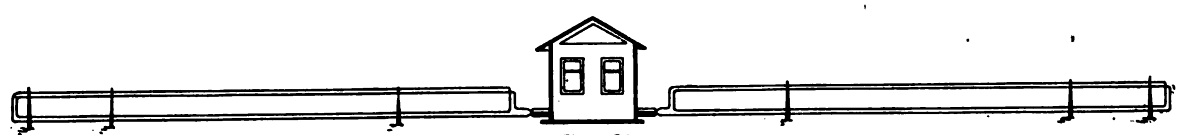


Figure 28

Figures 24 to 28—Loop aerials of the Weagant system containing either a plurality of turns throughout their length or through a part of their length. Various spacings between the upper and lower wires and between the wires and the earth are indicated

CHARACTERISTICS OF STATIC

In support of his theory which classified "grinders" as a type of static which is propagated vertically, and the "clicks", a type which is propagated horizontally, Mr. Weagant declared that continuous experimenting had established beyond doubt that the characteristics of the two prevailing types of static were well defined. The "grinders" are most prevalent in the warm season, between the noon hours and sunrise of the following morning.

Grinders generally produce in the telephone a continuous rattle, with occasional heavier crashes. This type of static seems to be vertically propagated and certainly affects aerials separated by considerable distances simultaneously. The two aerial system effectually excludes the grinders. The click type, however, which is apparently propagated horizontally, had to be dealt with in another manner.

Defining the clicks, Mr. Weagant said they are widely spaced crashes and are most noticeable during the cooler periods of the year and day. They do not interfere, except on rare occasions, with signals equal to the normal strength of Carnarvon, Nauen, or Lyons, but during reception from stations of smaller power, such as Clifden, Ireland and Eiffel Tower, Paris, the clicks caused marked interference with the two aerial arrangement, and any adjustments that reduced the click type of static reduced the signal also.

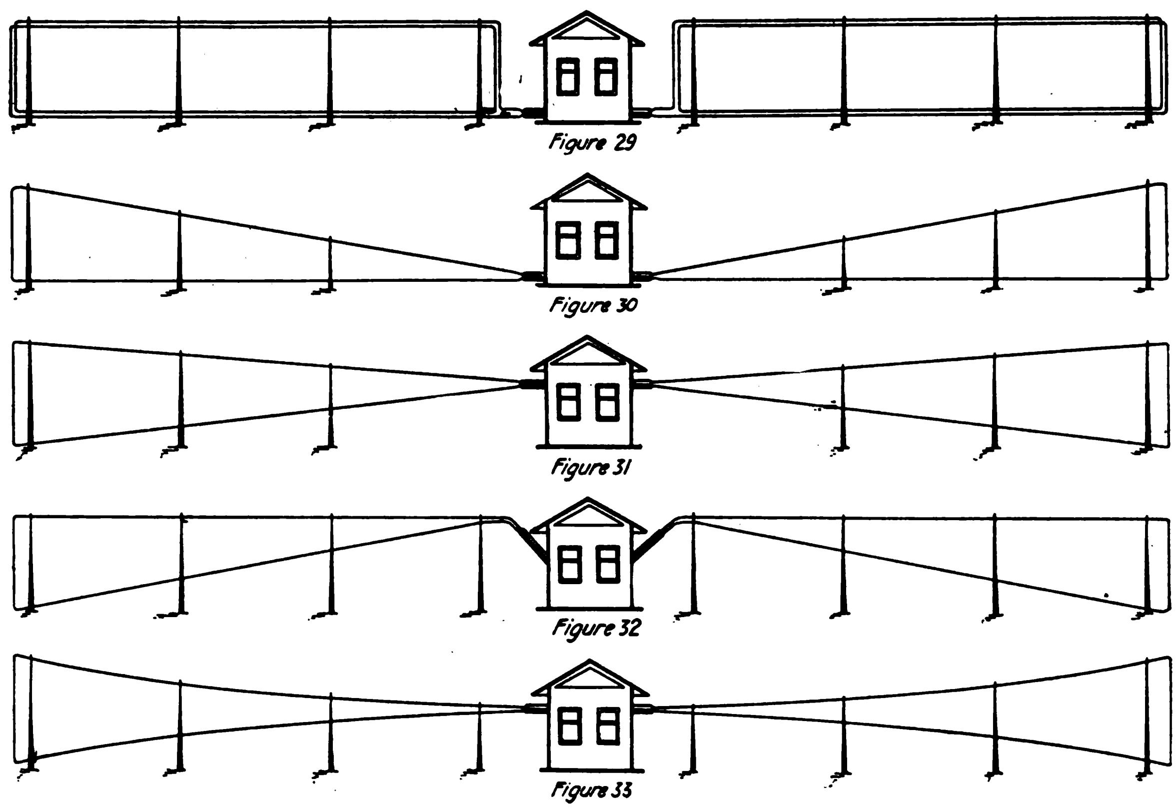
By applying a principle hitherto unknown in radio engineering, both clicks and grinders were eliminated while the full signal strength of foreign stations was retained. A description of the three aerial arrangement follows.

THE STATIC TANK

Since the two loop aerial system had not as yet shown itself capable of sufficiently differentiating between the horizontally moving type of static and the signal so as to permit reception during the severest periods of signal fading, Mr. Weagant carried on a series of scientific investigations with a three aerial arrangement in which the two loops of the previous system were used as a "static tank." This system made possible the reception of signals from European stations of a much lower order of power than that employed by Carnarvon or Nauen. Although many times during the summer attempts were made to copy Eiffel Tower, France, on 8000 meters, with the two aerial arrangement, satisfactory signals were obtained only during the time when the "grinders" type of static predominated. When the "click" type of static occurred these stations could not be read. As a proof of the utility of the three aerial system a particular test was made through static disturbances of such intensity that the signals from Eiffel Tower were much below normal. It was barely possible to determine the presence of signal with the two aerial arrangement, but with the three aerial arrangement the signal was not only readable, but was of such intensity that it could be read with the telephones removed from the ear.

Before going into the details of the static tank, it may be well to define it briefly. *The static tank may be characterized as a source of static currents of both the click and grinders type of variable frequency, but not a source of wireless telegraph signals.* Hence, static currents can be withdrawn from the static tank to balance out the static currents in a third receiving aerial associated with the system (which picks up both static and signals) retaining only the signal currents. As will appear further on, several modifications of the static tank are possible, but the one about to be described has proved very effective, and from a commercial viewpoint is thoroughly practical for 24 hour transoceanic reception.

Referring now to the diagram, figure 37, it will be observed that two closed circuit loop antennae, each of which are 3 miles long (for the longer wave lengths) are mounted on short poles and connected to the primary coils of a goniometer located at a central point of the antenna system. As usual, the detecting circuit is coupled to an intermediate circuit which embraces the rotating coil of the goniometer.



Figures 29 to 33—Experimental forms of the Weagant loop antennae designed to have graded constants

Immediately underneath the closed circuit loops is a long low horizontal antenna A-1, 6000 feet long (in the Lakewood installation) which, through the medium of the coils L-15 and L-16, is coupled to the intermediate tuning circuit, which circuit also includes the rotating coil of the goniometer. All three antennae lie in the same plane and are preferably pointed in the direction of the sending station.

In contrast to the two aerial system, of figure 18 and others following, the two loops in this arrangement are used to build up the static currents and to balance out the signal currents. The two loops then constitute a static tank in which static currents of any desired frequency may be stored up, so to speak, for balancing purposes.

The long low horizontal antenna A-1 on the other hand, picks up both static and signals and its primary coils L-15 and L-16 also act upon the detector circuits. By effecting proper coupling and connections between the static tank and the receiving aerials, the static currents accumulating in the static tank can be brought into opposite phase with the static currents in the horizontal antenna, resulting in substantially complete annulment, yet retaining the full strength of signal. In fact, Mr.

Weagant pointed out that the strength of the resulting signal was equal to that obtained with the two aerial arrangement when it was adjusted to give maximum signal currents rather than maximum static currents.

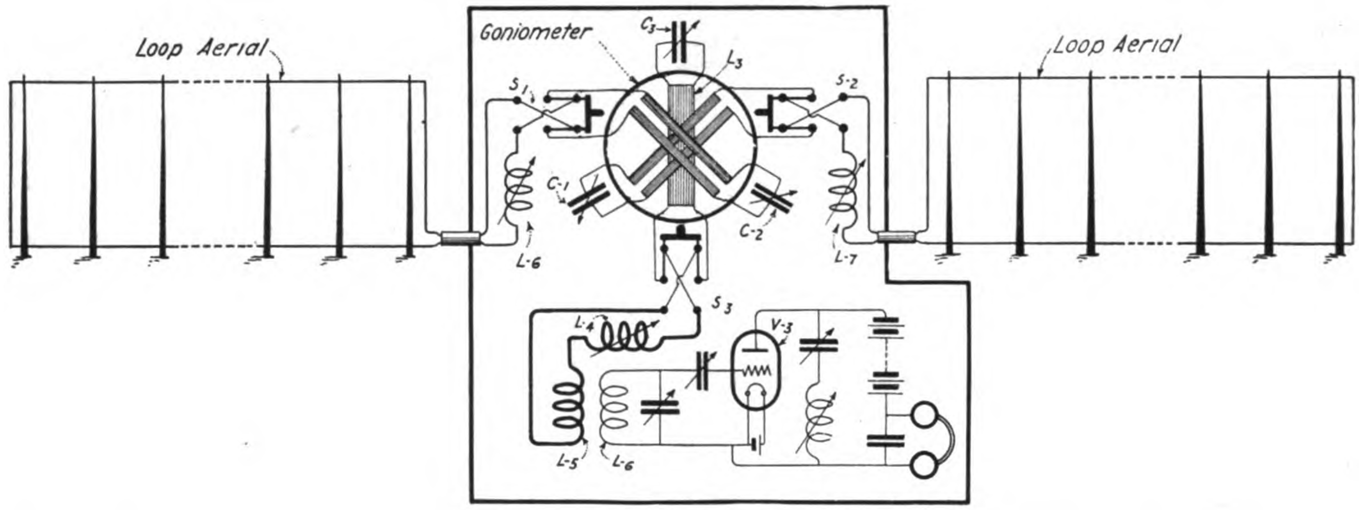


Figure 34—Circuits of the Weagant two-aerial system for static elimination showing the position of the goniometer and the necessary reversing switches for obtaining a satisfactory static balance. In this circuit the variable condensers are connected in series with the goniometer coils

How "Clicks" and "Grinders" Accumulate in the Static Tank

The fact that the static tank becomes a source of static currents of both the *click* and *grinders* type requires some explanation. For it would appear that since the "clicks," which have been classified as a type of static that is propagated horizontally, would be neutralized as are the signal currents when the goniometer is adjusted to annul signals. The static tank, however, has proved to be a source of both "clicks" and "grinders" as will now be explained.

Assume the reception of highly damped static waves from left to right or vice versa upon two loop aerials such as shown in figure 37, giving one-half wave length separation for the signal wave; the static wave acts first upon one aerial and then on the other, with the result that the first half-cycle of the highly damped oscillation in the first aerial is unopposed, because the current has had time to go through a complete half-cycle, before the wave continues its motion and affects the second loop.

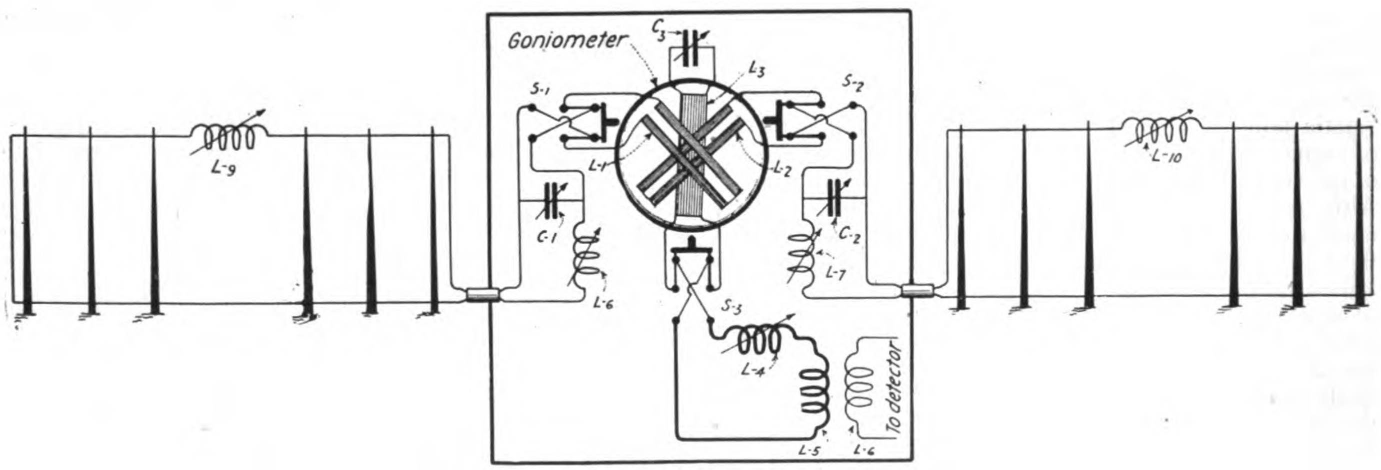


Figure 35—A modification of figure 34 employing parallel tuning. The condensers C-1 and C-2 are connected in parallel with the leads from the loops

The current generated in the second loop then flows back to the receiving apparatus. Further consideration will reveal that the first half-oscillation from the second aerial is opposed to the second half-oscillation from the first aerial, and so on throughout the wave train. But because the oscillations are damped, the opposing cycles in the first and second loops do not have the same amplitude and accordingly the result of the opposing oscillations is not zero as shown in figure 38. In other words, useful amounts of the click type of static as well as the grinders type are retained by the static tank and may be used to balancing out similar static currents in an ordinary receiving aerial. Still better results are secured by damping heavily the loop antennae through the insertion of series resistances until the wave trains, due to static, become shorter and shorter until all the energy is dissipated in the first half-cycle. Under these conditions, although the loops are coupled to the receiving set so that the wireless signal completely cancels out, the entire static current remains, resulting in the curious curve shown in figure 39 which comprises two half-oscillations, both in the same direction.

Mr. Weagant was careful to point out that the first half-oscillation of the signaling current is also unopposed, but in the case of undamped wave reception only 1/7000 part of the energy which is required to make a dot effects the detector; in other words, the static tank retains a very slight amount of the signaling current even when the loops give one-half wave lengh separation. A general order of the result obtained with the most effective spacing may be secured with any appreciable wave length separation; that is, although the loops may have fixed dimensions, they can be worked over a considerable range of wave lengths with slight decreases in the intensity of the signals.

In regard to the reception of the clicks propagated at an angle to the planes of the loops, it is interesting to note that as the angle increases, the resulting static pulses overlap, as shown in figure 39-A; and, as Mr. Weagant pointed out, through part of the azimuthal angle, the intensity of the oscillations produced by static vary along the cosine curve, spreading out somewhat as the angle increases. If, therefore, this system is balanced against a third aerial, the curve of reception of which is a cosine curve and both signal and static currents are flowing, the static currents due to the click type of static will oppose and the residue will be the order of the difference between the dotted curve shown in figure 40 and the cosine curve shown in the solid lines. From this it is apparent that a very large order of reduction is possible, retaining the full signal strength developed by the third aerial.

Early Form of the Static Tank

One of the early methods of using the static tank is shown in figure 41, wherein the cages or loops A and B are separated several thousand feet and connected to a centrally located receiving set by long low horizontal leads. The loop E, which in this case is the receiving antenna, is also coupled to the receiving set. Like the method shown in figure 37, loops A and B are employed as a static tank and loop E is the receiving aerial which picks up both static and signal waves. The procedure in this case is as usual in the three aerial system; the loops A, B and E, are all tuned to the frequency of the incoming signal, but A-1 and A-2 are coupled to the common receiving circuit in such a way that the signal balances out, the static currents being retained. The loop E picks up both static and signals and is also coupled to the receiving circuit. By proper adjustment of couplings, etc., a complete static balance is obtained.

The "Whippet" Static Tank

In order that the static tank aerials may give one-half wave length separation, very long antennae, up to six miles in length, are required for the longer waves employed in wireless communication from continent to continent. Offsetting any objection which might arise on this score, Mr. Weagant astonished his listeners by describing a miniature form of static tank and associated receiving aerial capable of transoceanic reception, which could be mounted upon the speaker's platform. He described the arrangement illustrated in figure 42, which, in addition to acting as a static tank, serves to prove that electromagnetic waves while in transit may be considerably distorted from their initial angle in respect to earth.

In brief, a horizontal antenna A-1, 25 feet in length is mounted on a "tether" arm B, which may be rotated around its vertical axis on the pivot P and placed at any angle in respect to the earth. The horizontal antenna mounted on the "tether" is associated electrically with the closed circuit loop A-2 which is employed as a receiving antenna. The "tether" antenna is employed as a static tank; that is, it may be made a source of static currents, but not a source of signal currents. The loop, on the other hand, is a source of both static and signal currents and the static currents therein may therefore be opposed to those in the "tether" and thus be annulled.

In point of explanation of the phenomenon of the pivoted antenna: It has been believed for some time that because the earth is not a perfect conductor, the wave front of horizontally propagated wireless waves may not be strictly vertical, but may be tipped forward or backward at an angle to the horizontal. Weagant was the first to prove this in practice, for he found that by tilting the antenna A-1 of figure 42 at various angles to the horizontal and pointing it in the proper direction, an angle can be found which presumably is normal to the wave front of the signals and at which the antenna will not pick up signals; but it continues to pick up static which was to be expected on the assumed theory of vertically propagated static waves. The "tether" antenna then becomes a static tank, but the correct angle, of course, must be found for each transmitting station in order that the tank will not pick up the signaling wave.

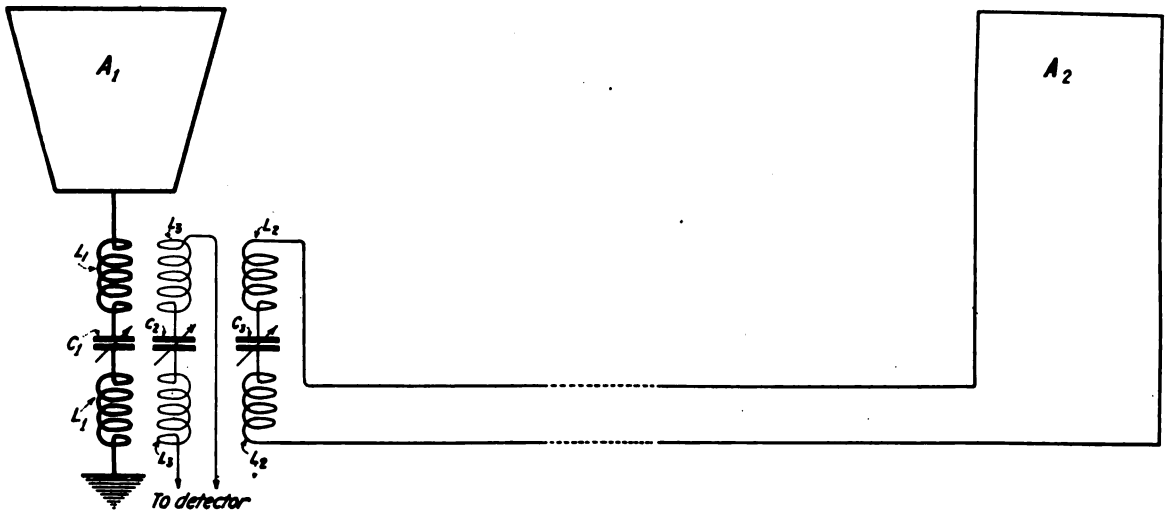


Figure 36-A—Showing the antenna structures employed by Weagant in the early experiments at Belmar. A loop connected up as a straight-away aerial was grounded to earth and balanced against a loop, with long low horizontal leads

Mr. Weagant has found that the "tether" antenna determines the angle of the advancing wave with remarkable accuracy, it being possible to determine the position for minimum signals within one or two degrees.

To illustrate more clearly the assumed operation of the "tether" antenna, a possible direction of wireless telegraph waves is shown by the single pointed arrows in figure 42; the vertical propagated static waves by a number of double pointed arrows. When the "tether" antenna A is adjusted at a right angle to the actual wave front, no electromotive forces will be induced therein. The static waves, however, act upon the "tether" antenna and induce therein electromotive forces, the frequency of which can be adjusted to the same value as the frequency of the static currents induced in the receiving loop A-2. Since the loop antenna A-2 is a source of both signal and static currents, the static currents of the "tether" antenna A-1 may be opposed to the static currents in the loop A-2, retaining the signal.

The two antenna in figure 42 may be, of course, coupled through the agency of a goniometer to obtain the desired static balance. The diagram simply shows the fundamental connections of the circuit.

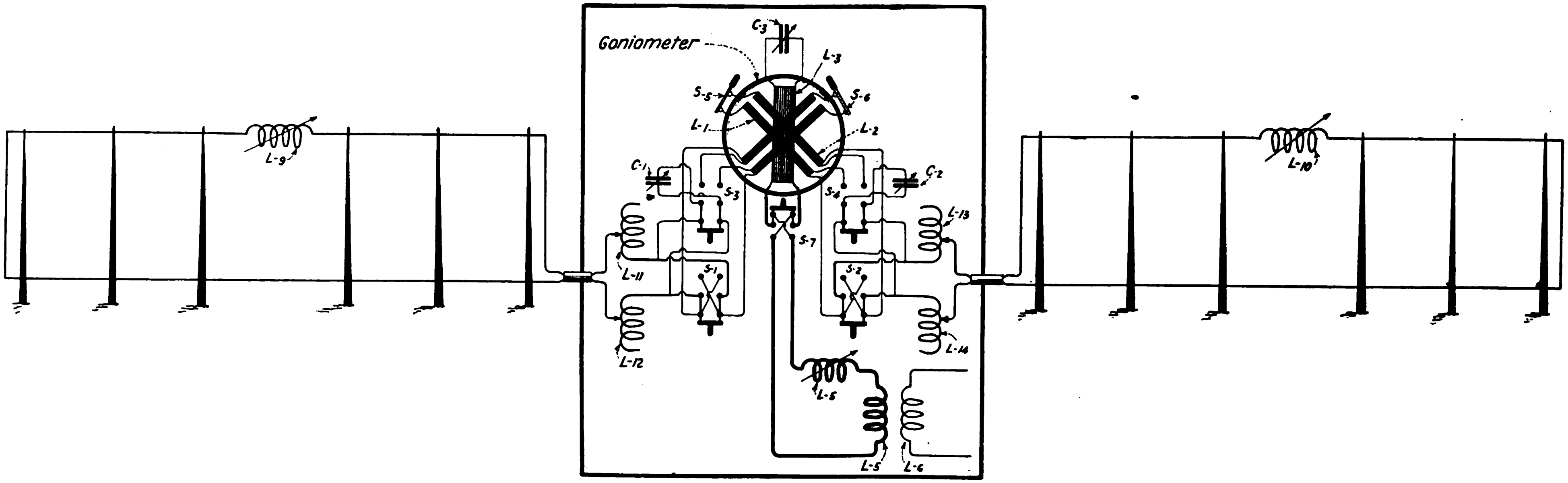


Figure 36—Complete circuits of the Weagant two-aerial system providing either series or parallel tuning. Switches S-1 and S-2 reverse the connection between the goniometer coils and the loops. Switches S-3 and S-4 place the variable condensers C-1 and C-2 either in series or in shunt with the stationary goniometer coils

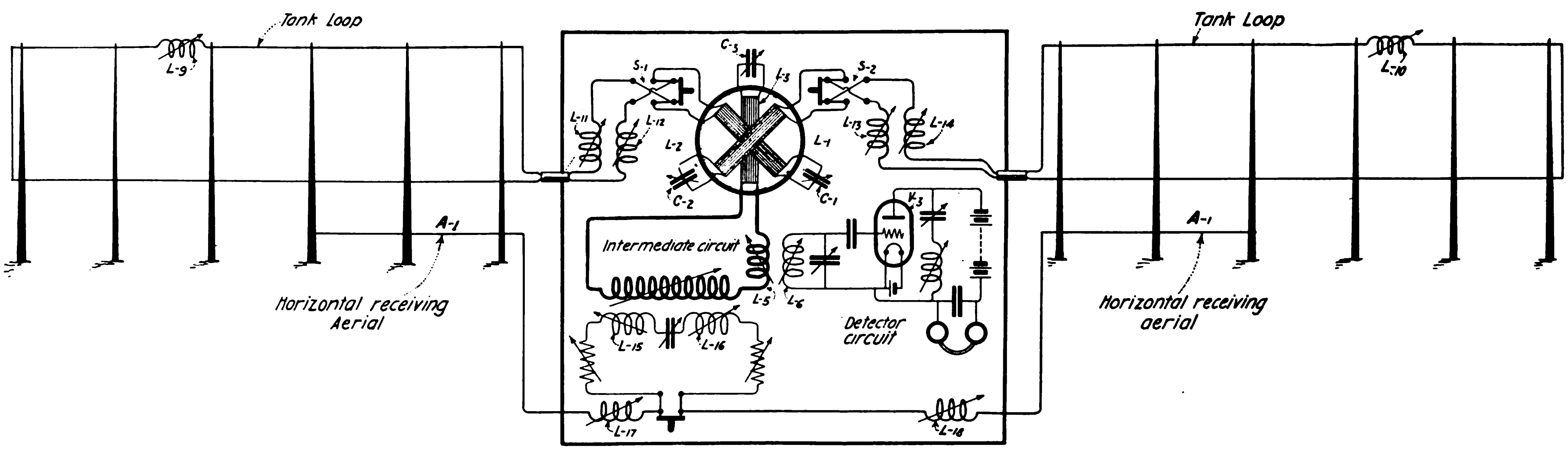


Figure 37—Fundamental circuits of the Weagant three-aerial system wherein two loops are used as a "static tank." This is the preferred method of annulling the interference of static waves. In accordance with the principle of this discovery two single turn loops are used in such a way that they become a source of static currents of any desired frequency but not a source of signal currents. The main receiving aerial is a long low horizontal wire A-1. This and the static tank are coupled to the receiving circuits within the station. The static tank is a source of static currents of both the clicks and grinders type. By proper adjustment of inductances, capacities and resistances in the static tank and the receiving aerial, and by finding a suitable position for the goniometer coil L-3, static currents of the frequency of those induced in the receiving antenna can be drawn from the static tank to balance out the static currents in the horizontal receiving aerial thus retaining the full strength of the signal current. So successful is this system in removing the most troublesome types of static interference that it permits 24 hour transoceanic wireless reception without interruption

It is to be noted that a condenser in dotted lines is connected across the tuning elements of the "tether" antenna. . This is the preferred connection for average working.

Owing to the very small length of the "tether" antenna A-1, large loading inductances must be inserted in the central point to obtain resonance with a transmitter operating at long wave lengths; and an eight-stage amplifier is required to bring the signals up to practical audibility. It is interesting to note that with an amplifier of such capabilities, when properly designed, a very small loop A-2 will give readable signals from high power stations several thousand miles distant.

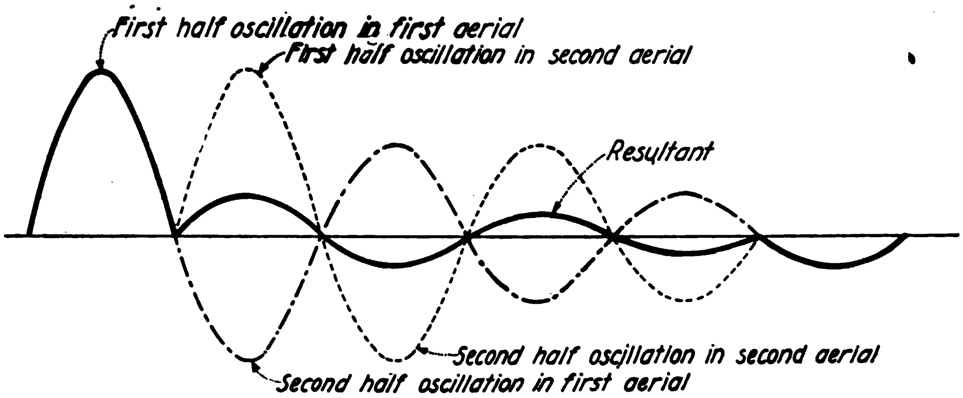


Figure 38—Graphs showing how the Weagant static tank retains "clicks," a type of static which is assumed to be propagated horizontally as electromagnetic waves. It would appear that since the static tank balances out horizontally propagated signaling waves, it would affect likewise, horizontally propagated static waves; and as a consequence, the static tank would become only a source of "grinders" providing no means for balancing out the "clicks" in the horizontal receiving aerial. The fact remains, however, that the static tank picks up and retains the energy of both grinders and clicks as will be evident from the curve. It will be seen that because the horizontally moving static wave acts first upon one aerial and then on the other, the first half oscillation induced in the first antenna is unopposed. The second half oscillation in the first aerial, however, is opposed by the first half oscillation of the second aerial and so on throughout the wave train. The resultant of these two graphs obviously is not zero, and hence sufficient amounts of the static currents of both the clicks and grinders type are retained for balancing purposes

A variation from the arrangement in figure 42 is shown in figure 43; here two pivotal antennae A-1 and A-2 are constructed as the "tether" antenna of figure 42 so that they can be placed at any angle in respect to the direction of the advancing wave. The antenna A-1 is then adjusted, let us say, to a certain angle with the horizontal so that it will be unresponsive to the desired signal. Next, the antenna A-2 is set at an angle to the horizontal so that it will be responsive to both static and signals. The antenna A-1 as before, constitutes, a static tank, whereas A-2 is a source of both static and signaling currents. Either of the antennae, of course, can be used as a static tank and the other as the receiving antenna.

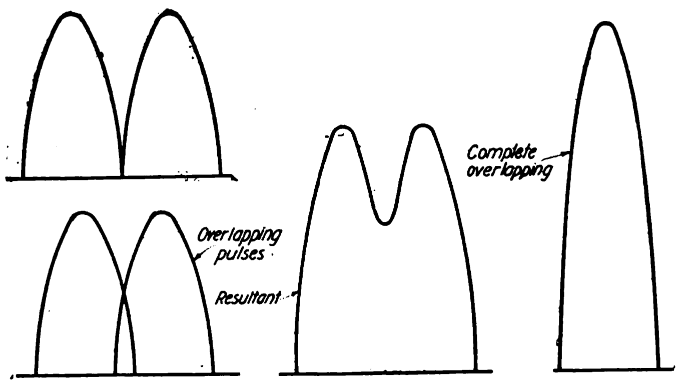


Figure 39—Upper left hand diagram. Showing the wave form of the resulting static currents in the Weagant static tank generated by "clicks" when the loop aerials are heavily damped by the insertion of resistances

Figure 39-A—Curves showing the wave form of static currents generated in the static tank by horizontally propagated "clicks," as the angle of the clicks increase in respect to the plane of the static tank

By the use of multi-stage valve amplifiers to bring the incoming signals to audibility, such small antennae are perfectly feasible for the reception of radio telegraphic signals over great distances and it is quite possible that they will be employed in commercial practice.

COMMERCIAL ASPECTS

Only those who have been actively identified with the radio art through its progressive steps and have had the opportunity to observe for themselves the magnitude of the interference engendered by static waves, can realize the boon which the Weagant system has given to commercial long distance wireless telegraphy. With ordinary apparatus and aerials, continuous transoceanic working, particularly during the summer months, was impossible; but such reception is now possible not only with lesser amounts of power at the transmitter, but with a much less expensive antenna structure at the receiving station, giving a better static balance than that obtained with the former costly types of aerials with high towers.

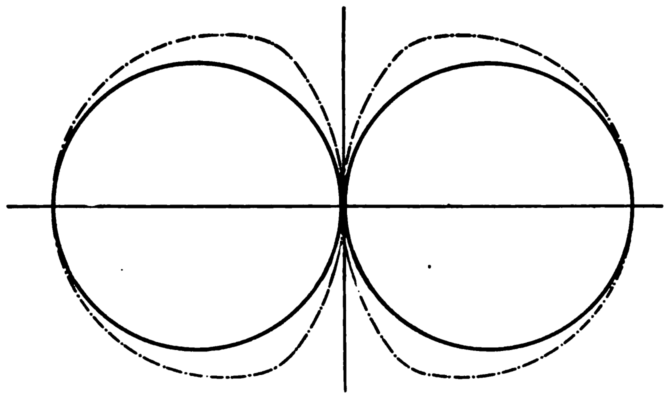


Figure 40—Reception curves of the Weagant static tank and the receiving aerial. The difference between the areas of the two curves shows the residue of static, which is practically negligible

No better estimate of the commercial practicability of the Weagant system can be given than that presented by the inventor himself. He said:

"Continued use has established beyond question that this performance is not occasional, or accidental; it is consistent. With this arrangement transatlantic radio telegraphy can now be carried on free from interruptions due to static of any kind whatsoever except local lightning. This cannot always be neutralized, but since the cables are also interrupted by this latter cause, it follows that a continuity of communication equal to that of cable operation is now possible by radio telegraphy, while the latter has the great advantage of cheapness and greater speed of operation. For many years attempts to work automatic high speed radio telegraphy have been made, but they have been successful only when static was absent. It is therefore evident that use can now be made of this method of working to a very great extent, thereby greatly increasing the number of messages which can

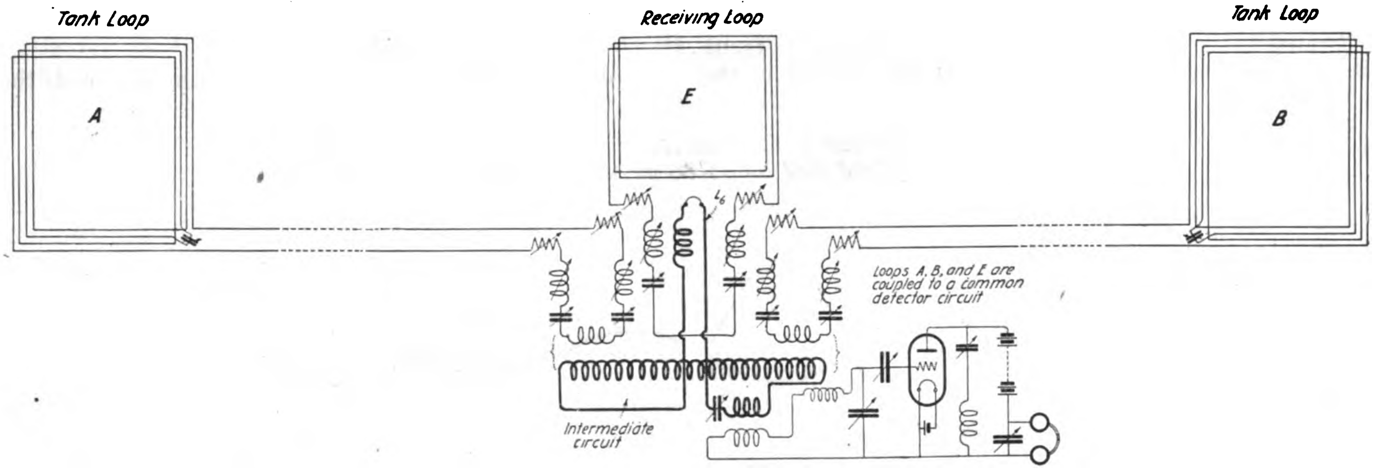


Figure 41—An early form of the Weagant static tank employing three cages or loop aerials. Loops A and B, separated several thousand feet are employed as a static tank and are coupled to the detecting apparatus in such a way as to build up the static currents and eliminate the signal current. Loop E is the receiving aerial which picks up both static and signals. The static currents flowing in the tank loops are balanced against the static currents in the receiving loop resulting in annulment, while retaining the signal

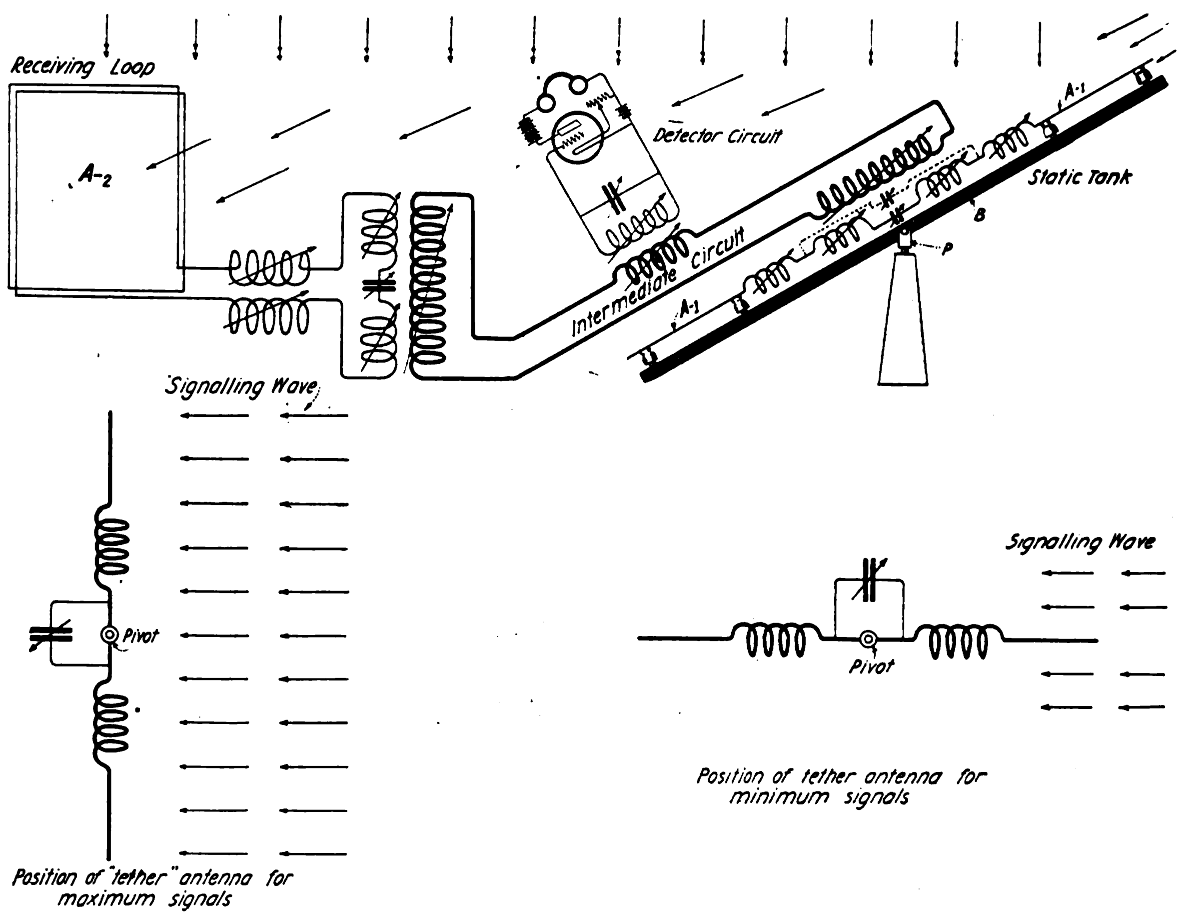


Figure 42—The Weagant "whippet" static tank—a discovery which presents some interesting novelties. In this system a horizontal aerial A-1, not over 25 or 30 feet in length is mounted on an arm B which may be revolved on a pivot P and placed at any angle in respect to the horizontal. The receiving loop A-2 is a closed coil of a few turns of wire, four or five feet square. Both aerials are coupled to a common detector circuit. By pointing the horizontal or "tether" antenna in the direction of the transmitting station and placing it at the correct angle in respect to the earth, a position can be found which is normal to the wave front, and at which the horizontal antenna will not respond to a given signal wave, but to static waves only. It thus becomes a static tank. The receiving loop collects both static and signals, and the static currents therein are balanced against those generated in the horizontal aerial.
Through the use of an ingeniously designed eight-stage amplifier the signals emanating from high power stations several thousand miles distant can be brought up to practical audibility with these antennae. In the diagram, the assumed direction of a distorted signaling wave is indicated by the single pointed arrows and the vertically propagated static waves by the double pointed arrows. It is readily seen that no electromotive forces will be induced in the horizontal antenna by the signaling wave, but it is acted upon by vertically propagated static waves. The two lower drawings show the position of the horizontal antenna for maximum and minimum signals

be handled over a given circuit. It may also be stated that the great barrier in the way of successful, practical radio telephony has been removed since static has interfered with radio telephony to a much greater extent even than with radio telegraphy." This summarizes the practical values of the Weagant anti-static invention.

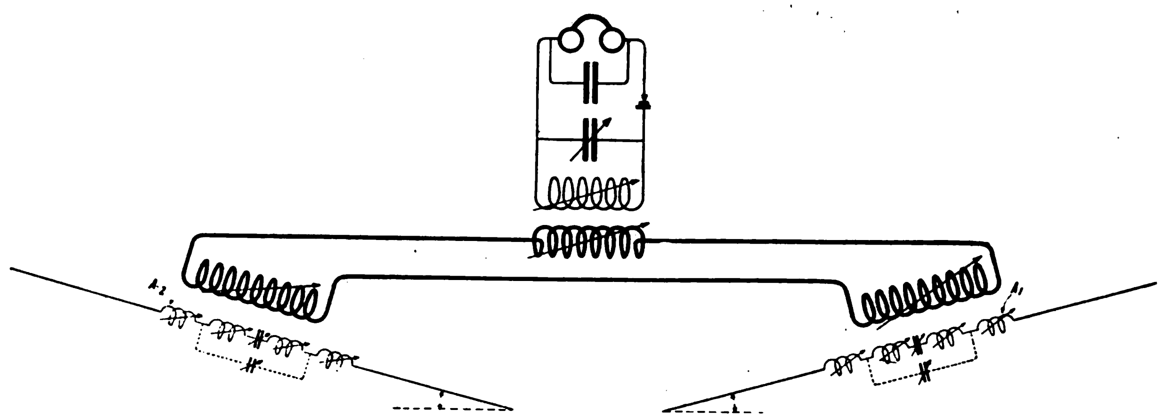


Figure 43—A modification of figure 42 where two short horizontal aerials are mounted on a "tether" arm, one being used as a static tank and the other as a receiving antenna. One antenna is set at such an angle in respect to the horizontal as to be responsive to both signals and static while the other is placed so that it is responsive to static only. Both antennae are coupled to a common receiving circuit wherein the static currents are opposed, the signal current being retained as in the several foregoing methods

Fuller's Method of Signaling with Arc Transmitters

DURING a sending period, the arc gap of arc transmitters must operate continuously. Signaling is accomplished by detuning the antenna circuit to a different wave length than that to which the receiver is adjusted. The usual method is to vary the antenna inductance by short circuiting a portion of the turns during the signaling periods. The antenna radiates a wave of one length when the key is depressed and a wave of another length when the transmitting key is open. A difference of 100 meters is generally sufficient for signaling. In high power transmitting stations large currents must be handled by the short-circuiting apparatus, and some difficulty has been experienced in opening and closing the circuits.

The well known method designed by Fuller provides an electromagnetically operated relay key which performs the function of short-circuiting a fraction of a turn of the aerial tuning inductances at several points.

Several turns must be short circuited by the multiple contact key in order to produce the desired change in wave length. By breaking the inductance into a plurality of sections, and short circuiting each section independently, only a portion of the energy impressed on the key circuit is handled by each contact. The energy handled by each contact is substantially constant, irrespective of whether the various circuits are opened simultaneously or at different times in any sequence. The preferred method of operation is, of course, to have these contacts open and close together.

In the diagram, taps are brought from the aerial tuning inductance 2 to various parts of the signaling key. The armature of the signaling key makes contact with the studs 15, 16, 17 and 18 short circuiting the turns and thereby changing the antenna wave length.

Fuller has disclosed other means of controlling the antenna current in an arc system as indicated in figure 2, in which a shunt oscillation circuit 12, 9 and 8 is connected across the arc gap proper 2. The spacing of the electrodes at 12 is preferably such that normally a very small amount of current will pass across the arc making the shunt circuit practically an open circuit and confining the oscillations generated by the arc 12 to the antenna circuit.

The resistance of the arc gap is preferably such that the current will spit across the arc gap spasmodically but will not flow continuously. Means are then provided for impressing an additional voltage on the arc 12, to reduce the resistance and form a shunt path for the current from the arc 12. The additional E.M.F. is provided by the DC generator 13, the circuit from which is closed by the key 14, the arc in which is extinguished by a magnetic blowout or other means.

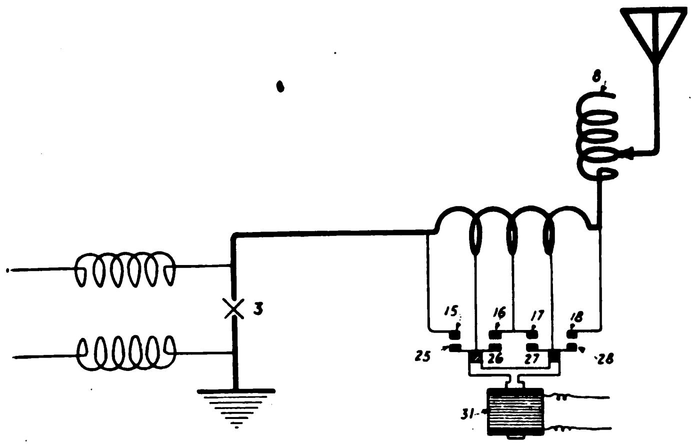


Figure 1—Diagram showing taps from the aerial tuning inductance to parts of the key

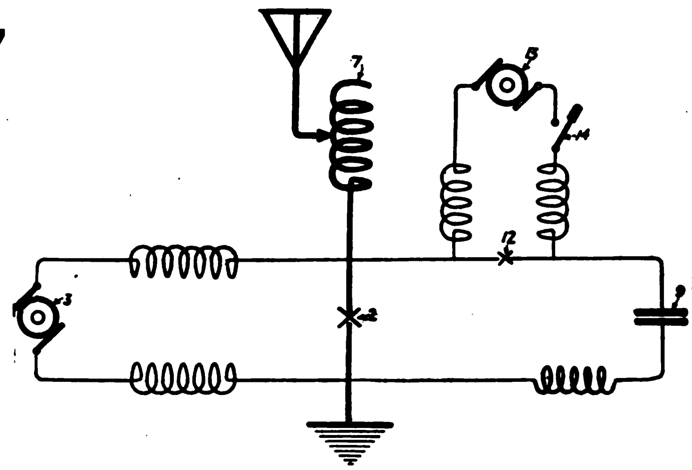
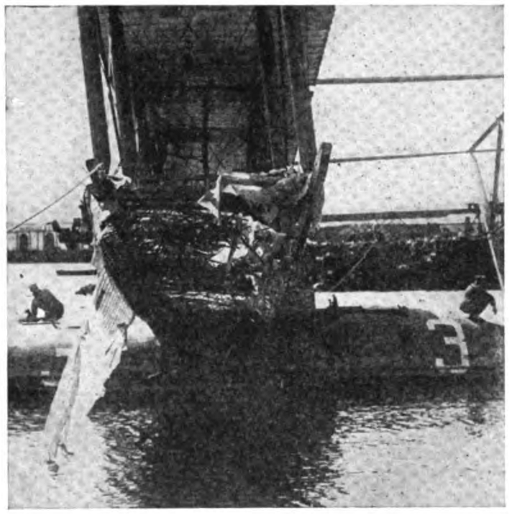


Figure 2—Diagram showing the use of a shunt oscillation circuit

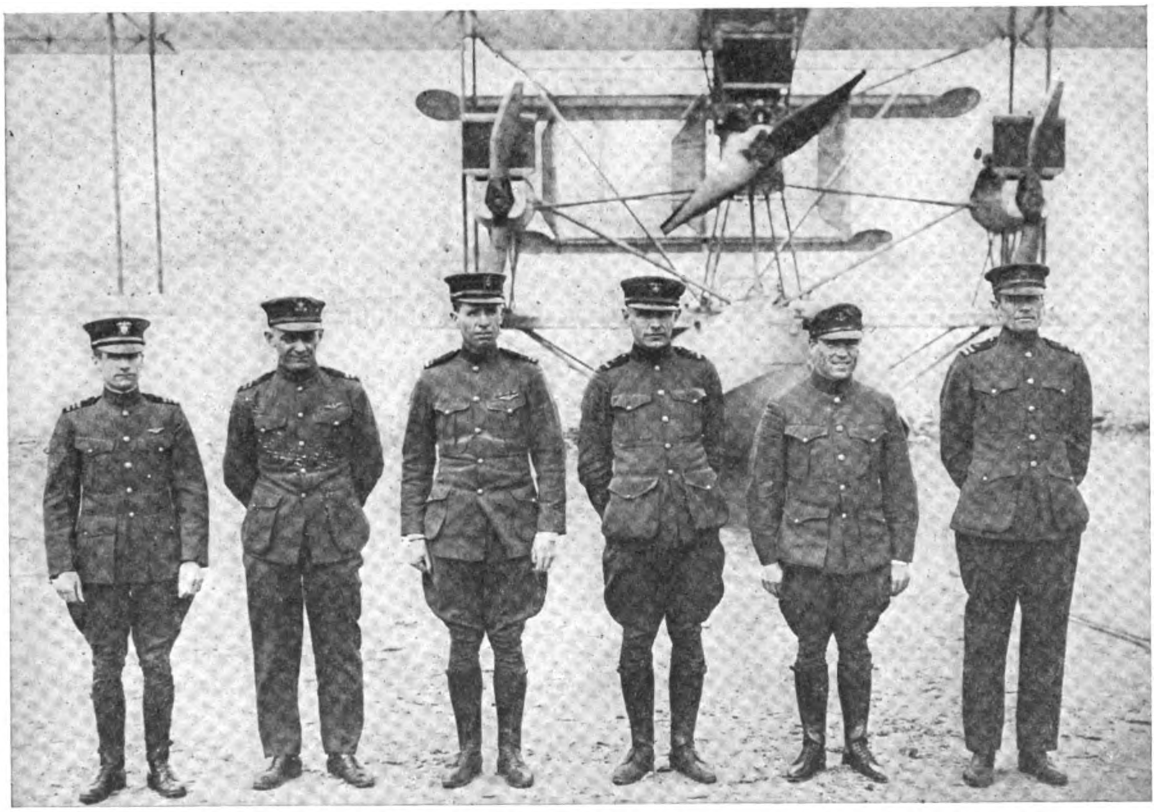
AIR MEN



Above: The NC-3 arriving at Ponta Delgada with lower wing damaged by the waves

To the left: Harry Hawker, the English aviator, who contested with American naval men the first honors of trans-Atlantic flight, but who was forced down in mid-ocean by engine failure

Press Ill. Svce.



The victorious crew of the NC-4, the first airplane to fly across the Atlantic; Ensign H. C. Rodd, wireless operator is fourth from the left. The others are, left to right, Lieut. Commander A. C. Read, commander; Lieut. E. F. Stone, pilot; Lieut. (j g) Walter Hinton, pilot; (Ensign Rodd) Chief Special Mechanic E. H. Howard, engineer (injured by propellor blade at last moment and could not go), Lieut. J. L. Breese, reserve pilot engineer

Cascade Amplification by a Single Vacuum Tube

A VACUUM tube for cascade amplification of variable E.M.F.'s without intervening transformers has been developed by Alexander Nicolson. The structure of the tube is shown in figure 1 and a circuit diagram in figure 2. The underlying principle of operation is as follows:

The input E.M.F. is impressed between the first section of the cathode and its associated input element, and serves to vary the discharge from the cathode section to

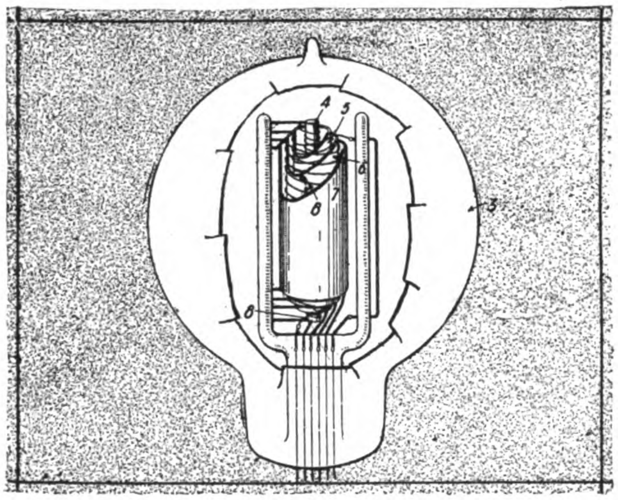


Figure 1—Showing the construction of the vacuum tube used in cascade amplification

another electrode which is maintained positive with respect to the cathode section. By inductively isolating it from the output circuit of the system, the electrode in question is made to function as an input element with reference to the second section of the cathode, and, by virtue of the varying charge delivered to it from the first cathode section, is made to vary the discharge from the second cathode section to a second electrode maintained positive with respect to that section. It, in fact, serves the double function of an anode for the cathode section and an input element for a third section.

Referring to figure 1, 3 is an evacuated vessel containing a group of concentrically arranged cylindrical electrodes 4, 5, 6 and 7. A filamentary cathode 8 is wound first about the outer surface of electrode 4, passing from electrode 4 to electrode 5 and from electrode 5 to electrode 6 and from electrode 6 to the leading-in wire.

The electrodes 4, 5, 6 and 7 are preferably made of nickel, and in the case of 4, 5 and 6 the outer surface is oxidized so as to form a dielectric or insulating film between the cathode filament 8 and the electrode on which the filament is wound.

The operation of the device as an amplifier will be more clearly understood by reference to figure 2. In this figure 8a is that section of the filament which is wound around electrode 4; and 8b and 8c are those sections which are wound on electrodes 5 and 6, respectively. The filament 8, as a whole, is heated to incandescence by a battery 15 and the input is impressed between this filament and the main input electrode 4 by means of the transformer secondary 17, the primary 16 of which is connected to the source of telephonic or other currents of varying frequency to be amplified.

The electrode 5 which is maintained positive with respect to the cathode section 8a by battery 18 serves as an anode with respect to this cathode section and with respect to the input electrode 4, and receives a varying charge by virtue of the variation in thermionic current flowing from the cathode section produced by the input E.M.F. The electrode 5, instead of being directly connected to the output circuit, as in former audion arrangements, is here inductively isolated therefrom by the impedance coil 19. The varying charge thus received by electrode 5 causes it to act as an input electrode for the cathode section 8b by varying the thermionic current from that cathode section to its inclosing cylindrical electrode 6. The latter in turn is inductively isolated from the output circuit by impedance coil 20 and serves as an input electrode for the cathode section 8c. The anode 7, associated with this cathode section 8c is included in the output circuit which comprises transformer primary 21, batteries 22, 23 and 18, and cathode 8.

It is important that in the arrangement shown the filament section 8a be connected to the negative terminal of battery 15 and that section 8c be connected to the positive terminal of the battery. Thus, because of the potential drop in the filament 8 as a whole due to the flow of heating current through it, the section 8a will be more negative with respect to electrode 5 than will section 8b, and similarly, section 8b will be more negative with respect to electrode 6 than will section 8c.

In the particular arrangement depicted the input energy is subjected to three distinct stages of amplification by what is the equivalent of three distinct audion arrangements. The first of these arrangements comprises electrode 4 as an input electrode, filament section 8a as

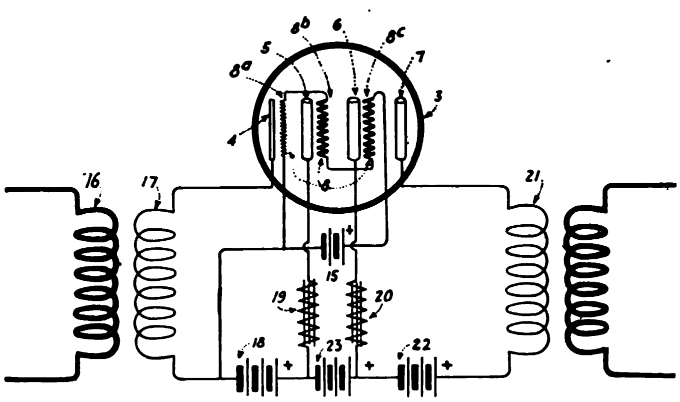


Figure 2—Diagram of circuit used in cascade amplification by a single vacuum tube

cathode and electrode 5 as anode. The second, comprises electrode 5 as input electrode, filament section 8b as cathode and electrode 6 as anode, while the third comprises electrode 6 as input electrode, filament section 8c as cathode and electrode 7 as the final anode and output electrode. The battery 23 makes anode 6 more positive than anode 5, while anode 7 is more positive than anode 6 by reason of battery 22. Each anode is thus more positive than the one preceding.

Hammond's Method of Modulating Antenna Current

IT is generally understood in the art of radiotelegraphy that if a properly designed undamped wave transmitter and receiver are operating in resonance, a change in wave length of 1/10 of 1% at either the transmitting

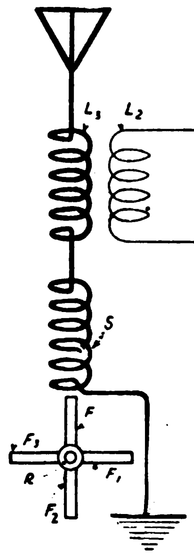


Figure 1—Illustrating the method used to vary the antenna circuit inductance

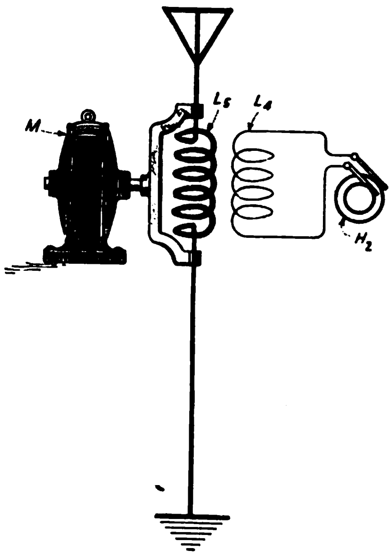


Figure 2—Showing method of controlling the output of the alternator

or receiving station will destroy the condition of resonance between them. Any device which will provide the necessary change of wave length at audibility rates may be employed for telegraphic signaling.

The necessary change in wave length may be produced by changing either the capacity or inductance of the oscillatory circuit. In fact, if a change of 1% be made in either the capacity or inductance of the transmitter, a change of perhaps 100% may be caused in the intensity of the received signals at the receiving station.

By periodically varying the capacity or inductance at a transmitting station such as shown in the accompanying figures 1 and 2, it is possible to produce at the receiving station an impulse of a sinusoidal character.

Hammond claims to have discovered that the variation produced in the transmitting apparatus to give signals at audio-frequencies is preferably of a very peaked form rather than of a sinusoidal form, the reason being, that due to the resistance of the receiving circuits, there is a tendency to flatten out the wave form. Therefore, to produce sinusoidal waves at the receiving station a very peaked wave form is necessary at the transmitting station.

In figure 1 a method of varying the inductance of the antenna circuit is shown. The high frequency alternator H-1 impresses undamped oscillation upon the antenna circuit through the coupling L-2, L-3. Another inductance S is included in the antenna circuit which is in magnetic relation to a rotating element R having pole pieces F, F-1, F-2 and F-3. As R is rotated, periodic variations of the inductance of S occur causing the antenna circuit to be thrown out of resonance with the high frequency alternator. The periodicity of the amplitude variations thus produced depends upon the speed of the rotating element R and upon the number of its pole pieces.

In the diagram of figure 2 the coil L-5 is mechanically attached to the motor M and rotated in respect to L-4 so as to vary its inductive relation. In this way, the amplitude of the antenna current is varied periodically at any desired frequency and the output of the alternator H-2 in accordance.

Methods of Varying Antenna Currents in Radio Telephony at Speech Frequencies

IT has been found, in attempts to develop the art of radio telephony, that a serious limitation has been imposed by reason of the fact that any telephone transmitter at present known to the art is incapable of handling all the energy which is required for successful modulation of high frequency power for commercial radiotelephony.

H. J. Van der Bijl has devised several ways by which antenna currents are varied indirectly by a microphone and associated circuits employing the magnifying properties of vacuum tubes. The method depends upon the fact that an electromotive force impressed upon the input circuit of a thermionic amplifier of the "audion" type produces an apparent change in the impedance of its output circuit; in particular, a change in electromotive force impressed upon the input circuit, resulting from a change in impedance in a local circuit associated with the input circuit, causes the impedance of the output circuit of the amplifier to vary in such a way as to produce therein much greater changes in power than take place in the above mentioned local circuit. The thermionic amplifier in this case acts as a magnifying device for changes of power in the local circuit, and on account of this property a primary source of modulated power, capable of handling only a small amount of power, may be used to produce much larger changes in the transmitting antenna.

A variable impedance path, for example, the output circuit of a thermionic repeater is inserted into the transmitting antenna carrying high frequency currents, and

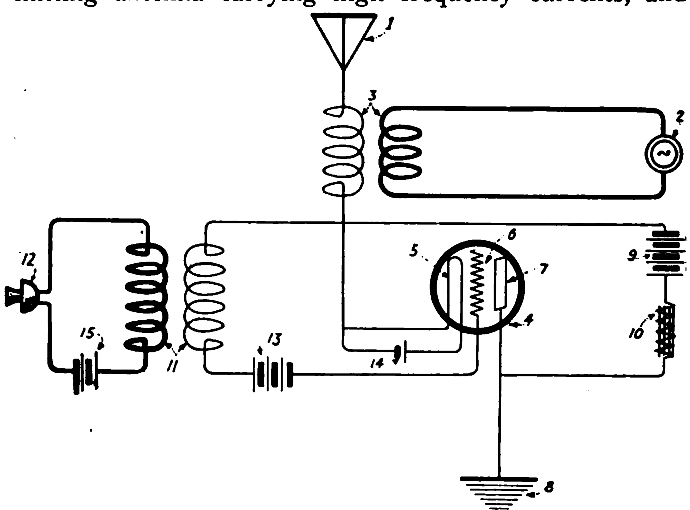


Figure 1—Diagram of a circuit used to connect an amplifier in series with an antenna

thereby producing large changes in radiated power at the expense of but small changes of power in the telephone transmitter.

Figure 1 shows a method of connection of an amplifier in series with an antenna; figure 2 represents a preferred form which is better adapted to the modulation of large amounts of power, such as would be required in commercial operation; and figure 3 shows another method of placing the amplifier effectively in series with the antenna by means of a transformer.

Referring to figure 1, 1-8 is an antenna, 2 an alternator or other source of high frequency currents; 3 is a transformer between the antenna and the generator 2; 4 is a thermionic amplifier of the "audion" type having an electron-emitting cathode 5, a grid 6 and a plate 7. The antenna system is earthed at the point 8. The plate circuit is completed through the choke coil 10 and the battery 9. A transformer 11 serves to impress upon the input circuit of the amplifier variations in electromotive force caused by the microphone 12 in the local circuit. Batteries 13 and 14 are connected as usual in the operation of the amplifier, and battery 15 supplies current to microphone 12.

An objection to the circuit shown in figure 1 is that the output impedance of the thermionic amplifier, as at present constructed, is so high that it cannot be efficiently inserted directly into an antenna circuit. To overcome this difficulty, and to provide also for the modulation of larger amounts of power, a number of these elements may be connected in parallel as shown in figure 2, in which corresponding parts are denoted by the same numerals as in figure 1.

In figure 3, the variable impedance of the output circuit is placed directly in the generator circuit, but since that circuit is coupled to the antenna by transformer 3, this output circuit is effectively in series with the antenna and generator, since an impedance that is connected into a circuit by means of a transformer is equivalent, for forced oscillations, to a certain other impedance connected directly into that circuit. The function of the choke coil 10 is to exclude direct current from the generator 2.

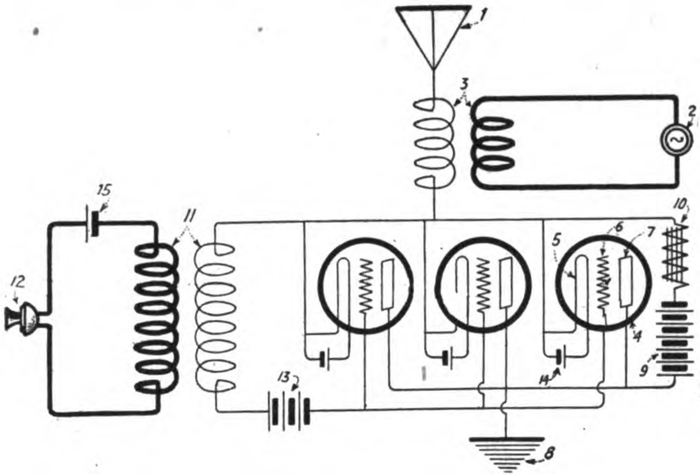


Figure 2—Another form suitable for the modulation of large amounts of power

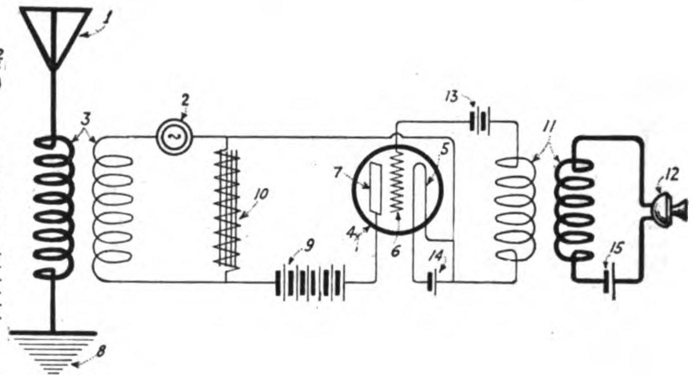


Figure 3—Method of placing the amplifier effectively in series with the antenna by means of a transformer

The operation of the system is as follows: The generator 2 impresses high frequency power upon the antenna. Due to the choke coil 10, practically the whole of the high frequency current must flow through the amplifier and is superposed upon the space current of the amplifier. The choke coil is necessary in order to provide a conducting path for direct current in the output circuit. A variation in resistance in the microphone 12, due to voice waves impinging upon it, causes an electromotive force to be impressed upon the input circuit, which, in consequence of a well known property of the amplifier, produces an apparent change in the output resistance of the device, this change in output resistance causing a change in the amplitude of the high frequency antenna current.

Radio Call Apparatus

WHEN continuous waves are employed for wireless transmission, it is often desirable to use very accurately tuned and highly selected receiving apparatus. This increases the liability of missing communications because a slight difference in the tuning of the receiver and transmitter, with continuous waves, completely eliminates the signals. In order to call the attention of a receiving operator whose apparatus is adjusted to a different wave length than that at which the transmitting station desires to work, John St. Vincent Pletts has devised the calling apparatus shown in figure 1.

It consists of a variable condenser H, a variable inductance F mounted on the shaft B coupled to a mechanical oscillatory system comprising a fly-wheel C and a spring D. If this device is connected in a wireless transmitter circuit and caused to oscillate mechanically, as by rotating the wheel, waves may be sent out which at first vary over a considerable range of frequencies and then over a smaller and smaller range until the wave length becomes constant. Such waves produce a distinctive sound every time they come into tune with a receiver and attract the attention of the operator, even though his receiver is not accurately tuned to the normal wave length of the transmitter.

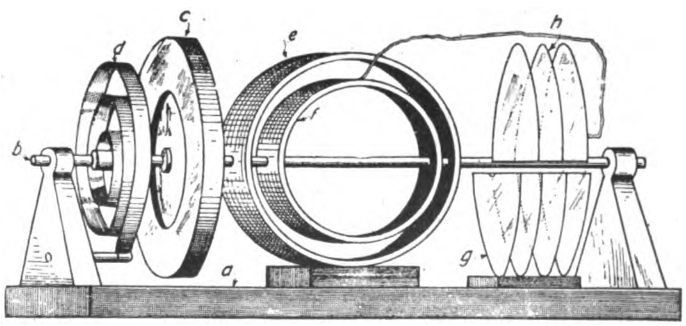


Figure 1—Showing the design of the radio calling apparatus

Undamped Wave Reception at Very Short Wave Lengths

IN receivers based on the interference or beat principle it is usual to employ a local oscillator which can be so adjusted as to produce oscillations differing in frequency by a desired amount from the oscillations produced in the receiver by the incoming waves. In some vacuum tube circuits the receiving device is its own local oscillator. The result is that during reception there are in the receiving circuits two sets of oscillations which

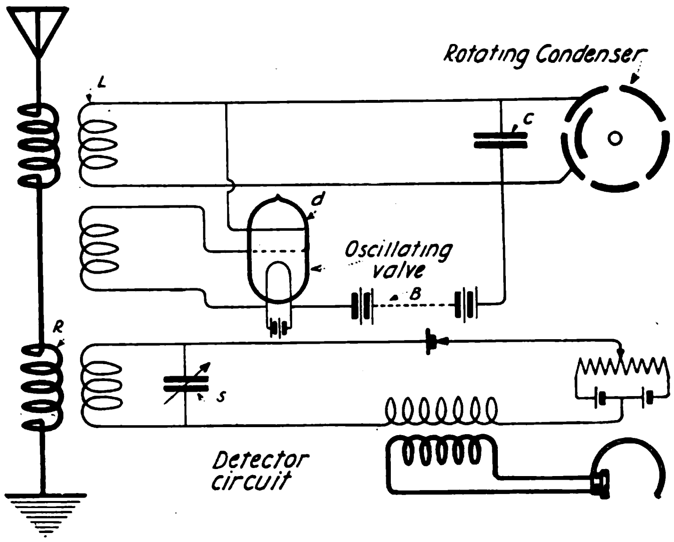


Figure 1—Circuit used in the new method of regularly varying the frequency of the local oscillations to permit undamped wave reception at short wave lengths

interact with each other, producing a compound oscillation of varying amplitude. The receiver usually rectifies this compound oscillation into a uni-directional current of varying strength and so produces in the receiving telephone a note which has a frequency equal to the difference of the frequencies of the received and local oscillations.

The constancy of the note depends upon the constancy of the frequency of the received and local oscillations. For frequencies below about 1,000,000 per second (300 meter waves) it is not difficult to maintain a sufficiently constant frequency; for frequencies about 3,000,000 it is still practicable though not easy to maintain a sufficiently constant frequency; for frequencies about 30,000,000 it is practically impossible to maintain the frequency sufficiently constant.

Assuming 30,000,000 to be the frequency received, then the local oscillator must generate a frequency of 30,001,000 or 29,999,000, in order to give an interference note of 1,000. Should either frequency vary one hundredth of one per cent, the interference note may change from 1,000 to 4,000. Practically when working with frequencies of this order the interference note varies so rapidly and to such an extent with the small variations of frequency which take place that the signals are unreadable.

In a new method devised by C. S. Franklin, the frequency of the local oscillations is varied by a small percentage, regularly and in a continuous manner. This may be done by arranging in the local generator a rotating condenser which consists partly of segments arranged on a rotating disc or cylinder, so that the capacity varies continually between two limits.

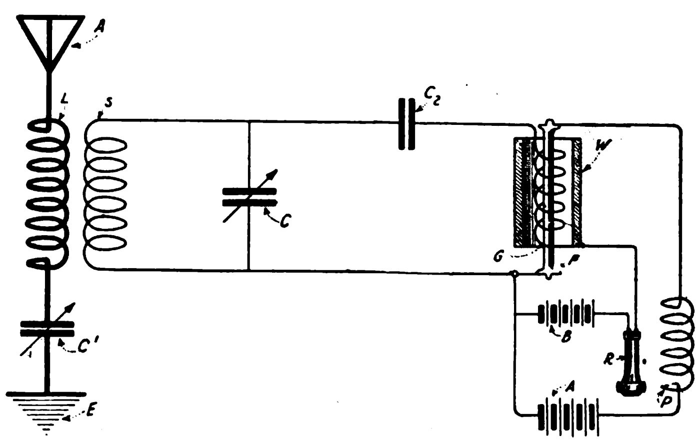
The circuit shown in figure 1 works as follows: Assume the received frequency to be 30,000,000 and the local generator arranged to give a 30,000,000 frequency with variations of a half per cent above and below this, 1,000 times per second, produced by the revolving condenser. During reception an interference note is produced which varies from zero to a frequency of 150,000. An audible sound is produced in the telephone only during the time that the interference note is varying through the range from about 8,000 to zero and back to 8,000; that is to say, while the interference note is within audible limits. The period occupied by this range is so short that only a "click" occurs in the telephone for every variation between the above limits of the frequency of the local oscillator. As, however, this variation occurs 1,000 times per second, a clear note having a frequency of 1,000 per second is heard whenever signals are received.

A receiver for short waves is thus obtained which has the great sensitiveness of the interference receiver, but is independent of very small variations in frequency either in the received waves or in the local oscillator.

De Forest Air Audion

LEE DE FOREST now claims that it is possible to receive radio telegraphic signals by means of a thermionic detector which operates in the open air. In the diagram figure 1, W is a plate which surrounds both the grid and filament electrodes. R is a receiving telephone connected in series with the B battery as in the usual circuits for the three electrode valve. G is the grid electrode which is wound around the filament F, which is a Nernst glower energized by an "A" battery with an impedance coil P in series.

The operating characteristics of this oscillation detector have not been disclosed, but will no doubt be forthcoming in the near future.



Circuit of connections for the De Forest Air Audion

A Summer on the Great Lakes

Some First Impressions of a Novice In Commercial Wireless Operating

By Julian K. Henney

I—Mal de Mer

AS I sit here by an open window listening to the deep-throated blasts of the first freighters of the season, I cannot help but think of the pleasant summer I spent on the Great Lakes last year. The thought comes to me that after all has been said and done, the best positions in the world are not those that have the highest salaries attached to them, but those which bring the greatest amount of pleasure and satisfaction to the men who hold them. Personally, I believe that right now I should much rather be a radio operator on the ugliest freighter in the world with the ordinary wireless man's salary, than the president of Germany or the Great Mogul of Hindustan, with the accompanying millions and minions. In fact, I should rather be boss over one measly bellhop than commander-in-chief of an army that was only looking for a chance to put the transformer terminals around my neck. This, however, is entirely a personal opinion and has little to do with the recital of my experiences on the Great Lakes.

After several days of waiting at the Marconi offices in Cleveland, I was assigned to the Juniata with Watson Snell as partner. I knew in advance that the Juniata was a pretty ship and the run from Buffalo to Duluth one of the longest on the lakes, so I was rather elated at being placed as I was. Snell had been on the same steamer the season before, so I imagined we would soon get acquainted with the officers and crew.

We did . . . and quite suddenly too.

We started on the first of July for Buffalo, where we were to board the steamer which left on the second. Both of us were not sorry to get started, incidentally, for the tariff on board and rooms in Cleveland is slightly higher than on shipboard; so as soon as our passports to Buffalo had been issued, we lost no time in getting to the Seeandbee.

We had first, of course, carefully stowed away our tickets in the unhandiest possible pockets, received our death certificates—as the operator terms his insurance policy—our water front passes, a letter of introduction to the skipper of the Juniata, several words of advice from the traffic manager and the superintendent of the company, supplemented with orders to be careful about jamming the new navy men. With this equipment we started for the steamer, prepared to spend a pleasant evening on the way to Buffalo where our "six on and six off" started in earnest. Learning that we were to sleep in the radio man's bunk while he was on duty during the night, both Snell and myself had visions of a wonderful snooze while the great side-wheeler rushed us toward our own steamer.

All day long the wind had been whipping the shallow waters of Lake Erie into one of those choppy seas which are characteristic of this body of water, especially in the early part of July. The waves could be heard coming over the breakwater as we lugged our grips to the dock where the Seeandbee was tied up, and it was with the greatest of difficulty that Snell managed to keep his straw hat firmly anchored to his head. As gusts of wind tore past my singing ears and stinging cheeks, I looked out of the corner of my eyes—at intervals when the tears were not running out of them like a miniature St. Mary's Rapids—to see if that straw bonnet was still jauntily perched on the side of my worthy partner's head. This reconnaissance work was fascinating. For the hat stuck to its perch marvelously, much to my enjoyment at the time, but to my later embarassment. About every ten steps Watson would come to a groaning halt, methodically set down his suitcase, his kodak and his mandolin, thus freeing a hand to pound the hat down over his ears, while I trudged valiantly onward toward the pier with a half-ton hand trunk to impede locomotion.

But all thought of high seas, higher wind, and worries in general, left our minds as we lugged our dunnage aboard the Seeandbee and up a half-dozen flights of stairs. We walked up one corridor and down the other, vainly seeking the radio room. Our luggage became heavier and heavier. Several aeons, or ages, or something passed; but at last a kindly disposed bellboy pointed out the locked door of the wireless room. We deposited our paraphernalia outside the entrance, and waited. After sitting on the madolin and the hand trunk, respectively, for a half-hour, Snell and I decided that the radio man was not coming, and that we would have to sleep on the floor or invest three-fifty in a stateroom. Upon reflection, however, neither scheme appealed as being particularly practical; so we sat and waited.

While thus in repose, tied up to the mandolin and the traveling bag, we could fully appreciate that the wind was whistling overhead in the rigging, and occasionally we would hear a sickly groan as the steamer leaned over and rubbed against the pier. We were still inside the breakwater, but whenever a hard gust struck the vessel she lurched and strained ominously at her hawsers. . . . We began to wonder if it would not be better to go by train to Buffalo, and not take chances on the Seeandbee's going down.

With each rise and fall of the ship under us, we looked —not at each other—but out of the porthole, estimating the desirability of the New York Central as a common carrier, rather than the Cleveland and Buffalo Transit Company. But we sat on mandolin and traveling bag, and waited. It was here that Watson told me he intended to learn to play the staunch musical instrument, and he also confided that he had paid as much as a dollar and a half for the affair. Potentially, it was a good investment, for when I later heard him learning to play it, I offered him ten dollars to throw it and his musical aspirations overboard. He refused; doubtless reflecting upon the mandolin's one-time utility as a mourner's bench.

Nevertheless, about ten minutes before sailing time the radio operator appeared, and strange to say he seemed quite pleased to see us. I forget his name, so the designation of Jones will have to serve the purpose of this narrative.

Jones was a pretty good chap. He was not specially enthusiastic about us sleeping in his bunk, but he did not object. He eyed our impedimentia with a wary eye, but my pardner and I were nothing daunted. We were to sleep in his bunk; we intended to stow our stuff in the wireless room; and there we were; there could be no arguing about it. Jones could hardly have been pleased to hear what he soon learned: that I was from Western Reserve University. He came from Case School, my college's mortal enemy, so I looked for a rehearsal of the Thanksgiving game on the spot. But, as I say, Jones was a pretty good chap.

At eight o'clock the steamer cast off, and soon we were on our way down the waterfront, inside the long breakwater that protects Cleveland's shipping from the choppy seas of Lake Erie. I had been rather apprehensive as to what would happen when we got out in the open, and my fears were realized with interest as soon as the Seeandbee poked her nose into the gale.

A huge roller took us off the port bow, twisting the ship from stem to stern; a gust of wind took a slap at the upper works at the same time. The vessel rolled over with a snap; I rolled to the floor; Snell rammed his head into the bunk, and Jones got white around the mouth.

When a fair equilibrium had been established the long-looked-for question came forth.

"Do you fellows get sick?" inquired Jones, and there was a slight suggestion of loftiness in his voice.

I was fully prepared to answer. I would play safe. "Well, I never have yet," was my reply.

Snell adopted a superior tone. "Oh no, not me," he replied. "I spent all last summer on the Lakes and never even felt bad. I guess a little thing like this won't bother me." His manner reminded me of how his hat had stuck on his head with a sort of summery jauntiness that riled one all up. We were quiet for some time, trying to adjust ourselves to the twisting of the floor under our feet. Finally: "How does it feel to be sick, I wonder," speculated Jones.

"I don't really know," said Snell, "that is, from experience; but they say you feel kind of hollow down in your hold, and then in the galley it feels . . . well your dinner kind of. . . . I believe I'll turn in and get some sleep!"

Snell made a motion as if to enter the bunkroom door, but catching my eye, decided to stick around. Jones kept up his searching investigation into the subject of seasickness. He might have been intending to write a book about it from the interest he showed in Snell's answers.

"The mate tells me that even skippers and mates get sick some times when it is rough," was one of Jones' observations which I recall.

"Yes I've seen it so rough that even the Old Man had to stay in bed," agreed Snell. "But this little sea tonight is nothing to what you get in Lake Superior." I felt that this was a jab at me. "Are you having any success with the outfit this year? I used to hear the spark up North once in a while."

"Why yes, I guess so," said Jones. "You see I've only made a few trips. I never got sick yet. But then it has never been so rough before."

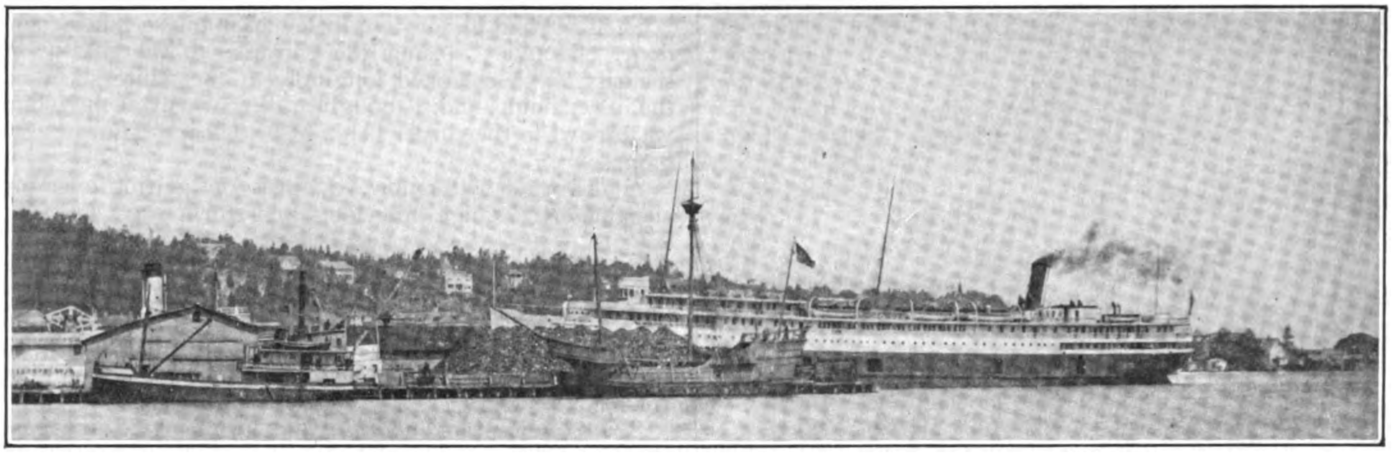
"Do you know Dietsch of the Detroit Third?" Snell tried again to change the subject.

"Yep, Dietsch has a pretty good fist, hasn't he? . . . You know, I'd hate to get sick on this tub. . . . What is a good thing to do for seasickness?"

About this time my mind's eye began to open. It became evident that the great wireless operator of the wonderful ship Seeandbee, the man who held the lives of all the ship's passengers in his hand, was worrying about something.

I shall never forget the little tableau which was then enacted in the radio cabin of the huge sidewheeler. Jones was at one end of the long room, perched upon the top of a high stool, the receivers over his ears, trying his level best to stick on the seat and to appear unconcerned. All his energy was needed to keep from sliding off on the floor with each lurch of the vessel, and he was continually sticking out an arm or leg to hold himself from the opposite wall. Snell stood in the doorway to the bunk room with a queer look in his eyes, one of which I could now interpret. I sat at the far end of the room in the dark, listening to the learned discourse on an ailment the existence of which, tradition records, has never been voluntarily admitted by those who acquired it. That night I discovered the only real preventative for the dread malady. I sat in the one chair that did not wobble and which had

Dark clouds sweeping by made us fully appreciate that the wind was whistling overhead in the rigging



The old and the new furnished a contrast when one of the massive modern Lake steamers nosed in behind a replica of the Santa Maria, the ship of Christopher Columbus

arms, my feet cocked up on the end of the operating table, my head resting on the back of the chair. In this position my body made a large V, with my "hold," as Snell called it, clear at the bottom. I was able to keep from falling on the floor at each lurch of the ship, and after a while I discovered that I did not observe that queer "elevator feeling" as the vessel rose and fell with the waves. I really felt fine, and was beginning to enjoy the affair to the limit. Catching Watson's eye, I nodded that I was on to his curves and immediately began to take an active part in the discussion.

"By the way, Jones, old man, you don't feel bad?" I asked.

"No indeed! Do you?" he replied. Then he added: I —I don't look sick, do I? Of course I could turn in if I got sick. I don't have to stay on the job if I am not able. I could turn in for a while and then—"

"Aw, you fellows can this 'sick' business! You make me tired! Use a little domestic science—" Snell was evidently rattled—"Why do you talk about it? If you're going to get sick go ahead; but quit thinking about it. Just because you feel kind of funny in the stomach is no sign—Ha, ha! Guess I'll turn in and get some sleep."

Snell turned again toward the bunks and I thought for a minute that he was going to desert me. But he had a new thought. Blandly, he asked if I were hungry. I immediately suggested that the three of us go down to the buffet and get something to eat. Jones looked horrified.

"Oh no, I can't leave the outfit," said the radio man. "I'd like to go, but something might happen."

So Snell and I made our way down to the lower deck and aft to where the buffet held forth with everything under the sun that was not good for one to eat. By holding on to the rail around the counter we managed to put down several shredded wheats and some coffee. A portly gentleman then staggered in and devoured a sardine sandwich and a bottle of ginger ale. We decided that the combination was the very thing for our friend up on top, and soon after we returned to the scene of action, properly equipped.

When we first glanced through the door the Case man who had turned wireless operator had his head on the table, pillowed in his arms. Snell coughed. Immediately, I opened up thus:

"What's matter, old man? Not sick in a little sea *like this are* you?"

"Nope," was Jones' energetic response. "I'm feeling a little sleepy, tho. And I can hear anything that comes in by putting on the receivers once in a while. It really isn't necessary to listen in all the time."

Snell turned to me. "By George, Henney," he volunteered. "I believe those bellhops down below were sick. Did you notice how sleepy they were?" He was quick to follow up this new avenue of attack. "Sleepiness is the first symptom, you know," he added seriously.

Poor Jones fell for the bait at once. "Is that right? But then, I haven't been getting much sleep lately. Guess that's why I am drowsy. How were the bellboys acting? Did you say they were sleepy?"

During the interchange, my friend Watson and I had firmly seated ourselves in the two good chairs, our feet high up in the air and our bodies in that comfortable and secure V position which I had discovered and passed on to Snell. But the poor Case man, he of the wonderful ship Seeandbee, was perched high up in the air on a rickety, swaying stool, the light of the lamp hanging over the operating table making clear every expression of his countenance. His feet were hitched in the rungs of the stool on which he was so precariously seated, and although he tried to conceal it, we could see that his hands were spasmodically twisting and turning, one to his stomach and the other to his mouth, as if he was expecting something. He tried to adjust his apparatus as a blind, but invariably they would return, respectively, to midsection and mouth. It was plain to see that the pangs of *mal de mer* were beginning to have their effect.

"You bet those bellhops are some sleepy." I hastened to assure him. "And you ought to see them rubbing their stomachs. You'd think there was static in 'em."

The hand came away from his waistline with a jerk so strong that it knocked the detector out of adjustment. By the time he had this fixed Snell was ready with another frontal attack.

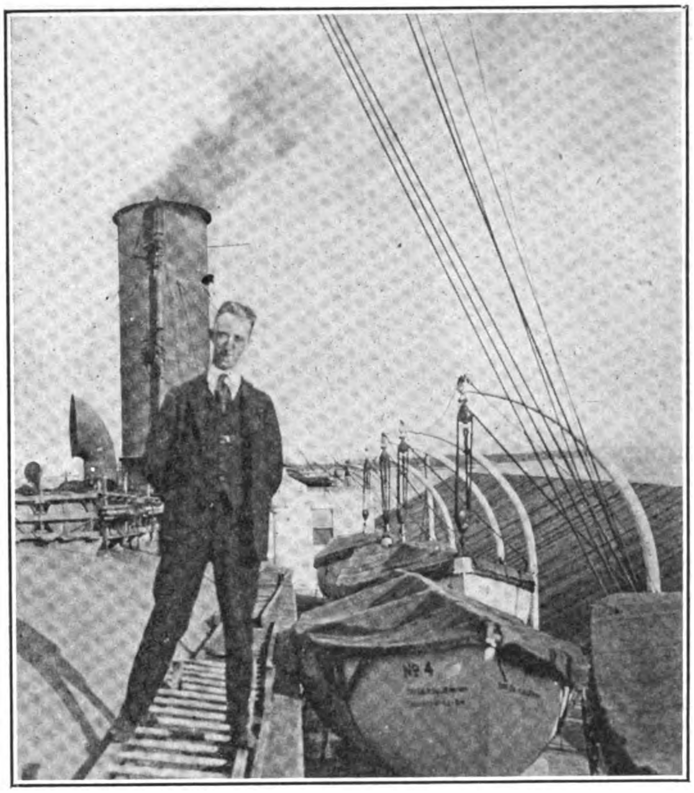
His voice took on a reminiscent strain. "I remember one time I was up in Lake Superior. It was blowin' something awful—just about like this, in fact—and the bellhops on board had been eating all kinds of stuff. They had turned out to see the fair at Houghton and all the candy, peanuts and popcorn in the place came back inside them. Well—would you believe it?—every last one of these fool kids got sicker 'n dogs. And the funny thing about it was the way they got sleepy just before they ran for the rail. They kept gettin' sleepier 'n sleepier, 'n they were all rubbin' their——"

"Wait a minute!" wailed Jones. "Somebody's calling me."

He pretended to listen awhile for signals. Then he announced that he must have been mistaken.

"I guess it was just—just static. This roll kind' a goes to my head. It's not likely that I'm going to get sick but you guys had better go to bed. It's blowing fit to kill outside, and I don't want to be bothered with any sick fellows 'round here."

Snell and I both assured him that we were over our sleepiness. "I wouldn't go to bed for the world now," said Snell. "All this reminds me of that night on Lake Superior. Yep. The swell was just about as bad as this



The author, who engagingly tells why he would rather be a wireless operator than the president of Germany or the Great Mogul of Hindustan

—it's rolling like thunder, do you know it, Henney?" He shifted his gaze. "Well those bellhops had been eating mince pie and drinking pink circus lemonade, and all that sort of stuff you know, and—

"By the way, Jones, feeling sick? That light makes you look kind of pale."

I felt it was up to me to say something. "If you want to turn in for a while old man," I began in sympathetic tones, "Watson and I'll be glad to stay on the job." This offer to stay up for him was very magnanimous, and Snell smiled approval. "Go and stretch out for a while," I added soothingly. "That's the best thing for seasickness. Just go to sleep and we'll have a good time sitting up while you are getting better."

Snell hitched his chair a little closer to the bunk room door, effectively closing the entrance to that haven of security. Jones looked longingly at the white sheet on the lower bunk; and, I thought, rather warily at the white wash bowl in the corner behind Snell's back. But he was game.

"I feel a lot better now. I guess I'm getting over my sleepiness. Strange how long this storm stays on, isn't it?"

We had been out all of three hours; which can be quite a long time from some viewpoints. Jones looked up miserably at the lamp swinging back and forth with the roll of the ship, and then added as if he had just thought of it. "If I get feeling bad, I'll let you fellows stay on duty for me."

Snell's voice took up its monotone. "Well sir, those poor bellhops were about the sickest bunch of fellows I ever saw. They had been eating all kinds of stuff down at the buffet and"—Snell's story always started and ended with the eats—"and the stuff simply wouldn't—. You haven't been eating anything, have you, old man?"

"Only a little popcorn this afternoon," came in a weak voice from the stool. "And I drank some buttermilk at Thompson's just before I left tonight. That ought to be all right, hadn't it?"

I looked at him with an expression of shocked amazement. Snell opened his mouth as tho to say something, and then closed it as if words simply couldn't express his horror. Jones paled.

"You don't mean to say that you put that combination in your stomach!" I gasped. "Acid and starch! Why man alive that's enough to kill you on land, let alone on board ship in a gale like this. Thompson's buttermilk! Did you hear that Watson? That rotten manufactured stuff with the microbes floating around on top with their toes up in the air! It's a good thing he didn't load up like that guy in the buffet, eh Snell? Just think of a nice smelly sardine sandwich and a bottle of ginger ale added to that mess—"

I was interrupted by a despairing groan from the top of the stool.

"Oh Gawd!"

Jones slipped from the stool, made a staggering dive for the door, missed Snell by a half inch, and a few minutes later we heard him plump down on the bunk.

Mal de mer had conquered.

The August Wireless Age Will Contain

an interesting article on the design and construction of buzzer transmitters for transmission at amateur wave lengths. Experimenters having a source of 110 volts D. C. or 500 volts D. C. are enabled, with this apparatus, to transmit over distances up to 100 miles. The transmitter to be described has been used in airplane communication with success. The construction is of marked simplicity.

A special article, on Resonance in the Audio Frequency Circuits of an Amateur's Transmitter, contains information of utmost value to experimenters contemplating the construction of Quenched Gap Transmitters.

Ensign Rodd

He Got Across

Something About Ensign Rodd, First Wireless Operator to Fly Across the Atlantic

TO Ensign Herbert C. Rodd, a former amateur of Cleveland, Ohio, and an ex-Marconi operator who enlisted in the Naval Reserve shortly after the United States entered the war, fell the unique distinction of manipulating the wireless apparatus on America's flying boat NC-4, the first craft to span the Atlantic by the air route. As the nation rejoiced on May 27th that the realization of a dream centuries old had a material basis in fact, universal congratulation was extended by wireless workers to the young man who had successfully maintained communication on the aircraft during its flight across the wide ocean.

That a former amateur should have been selected for this position of great responsibility is an additional fact to establish the importance of extensive development of the experimental field in wireless. Once again it is emphasized how much was contributed to the Navy's success by the civilians called to its ranks in the emergency, and this incident should be viewed as a climax to achievement, setting at rest for all time proposals looking for government ownership sponsored by Naval officials.

General public recognition has been given to the aerodynamic aspects of the great flight and it is looked upon as a gloriously fitting triumph for the United States, a country which produced the Wright brothers, the first to achieve mechanical flight in a heavier-than-air machine; also another American, Glenn Curtiss, first to make the airplane a water as well as an air machine. Little attention has been given, however, to the equally significant fact that the country of Ensign Rodd was the first to develop and encourage amateur wireless in a broad way and place it on a scientific basis. Now that it is generally recognized that the success of the flight was in a large measure due to the perfection of communication arrangements, it is equally fitting that the event be celebrated as a triumph for American wireless men.

As to the particular individual who handled the key: he is a typical American amateur in every respect. His mother, in commenting on his achievement, voiced in a sentence a biography which might be applied to the many thousands who are daily engaged in wireless experimentation. Mrs. Rodd said, "Ever since he was a boy, my son has been experimenting with electrical devices, endeavoring to improve them."

He joined the Marconi service at the opening of the Great Lakes navigation season, seven years ago. His first assignment was on the steamer Eastland, and during 1913 and 1914 he served as senior operator on the Octorara. He was then transferred to the Lakeland, on which vessel he won recognition as an S. O. S. celebrity. His vessel ran on the rocks off the port of Alpena, November 10th, 1914, during a gale and heavy snow storm. Rodd sent out the distress signals and established communication with the Marconi station at Cleveland, from which the wrecking tug Favorite was dispatched to the Lakeland's assistance. The young operator maintained constant communication with the wrecking tug until she arrived, and then joined the crew in lightening her cargo to the end that, with the assistance of the tug and life saving crew, the vessel was safely towed to Port Huron, Ohio.

The following season Rodd became operator at the Marconi station in Detroit, Michigan, remaining there for several months and then accepting a transfer to the yacht Nakomis. He remained on this vessel until the close of navigation in 1916.

In the Spring of 1917 he heeded the call to arms and entered the Naval Reserve as Electrician, First-Class. His first assignment detailed him back to the station at Detroit, and a later transfer brought him to the Marconi station in Cleveland. When a few months had elapsed, he moved on to the Marconi station at Calumet, Michigan, where he took charge of the equipment and received a rating as Chief Petty Officer. His ability had then attracted attention, and he was called to a naval station at Great Lakes, Illinois, where he was placed in the laboratory and assisted in the construction of the ground station and distant control station at this point. He was commissioned an Ensign in the Fall of 1918 and was transferred to Norfolk, Virginia, where he displayed such unusual radio ability that selection fell upon him as radio officer of the NC-4.

At It Again

After two years of painful suspension of activities the wireless amateur is again on the job. Above, a New York Y. M. C. A. enthusiast is making the familiar adjustments inseparably associated with the joy of "listening in"

On the left is A. W. Nelson of Montana longingly cuddling a radio phone transmitter

Press Ill. Svce.

And here, the most familiar of sights—the old aerial going up! The particular amateurs are Barber and Terleph of Richmond Hill, N. Y., but the task engaged in is applicable to ary locality in these broad United States

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

Efficient Receiving Apparatus and Experiments with Electrostatic Coupling

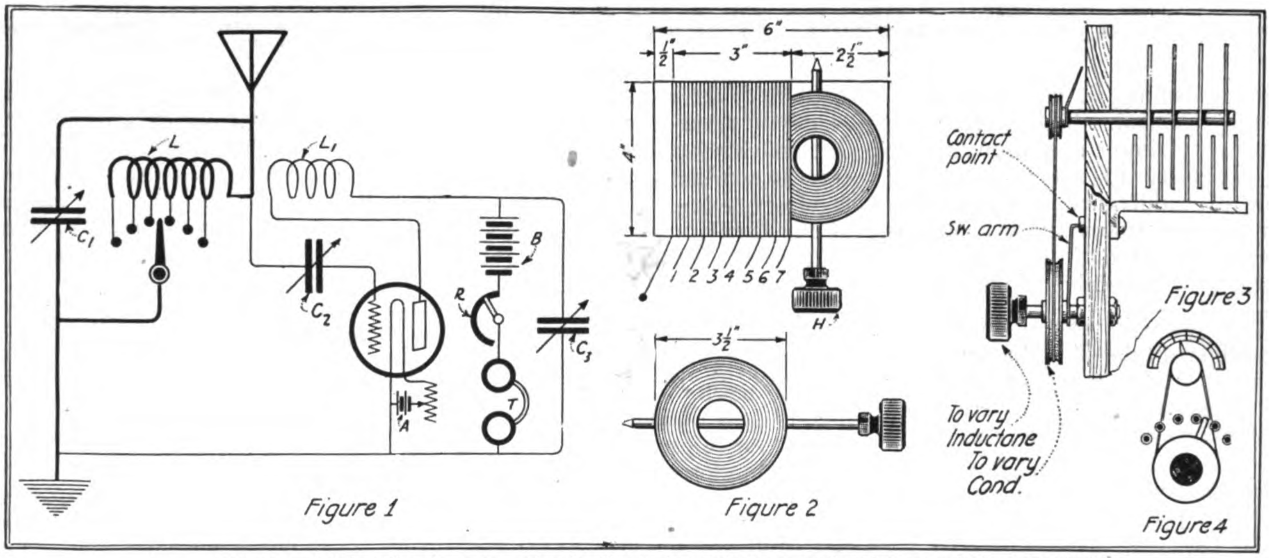
By E. T. Jones

THE receiving circuit about to be disclosed is superior to the usual run of circuits presented by various experimenters. One of the principal features is that the valve may be made to oscillate steadily at frequencies corresponding to waves as low as 150 meters. In fact, the circuit functions well at wave lengths between 150 and 3,000 meters, but for still longer waves the more common circuits are preferred.

Many of the several hundred circuits shown heretofore have the great disadvantage of introducing too much inductance in the associated circuits to operate on short wave lengths. In the following diagrams this is overcome in a way that improves the overall efficiency.

Figure 1 is an elementary circuit; L, constitutes the tuning inductance, and L-1 the tickler coil. It will be shown later that instead of providing two coils for the tickler, the primary is mounted in the end of the tuning inductance and caused to rotate in much the same manner as the movable coil in a variometer.

C-1 is the usual shunt variable capacity across the tuning inductance L. It is to be noted that no primary inductance is employed, and the losses which would be present in capactive or magnetic coupling are eliminated. In fact it was noticed that approxi-



Drawings showing the elementary circuit, the tuning inductance and end turn switch, respectively

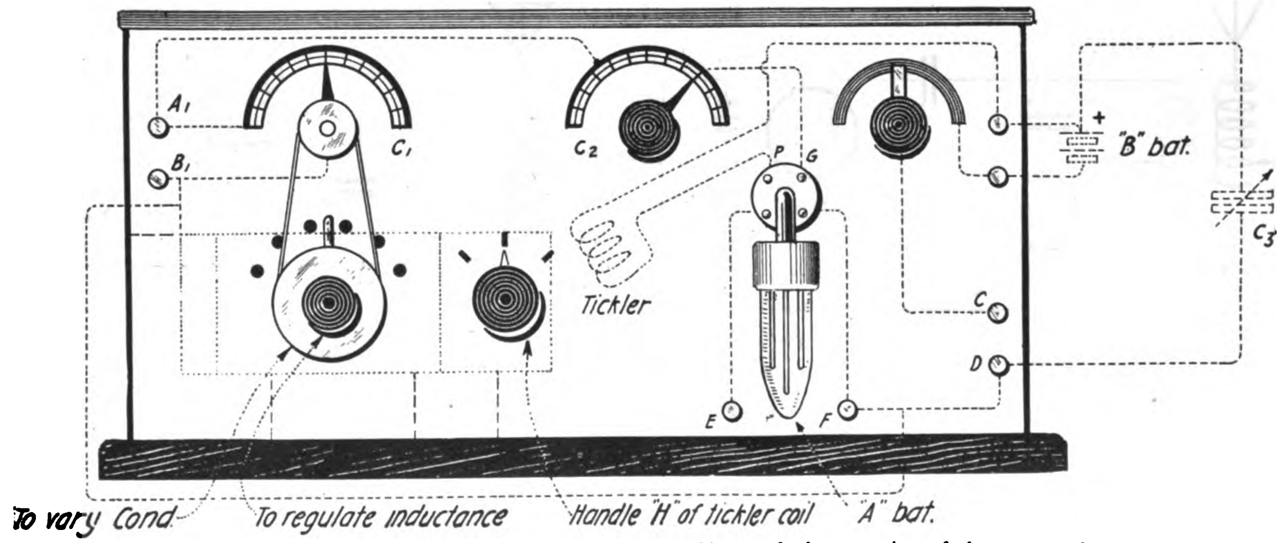


Figure 5—Showing complete apparatus mounted in one cabinet and phantom view of the tuner and its connections

mately twice the strength of signal was obtained when using the connections shown; and quite contrary to the belief that such a circuit would fur-

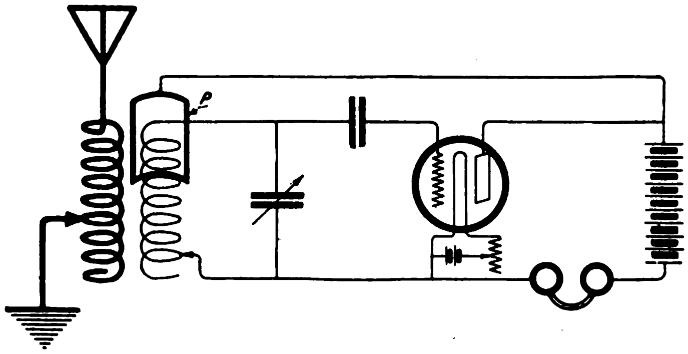


Figure 6—Showing plate circuit electrostatically coupled to the secondary

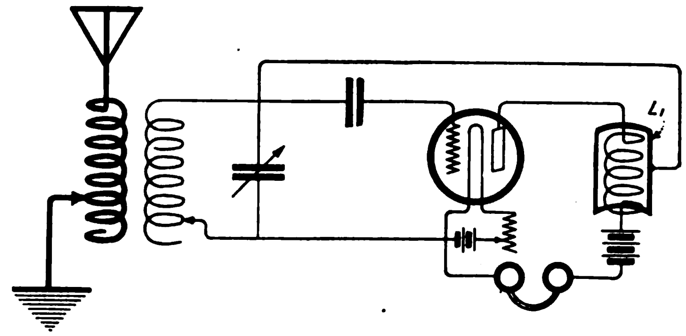


Figure 8—A modified method of obtaining electrostatic regenerative coupling

nish broad tuning, it was found exceptionally critical. This makes the tuning a very simple operation, it only being necessary to cut in a certain amount of inductance and vary the condenser until maximum response is had. A detailed outline of the construction of this receiver follows:

The Tuning Inductance

A cardboard tube 4" in diameter and 6" long has a 3" winding of one layer of No. 28 S.C.C. wire. Taps are taken off as shown by the numbers in figure 2, ¼"-¼"-½"-½"-½"-½"-½", which makes a total winding of 3".

The Tickler

The tickler primary is wound on a frame 3½" in diameter pivoted as shown and placed in inductive relation with the secondary inductance, the degree being controlled by moving the handle H. It is wound with the same size wire—No. 28 S.C.C.—for a space of ½". A very good form can be

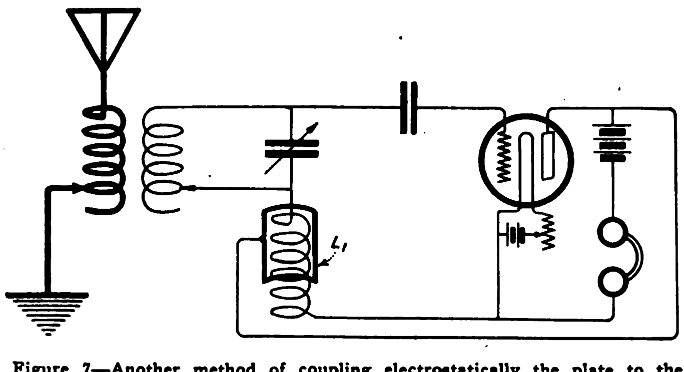


Figure 7—Another method of coupling electrostatically the plate to the secondary-grid circuit

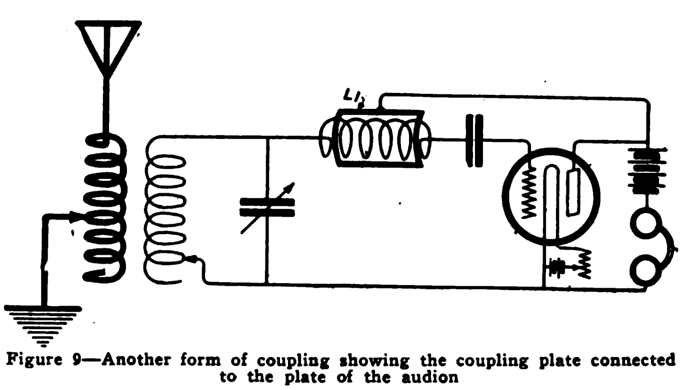


Figure 9—Another form of coupling showing the coupling plate connected to the plate of the audion

made of pasteboard tubing instead of the wooden form.

Any of the various forms of end turn switches can be provided. The design was purposely left out here for the sake of simplicity. All that is necessary after the completion of this inductance is to have a variable condenser mounted in the same cabinet as shown; and in order to simplify the tuning, the arrangement shown below is recommended.

This arrangement consists principally of having the condenser geared by pulleys to the handle of the inductance switch as shown in figures 3 and 4. The pulley mounted on the latter is made to move easily upon the shaft of said switch; this makes it unnecessary to use both hands when tuning, leaving one hand free for manipulation of the oscillating circuits.

It is best to mount the above apparatus in one panel separate from the oscillating circuits because if it is desired to change over from the short wave receiver to a long wave set, it can be accomplished by the use of a double pole double throw switch.

But for those desiring to put the complete apparatus in one cabinet the following details regarding the apparatus as shown mounted in the drawing of figure 5 will be of value. As therein indicated, the condenser is mounted at the top of the left hand side of the panel and just under it, the inductance coil, the aerial and ground connections being made to the binding posts A-1 and B-1. The tickler, previously described, is mounted so that its handle H protrudes outside of the panel.

The right hand side of the cabinet shows the audion adapter, the B battery resistance and the telephones, which are to be connected at C and D. The position of the grid condenser is also shown.

Figure 5 shows a phantom view of the tuner and its connections. Condenser C-1 is shunted across the tuning inductance and condenser C-2 is connected in series with the grid of the audion and the aerial connection A-1. R is the high resistance "B" battery regulator and C, D are the telephone terminals. The A battery or filament battery is connected to the terminals marked E, F. No dimensions are given owing to the fact that the condenser containers vary in size. Any experimenter interested in long distance amateur short wave reception cannot fail to investigate the merits of this circuit, for in addition to giving loud signals, it affords a notable degree of selectivity.

With this type of circuit one is not restricted to the use of very small antennae. By inserting a variable condenser in series with the antenna, if too large for the reception of 200 meter wave lengths, the strength of the signal is not decreased and in some cases it was found to improve the strength, probably due to the fact that the condenser tended to alter the voltage distribution so that a very high E.M.F. was impressed upon the grid of the tube.

Exceptional results were had with an antenna 60 feet long of four wires, spaced 4 feet apart. One supporting mast was 60 feet high, the other 25 feet high.

Some Experiments with Electrostatic Regenerative Coupling

A method of coupling valve circuits electrostatically for various purposes has been described in a former patent by Bucher. I have found certain forms of his method of capacitive coupling to

be very practical in oscillating tube circuits.

Figure 6 shows the plate circuit electrostatically coupled to the second-

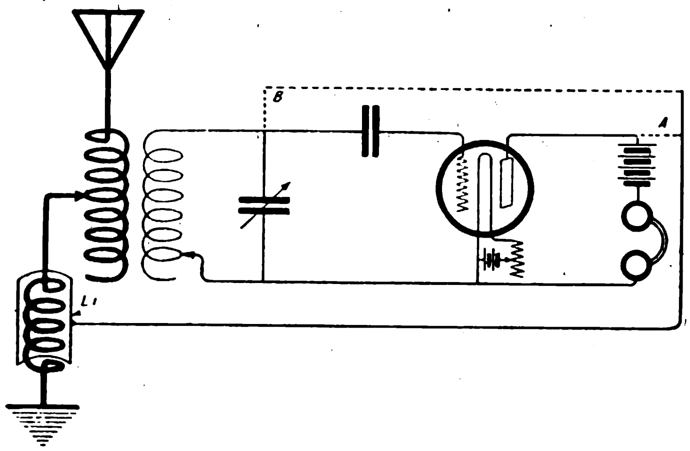


Figure 10—Electrostatic coupling obtained by connecting the coil L-1 in the primary ground lead and the coupling plate to plate circuit of the audion. Very efficient for long waves

ary. This is accomplished by bringing the metallic semi-circular plate P in proximity to the end of the secondary winding which protrudes out of the primary. Very good and valuable results were secured with this arrangement. The plate P has a critical position in respect to its distance from the secondary windings for each change of wave length, being closer for short waves and farther away for long waves. The plate P must be fitted with a long insulated handle because, due to the coupling between the body and the coil, the presence of the body has a marked effect on the oscillating period of the circuits.

Figure 7 shows another method of coupling electrostatically the plate to the secondary-grid circuit. Here the small inductance L-1 is inserted as shown and the plate P brought in close relation thereto.

Figure 8 indicates a modified method of obtaining electrostatic regenerative coupling. The plate P is connected to one side of the grid condenser and the small coil L-1 is connected in the plate circuit as shown. The coupling is varied as before by increasing or decreasing the distance between the plate and the coil L-1. This circuit gives as good results as the two aforementioned. The circuit of figure 9 is particularly useful for short waves.

Figure 10 shows still another form of electrostatic coupling. Although this circuit failed to function on short waves, it gave very good results on the longer waves. The coil L-1 is connected in the primary ground lead, and the plate to the plate circuit of the audion. On short waves such as 600 meters the plate had no effect, but after getting up to 5,500 and 8,000 meters, it required a very critical adjustment. As shown by the dotted lines two connections were tried, but the best results were obtained when it was connected to A.

Figure 9 shows another method which gave very good results on short wave lengths in the region of 200 meters and is substantially the same as figure 7. The plate P was connected to the plate of the audion and electrostatically coupled to the inductance L-1 connected in the grid circuit as shown.

This method of electrostatic coupling certainly has a wide range of applications in connection with audion regenerative circuits, and it is well worth one's time to dig in and see what is in store for the wireless world at large.

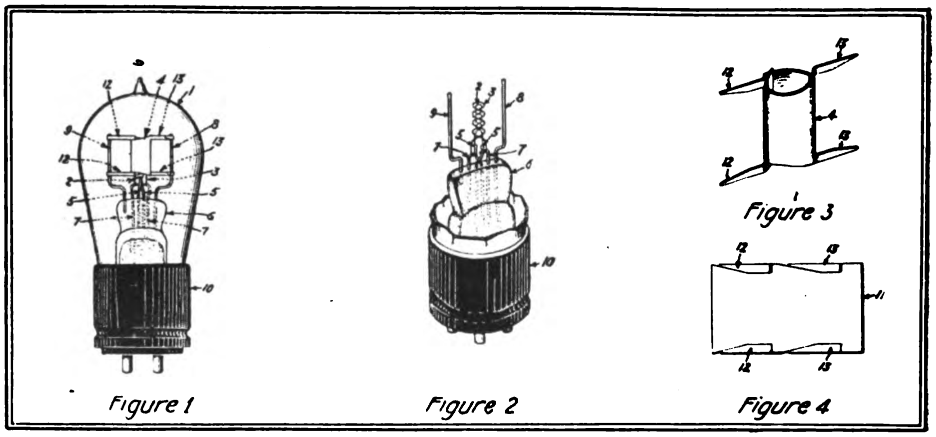
Vacuum Tube Construction

H. J. NOLTE of Schenectady, N. Y., has shown the design of the internal structure of a three electrode vacuum tube as indicated in the drawings, figures 1, 2, 3 and 4. Figure 1 is a view of the completed pliotron; figure 2 is a view of the pliotron with the bulb and the anode broken away; figure 3 is a view of the anode and figure 4 a sketch of a metal sheet from which the anode is constructed and which shows how the supporting strips are cut away.

The completed pliotron comprises an evacuated bulb 1 within which are located the cathode 2 in the form of a coil filament which is preferably of tungsten, a grid 3 in the form of a coil wire surrounding the cathode and a cylindrical anode 4 surrounding the grid.

Leading-in conductors 5 which are sealed through the stem 6 supply current to the cathode and leading-in conductors 7 which are also sealed to the stem 6 supply current to the grid. The anode 4 is supported by two arms 8 and 9 both of which are sealed into the stem 6. Arm 8 extends through stem 6 and serves to carry the anode current.

The sheet is then bent into cylindrical form and the strips 12 and 13 are bent away from the cylinder so as to extend in diametrically opposite direc-



Drawings showing the complete pliotron; view of pliotron with bulb and anode removed and finally the anode complete and method of construction

The anode is constructed of a rectangular sheet of metal as shown in figure 4. From each side of this sheet, strips of metal 12 and 13 are partly cut away in the manner indicated.

tions therefrom as indicated in figure 3. The ends of the strips are then wound around the supporting arm 8 and 9 as shown in figure 1 and welded thereto.

Controlling the "B" Battery of a Vacuum Tube

THE connections shown in the accompanying drawing for "easing up" the "B" battery control of vacuum tubes may be of interest to amateurs who are troubled with critical potentiometer adjustments. A 400 ohm potentiometer shunted across the last two or three cells gives a very fine control of the local E.M.F. It has the further advantage that it does not run down the entire B battery which would be the case if a potentiometer of such low resistance were shunted across all the cells. It will be noticed in the upper part of the drawing that an end cell control of the plate voltage is provided, a three point switch being connected to the two end cells to permit them being cut in or out.

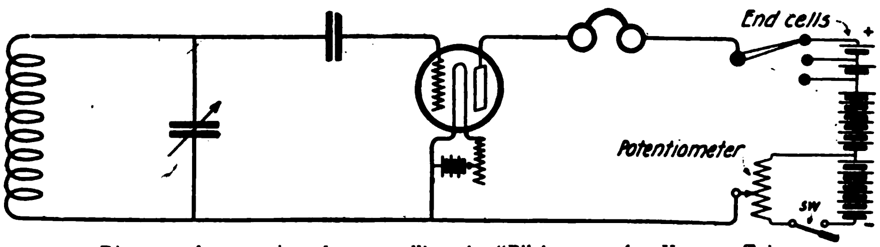


Diagram of connections for controlling the "B" battery of a Vacuum Tube

I have used this diagram of connections with great success.

LOUIS FUNKE—*New Jersey.*

Contest Winners for July

The May WIRELESS AGE subject for discussion was: "To what extent do you believe that wireless telephony will take the place of wireless telegraphy in amateur communications?" The usual prizes have been awarded to the writers of the following articles.

First Prize—Will It Be "Hello" or Telegraphic Buzzes

WE are asked to what extent in the future, the wireless telephone will take the place of the wireless telegraph. This question causes us to regret our lack of the gift of prophecy, for here indeed is a job for a wiseacre. The first thought that occurs to one in the consideration of this question is that everybody can talk, but that comparatively few can send and receive wireless messages; therefore, we are likely to conclude that the amateur will be in haste to abandon the crackling telegraph for the still, small voice of the radiophone. But there are considerations that will make many of us pause. A very little money will install a simple wireless telegraph set. If one merely wishes to receive, almost any piece of wire sticking up in the air a few feet will serve as an aerial. One can easily make a tuning coil, a fixed condenser and a detector stand. A pair of telephones will cost about five dollars, and a bit of galena a few cents. With this equipment one can hear stations hundreds of miles distant, perhaps a thousand.

Of course even the smallest and simplest sending outfit costs much more, but almost any young man of enterprise, industry and ingenuity is able to install a complete set if he wishes to do so. On the other hand, the radiophone is too costly for the average amateur. I have scarcely any idea what a transmitter, good for a hundred miles, would cost, but I do recall that I once saw a transmitter offered for $375, but it would transmit only seven miles. So, looking at it from a pecuniary standpoint, it does not seem probable that the amateur as we have known him in the past will plunge very deeply into wireless telephony.

Then it seems to me that to those who have wireless telegraph outfits, the wireless telephone would become a commonplace thing. As before remarked, anybody can talk, but to be an expert telegraphist requires severe, persistent endeavor; and the things that are acquired only by labor and sacrifice are the things that are most valuable to us—things that cannot be handed over the counter for so much money.

But cost is doubtless the chief factor in the question. Leaving cost out of consideration, it is almost idle to speculate. We know that wire telephony has elbowed wire telegraphy to one side to a great extent in the last few years. Perhaps the amateur will follow the line of least resistance, take something that requires but little training and go in for the wireless telephone as far as the state of his treasury will permit; but it is to be feared that this condition will restrain the enthusiasm of many of us. Of course the high cost of wireless telephony applies only to transmission. Any receiving set equipped with an efficient detector will reproduce the human voice. It is possible that when wireless telephone stations come to be established in all large towns (as they surely will), thousands of amateurs who know nothing of telegraphy will install receiving sets in order to enjoy the wonder of taking from the regions of space an energy that will reproduce words spoken hundreds of miles away. I well remember the surprise, almost terror, with which I suddenly heard a voice coming out of the depths of space as I sat with the telephones on my head one night over two years ago. The mysterious and unknown speaker ended by singing "The Swanee River."

So, to sum the matter up, I should say that the cost will prevent the average amateur having a wireless telephone transmitter, but that when strong transmitting stations are established in the principal places, receiving stations will be numerous. But I hope and predict that the amateurs as a body will not abandon that branch of wireless that requires practice and skill, and whose rewards are only for those who are willing to pay for them by earnest endeavor.

The development of a cheap wireless telephone transmitter may upset my prognostications; but that is just what we amateurs are waiting for—an inexpensive radio telephone set.

S. F. McCARTNEY—*Pennsylvania.*

Second Prize—Radio Telephony as Regards the Amateur

I AM somewhat "on the fence" in offering a comparison of the ultimate relative value of the wireless telephone and telegraph in amateur communication. Comparing them from the viewpoint of present day progress, I stand in favor of the wireless telegraph, but I see that in the future, wireless telephony may become a very serious competitor of the wireless telegraph. Although the two systems of signaling have points in common, the matter of expense, manipulation, etc., in the two types of apparatus is vastly different.

To my mind, the up-to-date and progressive amateur will be the first to experiment with radio telephony, but it is certain that for a number of years radio telephony will not replace, even partially, radio telegraphy. It must be admitted that radio telephony has advanced rapidly during the war, but the operating characteristics of the wireless telephone have not changed sufficiently to afford it a better position in the eye of the amateur. The wireless telephone necessitates the use of complicated and intricate circuits, and expensive apparatus that is beyond the resources of amateurs of limited means. In fact, one of the first things that must be done to create genuine enthusiasm among amateur experimenters is the production of a cheap wireless telephone set that he may construct or purchase. It is a well known fact that all amateurs are "dabblers" and like to construct their own apparatus. The experimenter can construct all of the apparatus employed in radio telegraphy because of its great simplicity, but this cannot be said of the apparatus used in wireless telephony.

Not only is the construction of the wireless telegraph apparatus less expensive, but the actual building of the apparatus gives experimenters an insight into the fundamental principles of radio and constructional details that tends to make them better informed men. The radio telephone includes so much apparatus that the amateur cannot construct, that he is not likely to attempt to build a set. If radio telephony is to replace, even partially, radio telegraphy in the amateur field, more simple circuits and less expensive instruments must be provided.

There is another point decidedly in favor of the radio telegraph. Surely as long as the amateur can signal 2,000 miles by radio telegraphy, he will never be content to telephone 50 to 100 miles, for after all, it is the range of the radio telegraph that gives the amateur such genuine amusement. If the telephone could be worked as far as the telegraph, my arguments would be just the reverse.

If, in the future, some one provides a wireless telephone transmitter that will permit experimenters to talk several hundred miles at the wave length of 200 meters, then it is apt to prove a serious competitor to the wireless telegraph, but it is very doubtful whether such a set will be produced.

The amateur, having plenty of funds, will undoubtedly construct a short range vacuum tube wireless telephone set to be operated alongside his standard transmitting set, but it is to be doubted whether he would be satisfied with a wireless telephone set alone. I firmly believe that the wireless telegraph set will stay on the "top of the heap" for many years to come.

ARLYN ROSANDER—*Michigan.*

Third Prize—This Experimenter Favors the Wireless Telephone

DURING the war vacuum tube wireless telephone sets were perfected by the allied governments to the point where it became possible to talk a hundred miles or so with an input of less than one kilowatt. Scores of amateurs are preparing to experiment with this new form of communication as soon as permission is given to use their transmitting stations. It is my opinion that the wireless telephone has been improved to such an extent that it may supersede the wireless telegraph in amateur stations.

The radiophone has many advantages over the telegraph and a few disadvantages. Among the advantages, the most important is the fact that one does not need to learn the telegraph code.

The second advantage applies only to amateur transmitters using the rotary or straight spark gaps operated in the open air. Here the wireless telephone, with its absence of the crashing discharge, is much to be preferred to the old type of transmitter, where a blinding flash occurs every time the key is pressed. Due to the comparatively low potentials used in wireless telephony, breakdowns of insulation in the aerial or apparatus are largely eliminated. For the same reason very little leakage from the aerial to the ground will occur when the wireless telephone is used, rendering it less liable to losses of energy.

Another advantage of the vacuum tube radio telephone set is that by inserting a key in the control circuits, it is possible to transmit telegraphic signals as well as the voice. The telegraph signals will carry a greater distance than the voice, making it possible to use the telegraph when operation over long distance is necessary and the voice when considerable correspondence is to be carried on in a short time.

Although telegraphic signals from such sets transmitted by undamped waves can be received only on an oscillating audion circuit, the voice may be heard on any standard wireless receiving set, making it unnecessary for the younger experimenters to go to the expense of building a regenerative vacuum tube receiver.

The only disadvantages of the wireless telephone over the telegraph are the expense, the short range and the precision of adjustment necessary if the telephone is to operate successfully. However, at the rate improvements are being made in the apparatus used in wireless telephony, it will be but a short time until instruments are placed on the market that will be entirely suitable for amateur radiophone stations. A precise adjustment of each complement of a wireless telephone transmitter is required if the set is to be successful. By the help of good books on the subject, any amateur can soon learn to maintain the apparatus in correct adjustment.

We will now consider some of the former uses of wireless telegraphy among amateurs. Before the war, amateurs operated, successfully, a line of radio relay stations, extending in all directions over the country. Hundreds of messages were transmitted every night. Some of these stations in order to get a message to the next station along the line, were obliged to span distances of several hundred miles, especially in the West, where, at some points, suitable amateur stations were few and far between. For this reason, constant and reliable service was not possible at all times, because of atmospherics and QRM.

Several leading amateurs advocated shorter relays, as a solution of the relay problem, but the war stopped all experimenting, so that lines having shorter relays have not yet been tried out. If, in the future, shorter relays become a reality, I believe the wireless telephone will offer a reliable and speedy means of relaying messages. Although the speed of transmission is reduced by having to pass through a greater number of stations, the telephone will make up for that loss, because many more words can be spoken in a given time, over the wireless telephone, than can be transmitted over the wireless telegraph.

Some owners of private stations use their sets to chat with near-by friends, for the mere novelty of sending signals through the air. This class of experimenters will be apt to adopt the wireless telephone more than any because the feat of actually talking through the air will appeal to them as a new toy.

There was some fear for a time that amateur wireless was done for when the President issued the executive order closing all private stations, for the period of the war, and again when anti-amateur legislation was introduced; but instead of discouraging the amateur's efforts, these obstacles seem to have created a new interest in the science, which has been augmented by the numerous inventions and improvements made during the war.

We may conclude that the wireless telephone is capable of replacing the telegraph for nearly all amateur purposes, the exception being stations located at great distance from one another.

J. E. LAW, JR.—*West Virginia.*

The Monthly Service Bulletin of the

NATIONAL WIRELESS ASSOCIATION

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

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A Letter of Appreciation

I WISH to thank you for accepting me as a member of the Association. I also wish to congratulate the N. W. A. on the way they handled the Alexander bill. You may be sure that thousands of amateurs throughout the old U. S. A. are grateful to the N. W. A. for the work accomplished.

I feel that the amateur would have been a thing of the past if the N. W. A. had not stepped up and opened the eyes of Congress to the fact that amateurs are not kids at play, but that they constitute a full-sized man's organization.

I would also like to see the suggestions go through that 9YI suggested in the March bulletin; that is, the matter of State Organization. In an organization of this kind each state could have a get-together meeting once a year which would be of inestimable value. Other state associations have been formed; what is to prevent us doing the same thing?

VICTOR H. CARRUTHERS, *Grace, Idaho.*

A Comparison of the Isolated Instrument and the Panel Transmitter

THE argument whether the panel type or isolated instrument type of wireless transmitter is best suited for the amateur, to my mind, depends upon the use to which they are to be put. One type of amateur uses his set simply for social purposes, and after it is once in operation, it is very seldom altered, but is used constantly to communicate with friends. This type of experimenter rarely carries on extensive experiments and knows little of the theoretical principles of his apparatus. The panel type of transmitter, in the opinion of the writer, is best suited for this amateur since it is compact, less liable to get out of order, is portable and presents a very neat appearance. On the other hand, the man who can truly be called a radio experimenter studies the theory of the different parts of the set, makes changes constantly to correspond with the advancement of the radio art, and also experiments to determine the characteristics of the several instruments used.

Intensive experimenting is not possible unless each instrument is isolated, this being true of all phases of scientific research, whether it be radio, electrical, chemical.

It appears to the writer that a panel type of transmitter would not appeal to the amateur with a scientific turn of mind. Even small changes must be made to satisfy his curiosity. Such experimenters represent the type of man that proved so efficient in the military service during the war.

The Government, at the present time, is utilizing the panel type of transmitter exclusively. Complete sets, up to 1 kw., are being used as one unit, even the motor generator being contained therein. This design has been adopted because it provides for ease of manipulation, quick installation and portability.

The progressive amateur finds that the vacuum tube is replacing the familiar spark gap transmitter as a source of radio frequency currents and its development is most assuredly in its infancy. It would be impracticable to construct a panel transmitter of this type because radical improvements are constantly being made. It is possible that, in a few years, the spark transmitter will be obsolete.

In conclusion, therefore, I believe that, of the two respective types of wireless transmitting sets for amateur use, the isolated instrument type is preferable, first, because the experimental type of wireless enthusiast is decidedly in the majority, and second, because it advances the knowledge of amateurs, and third, it eventually causes less trouble to our Government in the enforcement of the wireless law.

L. R. JEWETT—*Massachusetts.*

Improved Circuit for the Stern's Tube Transmitter and Receiver

By Morton W. Sterns

THE operation of the set I described in the June issue of THE WIRELESS AGE may be considerably improved upon by adding the features shown in the accompanying drawing.

In the first place, the carbon potentiometer now connected in the plate circuit, makes the impedance of the output circuit higher, thereby giving increased efficiency when receiving. It must, however, be shunted out of the circuit when transmitting. The resistance is a 20,000 ohm carbon or graphite potentiometer such as may now be obtained to control the voltage of the "B" battery.

I have added also, a double pole double throw change-over switch to change from "arc" to "spark" reception and a telephone jack for connecting the microphone transmitter in series with the ground lead.

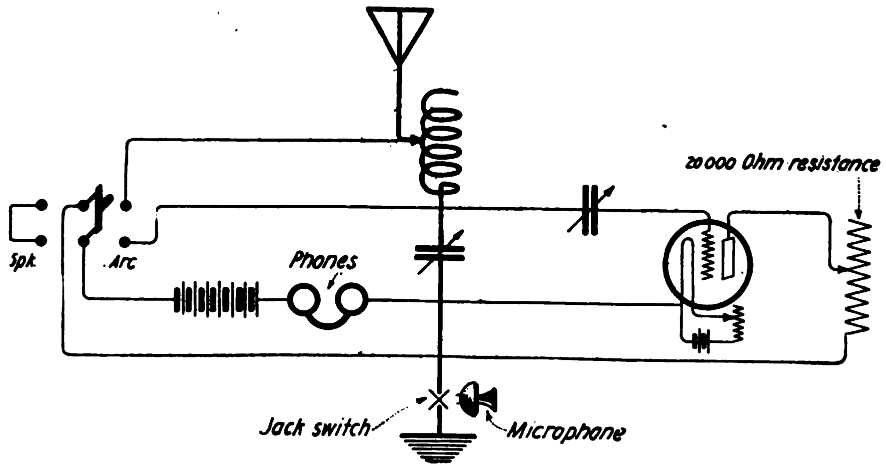

Diagram showing added features in the Stern's tube transmitter and receiver

It is, of course, understood that the two pole switch must be thrown to the "arc" position when it is desired to transmit, so that the bulb will oscillate. It will repay the effort to add these appliances.

Government Control

GOVERNMENT control of radio communication, placed in the hands of the navy department, appears to be a dismal failure when compared to the class of service rendered by private concerns prior to the war, when radio communication was a "free for all" service.

The causes for this are numerous. In the first place, naval work is, in the main, carried on by inexperiened, incompetent men, who have had little or no practical experiene in the handling of commercial radio traffic. Another reason is that the stations on shore which formerly handled only commercial business, and were kept working to their very limit with that, now have to handle naval work and matters of tactics as well as commercial traffic. I have seen traffic suspended for hours at a time—have heard as many as seven different ships after the operator at Miami station at one time, trying for hours to raise him. This has happened not once, but numerous times. Where was he? When this station was under the control of the Marconi Company the matter would have to be explained in a very satisfactory manner. Now it is different; it seems to get by without any trouble.

At the port of New York things are very confusing. There are three different stations using the same call letters—NAH—which is the cause of considerable difficulty to some ships. To illustrate: I have heard messages sent in to NAH, one station coming back with an O. K., while one of the other NAH's wanted a part of the message repeated. Sometimes one NAH will say "K" and another one will say QRT; if you answer one you get logged for unnecessary interference when told to QRT; and if you don't answer, the other station logs you for inattention. So what are you going to do?

The majority—I don't say all, but a surprisingly large number—of the naval radio men are very poor operators. They, by the way, are the only naval men aboard the merchant marine vessels, all the rest of the crew being civilians with the exception of half a dozen naval cadets who are learning navigation with a view of entering Pelham Bay. It is these men who cause unceasing tie-ups in traffic. One ship in particular, a well known passenger vessel, has an operator (or operators) on board of her whose maximum speed of reception seems to be between twelve and fifteen words a minute, providing the air is clear of static and interference. If there is any interference at all, this speed materially drops and the ship station is hopelessly lost. I have exchanged traffic with this vessel when signals were readable with the motor generator running, and if messages were sent to him at a speed greater than fifteen words a minute he could not copy them.

I have interviewed a number of naval operators on different merchant ships at various ports in the United States and in other countries, and they all seem to be of the same general opinion: That naval monopoly of radio is a dismal failure, due, for the most part, to the class of operators employed. They will tell some such story as this, when asked their opinion: "Before I joined the outfit I was so and so, making twice as much in a week as I can make here in a month. I joined up for the duration of the war, and now that the war is over, I am anxious to get back to my old job. They are discharging men from practically every other branch of naval service, and I think it is unfair to you and to us to keep us here where a civilian who makes this work his life's vocation would do much better. We take no interest in our work, we do it because it has to be done, we are only in hopes that such a kick will go in to the navy department regarding our service that we will be let go."

One of the naval operators on a passenger ship with whom I spoke said: "Do you suppose we keep a steady watch here like you fellows do? We do not. We work just about as we please, and as for messages, we don't give a hang whether they get off or not."

Now if that attitude was ever displayed by an operator in civilian service he would last with a private concern only long enough to be relieved by a man who *did* care. It is obvious that a man who is compelled to do a certain work against his liking will not do as good nor as efficient work as one who does that kind of work because he likes it and takes an interest in it. A man in a private concern who could not prove himself efficient would not last very long. I am certain that the navy's reputation for high efficiency was *not* established by the radio branch of the service.

The instruments that the naval operators have to work with are examples of the latest advancement in the art of radio communication and in themselves are works of art. But —put a man at those same instruments who takes pleasure and an interest in the successful working of them and he will get a great deal more efficient work from them than a man who "doesn't care."

One thing that the navy department is doing which is very unjust and entirely uncalled for, is the replacing of civilian radio operators on merchant marine vessels by naval operators. For instance, during the war, on some of the ships crossing the Atlantic, we were allowed to remain on. These in almost every case were *unarmed* ships. As soon as the ships were *armed* we were put off and navy men put aboard. Now on English, French and Italian ships, even transports, civilian operators were employed throughout the war. On American ships, the civilian radio men were ruthlessly "dumped." Even under the present conditions of peace, civilians are being replaced by naval radio men!

The loyalty of civilian operators during the war was unquestioned. Yet on American ships they were replaced on their jobs by an inferior grade of inexperienced and incompetent naval operators. We were immediately deprived of our means of livelihood. many of us, due to various reasons, could not join the naval service, even if we had been so inclined. This was very unfair treatment on the part of the navy department. It would not have looked so bad if the entire ship's crews had been naval men; but when every man from the master down to the coal passers were civilians, to have civilian radio men removed and naval men put on was rather a hard pill for us to swallow. On no other Allied ships was this done.

Navy radio men are as much out of place on a civilian merchant marine vessel as civilian operators would be if placed on a naval man of war. We are in hopes that in the near future naval operators will be removed from the merchant marine service and the ships turned over to civilian operators again as in the days before the war. Then, and *only* then, will satisfactory service be given, because the service will once more be conducted by competent men.

AN OLD TIMER.

Queries Answered

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

Positively no Questions Answered by Mail.

L. D., Kinsale, Va.:

The receiving apparatus you describe ought to respond to transmitting stations, during the favorable months of the year, over distances up to 2000 miles.

Any receiving tuner employed in connection with crystal detectors may be used with a vacuum tube, but the tube generally gives the best signals when connected in a secondary circuit in which inductance predominates. The shunt secondary capacity should not exceed .0005 mfd.

Any receiving tuner may be fitted with regenerative coupling. It is only necessary to put a few turns of wire in the plate circuit and inductively couple that circuit to some part of the grid or antenna circuit of the receiving set. THE WIRELESS AGE, from month to month, has published numerous diagrams applicable to such work.

The use of a variometer in the antenna circuit is not strictly essential but it aids one in obtaining fine tuning in apparatus when the inductance is varied by taps instead of by a "tens" and a "units" switch, such as is employed with modern receiving tuners.

Regarding your last query: You will find that the Marconi V. T. oscillation detector connected up in the receiving circuit shown in a leaflet which accompanies each order will double or triple your present receiving range.

* * *

A. R., Scottville, Mich.:

When a storage battery is on "floating" charge, a small charging current is passed through the cells continuously. In ship radio sets, two incandescent lamps passing ½ ampere each are connected in series with each bank of cells. This slow charge makes up for local losses and keeps the battery at its maximum E.M.F. at all times.

The American Morse test of 30 words per minute given in the Government examination for an Extra First Grade License Certificate is conducted by sounder, not by buzzer.

Replying to your last query: We do not believe that daily newspapers are in the habit of divulging the contents of radiograms unless they receive permission for so doing. The press matter sent out by Arlington, nightly, may be used freely by any one, but the ordinary radiograms cannot be produced without permission from the sender.

* * *

J. D. M., Springfield, Mass.:

The wave length of the radiated wave in wireless telegraphy is the actual physical distance between two successive points in the wave motion where the stress is in the same direction and of the same amplitude.

The length of the radiated wave bears the following relation to the inductance and capacity of the antenna circuit. Letting the Greek letter Lambda λ = wave length, L_1 = the inductance of the loading coil at the base of the antenna and $\frac{L_0}{3}$ = inductance of the antenna for alternating current and C_0 its capacity, the following formula obtains:

$$\lambda = 59.6 \sqrt{\left(L_1 + \frac{L_0}{3}\right) C_0}$$

Here L_0 is the inductance of the antenna for uniform curve distribution and C_0 its capacity for uniform current distribution. $\frac{L_0}{3}$ and C_0 may be taken as the inductance and capacity of the antenna for radio frequencies

The wave length of a simple vertical wire grounded at one end is four times its natural length. Thus an antenna of 100 meters in length will radiate a wave of 400 meters.

* * *

R. D. W., Plainfield, N. J.:

We do not know the nature of the crystals sold under the name of Lenzite and Radiocite.

Regarding your experiments with cerusite: Genuine cerusite will not act as an oscillation detector in radio. What formerly was assumed to be cerusite was nothing more than a grade of galena of a different crystal formation than that ordinarily used by experimenters.

You will have great difficulty in obtaining a permanent adjustment for galena. Have you tried an opposing contact of graphite, such as the lead from a lead pencil? It is said by some experimenters that this design tends to give permanency of adjustment.

* * *

W. G., New York City:
Note the reply to R. D. W. above. The cerusite crystals you sent to us are not suitable for detection of radio signals.

The radiophone transmitter set shown in the March issue will transmit 10 or 15 miles, the actual range depending upon the type of receiving apparatus employed. We are unable to state why your audiotron detector does not function properly. Perhaps there are weak cells in the B battery, or it may be that the secondary winding of your receiving tuner has insufficient inductance to impress the high E. M. F. on the grid circuit, requisite to make the vacuum tube function properly.

* * *

W. L. D., New York City:
The methods of connecting up the vacuum tube as a transmitter or receiver are numerous. We urge that you try all of the circuits heretofore published and decide for yourself which is the most applicable to your particular work. The text book "Vacuum Tubes in Wireless Communication" has descriptions of all the circuits that have been proposed or used.

The diagram of figure 48 on page 80 of that text book should satisfy your requirements, although if you employ a modern tube which is highly exhausted, you should connect a two megohm grid leak from the grid to the filament of each valve. The first tube in that diagram is connected for radio frequency regenerative amplification and one stage audio frequency amplification is provided for the plate circuit. In the newly revised edition of "Vacuum Tubes" you will find on page 180 in the diagram figure 133, the fundamental circuits of a vacuum tube radio telephone set that is applicable to most any type of bulb suitable for the generation of radio frequencies. The coil L-6 in that diagram has inductance from 10 to 13 millihenries, L-5 may have an inductance of ½ millihenry or so. The series condenser in the plate circuit may have a capacity of 1/10 mfd. The telephone transformer P-2, S-2 may be of the ordinary iron-core type. The filaments of the oscillator and modulator bulbs may be connected to the same source.

Wireless telephone communication may be carried on over distances of 100 miles with antenna current of 2 amperes provided at least a three-stage vacuum tube amplifier is used at the receiving station.

Figure 125 of "Vacuum Tubes in Wireless Communication" shows the diagram of a resistance coupled three-tube amplifier which is suitable for cascade radio or audio frequency amplification. The diagram shows a circuit for regenerative radio amplification and beat reception, but perhaps better results will be obtained by using a single bulb for generating radio frequency currents and placing it in inductive relation to some part of the antenna circuit.

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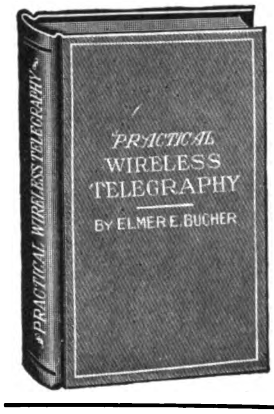

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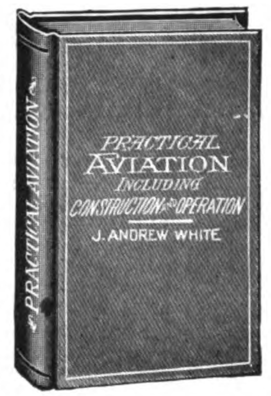

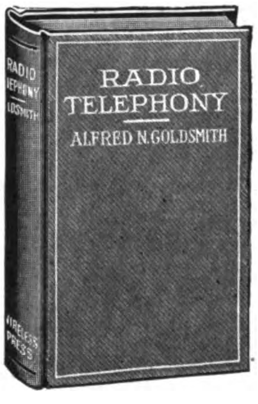

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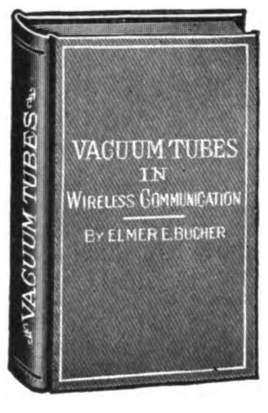

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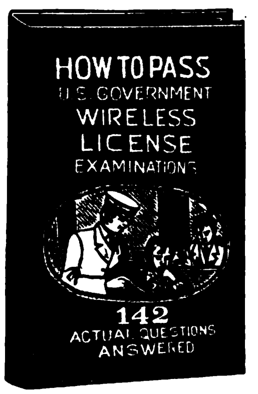

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