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THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

MAY, 1916

A Night in a Battleship's Wireless Room

THE complexity of the wireless traffic over the North Sea is well illustrated by the story of a correspondent who visited the radio room of a battleship of the British fleet. Not only could he pick up Poldhu, the German press sent out from Nordeich, and the Eiffel Tower, but communication from Madrid, the Russian commander in the Baltic, the Mediterranean fleet, the Admiral of the British grand fleet and the German headquarters were all plainly audible. This, of course, was accomplished by adjusting the apparatus to accommodate the varying wave-lengths.

The wireless officer in charge on the vessel which the writer visited had described it as "a wonderful night for wireless," though the night was muggy and cold. But there was something in the atmospheric conditions which responded exactly to the requirements of the wireless.

The operator had just finished taking the daily news message from Poldhu, the Welsh station of the English Marconi Company, corresponding to the American Marconi Company's station at Cape Cod, which sends press disptaches to Atlantic passenger vessels, and remarked that it ought to be possible in a moment to hear Nordeich, the high power German station which sends out the German press dispatches to ships at sea. The operator had his eye on the clock, whose minute hand was approaching the hour of nine. "He is very punctual, sir, is Nordeich; you can set your watch by him. I dare say he is just knocking out his pipe now; he will start in a minute. If you take the receiver you'll hear him."

"I fitted the receiver over my ears," the correspondent continued. "A black vulcanite disc which regulates and tunes the wave-length to synchronize with one of the many voices in the air, was set to a certain number. I listened; there was a very faint, ghostly chorus of indistinct whines and buzzes, like that coming from a colony of insects disturbed in some affair.

"Punctually as the minute hand rested on twelve, a strong, clear and strident note broke forth into the buzzing. 'There he is,' said the operator, who had a duplicate set at his ear. Nordeich began, as every one begins, by making his call sign, advertising to all whom it might concern that he was about to begin his daily recital of the German version of the war.

"'Now listen to Poldhu,' said the operator, adjusting the apparatus. The strident tones died away and in their place a deep, gruff muttering dominated the air. When I was listening to Nordeich, Poldhu had been among the little minor chorus of whines and buzzes; when the dial-change was made Nordeich sank to join its voice in that background of insect songs, and the rough voice took up the solo. Another adjustment and the gruff voice finished and in its place a musical note, small and bell-like, took up the tale.

"'That is the Eiffel Tower,' said the operator, and my imagination, which had been fixed on that tall group of masts that rises above the heather and gorse on the Downs beyond Mullion, transported itself to the night streets of Paris and that busy network of steel girders among whose interstices a little living, breathing human figure was sitting and pressing a key.

"Again there was an adjustment to reach another wave-length. 'Ah, you have got the Commander-in-Chief,' said the operator.

"But those were not all the wonders shown to me in the wireless office that winter night in the northern seas. It was indeed a 'wonderful night for wireless,' almost unique in the experience of those to whom I was speaking.

"We heard all kinds of things on that night which are seldom heard together and under the same conditions. We heard the Russian Commander-in-Chief in the Baltic, we heard Madrid and we heard the German Commander-in-Chief from his fastness across the North Sea.

"We heard the British Commander-in-Chief in the Mediterranean; all these of course were call signs known and recognized, but there were many others, coming, no doubt, from places as diverse and remote and as kindling to the imagination, which we did not know or recognize. Yet they were for the most part voices only—voices and nothing else.

"As I was turning away a bitter cry came from somewhere between Iceland and Ireland: 'Daffodil to Ranunculus: Two thousand pounds of marrowfat peas intended for me addressed to you at Happyhaven. Request you will reship same at earliest convenience.'"

WAR INCIDENTS

In the Judicial Committee of the Privy Council, before Lords Parker of Waddington, Sumner, Parmoor, Wrenbury, and Sir Arthur Channell, the prize appeal case of the Belgia came up for consideration, according to word from Great Britain. The vessel, which was German owned, was on a voyage from New York to Hamburg, when, on August 3 she heard by wireless that war had broken out between France and Germany. Her master determined to run into the Bristol Channel, and got to Newport the following day, but was not allowed to anchor in the harbor. The next morning, war having been meanwhile declared between England and Germany, she was brought into Newport as a prize.

The president found that she was captured at sea on the outbreak of hostilities. From that decision the appeal was brought. Sir Robert Finlay, K. C., having been heard for the appellants, judgment was reserved.

The French review of events of February 29, has this to say of the loss of a French transport: The auxiliary Provence II., temporarily employed to transport troops to Salonica, was sunk on February 26, in the Central Mediterranean. According to the original reports received, 296 survivors were taken to Malta and about 400 to the Island of Milo by French and British trawlers and destroyers on patrol duty, which hastened to the help of the vessel in reply to her wireless calls.

According to the latest information, there are now at the Island of Milo 489 survivors from the transport Provence, and eighty-five more are shortly expected there on board a patrol boat. The number of survivors is now believed to be 870.

This steamer, known in peace time as La Provence, is of particular interest to wireless men, as it was upon her that some of the earliest experiments with the Marconi Bellini-Tosi wireless direction finder were carried out.

How wireless is blocking the plans of naval officers to repeat the exploits of Captain Semmes of the Confederate cruiser Alabama is strikingly shown by a message sent broadcast by a British station on March 4 and taken from the log of the operator on the Zulia of the Red D Line. Here is the entry:

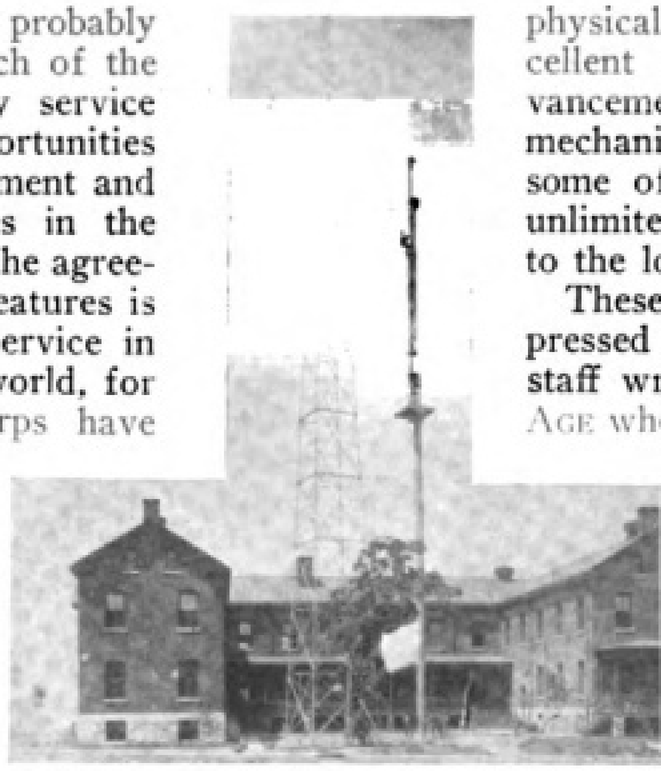
Copied the following at 8:40 p. m. on 600 M. German steamer is attacking shipping in the Atlantic and may probably be assisted by captured vessels which she could arm. Description: Six thousand tons, combined passenger and freight ship, two tall masts, guns concealed, speed 15 knots. Poses as neutral, carries torpedoes.

Reports from several authentic sources are to the effect that the German authorities at Brussels have offered a reward of $2,500 for information as to the location of a wireless telegraph station supposed to be working in some private house in that city. For months it has furnished the people of Belgium with war news which the Germans desired to keep from them, and the search for it has hitherto been unsuccessful.

Teaching the Nation's Defenders at the U. S. School for Signal Men

A Description of Their Training and the General Scope, Method and Usefulness of the Army Division Which They Make Up

IT is truly said that probably in no other branch of the United States Army service are there so many opportunities for character development and vocational training as in the signal corps. One of the agreeable and instructive features is the opportunity for service in various parts of the world, for the men of this corps have the care and operation of wireless stations and a complete network of cable and telegraph lines and telephone systems. These duties take them to all parts of the United States, the Canal Zone, the Philippine Islands, Hawaii and Alaska.



The old mast standing beside the new steel tower erected by enlisted men in the United States Army Signal Corps School at Bedloe's Island, New York

More than two-thirds of the men who enlist in or are transferred to the corps, at the expiration of their terms of enlistment are enabled to obtain lucrative employment in civil life, as a result of the technical training and experience acquired during their service in the signal corps. In this connection, Brigadier General George P. Scriven, Chief Signal Officer of the Army, says:

"Service with the signal corps of the army not only offers an excellent career for young, energetic and ambitious men and affords training in the development of self-control and regularity of habits, as well as improvement in physical vigor, but extends excellent opportunities for advancement in many lines of mechanical endeavor, including some of the most useful and unlimited occupations falling to the lot of man."

These words were deeply impressed upon the mind of a staff writer of THE WIRELESS AGE when he paid a visit to the training school for signal men at Fort Wood, Bedloe's Island, New York Harbor. The commanding officer at Fort Wood, Captain A. T. Clifton, Captain of the Signal Corps, very courteously delegated First-class Sergeant E. J. Wessen to explain to the writer the workings of the school. Courses of instruction are given here in military signalling, wireless telegraphy—there is a well-equipped wireless school—electricity, photography, line construction and other matters pertaining to what is known as "The Service of Information."

But where was the signal corps? The wireless school was unoccupied, its technical apparatus untouched. Where were the signal men?

The forty members of the corps had left Fort Wood that very day for Columbus, New Mexico, to form the nucleus of a field company to be organzied there.

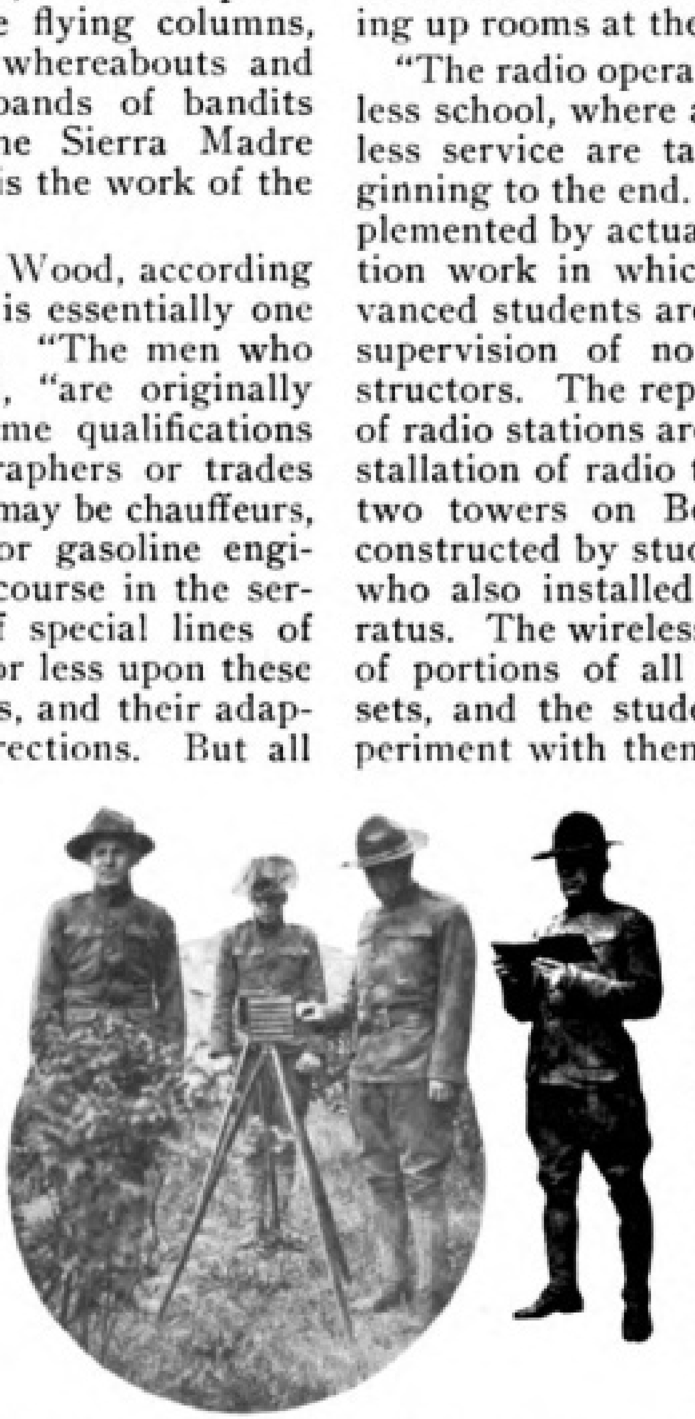
The immmediate adaptability of the school methods to practical service was at once demonstrated. The incident, furthermore, showed the demands that active service makes upon this branch of Army work. Those of us who have followed day by day General Pershing's brilliant pursuit of Pancho Villa—and who has failed to do so?—have become familiarized with the incalculable value of the army signalmen in maintaining lines of communication across desert stretches, and through bleak mountain passes, while aeroplane scouts, preceding the flying columns, inform them of the whereabouts and movements of the bands of bandits scattered through the Sierra Madre Mountains. All this is the work of the signal corps.

The school at Fort Wood, according to Sergeant Wessen, is essentially one for signal corps men. "The men who come here," he said, "are originally supposed to have some qualifications as electricians, telegraphers or trades of that nature. They may be chauffeurs, telephone operators or gasoline engineers. Their future course in the service, their pursuit of special lines of work, depends more or less upon these previous qualifications, and their adaptability in certain directions. But all men must become telegraph operators to some extent, and must learn the two codes, the American Morse and the International Code. Then they become familiar with the different methods of visual signalling, and attend the elementary electricity class. But before they are permitted to attend that class, they are first tested in arithmetic, and if found deficient in that branch of knowledge, they must perfect themselves.

"From the electrical class the men branch out into the lines for which they display their special aptitude. Every man must become familiar with the articles of war, of course, and with rudimentary drills. But actual technical instruction is held of more importance here, and given precedence over military instruction. During the first month at the post, however, the recruit receives one hour daily of military instruction, and all privates, that is members of the signal corps, have to take their turn at kitchen police and cleaning up rooms at the barracks.

"The radio operators attend the wireless school, where all branches of wireless service are taught—from the beginning to the end. This course is supplemented by actual practical construction work in which companies of advanced students are engaged under the supervision of non-commissioned instructors. The repair and construction of radio stations are taught, and the installation of radio towers. In fact, the two towers on Bedloe's Island were constructed by students at Fort Wood, who also installed the wireless apparatus. The wireless school is possessed of portions of all standard makes of sets, and the students are free to experiment with them at any time."

The first experiments in wireless by the signal corps were conducted in Long Island Sound in 1903, under the direction of Captain L. D. Wildman. The impelling reason for these tests was the fact that the cable between St. Michael, Alaska, and Safety Harbor was continually being worked out by the ice, which would move out in breaking up and carry the cable with it. The tests were made to determine the apparatus best adapted



The Signal Corps heliograph in operation. This instrument is designed to transmit signals by means of the sun's rays, the normal range being thirty miles, and rapidity of transmission, five to twelve words per minute. It is emergency apparatus for use when electrical means of communication have failed

A field equipment of the Signal Corps School set up and working. The apparatus shown here has been superseded by more efficient equipment, increasing the transmitting range and permitting closer wave-length adjustment

for this service. Communication was established in 1904, and since then there has not been twenty-four hours' interruption in twelve years.

Now high-power stations have been established throughout Alaska. The value of wireless communication was proved, and schools for instruction in the art were formed at Fort Wood, Fort Leavenworth and Fort Omaha. On the Pacific coast there is a 1 k. w. station for the coast artillery. Then there are 10 k. w. stations at Fort Sam Houston, Fort Leavenworth and Fort Omaha. In Alaska there are six 10 k. w. stations and three 3 k. w. stations.

In the field, the men of the signal corps use for advance lines a 1/4 k. w. portable set. At the field base they use a 1 k. w. wagon set and for the base of operations a 2 k. w. automobile set. If necessary an auto set can be used at the front. There is a signal school for officers at Fort Leavenworth, where instruction is given in advanced electricity and wireless telegraphy.

At Vera Cruz, in the spring of 1915 the men of the signal corps were confronted with the task of installing a wireless set on a train. The set was put in working order and was in operation all during the operations. The field pack set of the signal corps consists of a 1/4 k. w. apparatus with a forty-foot sectional mast in ten joints. Supporting guys form the ribs of an umbrella antenna. This set has been known to work sixty miles and is always good for twenty miles.

The 1 k.w. wagon set and the 2 k.w. automobile set were perfected in the signal corps laboratory in Washington. Their mast is 60 feet in length and consists of ten joints. In the case of the wagon set, the mast is erected by hand, but the mast in the automobile set is erected with the aid of collapsible shear booms on top of the automobile. The antenna in the sixty-foot mast is essentially the same as the other antennae. The range of these sets is about 200 miles. In all portable sets the counterpoise is used instead of actual ground connections.

In the field the work of the wireless sets is supplemented by the use of buzzer lines, which are laid on the ground and in trees, or anywhere so long as they are not hindering traffic. Such lines are laid rapidly by troops on a dead gallop, and by the aid of reel carts, specially constructed to carry a number of miles of wire. These

A portable tower carried by field troops in sections and erected in a few minutes, providing an elevation for observation and visual signaling

consist of seven strands of very fine piano steel wire, wound around one strand of copper wire. All have insulation designed especially for that purpose.

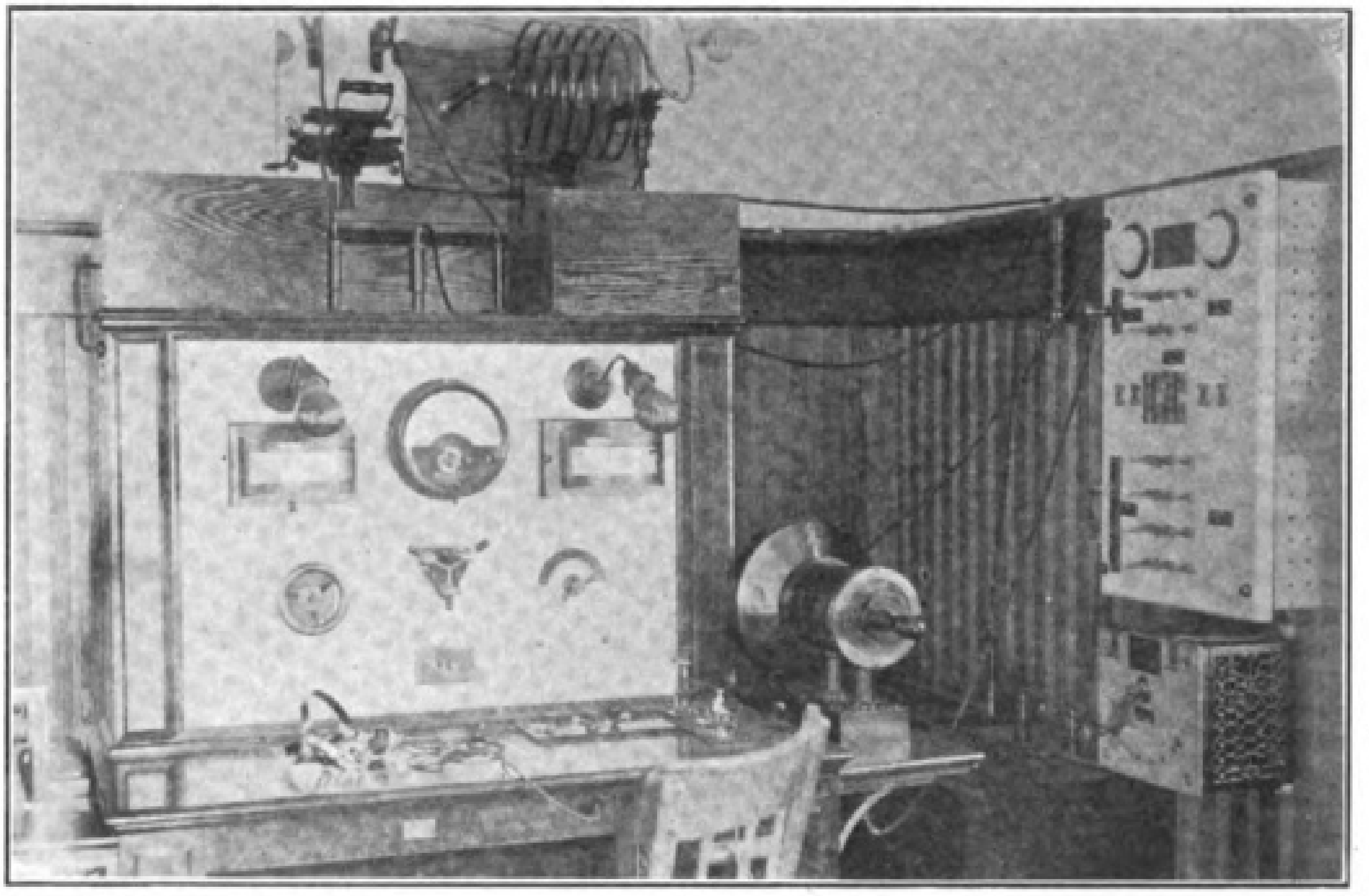
Naturally, the main function of the signal corps is the transmission of military information, and since in this pursuit are utilized the wireless, the telephone, the land line telegraph the aircraft, visual signalling, and especially many kinds of gasoline engines and motors, these methods are subjects of endless investigation and many possibilities. In addition at the technical schools at Fort Wood, Fort Leavenworth and Fort Omaha, general instructions are given in the care and handling of government property, rendering necessary reports and handling money received at military telegraph offices, as well as the practical military instruction covering the duties of a soldier. At the aviation school at San Diego, Cal., and the aviation center at San Antonio, Tex., instruction is given regarding the repair, maintenance and flying of aeroplanes.

Each field and telegraph company also has its school, in charge of capable officers, where classes are conducted for instruction in the duties performed by the signal corps. Separate laboratories are maintained at Washington, D. C., and at the United States Bureau of Standards in the same city, where detachments of the signal corps on duty at these stations are engaged in experimental work of a most interesting character. They are associated with electrical and wireless engineers of a high degree of training and ability, and this training furnishes opportunities for perfection in technical branches of electrical engineering.

But chief among the subjects taught are wireless telegraphy and modern aeronautics. Both of them are fields that are new and full of promise. The rapid rise of wireless telegraphy has been phenomenal. The United States Signal Corps has applied this means of communication wherever its use is possible. Through the development and construction of its high-power stations in Alaska, the Philippine Islands, and in the

Soldiers of the Fort Wood Signal Corps School wig-wagging messages in the field

United States we have seen how it has devised and constructed portable tractors of the automobile type for use at division corps and army headquarters, as well as skid and pack sets for use with small commands. Wireless operators are required for the operation of these stations, as well as expert gasoline-engine men for the high-power



United States Army Signal Corps wireless station at St. Michael, Alaska

stations, and chauffeurs with the tractors. The signal corps has also installed wireless stations on all army transports and supplies the operators needed at these stations.

It may readily be seen that a field of experimental work and research work of unlimited value and extent are opened up by the constantly changing aspect of wireless telegraphy and the rapid advance in the instruments employed for wire communication in the mobile army. The signal corps thus offers opportunities for easily and inexpensively acquiring high professional attainments, which may bring success in many important walks of life.

As Sergeant Wessen said, the schools at Forts Wood and Leavenworth cover courses lasting usually from six to eight months, at the end of which the men have ordinarily attained the necessary foundation in theory and practice, enabling them to attend the practical work. They are then sent out to all parts of the United States, the Philippines and Alaska, where they engage in work such as maintaining telephone systems at military posts; become operators at wireless stations, land line telegraph offices and cable stations; gasoline engineers and photographers at detached stations or with field and telegraph companies and linemen. The men who complete courses of instruction at the aviation school at San Diego are usually assigned to duty with aero squadrons at aviation centers.

The signal corps is continually engaged in installing and operating lines of communication as varied as may be found anywhere on the face of the earth. The operation of the Washington-Alaska military cable and telegraph system furnishes experience in deep-sea cable laying and sending and receiving messages by means of the siphon recorder. In Alaska, in the Southwest, the Philippines, the Canal Zone and Hawaii, the corps constructs and operates wire lines and wireless stations. Then service in the mounted organizations of the corps—field and telegraph companies—adds experience in the care and handling of animals and the novelty of service with line troops of the army.

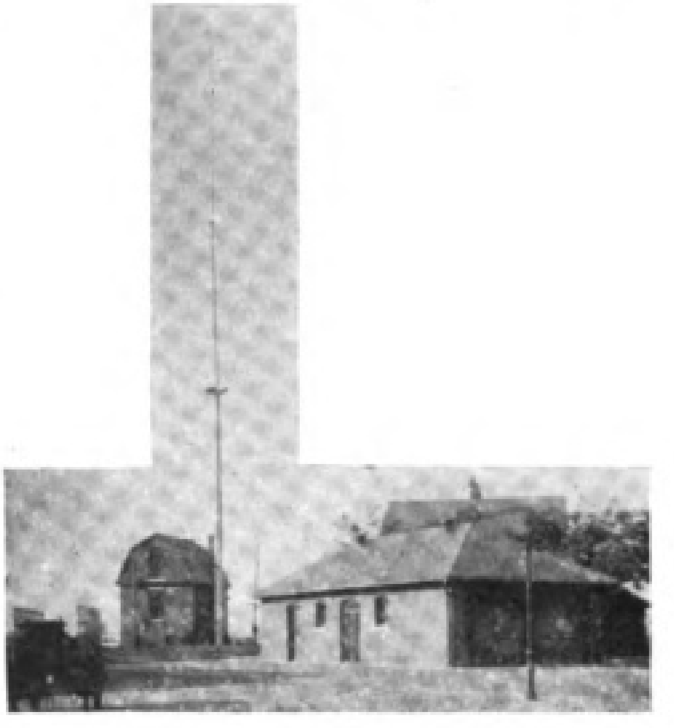
It is self-evident that no signalman can master a knowledge in all or even most of the subjects taught, but the varied operations of the corps make possible the gaining of a vast practical experience.

The Chief Signal Officer, General Scriven has laid particular emphasis upon the importance of the signal corps as an auxiliary branch of the army in the expressed belief that its functions are not in general well understood even by persons who are interested in military affairs.

"There are still people of intelligence," he says, "who in practice believe that the transmission of military thought is summed up in the use of notebook, the orderly, and his horse. But these are passing, and the trained soldier and educated volunteer understand the vital importance of time in military operations and the need for the immediate transmission of information. Hence, the necessity for a signal corps or its equivalent; for without its aid modern armies can no more be controlled than can great railway systems; the commander in the field remains blind and deaf to the events occurring around him, incapable of maintaining touch with conditions, and out of reach of his superiors or those under his authority, upon whom he depends for the execution of his plans. Time is the main factor in war; to arrive first with the greatest number of men, and with the clearest understanding of the situation, is to succeed. The last, and often the first, of these conditions, depends upon the lines of information of the army."

In discussing field lines of information, General Scriven gives an entertaining picture of the detailed work of the signalmen, especially with regard to the adaptation of the wireless in active army service.

He says: "The ordinary lines of information of a division under the three conditions of the camp, the march, and contact with the enemy are worth a word of consideration. Assuming that the division is to be assembled at some suitable locality, and a more or less permanent camp is established, an officer will no doubt first be sent to select sites for the encampments of the various units; quartermaster officers will locate their depots; and the medical officer the field hospitals. It will then become the duty of the signal officer of the division to install the lines of information. With division, corps, and army headquarters there will travel a radio tractor set of the largest or smaller type now adopted by the signal corps, and these will first be put in commission. Then the signal officer will establish at division headquarters a central station and connect this with the most convenient telegraph and telephone offices through which communication may be had with the commercial systems of the country or with the base. He will establish a camp and depot where will be stored all material needed for extended and varied service.



The old wooden mast at Fort Wood, recently replaced by the steel tower shown on the fifth page preceding. The students of the Signal Corps School erected the new aerial equipment and installed the apparatus

"Next he will connect by wire or radio with army headquarters (if such exist) and for convenience will carry telephone lines to the chief quartermaster and surgeon, as well as to the depots, hospitals, and corrals. As the troops arrive at their camps, telephone or buzzer lines will be run from the division central to brigade headquarters, the camps of the engineers, the signal corps, the cavalry, field artillery, to independent commands at a distance and probably to rear squadrons; through regimental to battalion headquarters; and in case of need to outpost stations or trenches. In a camp of this character the radio—pack, tractor, or horse drawn—should be of great value.

"On the march the lines of information and the stations for a division become fewer and the latter more difficult to reach. Some general considerations may be noted. First, a division on the march must at no time lose electrical connection with its base through the last station occupied, and for this purpose the pack radio may well be used. As the advance continues lines will extend forward, for the radio will maintain communication with the commanding general; that is the advance will be made to some position designated by him as his own during the day or night. This position becomes, so far as the lines of information are concerned, the headqarters. As radio stations advance they should be followed, if practicable by the telegraph train with the necessary material for a line to replace the field or buzzer wire, for the latter is expensive and may be scarce, and resulting faults are sometimes not readily located. Of course, the field line or radio only will be used for rapid work; the latter by the leapfrog method, i. e., by the use of three sections, the rear station jumping past the two preceding and thus constantly maintaining two stations in operation. During halts wire lines can be quickly thrown out, but here visual signalling may be used to adantage, and above all the radio, especially of the wheel type.

The wireless "Service of Information" at work in Mexico. This remarkable photograph shows the Signal Corps men in actual service maintaining communication between the flying cavalry column and the headquarters of the American punitive expedition

"The day's march over, the division eats and rests; not so the signalmen. Then radio stations must be established and buzzer lines run from the advance guard, from the flanks, from the corps headquarters, and from the rear to division headquarters, and others laid to outposts and reserves; and still others to detached posts, to observation stations and important stations where pickets are maintained. Again the field radio will be of enormous value.

"In a retiring movement lines of information will be as few as possible, and mainly used to connect the rear guard, probably by radio, with the general commanding. As the division approaches the enemy, the commander will make as certain that his lines of information—wire, radio or aeroplane—connect with corps and army headquarters, with supporting and reserve troops, and with the rear, and when actual contact comes, buzzer lines will be carried to brigades, to regiments and sometimes to the outposts. Of course, when the division is actually engaged against the enemy, its commander will extend his field or buzzer lines to the positions occupied by the infantry and artillery commands. He will depend in general on the radio to keep him in touch with his cavalry. From events abroad it seems that under no conditions in the field are lines of information of more importance than in the fire direction of field batteries, of enormous guns and mortars and in the trench fighting that has now become so enormously important in a campaign. The radio, though still of unproven value so far as known in aviation work, is of major importance in the field and especially when used at the larger headquarters. It is thought that the four types—pack, divisional tractor, army tractor and skid—now in use or under construction by the signal corps of the army, are quite equal to any elsewhere existing. To these must be added wheel radio of the horse drawn type especially adapted to service with field companies.

"So much for the lines of information of the larger bodies of troops. In the case of a small independent or expeditionary force the problem is easier, but not less important. If operating in an enemy's country, especially if the movements are connected with a boat expedition or with the navy, somewhat less weight must be given to wire communications and more reliance be placed on visual signaling, the aeroplane, and on the portable radio of the field or skid type. With all such expeditions a supply of pistols and day and night rockets should be carried, for they are of value as preconcerted signals, or to indicate location and time."

The signal corps, as at present organized, is made up of one chief signal officer, nine field officers, eighteen captains, eighteen lieutenants, and 1,212 enlisted men. In addition, there are allowed for the aviation section sixty officers and 260 enlisted men. It is maintained that if hostilities should break out this force would be too small. It is now proposed that the proper organization for the signal corps should consist of the overseas garrisons, four tactical divisions, and the coast artillery; and that the auxiliary troops should consist of one chief signal officer, four colonels, twelve lieutenant colonels, fifteen majors, forty captains, 101 first lieutenants, and 3,358 enlisted men. In the aviation section, the proper organization should be one colonel, one lieutenant colonel, eight majors, twenty-four captains, 114 first lieutenants, and 980 enlisted men. Should these organizations be established on the proposed footing, the opportunities in the signal corps would be immensely increased.

It may be of interest to describe in further detail some of the more important technical instruments and apparatus used in the signal corps service. Owing to the great importance of wireless telegraphy in military affairs, much attention is being given to this means of communication. Several types of apparatus have been devised by the signal corps and are in the hands of troops. The first of these is known as the radio tractor. The instruments and switchboards are installed in a specially designed covered body, which is mounted on the chassis of a commercial gasoline truck. Sufficient space is available for the transportation of a crew of ten men. By means of a special clutch and gear the engine is made to drive an alternator for furnishing the necessary electrical energy.

The mast and umbrella type antenna are raised by means of a shears located on top of the tractor, eight minutes being the average time consumed in erecting the antenna and placing the set in operation.

The tractors thus far developed are of 1 k.w. and 2 k.w. capacity. Under ideal conditions the larger set has transmitted messages for distances of 250 miles; the normal range of this type under the most trying atmospheric conditions is 100 miles. The 2 k.w. tractor is intended for use at field army headquarters. Its weight without crew is about 9,200 pounds. The smaller tractor, known as the divisional type, has a range of from fifty to 150 miles, varying according to atmospheric conditions. The weight of this set is about 5,700 pounds without crew.

Both types of radio tractors will, it is believed, prove satisfactory under field conditions. But it is probable that horse-drawn sets, specially constructed, must be provided for the field companies.

Two types of skid sets have been developed. These are intended to be transported in escort wagons or similar vehicles. In the smaller (1 k.w.) set the engine and the generator are mounted on skids and can be carried by two or four men. In the larger type (2 k.w) the engine and generator are mounted on separate frames, but so constructed that they can be readily bolted together. The weight of each unit does not exceed 350 pounds.

The receiving and transmitting instruments and switchboard are carried in a fiber case about the size of an ordinary trunk. When not in operation the switchboard lies flat in the case; in use its position is vertical.

The sectional masts and antennae are similar to those used with the radio tractors; that is, sixty and eighty feet long, according to the size of the set.

The receiving and transmitting instruments, which are of the latest type of radio pack set, are contained in a case slightly larger than the ordinary suitcase. The transmitter is supplied with energy obtained from a 500-cycle 110-volt self-excited alternating current generator operated manually by means of two crank handles connected with a series of gears for turning the armature at the necessary speed. The generator and gears are inclosed in a dustproof housing, so arranged that the gears continually revolve in a lubricant. The generator is mounted on a standard.

A forty-foot sectional mast is used. The antenna is of the umbrella type and consists of four stranded wires, each eighty-five feet long, insulated at the open ends and held by guy ropes. Instead of a direct ground connection, a counterpoise, consisting of four insulated wires, each 100 feet long, is radiated from the mast along the ground.

The time required to place the pack set in operation is three minutes. Its range under ordinary atmospheric conditions is twenty-five miles.

Another type of radio apparatus is the radio table set, designed for use on harbor boats employed in the sea coast defenses of the United States and this country's island possessions. Practically the same apparatus as that in the radio pack set is used in the table set, the only difference being that the instruments are mounted on a table, and instead of the hand generator, a motor generator, usually of the 110-volt direct-current type, is used. Current for the motor is supplied from the ship's lighting system. The antenna is erected on the ship's mast and does not form a part of the regular table set equipment.

Due to the fact that signals are transmitted largely over water, the transmitting range is slightly greater than that of the radio pack set.

The service buzzer, one of the most serviceable instruments used in the army, is strictly a portable device and can be used either as a telephone or for sending telegraph signals. When used in the latter way, the sound received in the distant telephone receivers is similar to a high frequency radio spark. Signals have been exchanged over a broken line, both ends of which were slightly grounded. By providing a suitable opening in the leather case for connecting cords and directly over the knob of the sending key a round aperture covered with flexible pigskin, the instruments can be operated with the case closed—a great advantage in inclement weather. An adjustable carrying strap is provided.

Such is the general scope, method, and usefulness of the signal corps of the United States Army, one of the most valuable branches of the military service, on which the country must depend in its hour of danger. Every conscientious wireless amateur, who follows his pursuit with care and energy to perfect himself in his peculiar line, will be one of the prepared men should his country need him—a man specially trained and ready for enlistment in the greater signal corps that the United States must then demand.

Insurance for Marconi Employees

The American Company's Plan of Showing Recognition to Those in Its Service

PERHAPS the most important announcement ever made by the Marconi Wireless Telegraph Company of America to its employees became known publicly on April 1 when the company gave notice that it had put into execution a plan to provide insurance for those in the Marconi service. This means, as set forth in a letter to employees by E. J. Nally, vice-president, and general manager of the company, that those who have been in the service more than one year have been insured for $500, and those who have been in the service five years or more have been insured for $1,000.

It is not likely that a more effective means of showing recognition in an impartial manner to a large army of employees could have been devised, for as the announcement states, "The protection of one's family in event of death is of vital concern," and "the ordinary cost of life insurance in proper amount is so great as to cause a heavy burden upon the income." An additional advantage of the boon is that the insurance can be obtained without medical examination.

Quite properly it has been said that "Created for and continuing its existence of service to humanity, the Marconi . . . Company has taken an epochal step. And the heroic sacrifices which Marconi men have made in faithful discharge of duty, already written into the record, . . . by this act have been monumented with a lasting testimonial more beautiful in spirit than could have been conceived in the rarest marble."

The details of the plan are contained in the letter to employees which follows:

April 1, 1916.

TO ALL EMPLOYEES,

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

Being constantly mindful of the loyalty and efficiency of our employees, and appreciating those qualities upon which the continued success of our company depends, and after a careful study of more than two years as to the best method of showing our appreciation, it has been decided to maintain for all employees, without expense to them, insurance in the sum of $500.00 for all those who have been with us over one year but less than five years, and in the sum of $1,000 for all those who have been in the employ of the company five years or more.

It gives us pleasure, therefore, to announce that you are now, and from this date, protected by life insurance payable to your beneficiary in the event of death while in our employ, without expense to you.

The protection of one's family in event of death is of vital concern. The ordinary cost of life insurance in proper amount is so great as to cause a heavy burden upon the income. In addition, many would be unable to pass the rigid physical requirements of the necessary medical examination for individual insurance.

We are, therefore, particularly pleased to announce that by arrangement made with The Travelers Insurance Company, this insurance will be granted upon present employees without medical examination.

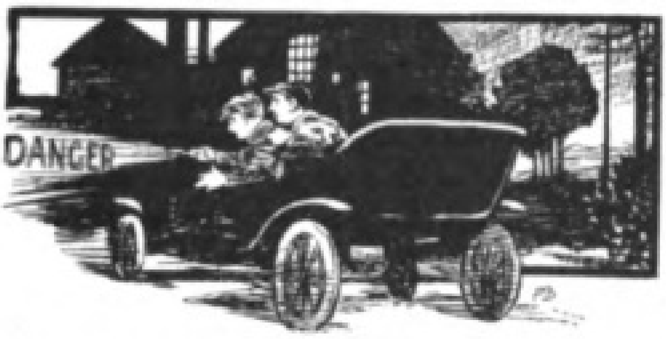
Attached is a form of application blank. Please fill this out at once and return it to the head of your department through the person delegated to receive it. From the information on this application the insurance will be issued by The Travelers Insurance Company, all charges upon which will be paid by us. In the event of the death of any employee the full amount of the insurance will be paid to his beneficiary. In the

(Continued on page 587)

In—and Out—of Sayville

By An Inquisitive Amateur

I READ with considerable interest the article entitled "A Trip to Sayville," published in the February issue of THE WIRELESS AGE, and it recalled the circumstances surrounding a visit which another inquisitive amateur and I paid to the Long Island station. This is the way our visit—which still remains somewhat vividly in my mind—came about.



My friends and I had spent many of our summer holidays at Sayville, but notwithstanding this fact we knew nothing from actual observation of the interior of the wireless station. Other amateurs, who asked us questions regarding the plant, remarked upon our lack of knowledge in such unmeasured terms that we determined to lose no time in familiarizing ourselves with the station.

It was before the outbreak of the European war that we came to this decision. The first measure to take in the undertaking, we were informed, was to obtain a permit to enter the station. This would necesitate a call at the office of the company controlling the plant—a considerable distance from our homes—and we concluded, therefore, to dispense with this formality.

"What's the use," argued my friend, "they'll probably be glad to see us anyway."

So, having borrowed an automobile, we started. It was four miles from our homes to Sayville and inadvertently we chose a dark night on which to make the trip. When we arrived in the neighborhood of the station we extinguished the lights on the automobile and followed the road with the aid of a pocket light. Arriving at the gate, we left the automobile and, undaunted by signs reading "No Admittance" and "Danger! High Power Voltage," we made our way on foot toward a structure which we afterward learned was the operating building.

The door which we opened showed a room brilliantly illuminated, and filled with apparatus which would have delighted any amateur, but no one seemed to be in evidence but ourselves. On the floor were tubular condensers; here and there were large coil boxes, while in another part of the room were various types of oscillating transformers and a rotary gap.

Our interest in the apparatus was rudely interrupted, however, by the sudden appearance of a man who warned us to leave at once. It is needless to say that we needed no second admonition, but hurried out of the building to the automobile at once. Once seated in the machine we disregarded speed regulations, and put as much distance between us

and the Sayville station as we could in record time.

When we are asked now regarding the plant we reply that we have been in it. We don't say, however, that we were put out of it.

Famous Escape of Goeben and Breslau Due to Wireless

A Vivid Account of the Manner in Which the German Cruisers Pierced the British Line in Their Dash from Messina to Constantinople

A SEMI-OFFICIAL history of the adventures of the Goeben and Breslau is now one of the books of the hour in Germany. Its author is Emil Ludwig, a German author of some distinction, and he says that he acquired the facts at first hand during a visit to Constantinople. It is quite clear that he has had access to the log-book of the Goeben, and that he has received information regarding the famous flight of these boats from the Commander-in-Chief, Vice-Admiral Souchon, whose photograph forms the frontispiece. Official photographs taken during the voyage figure in the volume.

The book, says the correspondent who sends a translation of some salient passages, is written with considerable objectivity, and it would seem that neither the author nor the German sailors, whose mouthpiece he is, bear any rancor towards British naval men. The writer dates the story from July 30, 1914, when he says, the crew of the Breslau gave cheers for the British destroyers Defence and Raccoon—cheers promptly returned—which she encountered. On the evening of the same day the Breslau received the following message from the British ship of the line Gloucester: "To-morrow an English sailor is to be buried; please run your flag down to half-mast." An invitation was extended to the British officers to come on board the Breslau on the following evening. Obviously only the respective staffs knew the possibilities of the European situation. The Gloucester disappeared during the night. Four days later the Gloucester was chasing the Breslau through the Mediterranean seas.

On the same morning on which the British ship had disappeared an order came from the Admiral that the Breslau should leave for Brindisi, there to await instructions. The Breslau weighed anchor and rushed away at 28 miles an hour towards Brindisi. *En route* the following emphatic message was received by the Admiral: "Political relations broken off between Triple Alliance and France, Russia and Great Britain." At one o'clock in the afternoon of August 1 the Breslau came alongside the Goeben before Brindisi. A third ship, a German passenger liner, General, joined the warships at about the same time. The General was off Crete when it got into wireless touch with the Goeben, and at 11 o'clock on the evening of July 31 received the following message: "Don't touch any French, British, or Russian harbor."

At midday on the following day the General received the following message from Vice-Admiral Souchon: "I have requisitioned you. Go to Messina." The Breslau, General and Goeben arrived at Messina on August 2. The Breslau steamed into Messina first, and at once telegraphed to the flagship: "Italian Government prohibits all coaling and provisioning at Italian ports."

The author describes this message as a terrible blow. The bunkers were empty, and yet an allied country refused to sell coal. The Admiral acted. He telegraphed to Rome—"We demand coal." He then demanded and obtained all the coal on board the German steamers at the port. All sorts and conditions of Germans helped to coal the warships while the Admiral pored over his maps. Towards midnight on August 2 he sent the following message to the General: "Coal as quickly as possible. Remain at Messina, but be prepared to put to sea at any moment." At one o'clock on the morning of August 3 the Goeben and Breslau put to sea. "Only the Staff knew why and whither." Throughout the next day Souchon anxiously awaited news by wireless, and it was not before six o'clock in the evening that an officer slipped on to the bridge with the following deciphered message: "France has declared war."

No one slept that night. Souchon was hard at work with Captain Busse, his Chief of Staff. "We shall see the Algerian coast at dawn and get the first shot in," he remarked. At two minutes to midnight the following message received by wireless was handed to the Admiral: "Breslau and Goeben must steam with all speed to Constantinople." The message was unexpected, startling, almost incredible." . . . The Admiral resolved to get his blow in at the first hour. . . . "At four o'clock in the morning, in the waning moonlight, the Goeben," says the narrative, "came within sight of the coast of Algiers. In the darkness the ship made for its goal, Phillippeville."

The description given of the bombardment of Phillippeville is vivid and minute. The Goeben, the bombardment over, veered round and made for the open sea, encountering the Breslau, which had previously attacked Bone. A little later the following "open" French wireless messages were intercepted: "Bone est attaqué croiseur allemande se dirige a toute vitesse à Phillippeville. Avisez." "Croiseur allemande apris avoir attaqué Phillippeville, sontinue à l'ouest à toute vitesse."* The admiral laughed as he read the messages. "The detached Breslau," he said, "had evidently done good work."

Free translation:
* "Bone attacked by German cruiser going full speed to Phillipeville. Advise." "German cruiser after attacking Phillippeville continues west at full speed."

At 10:50 in the morning the two German ships sighted two British ships, the Invincible and the Inflexible. Later a third British vessel of the Weymouth class joined the latter. Admiral Souchon remarked, "We must use the hours that remain before we are at war with England. Reach Messina. Get coal."

Ships' doctors, officers, and stewards joined in the work of stoking throughout the day, and suddenly at seven o'clock in the morning "we left the Englishmen." At eleven o'clock that night the following wireless from the Admiralty at Berlin was handed to the Admiral: "War with Britain hourly expected." Two minutes later (11:22 at night) the wireless officer deciphered by means of his lamp and his code book the following message received from Norddeich: "Britain has declared war."

The Admiral and his staff were not surprised, but the crew, when the news was communicated to them, "became quiet." At four o'clock in the morning of August 5 the two ships reached Messina. The General was waiting there, laden with coal, but the representatives of the Italian Government refused, on grounds of neutrality, to allow the warships themselves to coal there. Captain Busse, the Chief of Staff, to summarize this part of the story, struck upon the idea of making drunk an English merchant captain whose ship, laden with coal, was at Messina, so that a venial subordinate might be induced to sell the coal to the warships; but the agile British Consul at the port spoiled the plot. In the meantime, however, numerous German trading ships in the port and neighborhood had been summoned, and their coal commandeered by the warships. On the evening of the same day another shock occurred. An Italian officer, "representing the Commander at Messina," arrived, and was ushered into the Admiral's dining-room. The Admiral asked him to take a seat, but he preferred to stand.

"What may I do for you?" asked the Admiral.

"We want to know," replied the officer (in German), "how long the German ships propose to remain here? They can only remain 24 hours—in a neutral port." The semi-official writer proceeds: "The last words came with difficulty from the Italian's lips."

"Very well, I will remain here 24 hours," replied the Admiral. There was a pause. "Of course, I reckon the respite from this moment in which you inform me that Messina is in fact a neutral port."

At midday on August 6 the Admiral issued the following order to the three ships under his command: "News about the enemy is uncertain. I presume his strength lies in the Adriatic, and that he is watching both exits in the Messina Straits. Object: To break through to the East and reach the Dardanelles. Order of going: Goeben leaves at five o'clock, at 17 miles an hour; Breslau follows at a distance of five miles, and closes it up at darkness. I want to create the impression that we are wanting to go to the Adriatic, and in case I so succeed in creating that impression, we shall veer round in the night and make for Cape Matapan, if possible, throwing off the enemy. The steamer General to leave at seven o'clock in the evening, to keep along the Sicilian coast, and to try and reach Santorin. Should she be captured, to try and let me know by wireless. If she receives no further orders from me, to ask for them at Loreley." (Constantinople station ship).

As the ships—flags flying and music playing—were reaching the open sea, the following wireless message from the Kaiser reached the Admiral: "His Majesty expects the Goeben and the Breslau to succeed in breaking through."

Shortly after leaving the harbor an English cruiser of the Weymouth class, alleged to be the Gloucester, appeared on the horizon. The narrative proceeds: The Commander asked the Admiral whether they should open fire. "No; No." Astonishment. The wireless officers were even more puzzled. They could hear the wireless waves being transmitted by the operators on the British cruiser. They did not know the code, but they noted the call and the answer. The German boats were evidently expected, and all preparations for attacking them were being made. The British cruiser was emitting signals in three groups. The word "Mumfu" frequently occurred, and it was clear that it referred to the Goeben. The wireless receivers finally deciphered the signal of the British cruiser as follows: "Goeben making for the Adriatic."

The German wireless officer argued thus wise: "I can jam him. If I break my waves against his I can confuse, hold up, destroy his messages. Shall I jam his wireless?" he asked the Admiral.

"Shall we fire?" asked the Commander.

"No," was the answer to both questions. No one apart from the staff understood the Admiral. This is how he argued, however. "This boat is evidently a patrol intending to wireless our movements to the main British Fleet. He shall save us, not ruin us. He shall do his work. We shall neither fire at nor jam him. Let him wireless that the Germans are making for the Adriatic, whereas the Dardanelles is our object."

It was dark. The Breslau closed in. It was ten o'clock in the evening. Then came the order from the bridge—"Right about; starboard; make for Cape Matapan." The watching British cruiser saw the manœuvre, but before it could wireless the news that the Germans were making for the East the following order flashed out from the Admiral:—"Jam the wireless; jam it like the devil."

The Goeben operators began the work of confusion. Wireless wave broke in upon wireless wave; sound interrupted sound for two solid hours. And during all that time the British Fleet lay securely off Malta and the Straits of Otranto ready to prevent the Germans breaking through into the Adriatic. In those two fateful hours the British wireless operators were able to transmit only a very little, and the German operators and listeners knew that the international signal "V E" ("understood") never came through the air from the British Fleet. The British might have been able after great delay to understand a word or two, but in those critical hours the Germans broke through. Where did the error of our enemy lie? In England the excuse was advanced that the Germans had acquired knowledge of the British secret wireless code, and so deceived the latter into waiting. The British should have waited before the Straits of Messina and nowhere else. But so confident were they that the Goeben and Breslau must try and break through to the Adriatic in order to reach an Austrian port that they thought it safe to wait in the Straits of Otranto, which are forty sea miles wide. So positive were they on this point that the thought of our making for the Dardanelles never seemed to have occurred to them. But the lonely British patrolling cruiser kept on with great dexterity throughout the night at its wireless work. A wild weird song of sounds quivered through the air, wireless wave crashed into wireless wave, always confusion and uncertainty.

The writer admits that the wireless messages of the cruiser which he calls the Gloucester evidently reached the British Fleet, but they reached it too late—the German ships were *en route* for Constantinople. Two more wireless messages mentioned deserve reproduction. The first one received on the following day, was as follows:—"Entrance through Dardanelles impossible at present."

The Admiral put it on one side without comment, and continued his course. The other, from the Kaiser, was handed to the Admiral at Constantinople:—"His Majesty sends you his acknowledgments."

How to Conduct a Radio Club

(Especially Prepared for the National Amateur Wireless Association.)

Receiving Tuners for a Definite Range of Wave-Length

By Elmer E. Bucher

Article XXIII

THE wireless experimenter frequently wishes to construct a receiving tuner that has a definite upper range of wave-length adjustment for use with an aerial of given dimensions. It is not possible to give the actual dimensions for a primary winding suitable to all types of aerials as two antenna systems seldom possess identical dimensions or similar values of inductance and capacity. We may, however, take aerials of given dimensions, calculate approximately their inductance and capacity and fit to them a primary and secondary coil properly designed for a distinct value of wave-length.

It is generally assumed and experiment seems to prove that a secondary winding possessing a rather high value of inductance and a correspondingly low value of capacity is the one best suited for the crystalline and vacuum valve detectors. This, together with the fact that the capacity of the usual variable condenser supplied to the amateur market has a maximum value of either .0005 or .001 microfarad—rarely more—will be taken into consideration in the examples to follow. For either crystalline or valve detectors, the condenser in shunt to the secondary winding should not exceed .0005 microfarad. A special example, however, is cited where the capacity of the condenser totals .001 microfarad.

It is found by experiment that No. 32 S. S. C. wire is best suited for the secondary winding of a receiving tuner; No. 24 or No. 26 S. S. C. for the primary winding and No. 22 S. S. C. for the antenna loading coil.

Dimensions for the coils of a receiving tuner to be used with aerials of definite lengths follow:

Example No. 1: Assume that a four-wire flat top aerial of the inverted L type, 50 feet in length, 40 feet in height, the wires spaced 2 feet apart, is being discussed. This aerial is of the correct dimensions for transmission at the amateur wave-length of 200 meters and of course is used for receiving purposes for the shorter range of wave-lengths. The inductance of the aerial is approximately 32,000 centimeters, the capacitance .00022 microfarad, and the natural wave-length about 163 meters. A receiving tuner connected to this aerial and designed to work at the restricted wave-length of 200 meters should have the following dimensions:

The secondary winding is made on a cardboard tube, hard rubber tube or other insulating material, 2½ inches in diameter and wound for a distance of 1 inch with 100 turns of No. 32 S. S. C. wire. When shunted by a capacitance of but .0001 microfarad, the winding responds to a wave-length of about 500 meters and has sufficient proportions to allow the secondary winding to be placed in resonance with the primary winding (adjusted to 200 meters) with practically a zero value of capacity at the variable condenser in shunt. It is recommended that the turns of the secondary winding be equally divided between the points of a four-point switch.

A suitable primary winding for this tuner may be 3 inches in diameter, wound for ½ inch with twenty-eight turns of No. 26 S. S. C. wire. This winding, connected in series with the aerial previously cited, raises the wave-length of the antenna system to a value above 200 meters. The primary winding should be fitted with a sliding contact or a multiple point-switch for variation of the inductance values.

Example No. 2: Assume that it is desired to construct a tuner that will raise the wave-length of the aerial described in example No. 1 to an upper wave-length adjustment of 1,000 meters. In this case the secondary winding is 2½ inches in diameter, wound for 2 inches with 200 turns of No. 32 S. S. C. wire. Shunted by a capacitance of .0002 microfarad, which corresponds to the first ten or fifteen degrees of the average small variable condenser, the wave-length of the circuit is 1,150 meters.

Owing to the increased value of the wave-length the dimensions of the primary winding must be increased; it is now 3 inches in diameter, 4 inches in length, wound with 222 turns of No. 26 S. S. C. wire. This winding will, at its maximum value of inductance, raise the wave-length of the antenna system to about 1,150 meters.

The secondary winding should have its turns equally divided between the taps of a 6-point switch, and the primary winding should be fitted with two switches to be described further on.

Example No. 3: A station is fitted with a four-wire receiving aerial, 100 feet in length, 60 feet in height, and a receiving tuner is required for adjustment to a wave-length of 1,000 meters. We may safely assume the capacity of the aerial to be .0004 microfarad; the inductance 62,090 centimeters, and the natural wave-length 300 meters.

The antenna system will respond to wave-lengths slightly in excess of 1,000 meters with a primary winding 3½ inches in diameter, wound for 2 inches with ninety turns of No. 24 S. S. C. wire. A suitable secondary winding has 200 turns of No. 32 S. S. C. wire wound for a distance of 2 inches on a form 3 inches in diameter. Shunted by a capacitance of .00015 microfarad, the winding responds to wave lengths slightly above 1,000 meters. A 6-point switch is sufficient for variation of the inductance value.

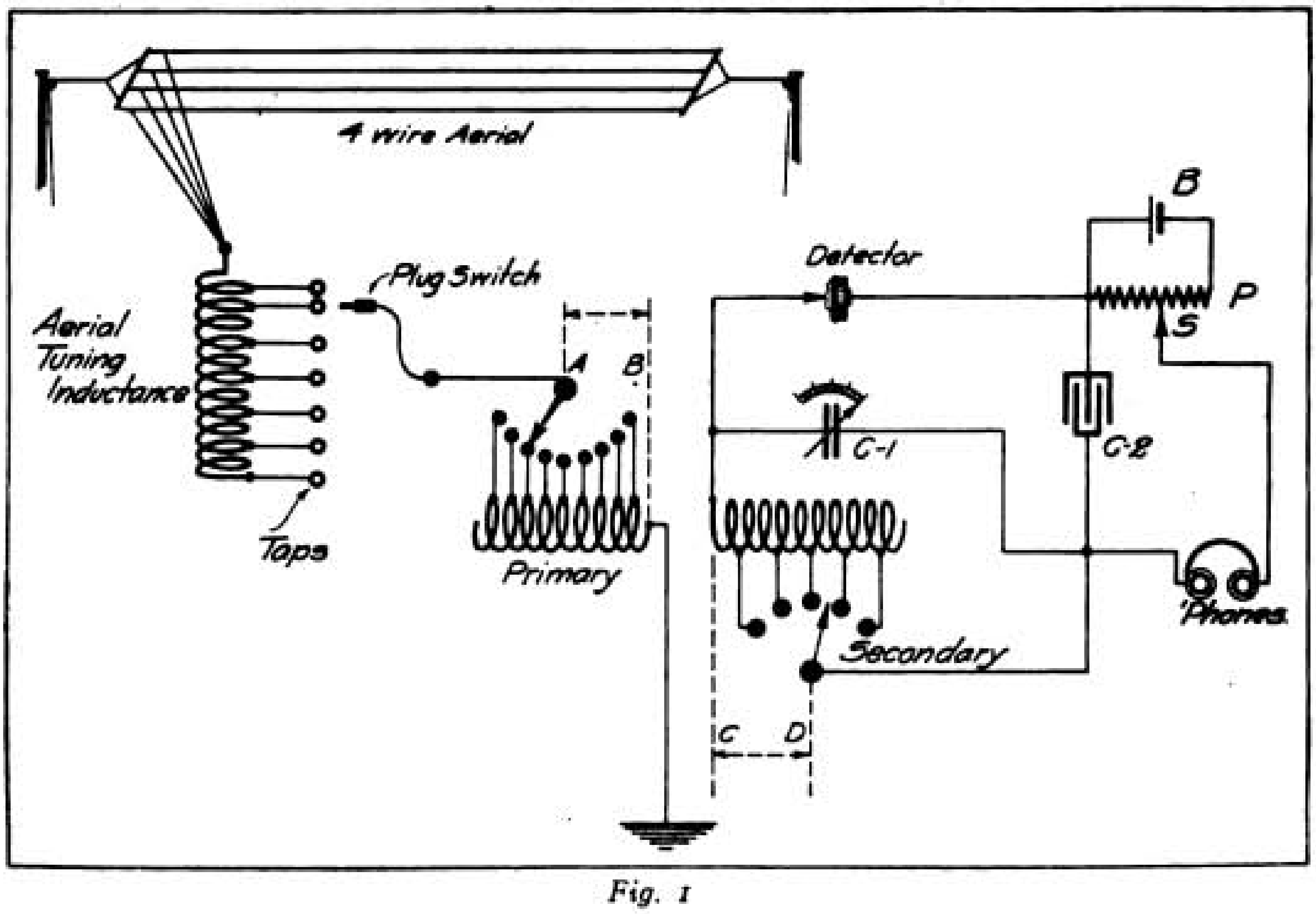


Fig. 1

Example No. 4: In this case the aerial denoted in example No. 3 is to be raised to a wave-length of 3,000 meters in both the primary and secondary windings. The primary winding is 4 inches in diameter, wound for 6 inches with 275 turns of No. 24 S. S. C. wire. The wave-length of the antenna system is raised to the wave-length of 3,000 meters by the addition of a loading coil which is 4 inches in length, wound for 4 inches with 222 turns of No. 22 S. S. C. wire. The antenna, the loading coil and the primary winding of the oscillation transformer connected in series will cause the aerial to respond to a wave-length slightly above 3,000 meters.

The corresponding secondary winding is 3½ inches in diameter, wound for 6 inches with 600 turns of No. 32 S. S. C. wire. A capacitance in shunt of .0002 microfarad will cause this circuit to respond to a wave-length of 3,000 meters.

Example No. 5: The dimensions of a primary and secondary winding for use at the wave-length of 10,000 meters are often required. The secondary winding, let us say, must possess a particularly high value of inductance in order that it may work with efficiency in connection with the vacuum valve detector. A hard rubber tube or one of other insulating material 6 inches in diameter, wound for 12 inches with 1,000 turns of No. 30 S. S. C. wire, fulfills the requirements. Shunted by a capacitance of .0001 microfarads, the circuit is responsive to the wave-length of 4,950 meters, but with a value of .0005 microfarads connected in at that point, the wave-length of the circuit is slightly in excess of 10,000 meters. This winding is well adapted for the longer range of wave-lengths and may be fitted with a multiple-point switch for variation of the inductance but, as will be observed, the wave-length can be varied over a considerable range by means of a small variable condenser alone.

With an aerial of four wires, 400 feet in length and 100 feet in height, the primary winding may be 7 inches in diameter, wound for 12 inches with 540 turns of No. 24 S. S. C. wire. The antenna system with the maximum value of inductance is responsive to a wave-length of about 11,000 meters. The capacitance of this aerial is about .00127 microfarads, the inductance 192,640 centimeters, and the natural wave-length 970 meters.

Example No. 6: Often for purposes of minimizing space and material, we desire a secondary winding, adjustable to 3,000 meters, to possess a large value of capacity at the secondary condenser and small values of inductance. A tube 3 inches in diameter, wound for 2 inches with 200 turns of No. 32 S. S. C. wire, responds with a capacitance of .001 microfarad in shunt, to the wave-length of 3,000 meters.

A suitable primary winding for the aerial cited in example No. 3 may be 3½ inches in diameter, wound for 4½ inches with No. 30 S. S. C. wire. The antenna system is then responsive to a wave-length value slightly in excess of 3,000 meters.

Example No. 7: In connection with the vacuum valve detector, many amateur experimenters obtain satisfactory results with a secondary winding of No. 36 S. S. C. wire. If the reduction in the cost of material and space is a consideration, a winding of this nature is recommended.

The dimensions for a 10,000-meter winding with a capacity of .0005 microfarad in shunt follow:

The secondary tube is 6 inches in diameter, wound for a length of 6 inches with 820 turns of No. 36 S. S. C. wire. For adjustment to the lower values of wave-lengths it may be fitted with a fifteen-point switch the taps of which are equally divided between the entire winding. The following dimensions for the primary winding and loading coil are correct for a four-wire aerial of the inverted L type, 200 feet in length and 60 feet in height. The approximate inductance of this aerial is 94,800 centimeters, the capacitance .00071 microfarad, and the fundamental wave-length about 450 meters. The primary winding may be 7 inches in diameter and 6 inches in length, wound with 272 turns of No. 24 S. S. C. wire. The loading coil is 30 inches in length and 6 inches in diameter, wound with 1,110 turns of No. 22 S. S. C. wire. The loading coil may be tapped every inch and the primary winding fitted with two switches for variation of the inductance. The condenser in shunt to the secondary winding may be one of the small Murdock type.

The dimensions given for the secondary windings in the foregoing examples are applicable to aerials of all lengths, but the primary windings must, of course, be altered with aerials of other dimensions. To obtain the correct value of inductance for the primary winding with other aerials a few trial experiments should be made, because if the wave-length of the secondary winding is already known, it is then only necessary to place the latter in inductive relation with the primary winding and alter the value of inductance at this winding or in the antenna loading coil, until response to a distant station (which is known to be in operation) is obtained.

In the design of a receiving tuner, the precaution to connect the multipoint switch of either winding so that the used turns of the primary and secondary are in direct inductive relation should be taken. They should bear the position shown in Fig. 1 where the turns, A to B, are those in use in the primary winding, C to D, the turns in use at the secondary winding. The zero value of inductance for the primary is obtained at the B end; the zero value for the secondary winding at the C end. And after this essential point is taken into consideration, it becomes self-evident that if the secondary turns are placed too far inside the primary turns, the turns, C to D, are moved beyond the turns, A to B, resulting again in a decrease of the coupling between the windings; hence it may be of value to leave the turns of the primary and secondary exposed in order that the relative position of the two windings may at all times be observed. This is particularly important at the lower values of inductance, but of course is not so essential at the maximum values.

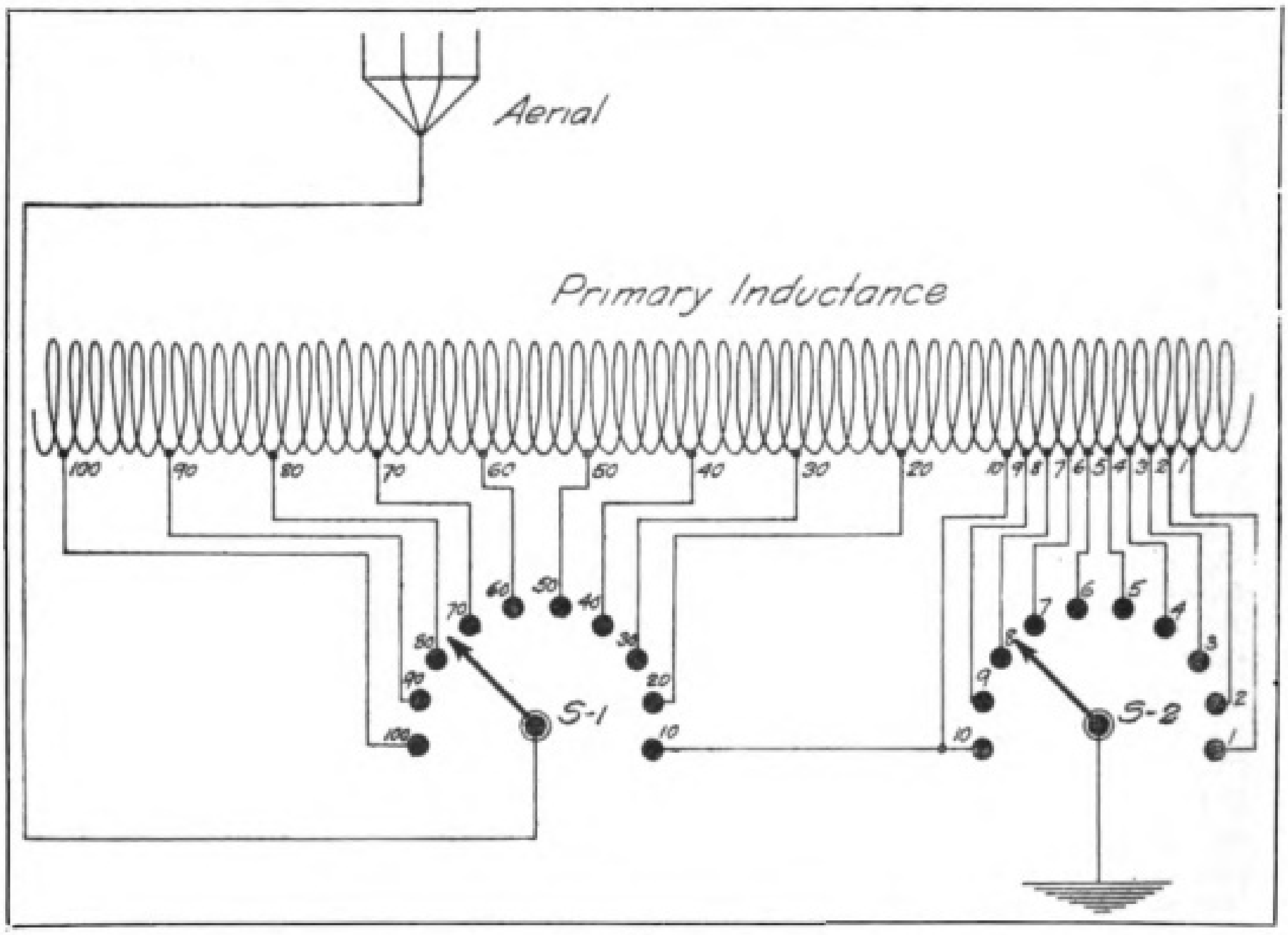


Fig. 2

Duplex Switch for the primary winding: To prevent the wires being worn through by excessive friction of a sliding contact, the primary winding of modern receiving tuners is fitted with two multi-point switches, as per Fig. 2. The switch, S-2, is connected to the first ten single turns of the primary winding and the taps of the switch, S-1, are connected to groups of ten turns. It is at once evident that any number of turns from 1 to the maximum may thus be included in the circuit. For larger windings, S-2, may be a fifteen-point switch, while the remaining turns may be connected in groups of fifteen to the point of the switch, S-1.

For receiving tuners like those described in examples 5 and 7 it is not entirely essential that switches of this type be fitted to the primary winding. These windings may be tapped every half inch and connected to the points of a single multi-point switch. A variometer similar to that described in the book, "How to Conduct a Radio Club," is connected in series with the loading coil and primary winding to obtain the necessary fineness of adjustment in that circuit.

The fixed or stopping condenser: The condenser of fixed capacity, C-2, indicated in the drawing (Fig. 1) may have values of capacity varying from .003 microfarad to .04, depending to some extent upon the type of telephone in use. This condenser may consist of several sheets of tin-foil, interleaved with thin paraffine paper, and the surface on one side of the condenser must have from 300 square inches to 1,200 square inches of tin-foil. Inasmuch as the dielectric constant of various grades of paper varies and also the fact that the capacity of the unit depends upon the pressure placed upon the sheets of foil and paper, it is not quite possible to give specific dimensions, but for general all around work a condenser should be constructed to have a surface on one side of 600 square inches, the sheets of foil being separated by thin paraffine paper. It is not required that this condenser be constructed of a single large sheet; it may be made of several smaller sheets with dimensions of, say, 4 by 6 inches, the only requirement being that the necessary surface on each side is obtained.

The potentiometer: The sensitiveness of crystalline detectors is enhanced by the addition of a potentiometer of suitable proportions and a small battery, as indicated in Fig. 1. The crystalline detector and potentiometer P may be one of the ordinary type of 400 ohms resistance, but there must be connected in series therewith a fixed resistance of about 1,800 ohms. If, however, a closer variation of the current is desired, the potentiometer, P, may have a resistance of about 2,500 ohms. It may then consist of a hard rubber tube properly threaded and wound with 650 feet of No. 32 "advance" wire, as made by the Driver-Harris Company, New York City. The battery, B, should be one of about 1½ volts. Particular care must be taken to have the polarity of this cell correct. The proper direction of current flow for different types of crystal is best obtained by experiment. Hence, it is of value to fit the battery, B, with a reversing switch, which may be of any design desired.

In a future issue, dimensions for the primary and secondary windings of a receiving tuner for other range of wave-lengths and with different size aerials will be given.

(To be continued)

A CLUB WITH ONE OFFICER

The Advanced Hamilton Radio Association, of Hamilton, Ohio, has rather unusual and interesting ideas in regard to both organization and qualifications. The association is governed by an executive committee of three members. A new member is appointed at each meeting to take the place of the first member, who withdraws. There is no officer except a secretary.

Each charter member must possess the following qualifications:

Have a U. S. Government wireless license; skill to send and receive at least twelve words a minute, and at least two years' experience in wireless telegraphy.

A Magnetic Amplifier for Radio Telephony*

By E. F. W. Alexanderson and S. P. Nixdorff

THE name of "Magnetic amplifier" has been given to a device for controlling the flow of radio frequency currents because this name seems to describe its function when it is used for radio telephony better than would any other. As the same device can be used for a variety of other purposes the above name may in some cases not seem so appropriate. However, the essential part of the theory that will be given refers to the amount of amplification which is possible of attainment and the methods of securing a higher ratio of amplification than would be given by the device in its simplest form.

The fundamental principle of varying an inductance by changing the permeability of its iron core is suggested in the early work of Fessenden as a means for changing the tuning of a radio antenna. The magnetic amplifier constructed as shown in Figs. 1 and 2 was, on the other hand, developed as an accessory to an alternator having a solid rotor in order to take advantage of the better mechanical construction of a solid steel rotor and yet produce the results that could be obtained by field control in a machine having a completely laminated magnetic circuit. The aggregate of the constant field alternator and the stationary controlling device has, as will be shown, the effect of a machine with variable field excitation. This analogy refers not only to the proportionality between excitation and electro-motive force but also to such phenomena as self-excitation and instability.

If two windings (e.g., *A* and *B* in Fig. 2) are related to each other and a common magnetic structure as shown in Figs. 1 and 2, it is apparent that there is no direct transformation of energy possible from one winding to the other. Each turn in the controlling or exciting winding *B* includes both the positive and negative branch of the flux produced by the A. C. winding, *A*, and hence there is no voltage induced in *B*. The current in either winding *A* or *B*, on the other hand, influences the permeability of the common magnetic material; and, therefore, changes the inductance of the other winding. If a current flows in either winding sufficient to saturate the iron, it is thereby rendered practically non-magnetic and the inductance of the other winding is reduced to the value it would have if the coil included only air. If, on the other hand, a current flows in the other winding which gives a magnetomotive force equal and opposite to the first, the iron is rendered magnetic again. Inasmuch as the two branches of winding *A* are wound relatively opposite to winding *B*, the one branch will oppose the ampere-turns of winding *B* on one-half cycle. and the other branch during the next half cycle. In order to have any large flux variation in winding *A*, the opposing ampere-turns must be at least equal to the ampere-turns in winding *B*. The relation of currents in these windings is substantially the same as that between the primary and secondary current in a transformer, although in this case one is an alternating and the other a direct current, or a current of a different frequency. It is thus obvious how the current flow in winding *A* can be regulated in proportion to the controlling current in winding *B*. When the magnetic amplifier is used in shunt to the alternator (Fig. 2), it has the immediate object of controlling the voltage rather than the current. The combined characteristics

* Presented before The Institute of Radio Engineers, New York, February 2, 1916. Reprinted by permission of The Institute of Radio Engineers.

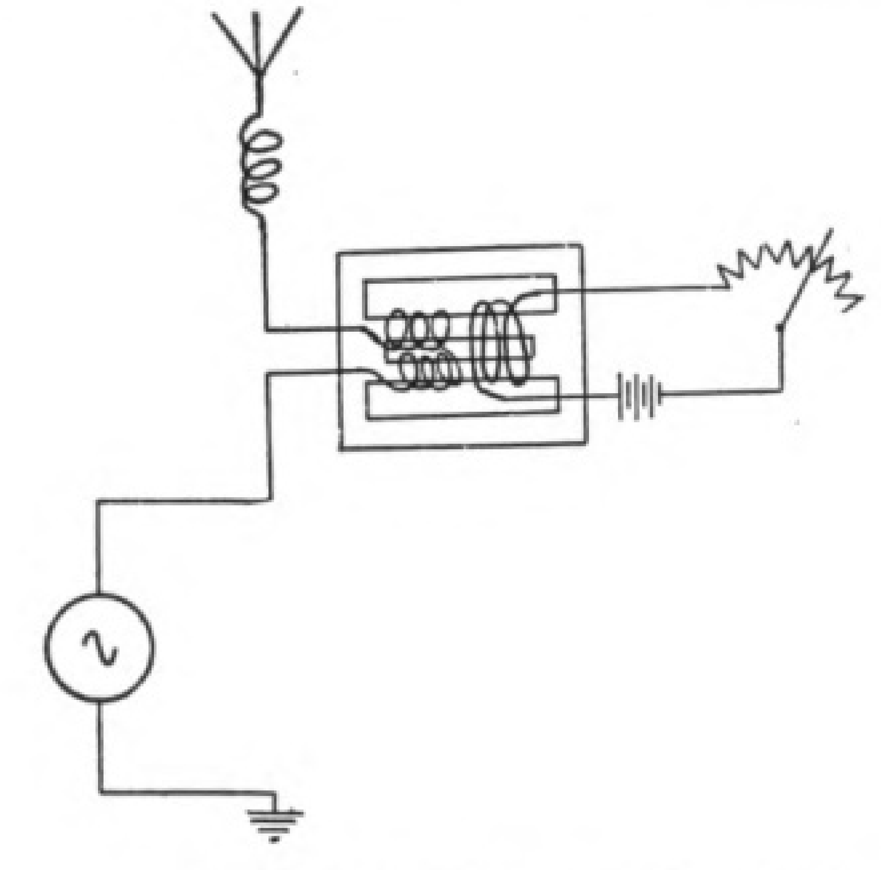


Fig. 1—Combination of alternator and amplifier in a simple form

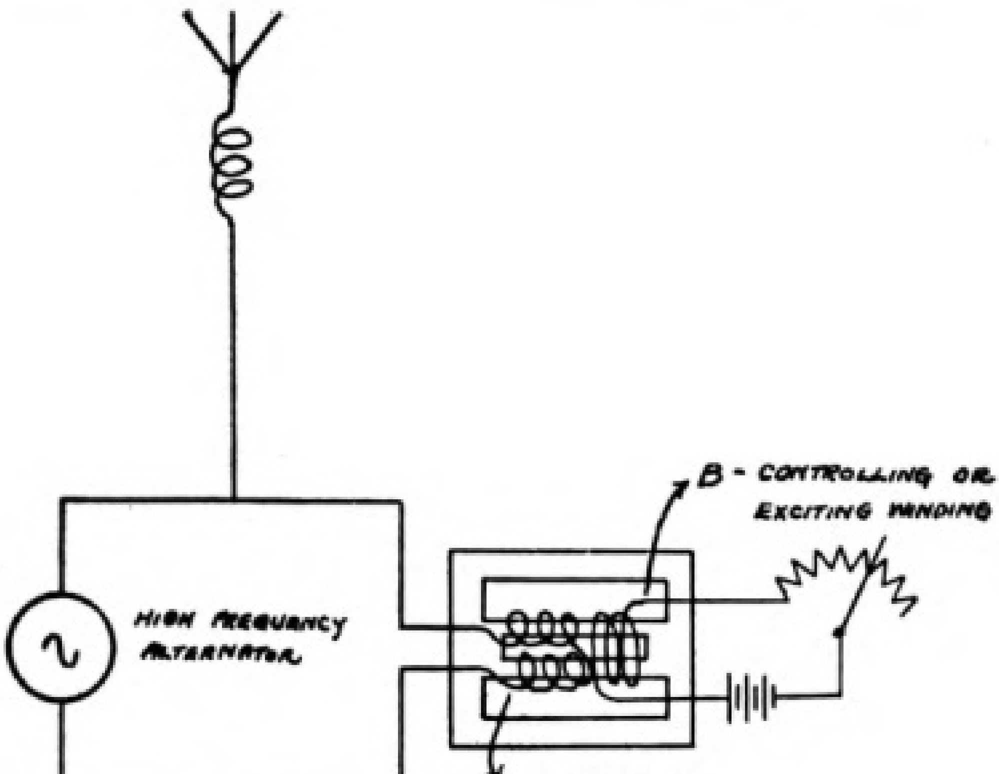


Fig. 2—Combination of alternator and amplifier in a simple form

can be derived from the separate characteristics of the alternator operating on an antenna, and of the alternator controlled by a variable shunt across its terminals, as shown in Fig. 5.

As indicated in Figs. 1 and 2, it is possible to connect the amplifier either in series with the alternator or in shunt to the alternator. Of these two arrangements, the shunt connection is preferable because the effect of the amplifier on the alternator is the same as if the electromotive force of the alternator in the antenna circuit had been reduced; whereas the amplifier in the series connection does not influence the electromotive force in the antenna circuit but changes the tuning of the antenna. The result of this change in antenna tuning has an undesirable effect on the speed characteristics of the alternator, because it is found upon further analysis that the control does not become effective unless the alternator is operated on the upper or unstable side of the tuning curve of the antenna. If, on the other hand, the alternator is operated on the stable side of the tuning curve, the change in tuning partly neutralizes the intended controlling effect.

Ratio of Amplification

The method of arriving at a theory for the ratio of amplification can perhaps be best explained by the following mechanical analogue:

A throttle valve in a steam pipe may be designed so that it is perfectly balanced and it might move on ball bearings so that an infinitely small effort would be sufficient to throttle an infinitely large flow of power. If, on the other hand, the valve were to be opened and closed 1,000 times in a second, the accelerating of the moving parts against their inertia would intermittently absorb considerable energy. Although this would be "wattless" energy (inasmuch as the energy consumed in accelerating would be given back in retarding), the device which performs this movement must control considerable power. In addition, if there be frictional resistance to motion, still more energy will be required *throughout* the cycle, and this is not "wattless" energy. In analogy to this, we must ask ourselves what are the corresponding "wattless" and "watt" energy in our magnetic valve which must be overcome in opening and closing it at the frequency of a telephone current. The answer is: the "wattless" energy is that required to create the magnetic field neglecting hysteresis (and eddy current losses). The "watt" energy is that lost during any number of cycles because of hysteresis. This energy is the integrated area of the saturation curve between the limiting points between which the changes take place. The energy of the controlling field is not necessarily equal to the energy of the radio frequency field but of somewhat the same order of magnitude. The wattless flow of energy is proportional to the energy per cycle and the number of times per second the energy must be delivered and returned. It can, therefore, be said that the ratio of amplification is proportional to the ratio between the frequency of the radio current and that of the controlling current.

However, the assumption that the energy per cycle is the same in the radio frequency and in the controlling circuit is only a first approximation. The object of design and improved arrangements is evidently to make this energy ratio as favorable as possible; in other words, to produce a maximum flux variation in the radio frequency circuit for a minimum variation in the controlling circuit.

In order to understand these relations it is necessary to make a further study of the laws governing changes of permeability. The object of the magnetic amplifier, when used for radio telephony is not only to control the radio energy but also to reproduce a telephone current in its true shape. An important part of the analysis is, therefore, a study of the conditions that lead to linear proportionality between the controlling and the controlled current.

Magnetic Theory and Characteristics

The magnetic amplifier can be operated in two ways, as indicated by the diagram in Fig. 6. In one case, when the two A. C. windings are in series, the current in both windings is definite; and the flux in the corresponding branches of the core adjusts itself accordingly. In the second case when the two A. C. windings are in multiple the currents in

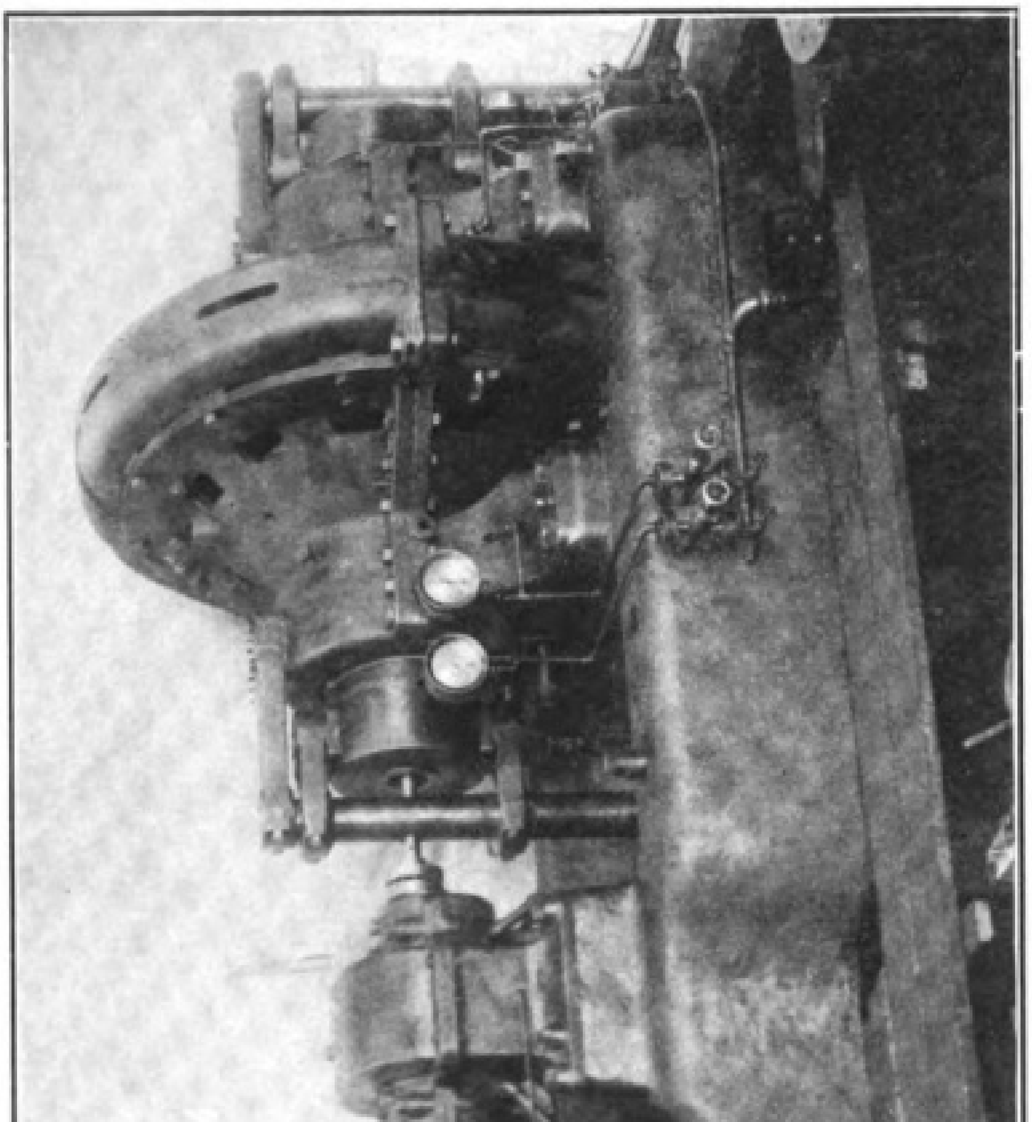


Fig. 3—75 k.w. radio frequency alternator used for tests

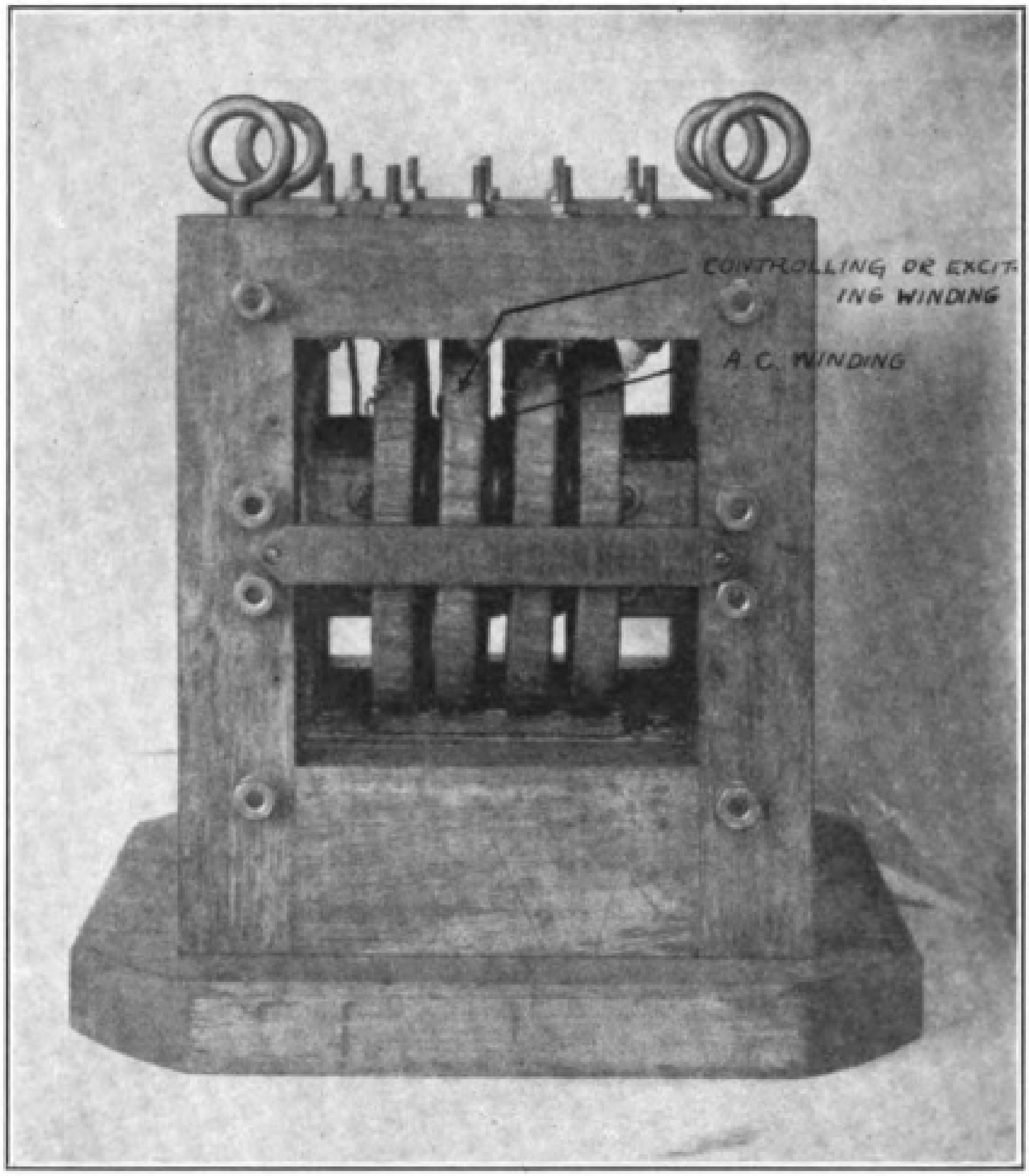


Fig. 4—Amplifier coil used for tests

each winding are not immediately obtainable; because a cross current of a strength not yet defined may flow between the two windings. We know on the other hand that the flux variations in the two branches of the core must be identical, inasmuch as they produce the same terminal voltage in the multiple connected windings.

The characteristics of the amplifier winding in series and multiple connection, as obtained from tests, are shown in Figure 6. The upper curve represents series and the lower, multiple connection. The curves are plotted in ampere-turns and volts per turn, so as to make the conclusions independent of the number of turns. Both curves represent the same D. C. excitation. These curves, as well as theoretical considerations, show that the multiple connection gives a lower curvature and a lower impedance. For zero D. C. excitation it is evident that the volt-ampere curves for these two connections must be identical. It thus follows that the change of impedance corresponding to a given D. C. excitation is greater with the multiple connection. The multiple connection is, therefore, altogether more advantageous because a lower impedance with a certain control excitation means greater sensitiveness; and a lower curvature means that larger currents can be carried without causing instability, as will be shown later. While thus the second

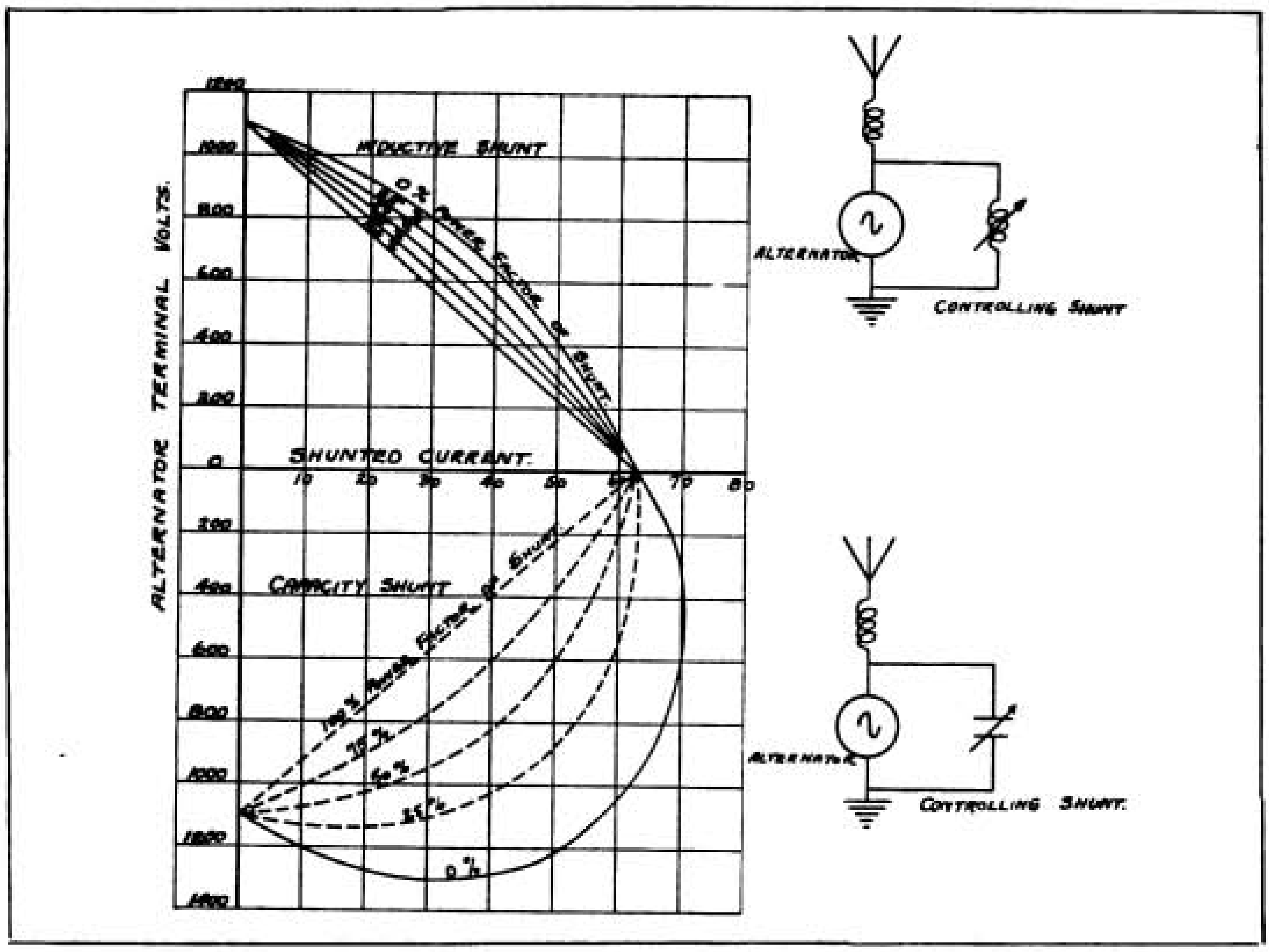


Fig. 5—Characteristics of alternator when controlled by variable shunt impedance

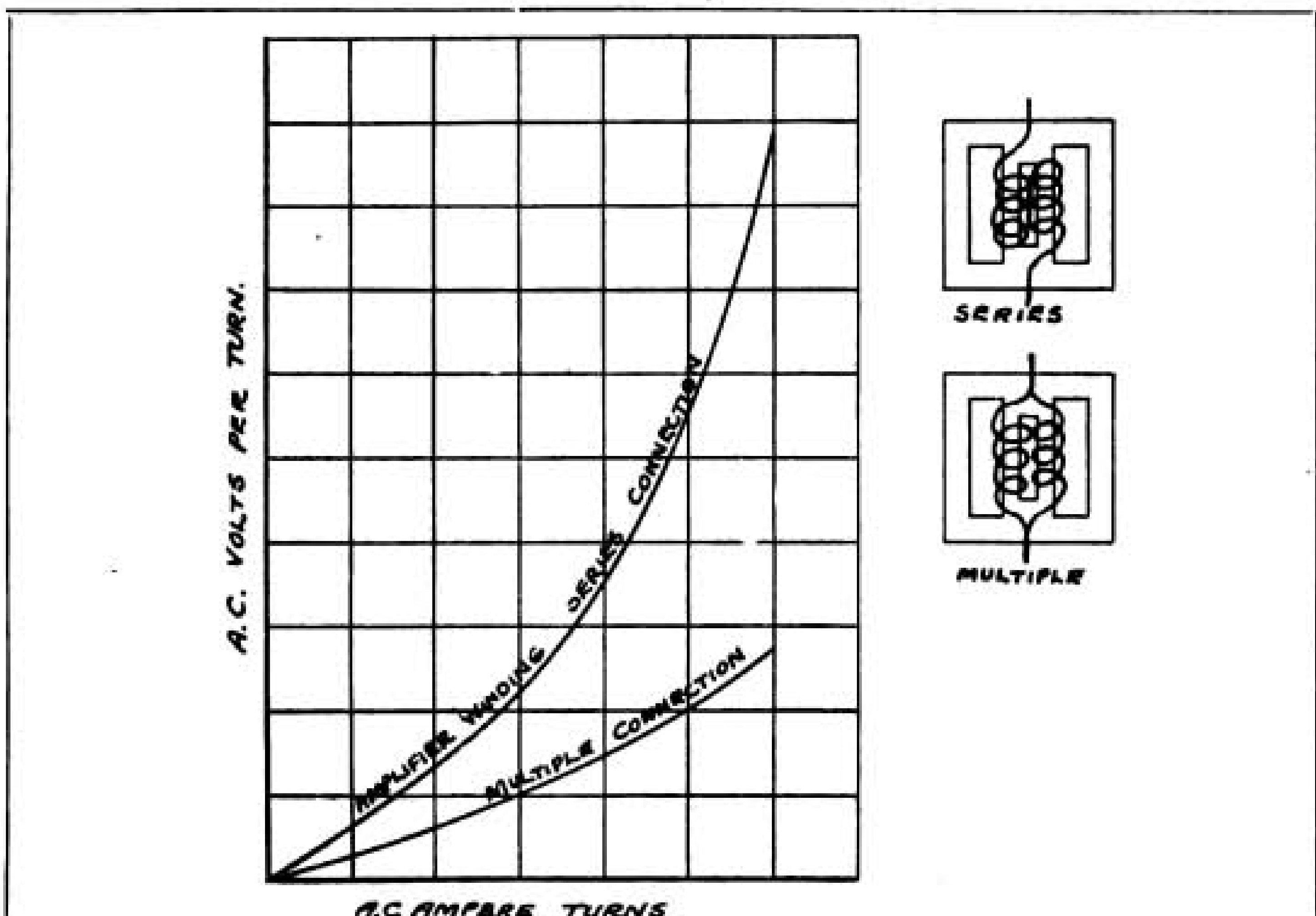


Fig. 6—Comparative volt-ampere curves with the same D. C. excitation

mode of operation with multiple A. C. winding appears to have better characteristics, there are some other considerations which must be taken into account before it can be concluded that this connection could be used.

Object of Short Circuit Condenser

In the multiple connection, the flux variations are forced, as already explained, by the short circuit that is formed between the two multiple coils. The induced current in this short circuit tends to oppose any changes in the average flux, and thus a telephone current in the controlling winding would simply cause a corresponding short circuit current between the two A. C coils without producing the desired flux variations. This difficulty can, however, be overcome by taking advantage of the fact that the A. C. winding needs to operate only at radio frequencies, which are very much higher than the frequency of the telephone current. It is, therefore, possible to find a condenser of such value that it acts as a short circuit for the radio currents and on open circuit for the telephone current. Accordingly a condenser is introduced in series with each of the A. C. coils, as shown in Fig. 9.

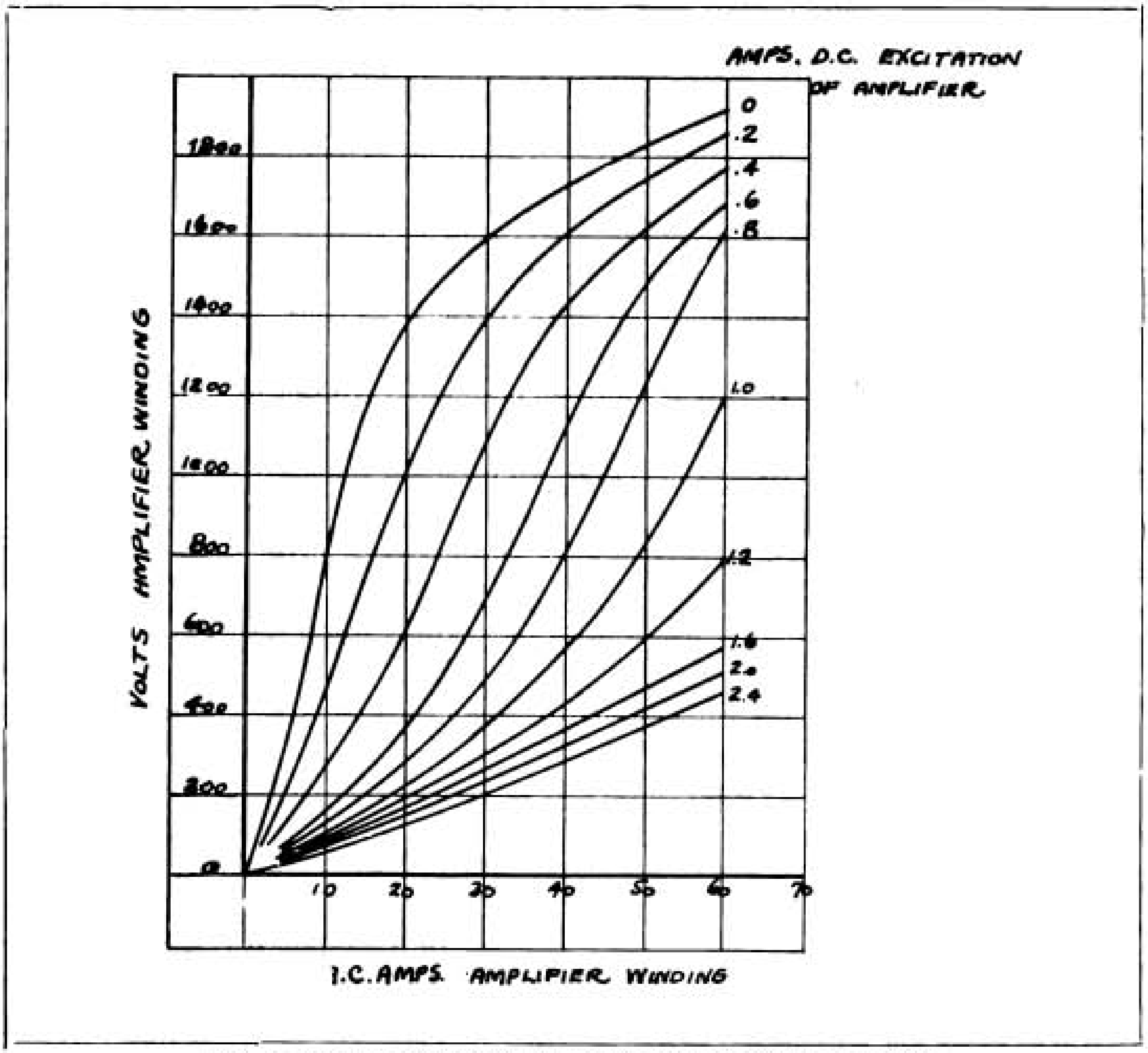


Fig. 7—Characteristics of amplifier coil windings in multiple

Combination of Alternator and Amplifier

In order to demonstrate how the magnetic amplifier can be used for controlling the voltage of an alternator, reference may again be made to the alternator characteristics, as shown in Fig. 5. The alternator voltage is plotted against the current in the shunt cir-

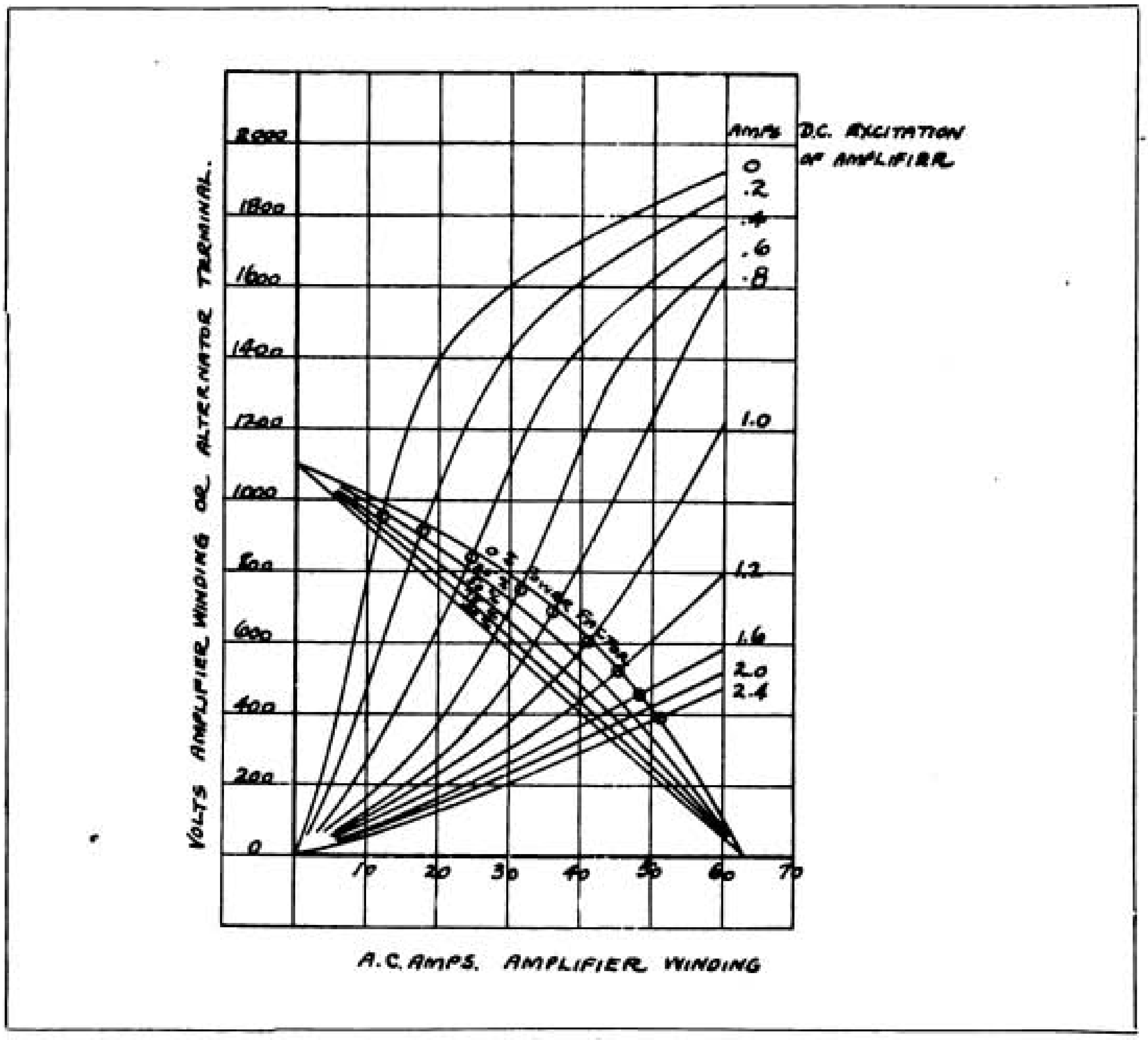


Fig. 8—Alternator and amplifier characteristics superimposed

cuit. The magnetic amplifier is used as this shunt circuit and the volt-ampere characteristics of the amplifier can, therefore, be directly combined with the volt-ampere characteristics of the alternator. The volt-ampere characteristics of the amplifier are shown in Fig. 7. Fig. 8 shows the alternator and amplifier characteristics superimposed. The intersections between the sets of curves give the alternator voltages at the corresponding amplifier excitations, and thus another curve can be plotted between alternator volts and amplifier excitation. This curve, as obtained from test, is the upper curve in Fig. 9, which approaches the X axis asymptotically with increasing excitation of the amplifier. It is possible in this way to reduce the voltage practically to zero without using an excitation which is excessive from the point of view of heat capacity of the exciting winding. A magnetic amplifier may be used in this way as a controlling device for radio telegraphy. However, in this form, it is not well adapted for telephony; because, as shown by the curves, the relation of volts of alternator to amperes of excitation departs too far from the desired linear proportionality. Such proportionality can be obtained by the introduction of a series condenser, as shown in Fig. 9, while at the same time the sensitiveness of the amplifier is greatly increased so that a much smaller control current is needed. If the condenser is chosen so that it exactly neutralizes the inductance of the amplifier winding at some definite value of excitation, the resulting impedance at this excitation becomes a minimum; and the impedance at any lower excitation is determined by the

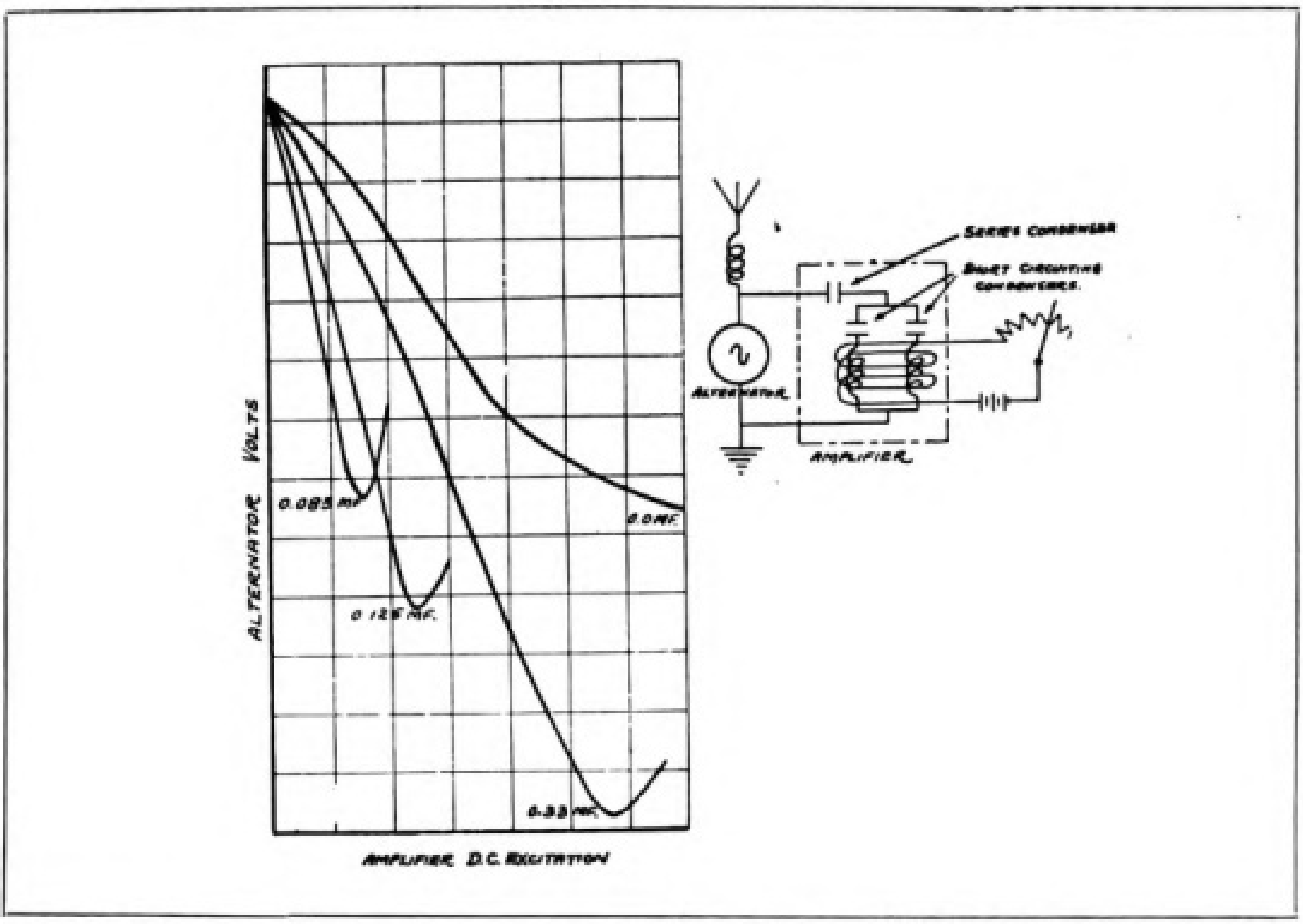


Fig. 9—Curves obtained from test showing sensitiveness of alternator voltage control with different series condensers

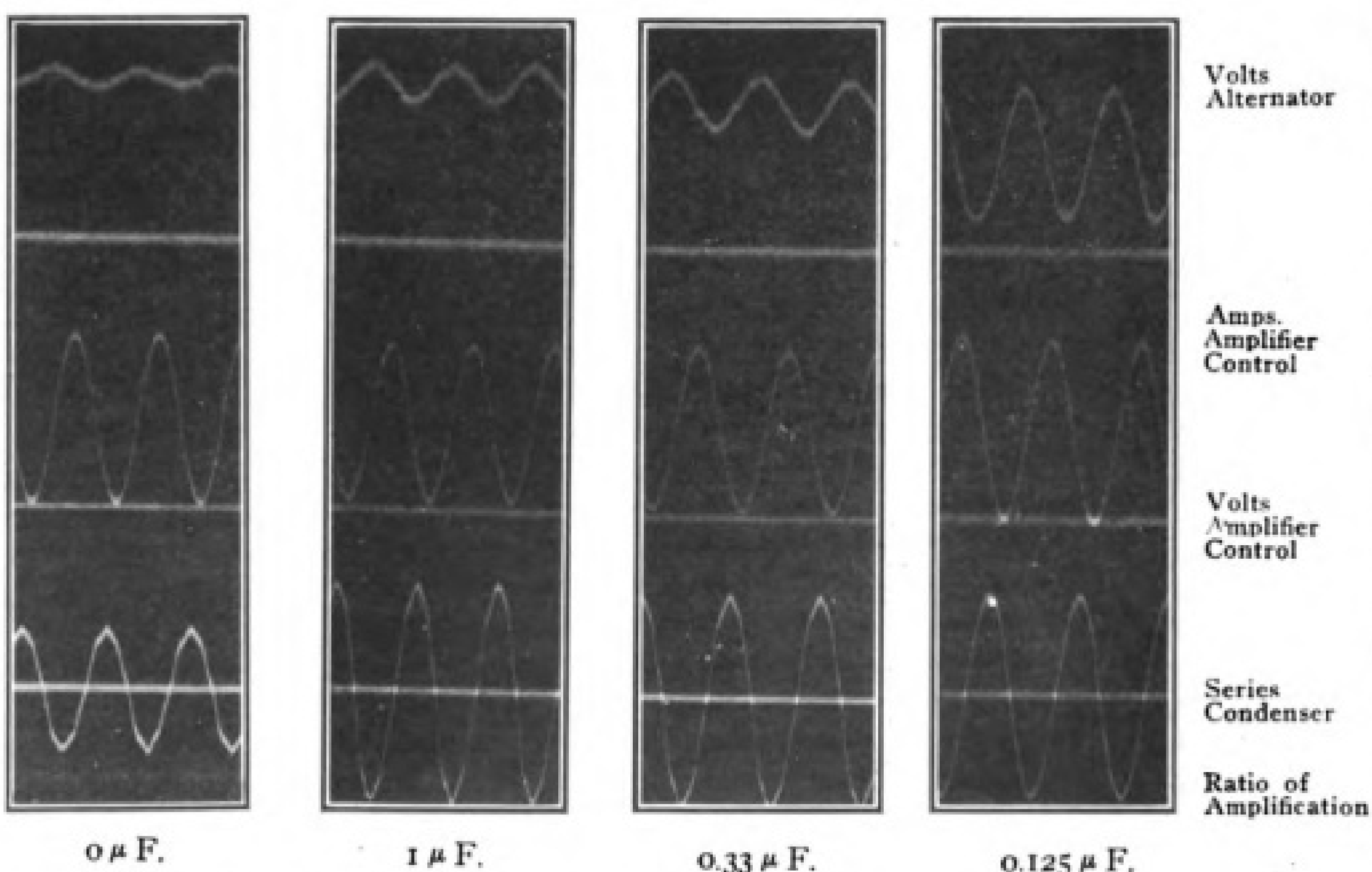


Fig. 10—Oscillograms showing ratio of amplification with different series condensers

difference between the inductive reactance of the amplifier coil and the capacity reactance of the series condenser. The smaller this difference, the lower will be the amplifier excitation that gives minimum impedance and the corresponding minimum of the alternator voltage. This means that the sensitiveness of the amplifier is increased because a smaller excitation is needed to reduce the alternator voltage. The increase of sensitiveness that can be obtained in this way is, however, not unlimited. If the minimum impedance is obtained as a result of a large inductive and a large capacitive reactance, the care loss due to hysteresis and eddy currents becomes appreciable and appears as an equivalent resistance which cannot be neutralized. Fig. 9 shows, from results of tests, the variations of alternator voltage that can be obtained by different values of series condenser and the corresponding increase of the sensitiveness of the amplifier. The sensitiveness is represented by the steepness of the curves. It can be seen from the shape of these curves that the increased sensitiveness is gained at the expense of range of control or differ-

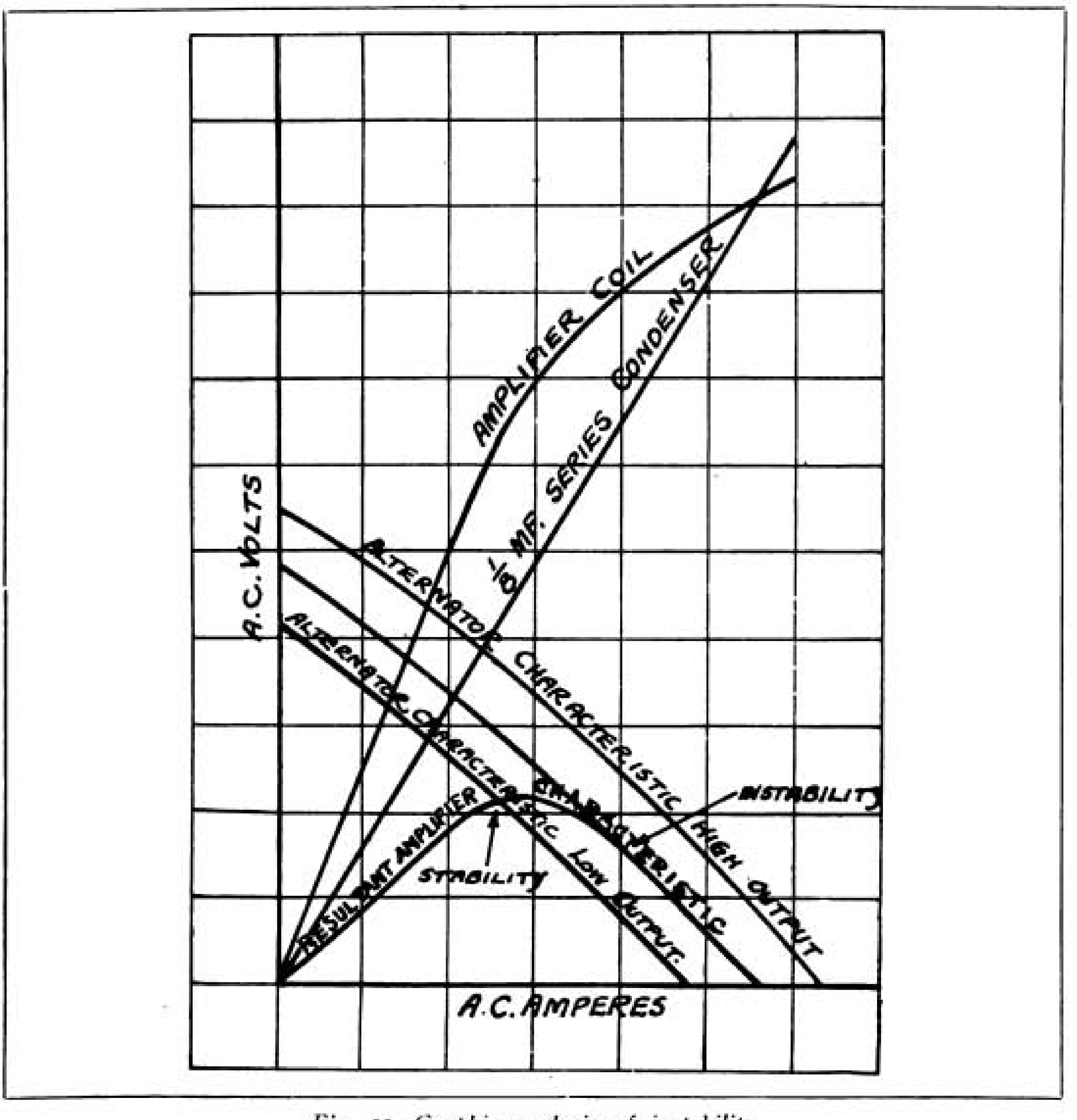


Fig. 11—Graphic analysis of instability

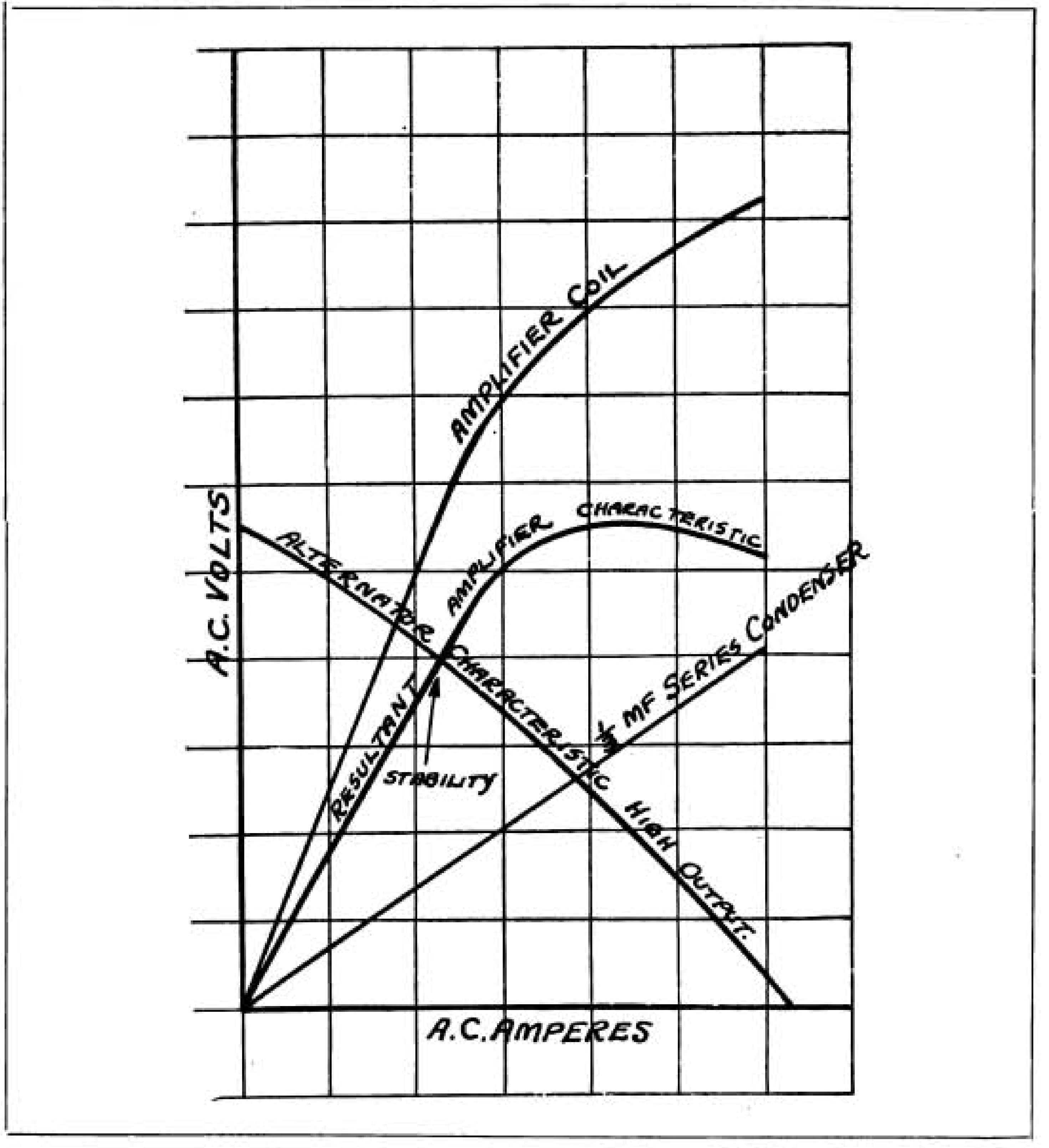


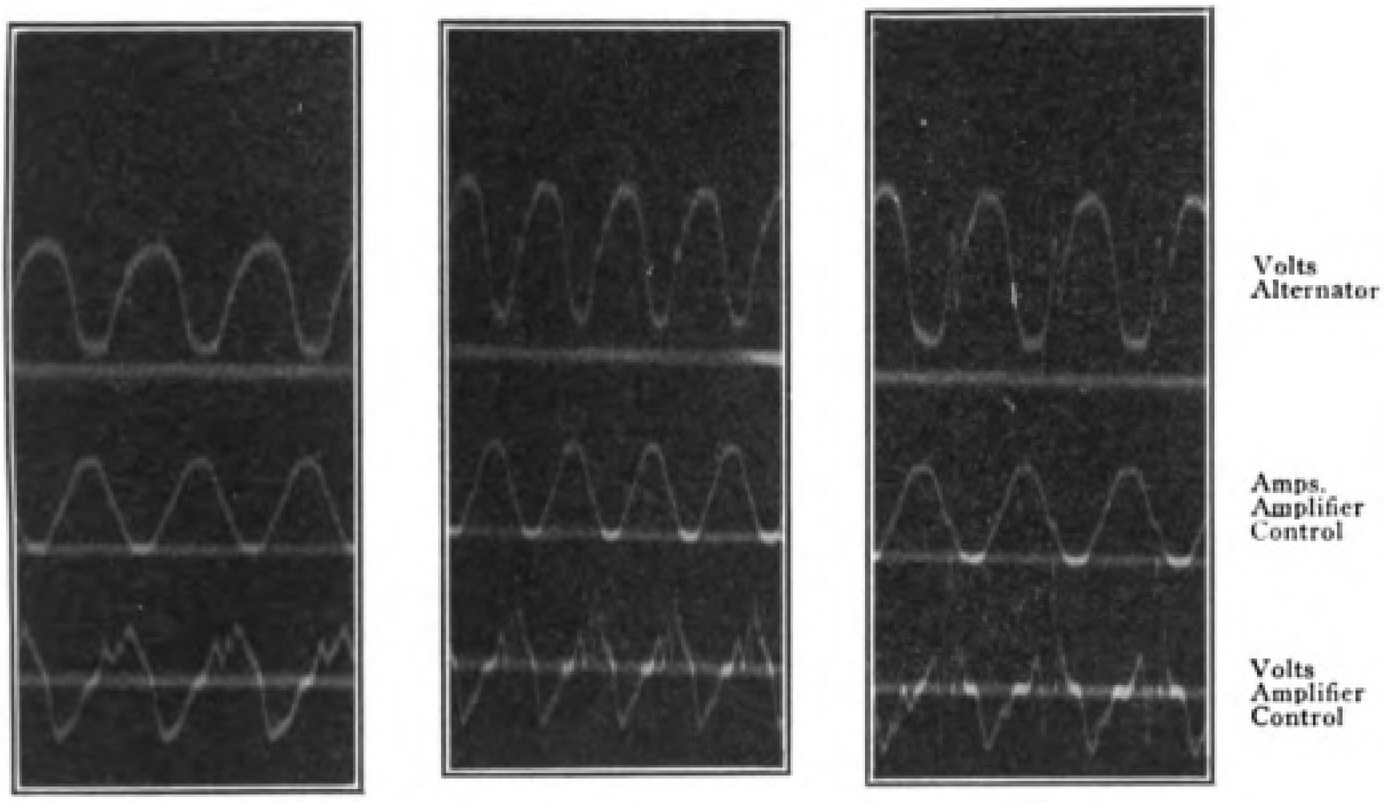
Fig. 12—Graphic analysis of instability

ence between maximum and minimum voltage. However, all the curves show a practically linear proportionality between excitation and voltage over almost the whole range available. The difference in sensitiveness with various series condensers is also illustrated by oscillograms, Fig. 10. The upper curve represents alternator voltage. The two lower curves represent amperes and volts, respectively, impressed upon the amplifier controlling winding, the frequency of the controlling current being 500 cycles. The effect of departure from linear proportionality and the consequent distortion of wave shape is shown in Fig. 15.

The amplification ratio is defined as the difference between the maximum and minimum kilowatts output divided by the effective alternating volt-amperes supplied to the controlling winding. The ratio of amplification can be derived directly from the oscillograms with reference to the calibration of the oscillograph curves. The ratio of amplification for operation suitable for telephone control ranges from 100:1 to 350:1.

Instability

The voltage which results from the combination of alternator and amplifier can be determined as has been explained by the intersection of the alternator and amplifier characteristics. When the curves have a definite and sharp intersection point a definite alternator voltage results from each excitation of the amplifier. If, on the other hand, the curves should have such a shape that the alternator and amplifier characteristic curves become parallel in some place, the intersection becomes indefinite and the result is instability and generation of self-excited oscillations. This is a condition that must be avoided for telephone control; whereas it may have useful applications for other purposes. The conditions that lead to instability can be graphically analyzed as shown in Figs. 11 and 12. Fig. 11 corresponds to a series condenser of ⅛ μf. (microfarad) which leads to instability at higher generator outputs; whereas, Fig. 12 corresponds to a series condenser of 1/3 μf. and represents a condition which is stable for all voltages at which the generator can diagram is the volt-ampere curve of the amplifier coil and the straight line through the origin represents the series condenser. The lower curve is the difference between the volts amplifier coil and volts series condenser, which is for the present purpose a sufficiently close approximation of the volt-ampere curve of the combination. This resultant volt-ampere curve in the left hand diagram rises to a maximum, then falls again and crosses the zero line. The crossing of the zero line means change be operated. The upper curve in each from inductive to capacitive impedance.



0.125 μ F. 0.125 μ F. 0.125 μ F.

Fig. 13—Oscillograms showing instability at higher alternator voltage

With reference to any circuit which has a volt-ampere characteristic with a bend in it, it can be said that as long as the volt-ampere curve is rising, the circuit is stable where it is connected to a source of constant potential, and wherever the volt-ampere curve is drooping, the circuit is unstable on a constant potential. The rising part of the curve corresponds to a positive resistance and the drooping side to a negative resistance. Well-known types of negative resistance are electric arcs or series commutator generators. A circuit of this character is stable only when operated on a source of potential which has characteristics equally or more drooping than the drooping volt-

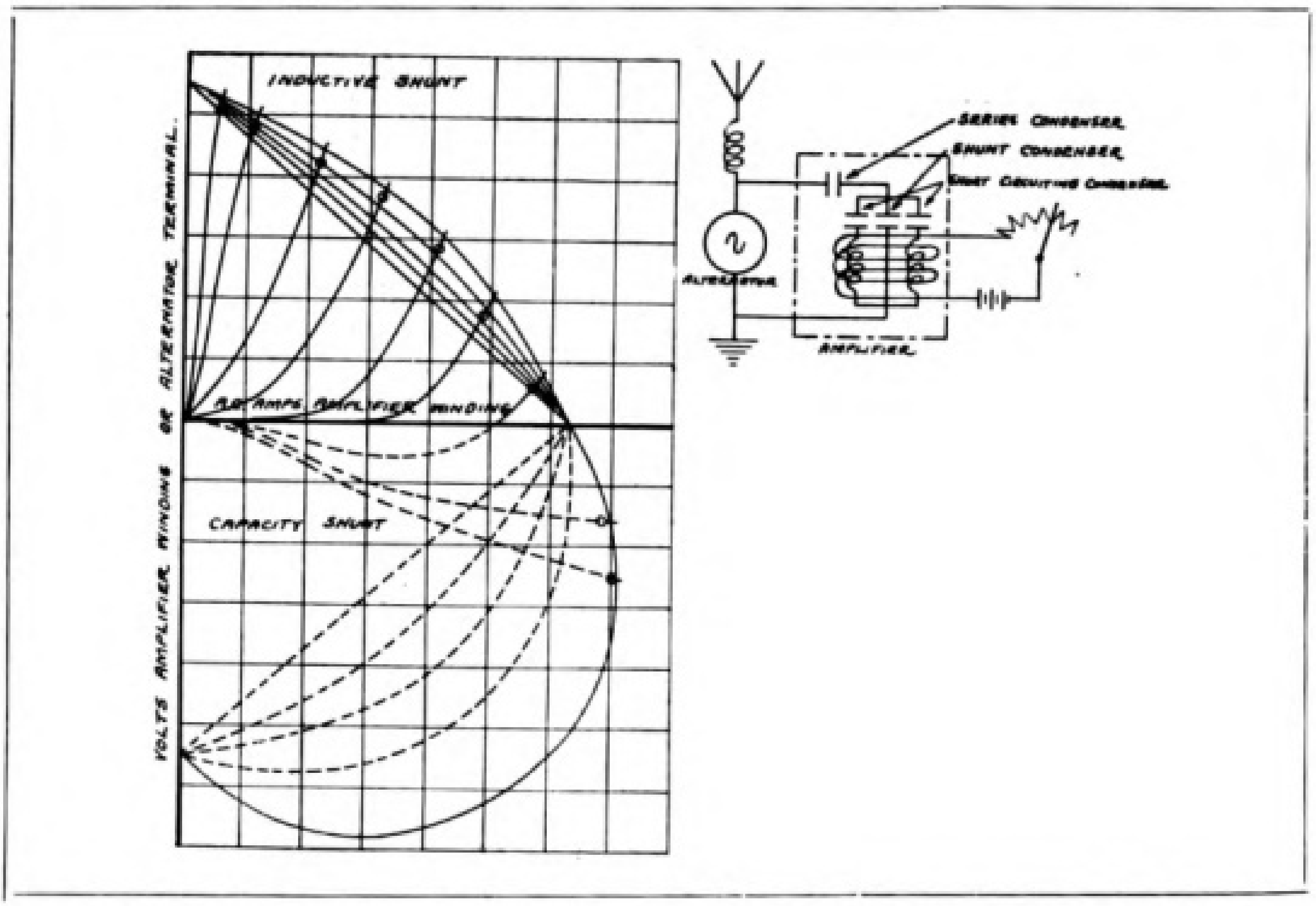
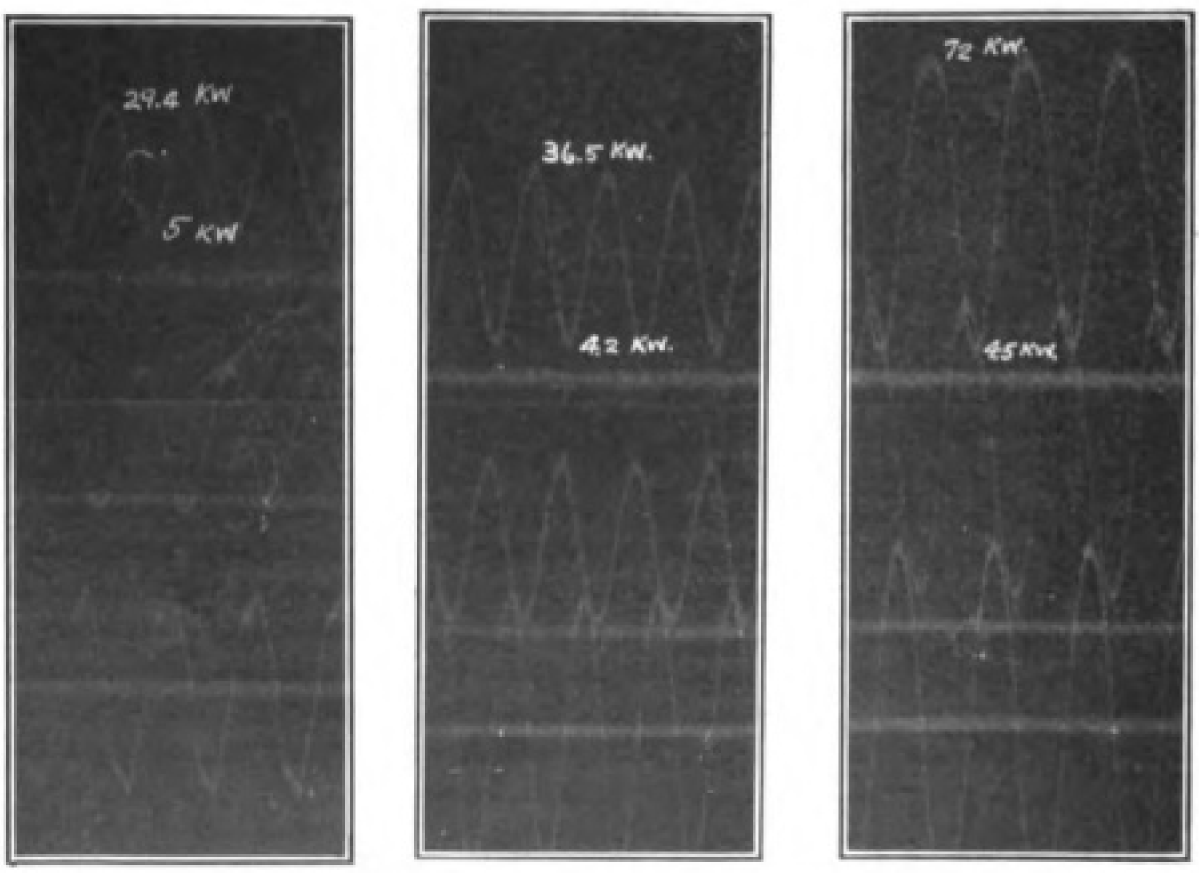


Fig. 14—Volt-ampere characteristics of amplifier with shunt and series condenser showing intersection with alternator characteristics



Volts Alternator

Amps. Amplifier Control

Volts Amplifier Control

Shunt Condenser

Series Condenser

Ratio of Amplification

None	0.056 μ F.	0.33 μ F.
0.33 μ F.	0.33 μ F.	0.33 μ F.
224	360	236

Fig. 15—Oscillograms showing effect of different shunt condensers

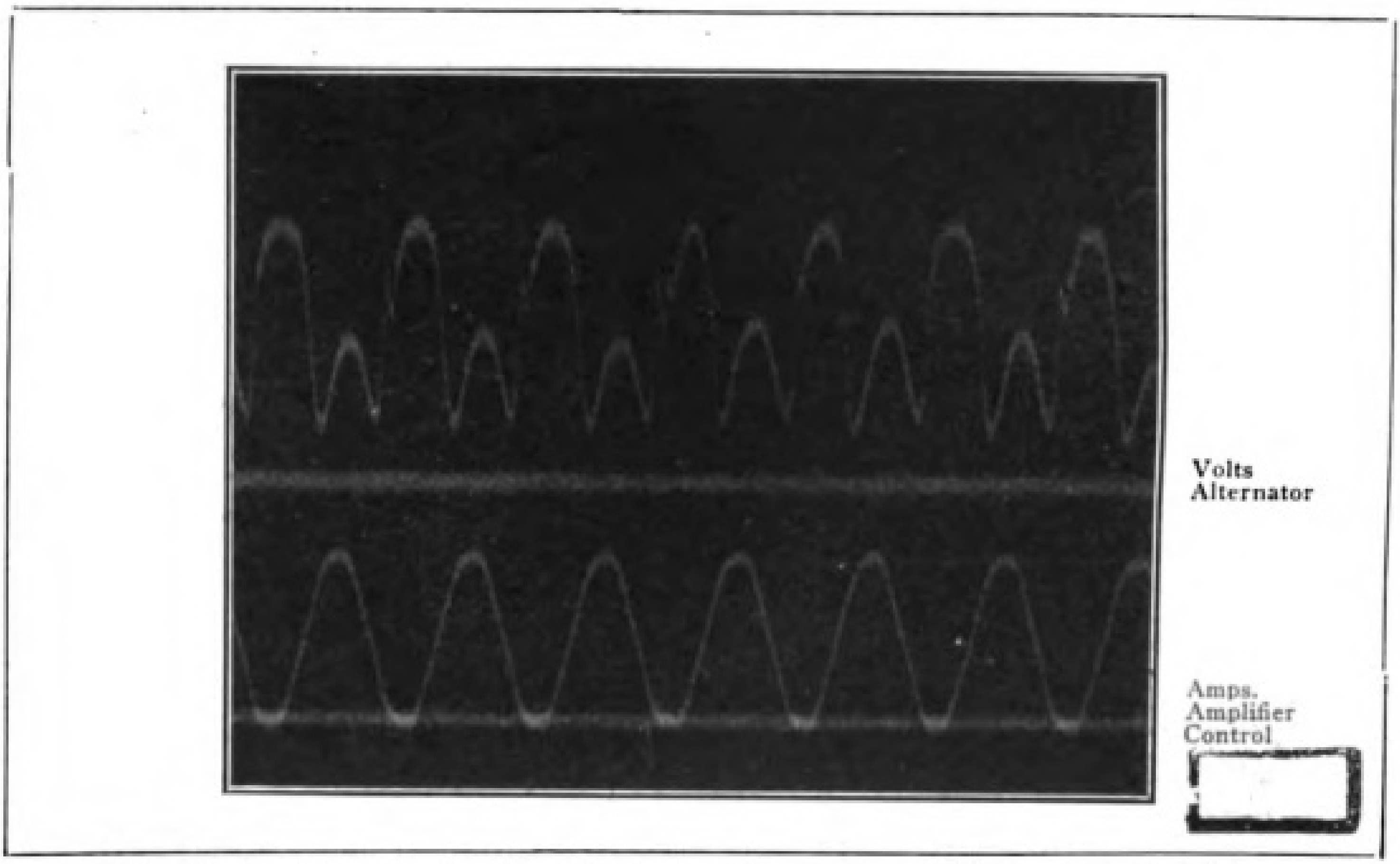


Fig. 16—Oscillogram showing distortion where range of linear proportionality of control is exceeded

ampere curve. These same curves (Figs. 11 and 12) show the volt-ampere characteristics of the alternator. In Fig. 12, the resultant characteristic is only slightly drooping at the end, whereas, in Fig. 11 the condition for instability is indicated by the place where the volt-ampere curve of the amplifier is more drooping than the volt-ampere curve of the alternator. Fig. 11 also shows that the alternator curve corresponding to low output intersects the amplifier curve at the stable portion and the characteristics for increased output reach the unstable portion of the resultant amplifier curve. This change from stability to instability is shown by the series of oscillograms in Fig. 13. The instability, as shown by the self-excited oscillations re-occur at the same place of the wave which is the point at which the characteristic curves are tangent, as shown in Figs. 11 and 12.

Shunt Condenser

A further improvement in sensitiveness can be obtained by using a combination of shunt and series condenser. The shunt condenser is so proportioned as to make the amplifier take leading instead of lagging current at low excitation. Complete characteristic curves of the amplifier with shunt and series condenser and the superimposed alternator characteristics are shown in Fig. 14. The series of oscillograms (Fig. 15) show the effect of different amounts of shunt condenser. While the series condenser is used within the limits of stability to increase the sensitiveness, the shunt condenser has the object of allowing the alternator to assume its full maximum voltage. The last oscillogram (Fig. 15) shows an alternator output of 72 kilowatts.

Applications of the Amplifier

The oscillograms of Fig. 17 shows telephone control of the alternator output. The two curves on the oscillogram, which curves are relatively upside down, show that the variation of the alternator voltage is in all details an almost exact reproduction of the controlling telephone current.

While a specific method of adapting the magnetic amplifier to an alternator as described above has been worked out both theoretically and experimentally in greater detail, there are obviously a variety of possibilities of adapting the same devices and theories to other conditions. Outside of telephony, the magnetic amplifier will probably be found of value as a non-arcing key for telegraphy, and particularly will make possible high speed telegraphy at the same rate and with the same means as high speed automatic telegraphy on land lines. Oscillograph records have been taken of telegraphic control transmitting from 500 to 1,500 words per minute.

The structure and the mode of operation of the magnetic amplifier which has been described in such that there appears to be no limit to the power that might be controlled in this way if the apparatus is designed with suitable dimensions. The 72 kilowatt control which has been demonstrated may be sufficient for most purposes, but there would be nothing surprising if several times this amount of energy were to be used in trans-Atlantic radio telephony or high speed telegraphy in order to make the service thoroughly reliable.

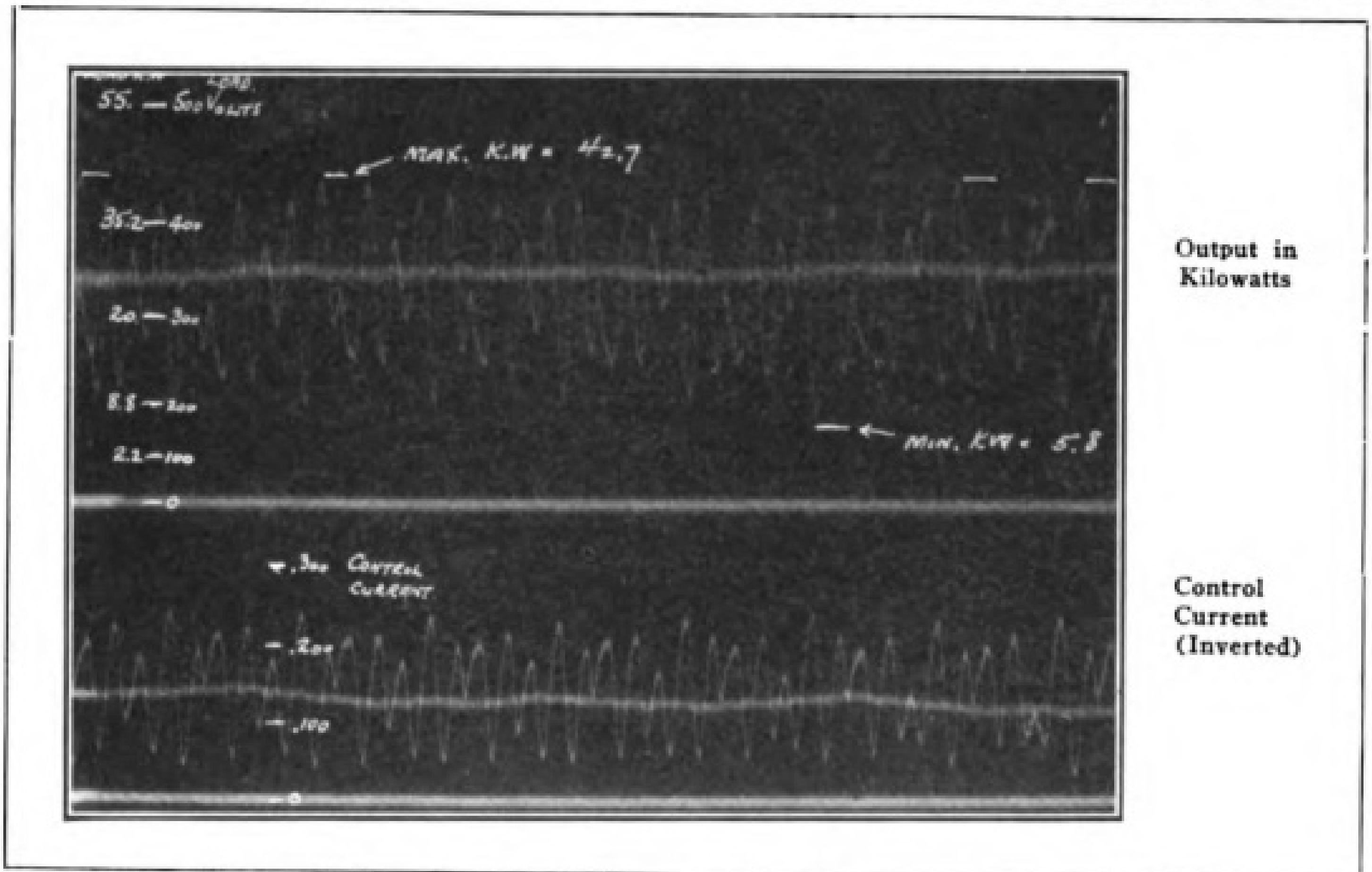


Fig. 17—Oscillograms showing telephone control

Sending Aid to Shackleton Expedition

A wireless despatch recently received from the Shackleton Antarctic expedition's auxiliary ship Aurora, reported the vessel as 250 miles southwest of Port Chalmers, New Zealand. The despatch said:

"We are setting toward Snares Islands under the influence of wind and sea. We are unable to manœuvre the ship owing to damage to the jury rudder."

A further wireless message from the Aurora received later said:

"We are now sailing at the rate of three knots. All well."

The authorities sent a tug to the assistance of the Aurora.

Emergency Lighting System

An emergency lighting system for steamships has been announced by the United States Bureau of Navigation. The invention is the work of R. Y. Cadmus, radio inspector at Baltimore. It is designed to furnish light in case of accident while the passengers are being removed. Power is furnished by the plant for the auxiliary wireless system. On a sinking ship the general lighting plant is submerged soon after the vessel begins to go down, but by means of Mr. Cadmus's invention the upper decks will still be illuminated long after the engine room is under water.

The Flatbush Signal Corps

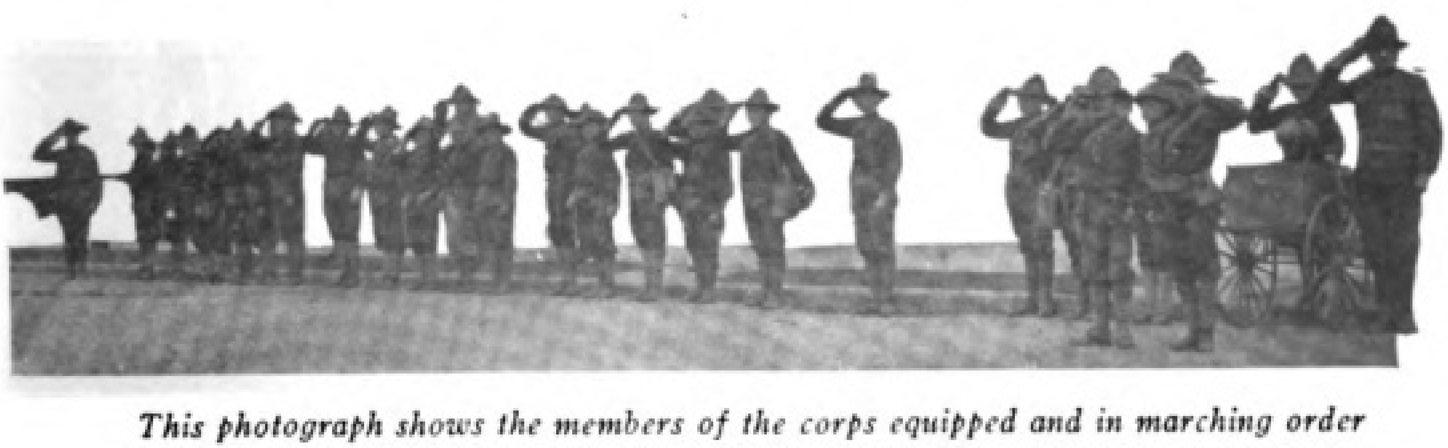
Some Details of the Military Organization Created Largely Through the Efforts of One Man and a Few Suggestions for Establishing Similar Corps for the Third Line of Defense

The Signal Corps operating portable field apparatus

OF special interest to readers of this magazine, because of its affiliation with the National Amateur Wireless Association, is the Flatbush Signal Corps, which is making an enviable record and securing recognition which extends far beyond the immediate vicinity of its headquarters. This organization, attached to St. Stephen's Church in the Flatbush section of New York, is commanded by Captain George H. Smith, formerly in the U. S. Navy, also the First Battalion Signal Corps, N. G., N. Y., and a member of the Military Committee of the National Amateur Wireless Association. At present there are sixty-five members, all uniformed and fully equipped.

Clubs and individual members of the Association who are planning or already organizing signal corps units for the nation's third line of defense will find that in many respects, the regulations which govern the Flatbush company are of value in suggesting efficiency of organization. The corps has five commissioned officers; aside from Captain Smith, already mentioned, these are: Lieutenants Griswold and Mattes, ex-captains of the American Boy Scouts; Lieutenant Lenart, corporal, 23rd Regiment, N. G., N. Y., and Rev. L. D. Gable, chaplain, with rank as first lieutenant.

The recent rapid enrollment of new members has made necessary dividing the corps into three platoons for drill purposes, but the early work of the year was conducted with two-platoon



This photograph shows the members of the corps equipped and in marching order

The reel cart pictured here carries a quarter-mile of double twisted buzzer wire

formation, under command of Lieutenants Griswold and Lenart. The company holds weekly drills, on Friday nights, and at the beginning of the season devoted the first three sessions to company drill by squad and full assembly. Commencing with the fourth week, the captain and the lieutenants each took command of a section of twelve members and simultaneously gave instruction in two classes of visual and electrical signaling. That is, on the same evening, the first section received instruction in semaphore, the second in wireless, the third in wig-wag, the fourth with the buzzer. The following week the assignment of subjects was altered to give each section instruction in another branch of the work, and so on through thirty-six drill nights; in this way all of the members are taught every branch of the signal service. The manual of the pistol and flag, field telephony, night signaling by semaphore and flashlight, drill with the searchlight, first aid, and whistle and bugle signals, are some of the other subjects in which every member is required to perfect himself.

The varied system of instruction not only makes for individual and company efficiency in this case, but insures an unusually high percentage of attendance. The records show that the absentees have never run over three out of the entire company, and then only when some special condition at home prevented a member's attendance. The rules and regulations provide for fines up to fifty cents for delinquency. Those who absent themselves for more than two weeks are summoned to appear before a court-martial, and if they do not appear, are dropped from the corps.

Securing members has been the least of the problem. The corps was started with twenty-two on the roster, and every Friday night since, Captain Smith has found it difficult to take care of the new applicants for enrollment. The officers whom he has appointed are experienced

In this photograph the members of the corps are shown in the wig-wag drill cadet and militia instructors, and all promotions are made by strict competitive examinations embracing all the subjects in which instruction has been given. Members pay dues of five cents each week and supply their own uniforms, costing $2.50 complete. The technical equipment used by the company is valued at about $250 and has been acquired through donation or paid for out of dues.

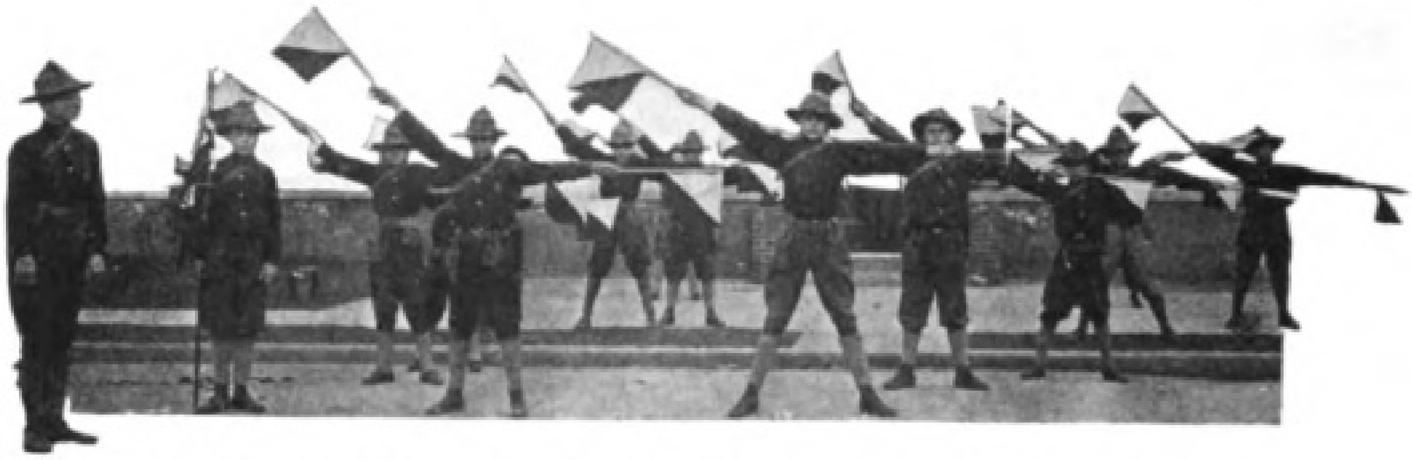
Everything essential to practical instruction has been acquired under this system. The corps has wig-wag and semaphore flags for each member, a searchlight and lamp semaphore for visual night signaling; a set wire-wound tuning coil, galena detector and 500-ohm phones. It is at once obvious that the range of this apparatus is limited, yet sufficient for practice and drills. The mast equipment is excellent. Six 4-foot sections with guys and connecting straps attached are easily carried over the shoulders of two of the members, allowing two 12-foot masts and 200 feet of antenna wire to be easily transported and quickly erected anywhere. Twenty dry battery cells and a battery ammeter complete the technical equipment.

Every member of the corps is required to become thoroughly familiar with sig-

The portable wireless set used in the exercise of tactics

of national colors and a guidon, as well as full camp equipment, comprising cooking utensils, tins and knives and forks. The technical apparatus includes a reel cart with a quarter-mile of double-twisted buzzer wire, a pike and ground spikes for laying the wire, tools such as hammer, pliers and hatchet, two field buzzers, boxed, with batteries, keys and straps attached, and two field telephones. The wireless transmitting and receiving apparatus used at present is described as merely a short-range practice set, purchased out of existing funds and to be replaced later by field apparatus with a ten-mile range. The transmitting set is contained in a box carried by shoulder strap and comprises ½-inch coil, zinc spark gap, single circuit telegraph key and sending condenser. The receiving set, also made in portable form, has a bare naling of all classes, as well as to learn the ceremonies drill and field maneuvering. A company review is planned before the close of the indoor drill season and the company will have a place in the New York Memorial Day Parade. Outdoor work already scheduled includes a visit to a nearby fort and a summer camp over the holidays.

Serving as a pattern for newly created signal corps companies, the Flatbush organization illustrates what may be accomplished in a short time with proper supervision by experienced instructors. The members are absorbed in their work of preparation for possible emergency and friendly rivalry in the branches of military efficiency and take part in the close contests in the basketball series played between teams organized in the various units of the corps. National



A semaphore drill. The corps has lamps for visual night signalling

Guardsmen are taking special interest in the corps and several officers high in the State service have inspected the organization and given it unqualified approval and support.

Captain Smith, who is on the Military Committee of the National Amateur Wireless Association, and is assisting in the preparation of the plans for nation-wide organization which are being carefully worked out at headquarters, has expressed his willingness to give further details to those who are interested in joining the corps with a view toward building up to a full battalion.

THE WIRLESS AND THE CABLE

The volume of traffic dealt with by cable companies, says "The Year-Book of Wireless Telegraphy and Telephony," depends not merely on atmospheric and other conditions, but also upon the traffice capacity of each cable. Only a certain number of words can be transmitted per minute and it often happens when lower rates or other reasons conduce to heavy increases in the volume of business, the existing cables become "blocked" thereby. If the increase in the volume of business is maintained, there is no other solution but laying additional cable, a matter of great expense and delay. With wireless operation, on the other hand, improvements in apparatus and increase in power permit of dealing with increased business, over and above its existing capacity, at comparatively little increase in expense, and with far less delay in point of time. The old objection with regard to continuity of service has practically disappeared before the improvements made in recent years.

We sometimes hear of objections raised to wireless transmission on account of the fact that messages sent can, without much difficulty be picked up by any receiving stations capable of being tuned for the purpose within the radius of transmission. Cable advocates point with pride to their own potentialities of secrecy. Careful analysis of the situation hardly justifies this claim of superiority. It is obvious that, in by far the greater number of instances, messages picked up by persons whom they do not concern will receive little consideration. Anyone who, for commercial or other reasons, is directly interested in acquiring knowledge of the messages sent would be equally likely to be able to gain such knowledge even if the messages were dispatched by cable, although at a little further expenditure of trouble. But, if the motive of self-interest were at work, the extra trouble would be a matter of little moment. The cable companies have to work in connection with land-lines and these latter are almost as easily tapped as wireless transmissions. The only reliable method of attaining secrecy is by the use of codes and these may be as effectively employed in wireless as in wire transmission.

With the Amateurs

THE troubles of a Texas amateur operator in these days of punitive expeditions are well illustrated by the following letter received by David Harrell, secretary of the Austin Radio Club:

Headquarters Southern Department,
Fort Sam Houston, Texas.

DEAR SIR:

Information has reached the Commanding General, Southern Department, to the effect that you are equipped with receiving and sending instruments for wireless telegraphy, and he directs me to communicate with you and to request that you make use of the enclosed penalty envelope, which requires no stamp, to inform this office in the event this information is correct that you have immediately dismantled this apparatus, and that you agree to make no further use of it until such time as you may be informed by these headquarters that its use by you will no longer be considered in violation of Federal law.

It is also requested that you furnish these headquarters with a list of names and addresses of any other amateur operators in your vicinity whom you know, in order that similar instructions may be furnished to them.

The Department Commander further directs me to inform you that unless prompt action as requested results from this communication, the matter will be placed in the hands of the United States Secret Service authorities and steps taken by the United States District Court to enforce what is herein requested.

Respectfully,
MAX BUNDY,
Colonel, Adjutant General, Department Adjutant.

The Colorado Wireless Association of Denver has, since its organization last October, established some enviable receiving records, including NAU (Porto Rico), NAW (Cuba), KIE and KHX (Hawaii), NPR, NPV and NPS in Alaska, NAX, NPJ and NBA at Panama and OUI and POZ in Germany. The station is equipped with a vacuum valve detector, two 1 k.w. rotary quenched gap sets, a two-step amplifier and tuning inductance for receiving waves from 200 meters to 20,000. The aerial is 400 feet long, 150 feet high, composed of six strands of No. 12 aluminum wire on twenty-foot spreaders. The association station (KIX) has a limited commercial license to work with Victor, Colorado (KIW), and also transmits time signals every night at ten o'clock, mountain time.

Signals are received from NAA, NAR and NPH. The signals from NPH vary greatly from the Arlington signals, sometimes being as much as four seconds slow, while the signals from Key West hardly ever lag more than three-tenths of a second behind Arlington. Several times members have heard both the signal and compensating wave of Arlington's Poulsen transmitter when using a very sensitive galena detector.

The association conforms in many details with the suggestions given in the book "How to Conduct a Radio Club."

The Essex County Wireless Association of Beverley, Mass., is developing into a thriving club and already has half a hundred members. One of the interesting departments the club has formed is a question and answer department by means of a card index system. This index will hold information sufficient to answer any one of a thousand questions, indexed in such a manner that if any member asks a question the desired information can be found in almost a second's time.

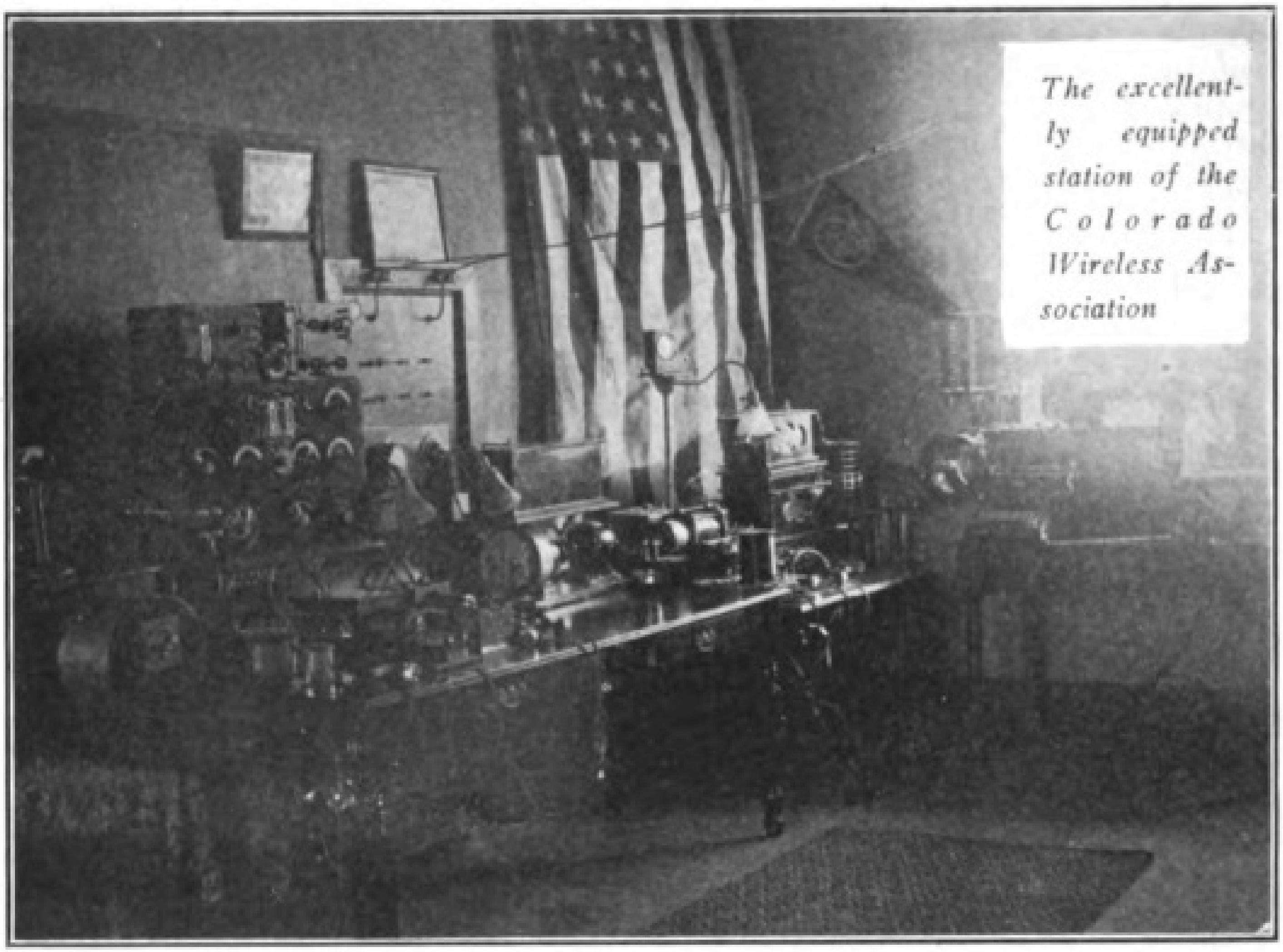
Membership in the association is open to anyone interested in wireless or electricity. An honorary member, says its constitution, shall be a person of recognized ability or one who has rendered service to the radio field and to the club.

An interesting section of the constitution is as follows:

"Any member found guilty of violating the radio laws which the United States has made or is a party to such violation shall be expelled from membership."

work was done on the evening of December 31, when a New Year's message was relayed from St. Louis to St. Paul, where it was delivered to the new governor of Minnesota. The Washington's Birthday message started from one of the association's star stations, 9XE.

Another important feature is the attempt to control interference. This attempt will be made through proper organization. The officers have an ex-



The excellently equipped station of the Colorado Wireless Association

The Mississippi Valley Wireless Association, of Dubuque, Ia., which was recently organized, has for its officers: President, A. S. Blatterman, St. Louis, Mo.; vice-president, D. C. O'Neil, St. Louis, Mo.; secretary, J. D. Brennan, Dubuque, Ia.; treasurer, E. C. Fawkes. The association has a board of six directors.

The primary object of this organization is to establish a reliable intercommunicating club or a chain among the members. Relaying is to be an important feature. The first of this

cellent plan which they think will work.

An interesting bulletin is sent out semi-monthly for the benefit of the members.

This organization consists of the states in the Mississippi Valley and all of the wireless operators in these states are invited to join. The annual dues are fifty cents, which go to cover the cost of the bulletin, postage, applications, etc. Application blanks may be had by sending to the secretary, J. D. Brennan, No. 501 Alpine street, Dubuque, Ia. As a list of stations are to be published soon it is desired that all interested send for the blanks at once. The list of stations will be sent to the members free of charge.

The San Francisco Radio Club has been organized with fifteen charter members. The officers are as follows: President, A. W. Martin; vice-president, F. G. Taylor; secretary and treasurer, William Griffith; corresponding secretary, Thomas J. Ryan; sergeant-at-arms, C. P. Altland; radio police officer, Edward M. Sargent. Anyone wishing information concerning the club should address the corresponding secretary, Thomas Ryan, No. 82 Downey street, San Francisco, Cal.

The amateurs of Portland, Maine, have formed the Portland Radio Association. Their first meeting was held on January 4, and on March 7 they moved into their new club room at No. 487 Congress street. Here a 150-foot antenna has been erected, and a complete receiving set installed. The clubroom is finished in green burlap and mission. A large mission table and chairs make the room very attractive. There are thirty-one paid-up members in the association, and a number of applications are on file.

The officers of the association are: President, H. W. Castner; vice-president, W. H. Richeleau; secretary, C. T. Beardsley; treasurer, E. S. Rogers.

Various committees for managing the various branches of the club have been appointed and blackboards for descriptive lectures, practice sets, test apparatus, etc., have been installed. A committee for booking up a course of lectures for each meeting is making good headway, and promises some very interesting talks, beginning in a few weeks.

The club takes pleasure in extending an invitation to all radio men to visit the club rooms when in Portland.

At the January meeting of the Amateur Marconi Radio Association of Troy, N. Y., the semi-annual election of officers was held. W. W. King, W. A. LeMay, and E. M. Williams were re-elected president, vice-president and secretary, respectively, and C. E. Everingham was elected treasurer. The first anniversary meeting of the association was held in February. The principal speaker was R. B. Bourne, a former commercial operator.

At the meeting in February a system of giving practice in receiving, similar to that described in "How to Conduct a Radio Club" was put into operation. There was also a large display of the many different types of wireless instruments for amateur use. The membership has increased to about twenty. Meetings are held every other Saturday evening at the Y. M. C. A.

The association will be glad to hear from other wireless societies, and amateurs throughout the country, especially those in the West and South. Address all communications to the secretary at 1627 Seventh avenue, Troy, N. Y.

The Connecticut Valley Radio Club of Springfield, Mass., has been granted permission to use two rooms in the Technical High School of that city and is now planning to obtain a set. At present a temporary set furnished by the forty-seven members of the club is being used.

Meetings are held every other Friday. Persons living near Springfield who are interested in wireless are invited to join the club. Further information can be obtained by addressing George Beecher, secretary, at No. 416 Allen street, Springfield, Mass.

A group of amateurs of Buffalo, N. Y., have organized the Amateur Radio Association of Buffalo. The president, A. J. Carver, is one of the pioneer wireless men of the city. The other officers are: Vice-president, Norman Badina; treasurer, Francis Adams; recording secretary, H. E. Wilkinson; corresponding secretary, Newton J. Frank; sergeant-at-arms, Otis Boowen. Correspondence should be addressed to the secretary at No. 411 Humbolt Parkway, Buffalo, N. Y.

The Harvard Wireless Club is a reorganization of a club of the same name which existed at the University several years ago, but which has been inactive for some time. It was reorganized in the early winter of 1915, and now has a good membership and a first-class wireless station.

This station is in the club room in the basement of the Harvard Union, where the business of the club is conducted. It is the custom to have some one prominent in the radio field address club meetings. There are ample facilities for amateurs to learn the code.

The transmitting instruments comprise a ½ k.w. transformer, four condensers, two oscillation transformers, and two short wave condensers. The receiving equipment is composed of a vacuum valve transformer panel set loaned by one of the members of the club, and a long wave receiving transformer.

Both Berlin and Hanover are received regularly, and other stations in America, from Canada to Panama, are copied. The club carries on regular communication with ICM (Laconia, N. H.), and has been heard by 3NB (Vineland, N. J.), and by 8ZW (Wheeling, W. Va.). The last-named station is over 500 miles away, giving the club a record of over one mile per watt.

The club is planning to hold a large open meeting, which will probably be addressed by an army officer.

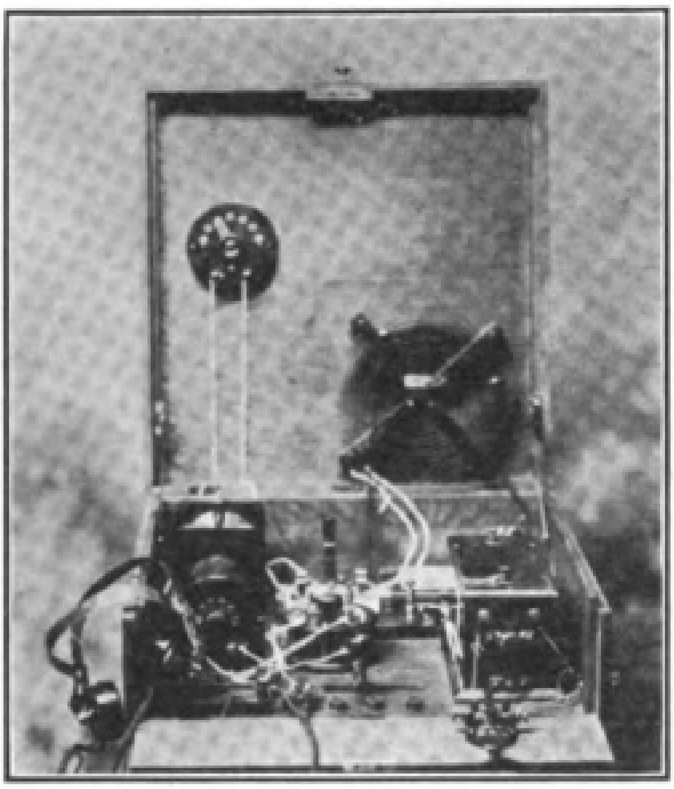
The officers of the club are: Permanent president, Professor George W. Pierce; manager, E. B. Dallin; secretary, E. F. Henderson. The secretary will be glad to receive letters from presidents of other radio clubs or others interested.

Listening to Panama in Cambridge, Mass. The operating set at the Harvard Wireless Club

An accompanying illustration shows a very compact portable wireless outfit mounted in a specially designed, quarter-sawed oak case, made by Darrel J. Cyr, of Sioux City, Ia.

From left to right the outfit consists of: A loose coupler with a fixed condenser placed beside it; a twenty-three-plate variable condenser, a three-cup detector (the bracket being on a rod so as to slide to the different minerals, which are galena, silicon and molybdenite), a fixed spark-gap; a 2-inch spark coil and a moulded sending condenser back of it. The key is on the hinged front, which drops on pegs so that it is level. The helix is fastened on the cover.

The aerial switch is seen in the rear center. A 3,000-ohm head set is shown in the picture. The 5,000-meter loading coil has recently been placed in the case. The aerial consists of six wires, spaced 18 inches apart, in the shape of a V. When it is hung on 18-foot poles on top of a house 35 feet high, NAA, WSL and other stations can be heard.



Darrel J. Cyr's portable apparatus

Mr. Cyr is a member of the Central Radio Association and the National Amateur Wireless Association. His call letters are 9TO.

The regular meeting of the Cedar Wireless Association of Cedar Rapids, Iowa, was held on March 30 at the Y. M. C. A. Committees on social and executive affairs were appointed. After the business meeting a treatise relating to wireless transmission and interference was read.

A class of instruction has been formed by the Inter-City Radio Association of Allentown, Pa. Persons desiring information in reference to the association should communicate with D. H. Goodling, No. 330 North Madison street, Allentown, Pa.

Wireless messages from the United States punitive expedition's field station in Mexico have been heard by the licensed amateur operators of Austin, Texas. While none of the messages can be given out, David Harrell, Jr., a licensed amateur operator, said that he could catch the messages as they were flashed across the border.

J. A. McKay, Salt Lake Route operator at Milford, Utah; J. G. McCullom, No. 942 Harvard avenue, and J. L. Lundberg, No. 70 P street, of Salt Lake, were among the hundreds who received the news of the Willard-Moran fight by wireless telegraphy.

The news was flashed through the air by S. H. Besley, No. 171 East Seventh South, who had his instruments located in the rooms of the Salt Lake Transportation Club in the Keith building.

Within a few seconds after the result of the fight was announced, Mr. Besley was sending the news to those with whom he was in communication. A few minutes later he told them the story of the fight by rounds.

The New London (Conn.) Radio Club has been organized with the following officers: President, Wesley Bradshaw; vice-president, Acors B. Boss; secretary and treasurer, Paul Tilden. At present the club has eighteen members, of whom twelve either hold or have applied for amateur licenses. The club's headquarters are in the New London Y. M. C. A.

The Sacramento Radio Club, of Sacramento, Cal., was organized recently with a charter membership of eleven. Meetings are held every second Wednesday of each month. These meetings are held at the homes of the club members, but it is hoped to obtain a room at the local Y. M. C. A.

The club is taking the initiative in forming a relay league with amateurs throughout the Sacramento Valley. This league will be instrumental in relaying flood and weather reports to the state reclamation headquarters. The officers of the club are: President, Carl Schoefer; vice-president H. Stevens; secretary, Rad Coover, and treasurer, Carleton Flint. Anyone desiring particulars about the club can obtain them by writing the secretary at 1613 Nineteenth street, Sacramento.

The Hoosier Radio Club of Indianapolis, Ind., has been reorganized and the following officers elected: President, R. C. Kennan; vice-president, N. Hilgenberg; secretary, N. Watson; treasurer, B. K. Elliott.

All Indiana amateurs are requested to send their names and addresses to N. Watson, No. 204 N. Hamilton avenue, Indianapolis, Ind. The Hoosier Radio Relay Chain is to be formed throughout the state and all amateurs, regardless of equipment, are needed.

Attention is also called to the fact that any amateur having difficulty in the operation of his apparatus can secure the advice of the best radio men in the state by addressing the secretary and enclosing return postage.

The St. Louis (Mo.) Radio Club has taken up quarters at the Y. M. C. A. building. The following officers have been elected: President, H. Blatterman; vice-president, W. Boelsing; secretary, F. Best; treasurer, W. Russell; station inspector, L. Benson. Correspondence with individuals and other clubs is invited. Correspondence should be addressed to Fred Best, No. 4104 Easton avenue, St. Louis.

At a meeting held on March 10, the Oklahoma Radio Experimental Association of Oklahoma City, elected the following officers: President, Kenneth Ehret; vice-president, Harry Cole; secretary-treasurer, Clifford A. Smith; business manager, Keith Danvers. The association has twenty-five members, and expects to double the membership within the next six months. Meetings are held every two weeks and copies of the papers read are sent to the branch clubs in other parts of the state of Oklahoma. All amateurs in Oklahoma are invited to join the association. Correspondence should be addressed to the secretary at No. 922½ W. Main street, Oklahoma City.

The Hawkeye Radio Association was organized over one year ago by amateurs in Ames, Iowa. Since that time it has worked to promote the interests of wireless in Iowa. Every person who owns or operates a station and can work at the rate of five words per minute may become a member.

At present organized relay work is being planned. The association has gained recognition from all of the national relay organizations. To aid this work a directory is being made of all Iowa amateurs.

Under the leadership of Professor A. N. Goldsmith, the editor of the "I. R. E.," a radio club composed of about forty students of the College of the City of New York has been organized. At a meeting held February 24, a constitution was adopted and an election of officers held.

The following were elected: President, Joseph D. Fried; vice-president, Edward T. Dickey; secretary, Herbert Kayser; treasurer, Moses Buchbinder.

Professor Goldsmith has allowed the members of the club the use of the wireless laboratory of the college, which contains the most modern types of apparatus.

Practice sets have been constructed and under the instruction of Professor Goldsmith it is expected that the members will greatly improve their knowledge of radio communication.

Letters should be addressed to the secretary, Herbert Kayser, 41 Convent avenue, New York.

The Y. M. C. A. Radio Club has been organized at the East Side Branch Y. M. C. A., East 86th street, New York. The first meeting of the club was held on December 11, 1915. William Bohn, director of the Y. M. C. A. telegraph school, addressed the amateurs and commercial men present, and offered suggestions as to how the club should be organized. The officers elected that evening were: Representative of the Y. M. C. A., William Bohn; president and chief operator, S. A. Barone; secretary, J. D. Blasi; treasurer, Frank Hayes.

The club was organized for the purpose of bringing the amateurs into closer contact with each other; to conduct research work; discuss difficulties encountered by members and establish a wireless relay league systems between all Y. M. C. A.

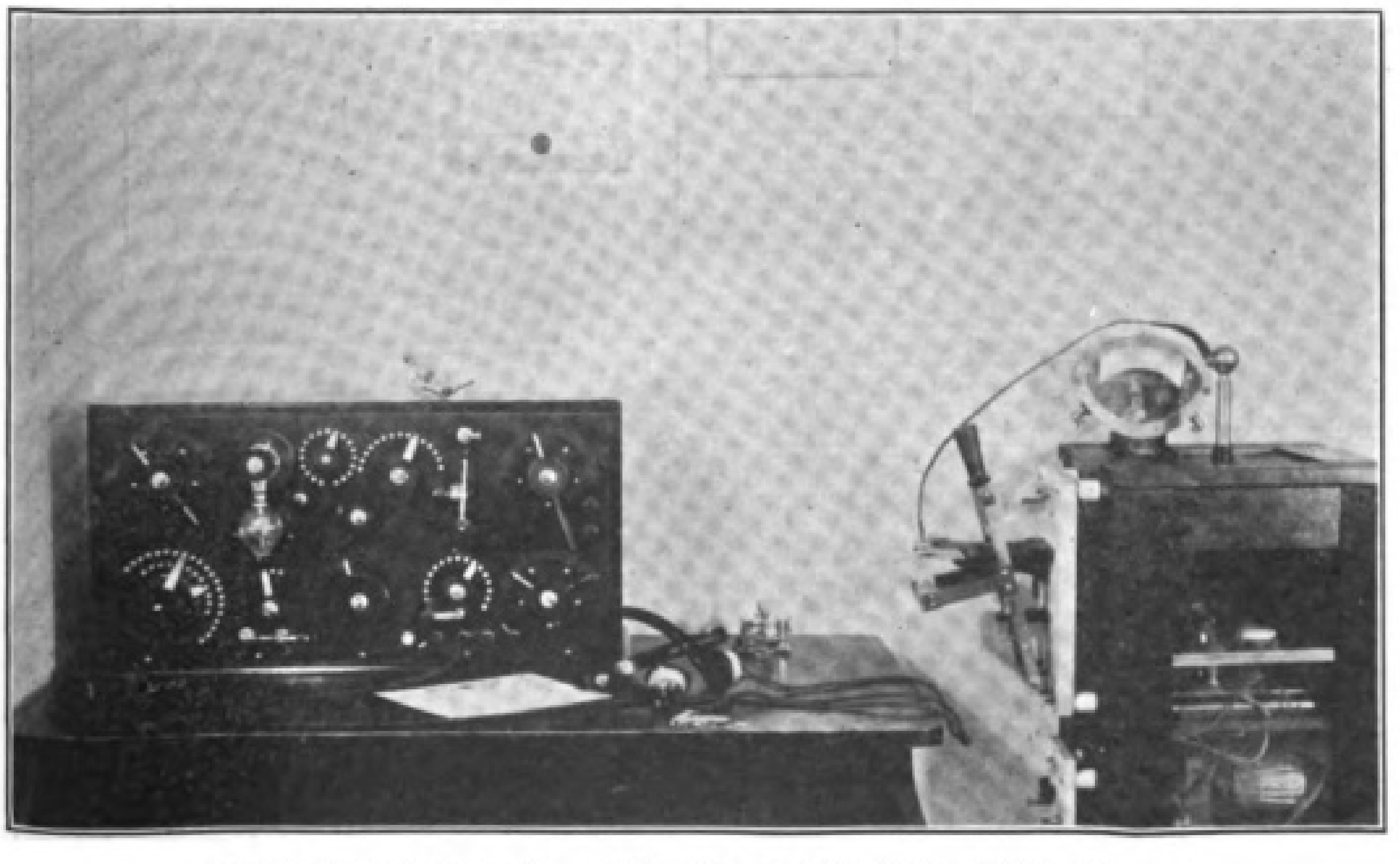
For this purpose the installation of a high-power transmitting set is under way at the present time. This will be loaned to the club by the Y. M. C. A. Telegraph School, and will have its own motor-generator. It is a complete 1 k.w. transmitting equipment with a non-synchronous rotary gap.

The club also has under construction an efficient receiving set, which includes the latest vacuum valve devices. In addition, it is considering the installation of a receiving set of high wave-length for the reception of undamped oscillations. Distances of more than 5,000 miles have been received.

The station referred to will maintain a constant watch every night between half-past seven and half-past nine o'clock. It will have three competent operators on duty at each watch. Messages for persons in the Y. M. C. A. will be transmitted, but their delivery will not be assured unless directed to another Y. M. C. A. of the league. The club will help equip other Y. M. C. A.'s wishing to join the league.

All interested should communicate with William Bohn, East Side Branch Y. M. C. A., New York City.

From D. R. Simmons, of Shreveport, Louisiana, THE WIRELESS AGE received a photograph of his well equipped wireless station, published on this page. Mr. Simmons writes that he can hear amateurs within a radius of 1,000 miles. With the exception of the vacuum valve detector, the entire set was made by the owner, whose call letters are 5AX.



A wireless station of considerable merit built by D. R. Simmons

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

The Constructional Details of a Non-Synchronous Rotary Spark Gap

The details given in the accompanying figures cover the construction of a rotary spark gap of a non-synchronous type, which may be driven by an A. C. or D. C. motor. This gap is patterned somewhat after that type employed by the Marconi Company and will give a clear and pleasing musical note if adjusted to the proper speed. It is to be especially noted that the rotor consists of a piece of hard rubber, mounted on the shaft of the motor, which supports two brass spark electrodes. These electrodes are connected together by a thin piece of brass strip.

The stationary electrodes are supported on the bakelite ring, as indicated in Fig. 5. The circumference of this ring is divided into ten equal parts, as shown, where a hole is drilled and tapped for an 8/32 machine screw, as shown in Fig. 1. For the stationary electrodes of the spark gap, ten 8/32 machine screws, threaded their entire length are required. It is also clear from the drawing that each of the machine screws is locked in position on the bakelite ring by means of two nuts, one on the inside and one on the outside. When the electrodes are properly placed in position, projecting to equal distances around the entire ring, each set of five should be connected together by means of a piece of copper wire or preferably by a thin piece of brass or copper strip.

The details of the rotor are given in Figs. 2 and 3. The arm is made of hard rubber, which must be made perfectly true or execssive vibration will be set up. The drawing gives precise measurements for the details and shows exactly where the holes should be drilled and tapped.

A spark point for the rotor is indi-

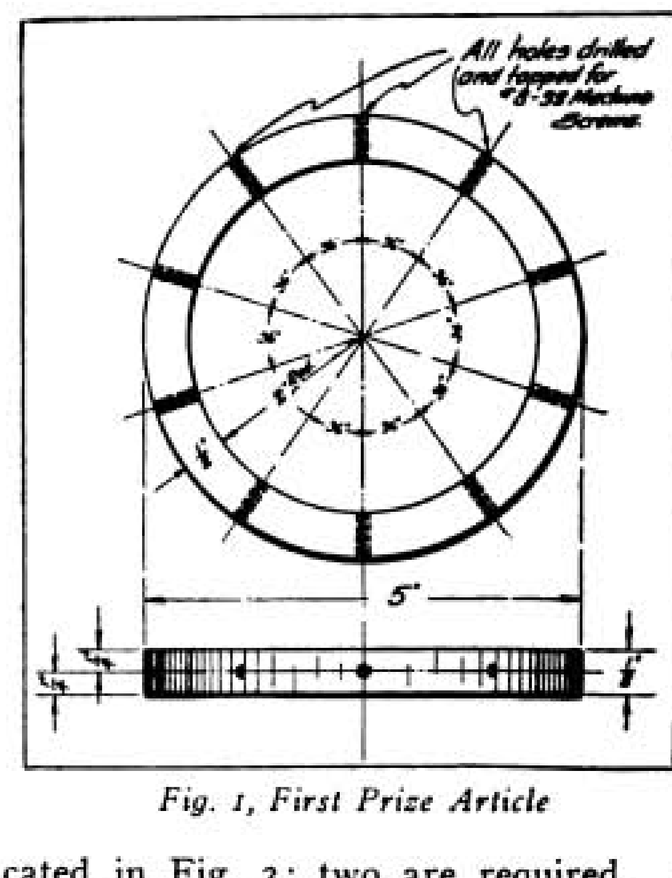


Fig. 1, First Prize Article

cated in Fig. 3; two are required. A ¾-inch piece of 3/16-inch round brass rod is obtained and threaded to within ¼ of an inch of the end. The end that is not threaded should have the edges rounded to prevent brush discharge.

A thin brass strip connects the two spark electrodes on the rotor. The ends are bent ⅜ of an inch from the end to form an angle to bend around the rotor on the opposite side to which the set screw is placed. Then the spark points are screwed into the ends of the rotor (item 2), as shown in

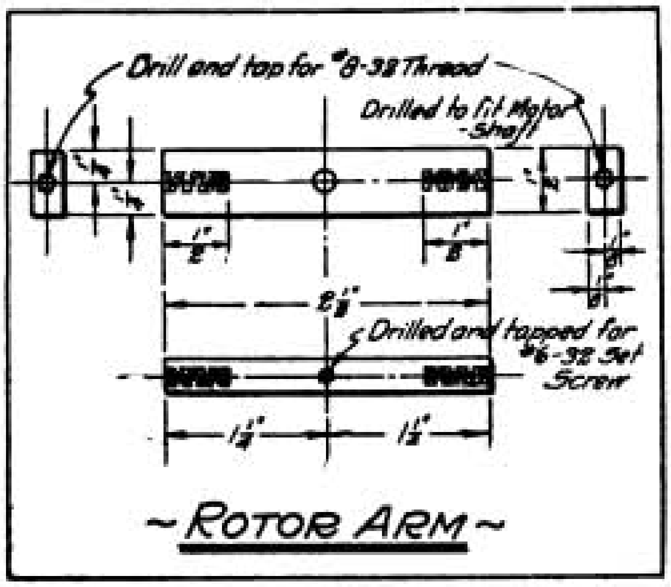


Fig. 2, First Prize Article

Fig 5, after which it is mounted on the rotor shaft.

The brass posts which hold the bakelite ring are indicated in Fig. 4 and need no comprehensive description as the drawing is clear and the actual length of the posts must be left to the decision of the builder, as it will vary with various types of driving motors. Fig. 5 gives a clear idea of the assembly of one-half of the rotary gap. The con-

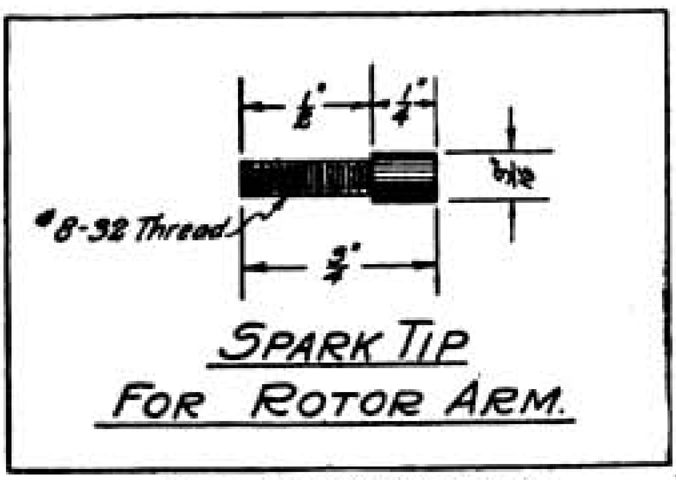


Fig. 3, First Prize Article

struction of the base and other small details must be left to the maker.

With a gap of this type it is essential that the driving motor be well insulated from the gap proper and that the power leads from the main line to the motor be placed at right angles to the high frequency circuits of the radio transmitter to prevent burnouts. It is still better to connect protective devices to the circuits of the motor or to mount the motor inside of a metal box, which is positively connected to the earth. In this manner the motor is protected from the electrostatic induction of the transmitter.

A particular point in connection with this gap is that the distance between the spark points on the rotor and the stationary electrodes must be exceedingly small; in fact a gap of 1/100 of an inch

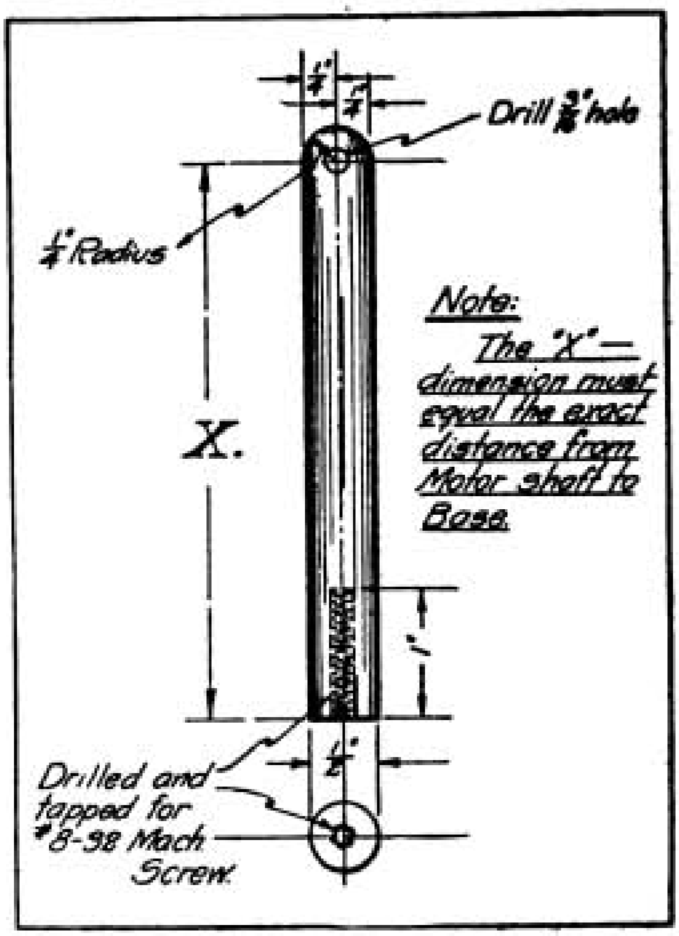


Fig. 4, First Prize Article

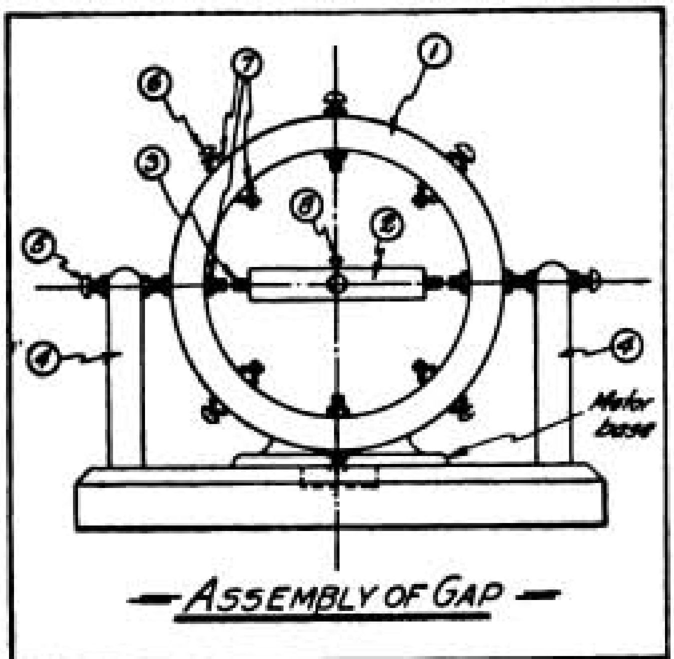
is considered sufficient. The actual quality of the note can be obtained by listening in on the head telephones of a receiving set. Careful adjustment should be made of the speed of the rotor and also of the voltage of the high potential transformer.

E. CHESTER STEPHEN, *New Jersey.*

SECOND PRIZE, FIVE DOLLARS
Directions Regarding How to Make a Self-Supporting Aerial Mast

About four years ago I erected a self-supporting aerial mast which has not required repairs or maintenance of any kind during this period and it appears to be in as good condition to-day as when first erected. My design does away with the unsightly guy wires of the usual mast and, in addition, the construction is economical.

The following materials are required: Three pieces 2 inches by 3 inches by 24 feet, straight-grained white pine free from knots; one piece 6 inches by 6 inches by 6 feet, oak; four lengths of ½-inch gas pipe, each 3 feet in length, fitted with tees on one end and flanges on the other; two bolts, ⅝ of an inch by 7 inches with washers; two bolts, ⅝ of an inch by 11 inches, with washers; six carriage bolts ¼ of an inch by 3½ inches, with washers; four strain insulators; 150 feet of No. 12 galvanized iron wire; eight screw eyes with 1-inch eye; four 6-inch turnbuckles with 9¼-inch bolts; 100 feet of pine, 3 inches by 1 inch for lattice work on the lower half of the mast.



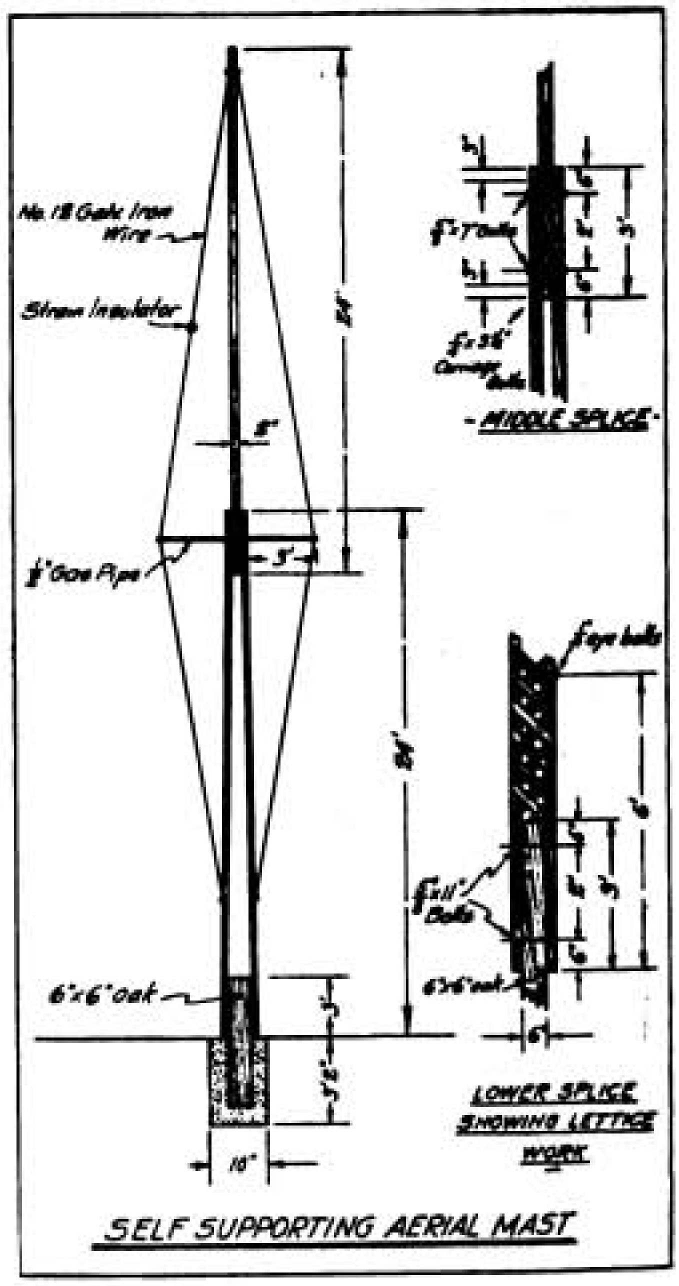
—LIST OF MATERIAL—

Item	Part	Size	Material	Amt	Fig.
1	Stationary Tip holder	(see Fig 1)	Bakelite	1	1
2	Rotor Arm	[illegible]	Brass	1	2
3	Rotor Spark tip	(See Fig 3)	Brass	2	3
4	Upright	(see Fig 4)	Brass	2	4
5	Stud & Set Screw	2" 8-32 R.H.M.S	Brass	2	5
6	Stud	1" 8-32 R.H.M.S	Brass	6	5
7	Lock Nuts	8-32 Hex	Brass	20	5
8	Set Screw	¼" 8-32 R.H.M.S	Brass	1	5

Fig. 5, First Prize Article

Lay the three long pieces on their 2-inch faces and drill a ¼-inch hole three inches from both ends. Through these insert the 3½-inch carriage bolts. This is done as a precaution against future checking and subsequent cracking. Before the bolts are put in place smear them well with white lead; next, turn the pieces over on their 3-inch faces and drill a ⅝-inch hole six inches from one end. Two feet further down drill another ⅝-inch hole. On the other two pieces drill the ⅝-inch holes at both ends and space them as just described. For the sake of cleanness, I will designate the piece having the hole at one end as A, and the other two pieces as B and B¹. Eighteen inches from the upper ends of B and B¹ fasten the pipe flanges by means of 1½-inch wood screws. Six inches from the upper end of A fasten the screw eyes, one in the center of the 3-inch faces.

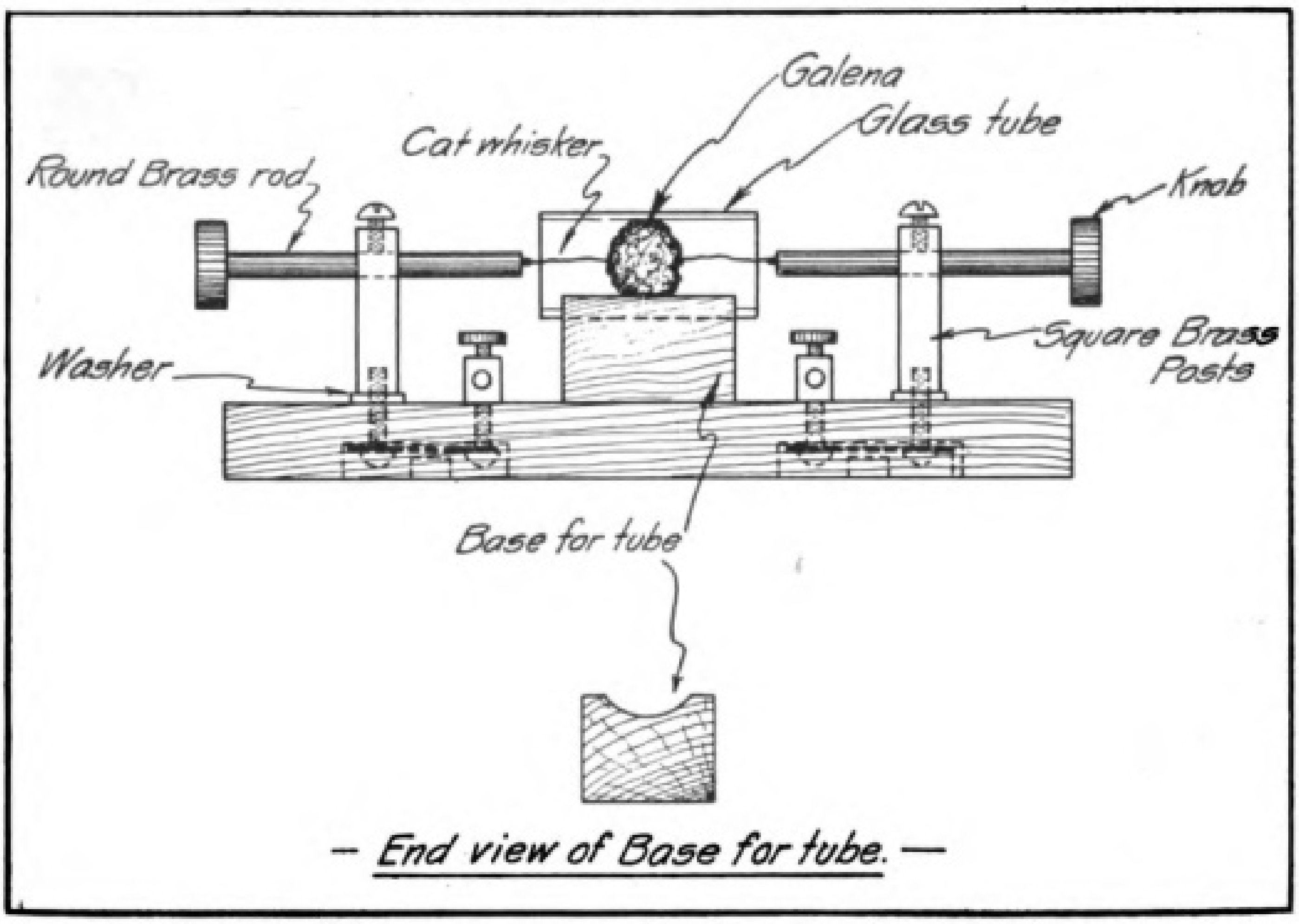
Six inches from one end of the piece



Drawing, Second Prize Article

of oak drill a ⅝-inch hole, and two feet further drill another ⅝-inch hole. Paint the three long pieces with a good priming coat; likewise the pipes and fittings. Paint the oak piece with black asphaltum varnish.

Lay the piece, A, on its two-inch face and lay the pieces, B and B¹, one on each side of A so that the holes in the



Drawing, Third Prize Article

lower end of A line up with those on the upper end of B and B¹. Pass the ⅝-inch by 7-inch bolts through the holes, using washers on both sides, but do not tighten them completely. Now, line up the holes in the lower ends of B and B¹ with those in the oak piece and pass through the ⅝-inch by 11 inch bolts, using washers on both sides. In both instances smear the bolts with white lead. Now lay the masts on two wooden saw horses or boxes whereby the assembly will be considerably facilitated. Then tighten the bolts of the middle splice. Next put on the lattice work. This is effected in the following manner: Place a piece of the 1-inch by 3-inch stock at an angle of forty-five degrees to the top edge of the oak piece and nail it fast with four 2½-inch nails driven in at an angle. Trim the ends flush with the sides of the mast. Then place another piece against the one just nailed down and again, nail down another piece. This latter piece is simply used as a spacer to get even spacing between the lattices. Next turn the mast over and nail the lattice work in the same manner, but in the opposite direction so that the front view of the mast presents a criss-crossed appearance, as shown in the drawing.

Put in place the other two flanges on the front and back of the mast at the same height as those previously mentioned and put in the four lengths of the pipe with the "tees" on their ends pointing up and down.

The wires which hold the mast vertically, acting as braces which prevent it from swaying, are next put into position. To do this, cut four pieces, twelve feet long and fasten a strain insulator on one end; the other end should be fastened to the screw eyes at the upper end of A. Fasten a wire to the other end of the strain insulator, pass it through the "tee" which has previously been bushed with a piece of rubber tubing. Fasten it to the turnbuckle which previously has been fastened to the screw eyes in the pieces placed in B and B¹. Do this with all four wires, fastening the front and back wires in the screw eyes placed in the lattices at the six-foot height. Adjust all the strain wires so that the mast will be in perfect alignment.

Dig a hole, 10 inches by 10 inches by 3 feet, 2 inches in depth, and set the oak piece in it to a depth of three feet. Fill the rest of the space with concrete. Having placed the pulley and rope in position and applied two good coats of paint to the entire structure, the mast is now

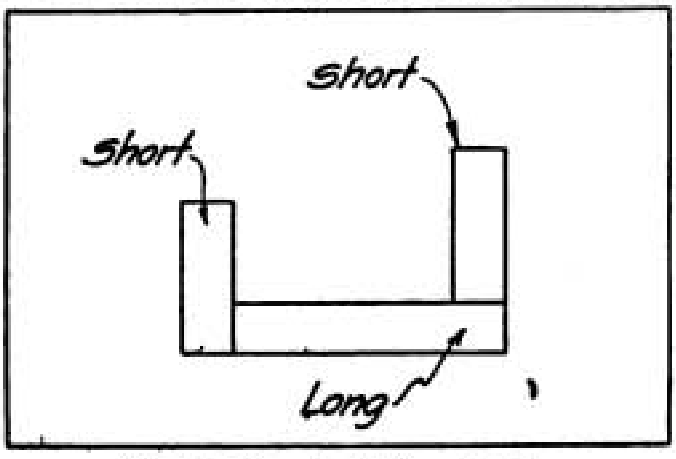


Fig. 1, Fourth Prize Article

placed in position. Fasten the lower end of the mast quite tight into the oak piece with one bolt, while the mast is resting on the ground. Three persons braced against the lattice work, with the aid of poles about 14 feet in length, can raise the mast to a vertical position. Two persons hold the mast in a fixed position, while the third changes his pole to a lower position. A fourth person now slips in the second bolt when the mast is in position.

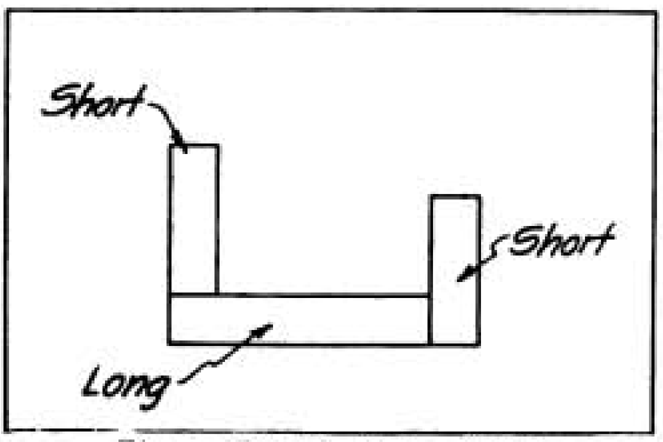


Fig. 2, Fourth Prize Article

The experimenter will find a mast of this type serviceable and strong in every respect. The one I constructed supports an aerial of three No. 12 copper wires on 5-foot spreaders with 3-inch ball insulators, the span being 70 feet in length.

Rudolf Skriwanek, *New Jersey.*

THIRD PRIZE, THREE DOLLARS

A "Catwhisker" Detector of Unique Design

Like many other experimenters, I constructed several types of detectors before I found one wholly suitable for my station. After considerable experimenting I developed the design shown in the accompanying drawing, from which it will be observed that a crystal of galena is inserted in a glass tube, which is supported by a hard rubber base. Two round brass rods are mounted on the vertical brass binding posts and are fitted each with a small "catwhisker," preferably a fine piece of steel wire, which makes contact with either side of the crystal.

There are several methods by which this detector may be adjusted for sen-

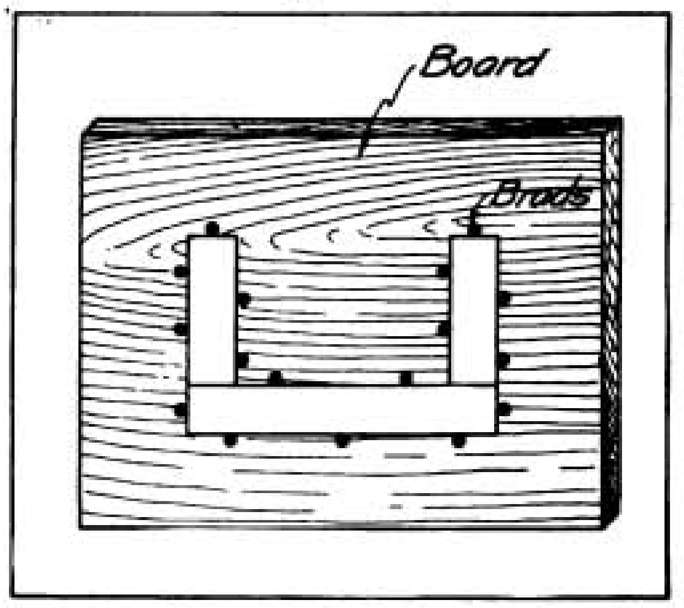


Fig. 3, Fourth Prize Article

sibility; first, the standards may be moved from side to side; second, the rods, to which the "catwhiskers" are soldered, may be moved in and out; third, the glass tube holding the mineral may be revolved.

If the mineral is too small to fit in the tube, wrap tinfoil around the edge until it just fits.

Owing to the lightness of the contact necessary with this type of crystal, I find it easier to locate a sensitive point with this type of construction than with any other design described. I trust the results obtained by others will bear out my statements.

Daniel O'Connell, *New York.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

An Efficient ½ k. w. 60 Cycle High Potential Transformer

The transformer of the type about to be described is one that has been thoroughly tried and tested and found to possess a high degree of efficiency.

The dimensions and assembly of the coil will first be given. The strips of metal are preferably made of silicon steel, although ordinary soft iron may be used with a loss in efficiency. For the complete core 230 pieces of sheet iron, 4¾ inches by 2 inches, and 230 pieces, 7¾ inches by 2 inches, are required. After the sheets have been cut to the proper size, remove all rough

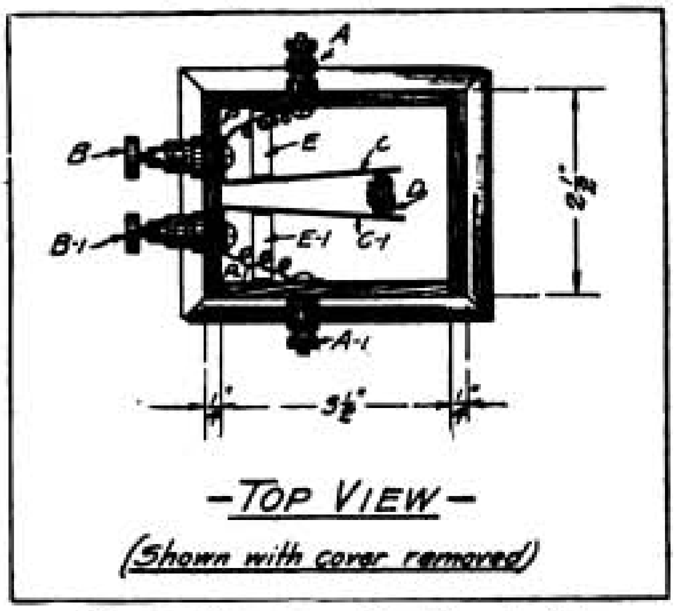


Fig. 1, Honorary Mention Article, Carl W. Crouse

edges with a file, then place the strips on a flat piece of metal and beat them out perfectly flat with a light rawhide mallet. Place the long pieces in one pile and the short pieces in another. Start the assembly by placing a long strip in position, followed by two short ones, according to Fig. 1. In the second layer, reverse the positions of both long and short strips, according to Fig. 2. The third layer is placed in position like the first, while the fourth is laid out similar to the second layer.

The assembly will be considerably facilitated if long brads are driven into a smooth board, as shown in Fig. 3; thus the strips of iron can be more readily placed in position, using the nails as guides.

After the short pieces of iron have all been used and one of the longer legs of the core is complete, bind one of the short legs tightly with two layers of friction tape. This leg is for the primary winding. The secondary leg must be insulated with two layers of 3-64-inch sheet mica, 2½ inches in width, which is secured in position by a layer of friction tape.

The secondary coil, which consists of three pounds of No. 32 enameled wire, is wound on a circular form of oiled paper, 3-16 of an inch in thickness, and of proper diameter to fit the core. Two layers of oiled paper are used between the layers of the winding and also over the last layer. The winding should extend to within ⅜ of an inch of the edge of the oiled paper. The final connections from the secondary winding are made from thin copper ribbon which is soldered to the enameled wire, making connecting leads that are not easily broken. When the secondary coil is completed, give it a coat of best quality shellac and dry thoroughly.

The primary winding is made on a form similar to the secondary with two layers of oiled paper between the layers of the winding. It consists of 350 turns of No. 14 double cotton covered wire wound in layers. When the coil is completed, bind it tightly with a layer of tape followed by a coat of shellac, after which it is allowed to dry. When both coils are thoroughly dry, put them in their respective positions on the core, after which the remaining strips of iron are placed in position one

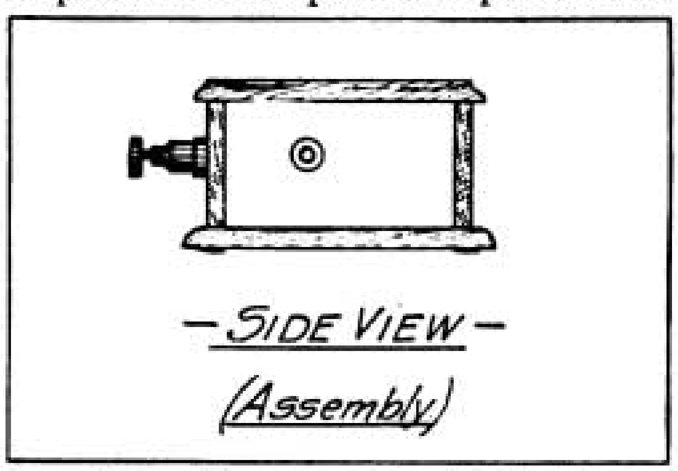
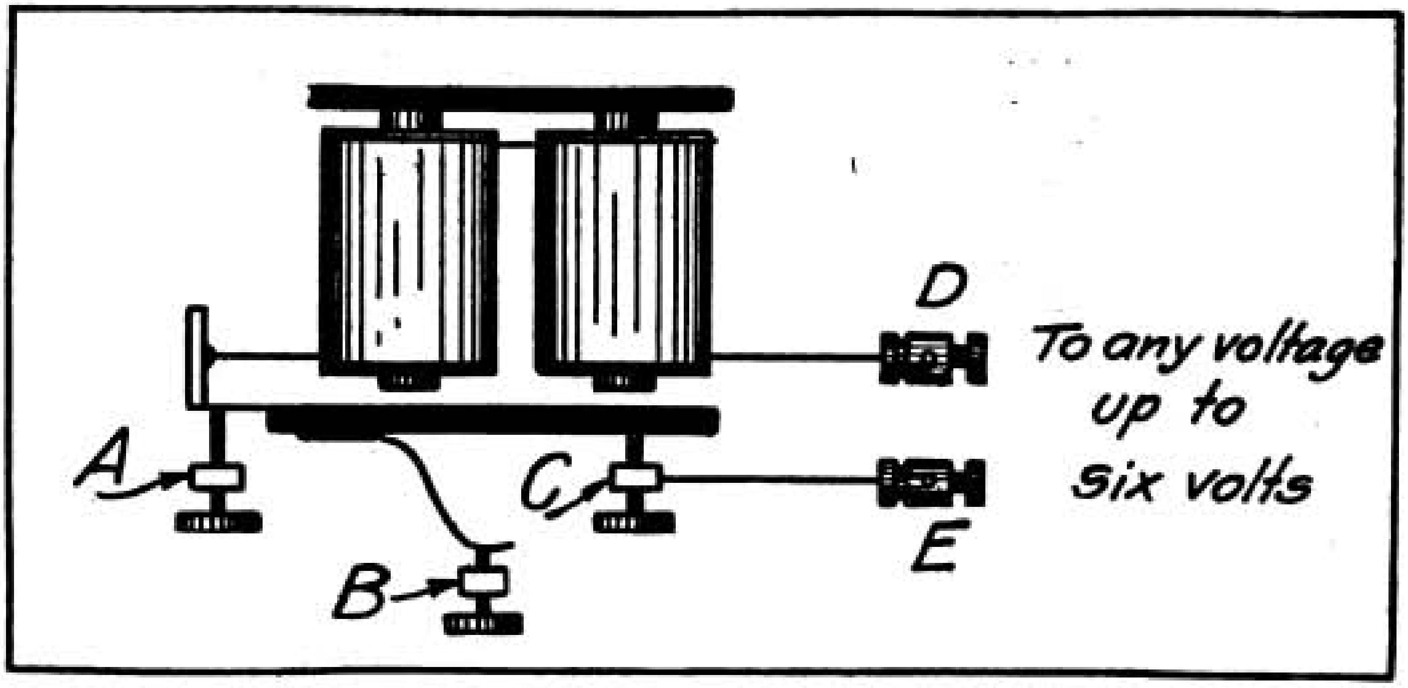


Fig. 2, Honorary Mention Article, Carl W. Crouse

by one, a mallet being used to drive them in place if necessary.

The finished transformer should be mounted in a small neat box and supported in the latter by blocks fastened underneath the core. The primary wires should be brought to binding posts on one end of the box, while the secondary leads may be brought to binding posts mounted on electrose, hard rubber or other suitable insulated bushings.



Drawing, Honorary Mention Article, John G. Speicher

When complete the transformer draws about 5 amps. on a 110-volt, 60-cycle source of current.

If constructed in accordance with the foregoing instructions, the transformer described will well repay the time and money expended upon it and should be a source of satisfaction to its maker.

PAUL J. HOFFMAN, *New York.*

HONORARY MENTION

I constructed a receiving detector along the lines indicated in the accompanying drawing which I have used at my station for an indefinite period without burning out. In fact, it has remained in adjustment continuously and has required no attention on my part.

In the drawing D is a carborundum crystal which is held between two pieces of spring brass, C. These should be about 3/8 of an inch in width and 2 1/4 inches in length. They are bent and fastened to the binding posts, B and B-1, as shown. These binding posts are for connection to the head telephones and are connected by the wires, P and P-1, to the binding posts, A and A-1, respectively. The latter are connected to the leads from the receiving tuner. The box I constructed (Fig. 2) is 3 1/2 inches in length, 2 1/2 inches in width, and 1 1/2 inches in height.

After the foregoing parts are completed and the base has been put on, the crystal is placed in the holder and adjusted for sensibility. When a place is found where the signals come in very loud (as they should if the crystal is a sensitive one) the box is filled with sealing wax and the cover put in place.

My experiments reveal that carborundum crystals of a pinkish color are the most sensitive and I find that in the majority of cases local battery current is not required. With a detector of this type, a 2,000-ohm Brandes head set, a triple slide tuner and a 40-foot aerial, I am enabled to receive signals from the Arlington station every night.

CARL W. CROUSE, *Illinois.*

HONORARY MENTION

I found by experiment that to produce a high tone from an ordinary buzzer, the armature must vibrate in a small arc. Also the vibrator should be adjusted as rigidly as possible. To effect this I bent back the usual small spring, between the armature and the set screw, and set the contact maker, C, next to the soft iron armature. I also attached a second set screw at A and a third one at B. By careful adjustment of all screws an extremely high spark note is produced, which will be found very satisfactory for the adjustment of crystals or other requirements at a radio station.

My experiments reveal that the following method of adjustment is practicable; the set screw, A, should be turned about three turns and then the set screw. B, adjusted one turn or two, until the satisfactory tone is produced. The set screw, C, should be so adjusted as to allow twice the width of the armature between the electro magnet and the point of the set screw, C.

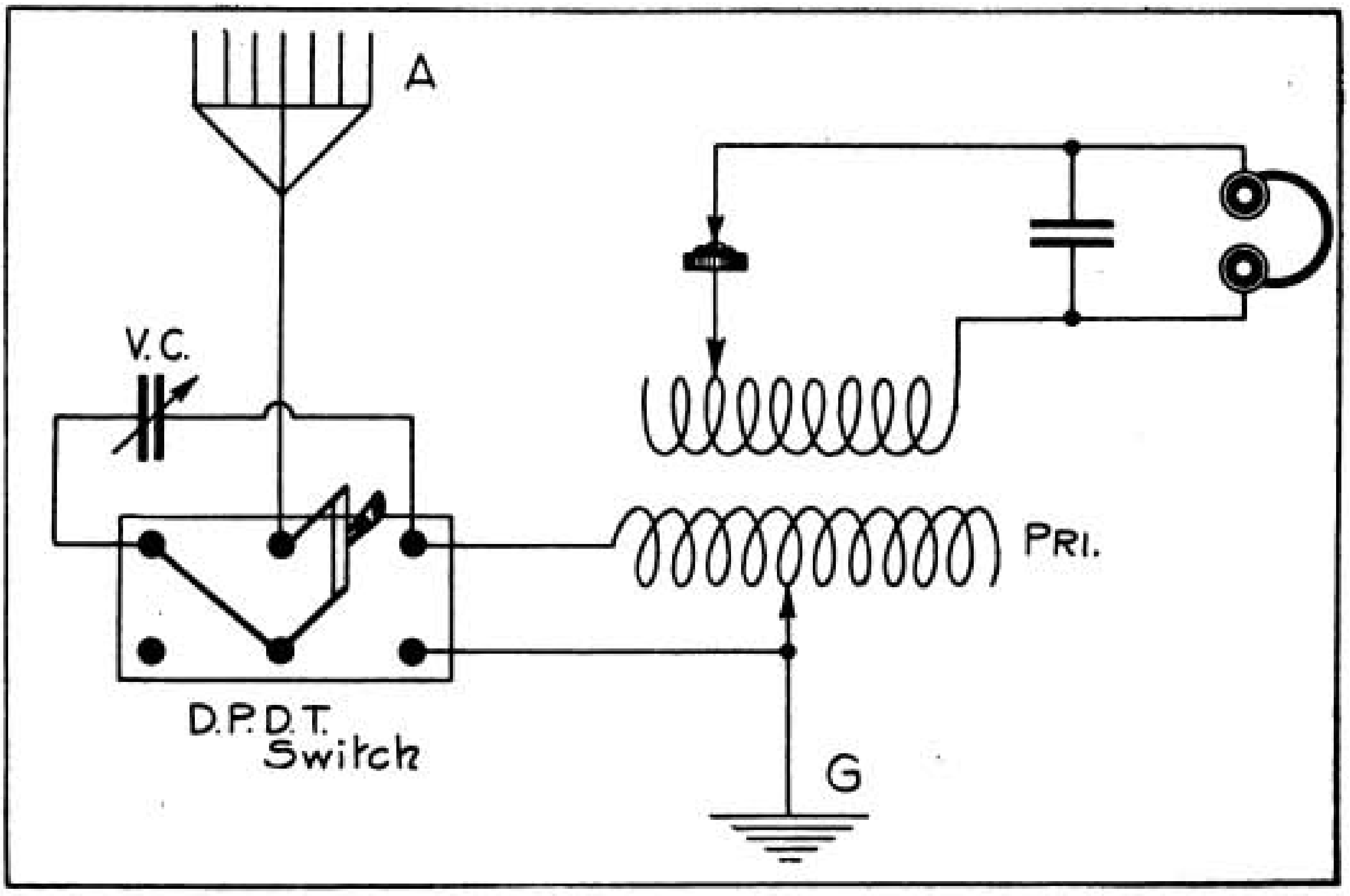
JOHN G. SPEICHER, *Illinois.*

HONORARY MENTION

The accompanying diagram indicates how a variable condenser may be connected either in series with the antenna system or in shunt to the primary winding of the receiving transformer by means of a single switch. When the switch is in the position indicated in the drawing, the condenser is connected in series. When it is turned to the left the upper two contacts are connected together and the lower two on the left likewise. This places the condenser in shunt to the primary winding. The two brass parts of the switch must be insulated from each other in order to effect the purpose as described.

I have noticed that in practically all high priced receiving sets, especially in the Marconi apparatus, there is a switch of this type used in some portion of the circuit and, therefore, I thought it would be of value to the amateur reader.

FOSTER E. STURTEVANT, *New Hampshire.*



Drawing, Honorary Mention Article, Foster E. Sturtevant

HONORARY MENTION

At this season of the year the amateur who spends considerable time out of doors is interested in the design of a portable receiving set. I suggest the design shown in Figs. 1 and 2. The transmitting set contains a spark coil, a spark gap, a helix key, condenser, etc., while the receiving set consists of an inductively-coupled receiving tuner, fixed and variable condensers, galena and silicon detectors and head telephones, all securely mounted in place.

The case is made of oak and opens like a desk, the lower portion of the case holding the batteries for the sending set and also containing a drawer in which the head telephones and other necessary accessories may be carried.

This set is very convenient for any amateur wishing to take a camping trip, with the additional assurance that, when the apparatus is not in use, it may be locked up to prevent meddling. The case is also dustproof and corrosion or rust troubles are eliminated.

D. B. ALCORN, *New Jersey.*

LONG DISTANCE COMMUNICATION

In reference to the articles by R. H. E. Mathews, and N. B. West, in the February and March issues respectively of THE WIRELESS AGE, I wish to report that I also have successfully worked with 9-KU and, as Mr. West states, 9-KU was tuned by the radio inspector to a sharp 200-meter wave. At the time I communicated with him I was using a cheap pair of 2,000-ohm receivers and, it was the early part of the season at a time when receiving conditions were not at their best. I have heard this station a number of times since, while using a single vacuum valve bulb, and recently with a galena crystal.

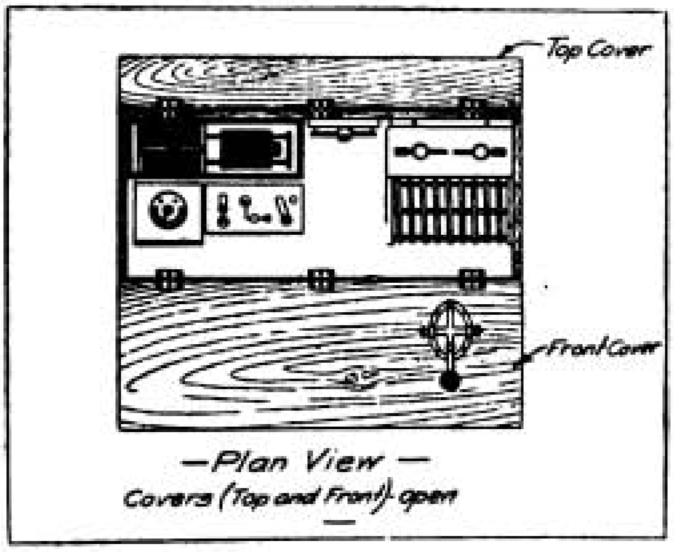


Fig. 1, Honorary Mention Article, D. B. Alcorn

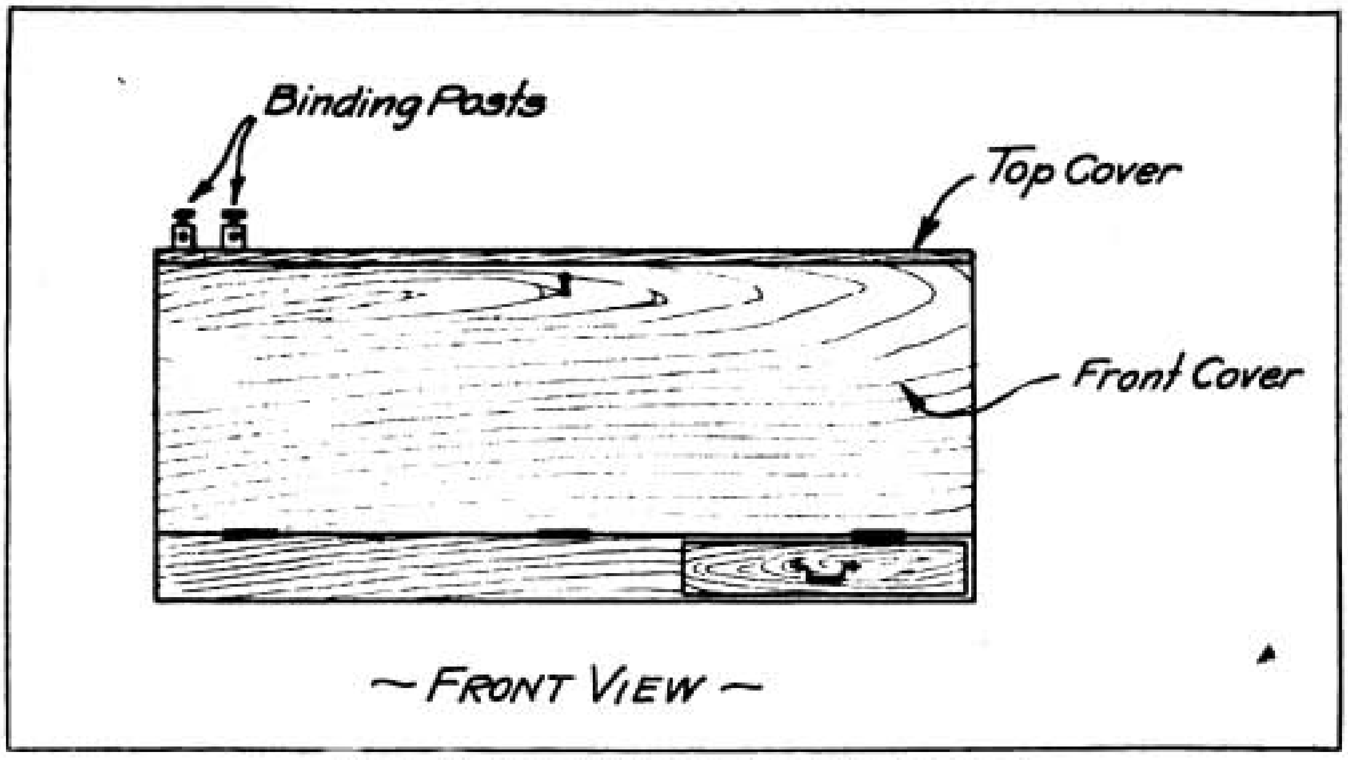


Fig. 2, Honorary Mention Article, D. B. Alcorn

I have also communicated with a 200-meter station at Lawrence, Kans., without any difficulty whatsoever. The latter station was very sharply tuned and has been heard at my station, between 4 and 5 p. m., central standard time. These signals were received on a single vacuum valve bulb. While the distance covered is more than 500 miles, these results are not at all uncommon in the Middle West, and the fact that I have also communicated with stations in or near New York City, operating on very short waves and at a time when atmospheric electricity made the reception of signals very difficult, would indicate that such results need not be uncommon in the East as well as in the West.

I believe that if the apparatus is properly tuned, the spark carefully adjusted and the correct value of condenser capacity employed, and particular care is taken to cut down all resistance joints and leakage of the high potential energy, it is not at all difficult to communicate with an amateur 200-meter set at a distance of from 60 to 100 miles during the daytime, even in summer, regardless of the locality.

MRS. CHARLES CANDLER, *Ohio.*

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Curacao	Pacific Coast Steamship Co.	WGK
Ravalli	Pacific Coast Steamship Co.	WGI
Cubadist	Cuba Distilling Co.	KNV
Mielero	Cuba Distilling Co.	KNT
Sucrosa	Cuba Distilling Co.	KNS
D. N. Luckenbach	Luckenbach Steamship Co.	KGW
Calgary	Standard Oil Co. of New Jersey	VEV
Clan Ferguson	Clan Line	YOQ
Petoskey	Chicago & South Haven Steamship Co.	WDH
Conneaut	Wyandotte Transportation Co.	WCU
S. Y. Galatea	E. L. Ford	WGF
Suruga	Barber & Co., Inc.	KGD
Jalisco	Mexican Navigation Co.	XXA (Temporary)
Coahuila	Mexican Navigation Co.	KEW
Tegucigalpa	Vaccaro Brothers & Co.	VB
Westwego	Union Petroleum Steamship Co.	KGE
G. R. Crowe	G. R. Crowe S. S. Co., Ltd.	VET
Dara	Bombay-Persian Steam Navigation Co.	TZK
Matinicock	Standard Oil Co. of New Jersey	KID
Standard Arrow	Standard Transportation Co.	KSV
Royal Arrow	Standard Transportation Co.	KSW
Acme	Standard Transportation Co.	KIJ
Astral	Standard Transportation Co.	KIQ

THE SHARE MARKET

NEW YORK, April 11.

Quoted today at 2, the shares of the Canadian Marconi company have registered a notable advance. In spite of the war conditions in the Dominion, the company is doing a profitable business and the rise in the price of the stock did not surprise those who have kept informed concerning the business of the corporation. As the par value is five dollars, an increase of one-quarter corresponds to a rise of five points on a stock with a par of $100.

The publication of the annual report of the American Marconi Company, although very favorably commented on in financial circles, made absolutely no difference in the price of the shares, on account of the dullness of the market. In London the closely-held shares of the English company moved up from one-half to one point.

Bid and asked quotations today: American, 3⅝-3⅞; Canadian, 1⅞-2¼; English, common, 10-12; English, preferred, 9-11½.

CARRANZA ORDERS EQUIPMENTS

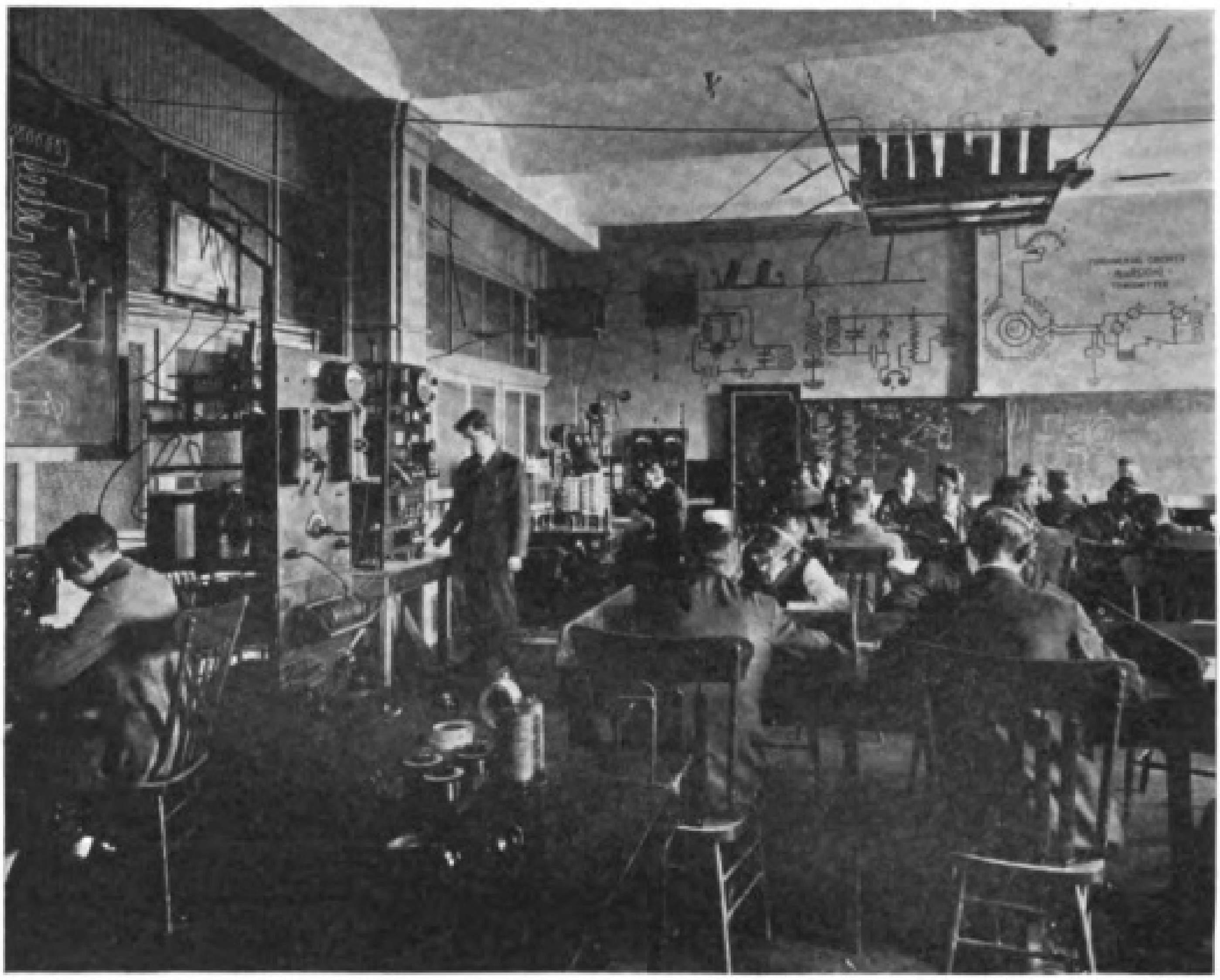
Y. G. Jurado, representing the Carranza Government of Mexico in San Francisco has closed a contract with the Marconi Wireless Telegraph Company of America, calling for four 5 k.w., 500-cycle, quenched gap wireless sets. These are to be installed in plants that the Mexican Government proposes erecting at various points along the Mexican Coast.

MEETING POSTPONED

The annual meeting of the Marconi Wireless Telegraph Company of America, which was called for April 17, at Nos. 243 and 245 Washington street, Jersey City, N. J., was postponed till twelve o'clock, noon, May 17, on account of the absence of a quorum. Of 1,880,414 shares outstanding, 343,456 were represented.

The Marconi School of Instruction

Educating Prospective Guardians of Ships and Lives



A class of young men in the School of Instruction, studying to become proficient in wireless

IN a large, high hall filled with the regulation operators' tables, sat a group of serious looking boys with head telephones clamped over their ears. On the walls were sweeping black diagrams of wireless apparatus and the upper works of a ship with an aerial swinging between the masts. Around the walls stood alternators, heavy motor-generators, detectors that have caught far-away Nauen, tuners, wave-meters—in fact, all the apparatus necessary for the complete equipment of wireless stations. In the midst of these instruments sat students of the radio art copying rapidly on yellow pads the messages that came from the Wheatstone automatic transmitter. This was the panoramic impression received by a visitor at the Marconi School of Instruction in New York City.

The school, which is at No. 25 Elm street, was established in 1912, under the supervision of its present instructing engineer, E. E. Bucher. The qualifications for entrance are not severe. The application of any young man between the ages of eighteen and twenty-five, with a grammar school education and two good references, will be considered. Neat appearance is essential, and the education of the prospective wireless operator should include a sound knowledge of arithmetic and geography, together with the ability to write with reasonable speed and legibility. While familiarity with electricity and enough practice to receive in the continental code at the rate of ten words a minute are highly desirable, it is not an absolute requirement, for the school provides unexcelled facilities for the attainment of this special skill.

Unlike a wire telegraph operator, the wireless man must have a thorough knowledge of the construction and operation of his apparatus. Before an operator is allowed to take charge of a Marconi station, he is required to obtain a first grade commercial license issued by the United States Government, and to do so must be able to connect up a complete wireless equipment. He will be asked to draw a circuit diagram of the set, make temporary repairs, locate faults, adjust the wave-length and, in general, grasp the theory and practice of the operation of every part of the set. As no two students absorb all parts of the course with equal facility, the instruction has developed into a system of individual coaching. Supplementing a great deal of practical work and a series of lectures, several text books have been adopted. These consist of "Radio Communication Laws of the United States," "Handbook of Regulations, U. S. Naval Radio Service, 1913," and the "Naval Manual of Wireless Telegraphy for 1913," by Commander Robinson. On shipboard only the continental code is used, although shore operators who handle land line messages must be familiar with Morse as well.

In the class room every desk is fitted with a head telephone and a buzzer. The latter accurately imitates the sound of a standard wireless transmitter. The operators' tables are so connected that Harry Chadwick, telegraphic instructor, is able to send to all the class at once, to special groups or to individuals in the class. A ship's call letter is assigned to each of the students. By the use of the Wheatstone automatic transmitter any rate of sending speed can be obtained so that the student may practice receiving anywhere from ten words a minute up to the human limit.

The mechanical equipment of the school is unusually complete, consisting of a ½ k.w., 500-cycle set, another ½ k.w. set of 120 cycles, two 2 k.w. sets of 500 and 240 cycles respectively and two 1 k.w. sets of 60 and 500 cycles. There is a storage battery emergency outfit, all types of Marconi receiving sets, a full equipment of experimental apparatus, including a Fleming cymometer for determining wave-lengths and high frequency measurements, and several kinds of wave-meters and decremeters.

The average student completes the course in three and a half months. Then he is assigned to a ship, where he receives the rank of a junior officer and a salary ranging from $25 to $60 a month, with meals and quarters while on shipboard. A commission of twenty-five per cent. of the message tolls which accrue on the vessel are divided between the junior and senior operators. There are a number of money-making sidelines that the operator can carry on in addition, such as handling the sales of the Ocean Wireless News—a daily newspaper published on passenger ships at sea. Later on, graduates of the school who have shown special ability may be transferred to land stations or enter the engineering or construction departments of the company.

Wireless operators receive almost unlimited shore leave in foreign lands, and there is no port from Punta Arenas to Archangel where wireless equipped steamships do not touch. No longer is it necessary for the boy who craves the varied scenes and excitement of a seafaring life to bind himself to a long, hard apprenticeship before the mast; the cabin boy of fiction has given place to the alert wireless operator—the guardian of the vessel and a trusted assistant to the captain himself.

Hammond's Wireless-Dynamo Torpedo

John Hays Hammond

Details of the Invention Brought Out in Congressional Hearing on United States Fortifications

There is one condition attached to the acquirement of the patent rights by this government. The torpedo must demonstrate its value before a joint army and navy board.

The virtue of the wireless-dynamic torpedo is thus explained by Mr. Hammond:

"You can take a charge of explosives or a projectile and deliver it at the target under constant control from the shore."

JULES VERNE, with all his imagination, again has been outdone by modern inventive genius, says a Washington correspondent. Sandwiched in among the technical details about coast defenses in the recent hearings on the fortifications, is the story of the Hammond torpedo, scientifically called the wireless-dynamic torpedo.

There has been a good deal of discussion about this invention of the young son of the mining engineer, John Hays Hammond, but until this time it has not been disclosed in such detail. In question and answer form the hearings tell a remarkable story of its performances. As already reported, the invention has so conclusively demonstrated its efficiency as a destructive agency that the United States Government is preparing to buy the patent and to proceed with installations for coast defense. The fortifications bill carries an initial appropriation of $1,167,000. The inventor wants his own government to have the benefit of his device on terms that are pronounced most reasonable. England, it is said, is willing to pay $10,000,000 instantly for it.

The torpedo, as described by Mr. Hammond, is at present of two types—one to be used above water, traveling at fifty miles an hour, and the other a submerged type, except for a short wireless mast virtually immune from gun fire, with a speed of twenty-eight miles an hour. The surface type is a new sort of craft, called by naval experts the sea sled. They can be made of any size desirable for the purpose in view and travel so fast as to be safe from destructive gunshot.

The experiments at Gloucester have been made with a thirty-ton boat. The inventions do not cover any special type of boat, but the patents relate wholly to control and to the method of firing torpedoes from these carriers. The boat can be controlled just as easily for most purposes from an aeroplane or warship as from a shore station.

Here is a summary of some of the features of the invention, according to description:

It can be steered by wireless in any direction.

Its engines (two 500-horsepower gasoline motors) can be started, stopped and controlled at various speeds by wireless.

It can carry a ton of high explosive.

It is more accurate, in the opinion of army experts, than the fire of big guns.

It can be operated against an enemy by a single man, who remains ashore, or on a warship, or in an aeroplane, and whose sole instruments are a telescope and an electric key.

It cannot be interfered with by adverse wireless waves, because it is controlled by a system of selective transmission.

If the wave-length controlling it is discovered by an enemy, that wave-length can be changed while the torpedo is in sight.

If an enemy attempts to interfere with it by wireless, it possesses the faculty of pointing immediately in the direction of that enemy and making directly for him.

It can be operated at night as well as day, subject to accurate control by an arrangement of tiny lights, so shielded as to be visible only to the operator.

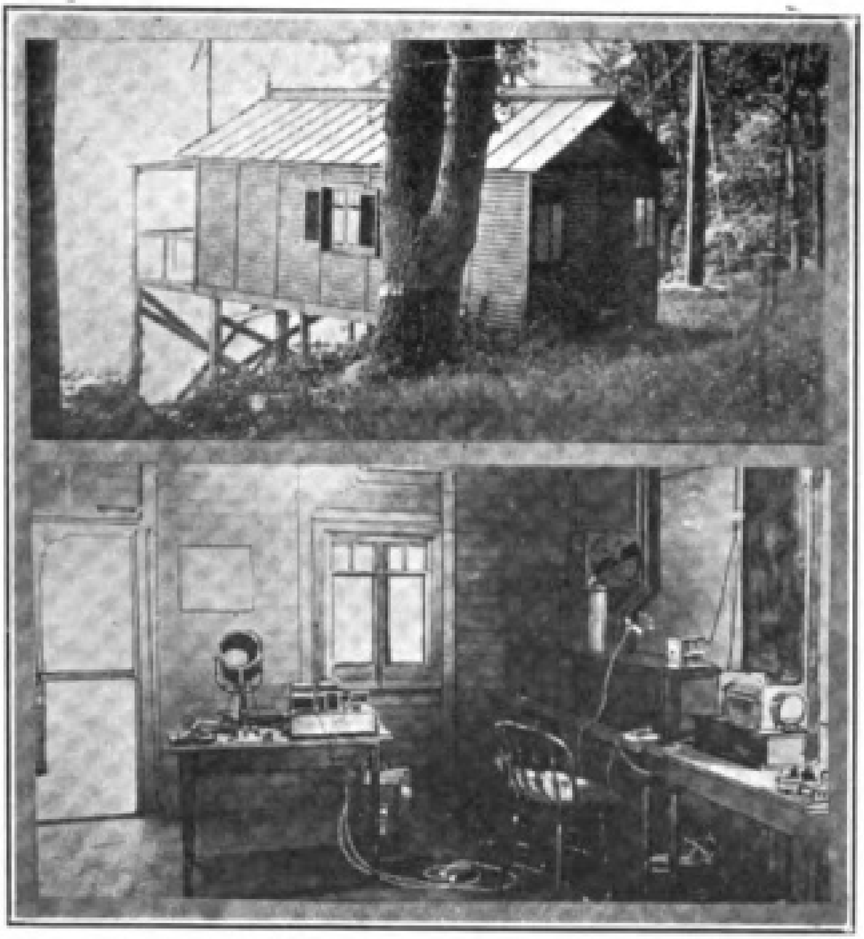
It carries a searchlight of its own, which may be turned on and off by wireless.

The surface type will cost about $47,-500 each.

The submarine type will cost about $9,000 each.

The surface type has a cruising radius of 200 miles, at fifty miles an hour.

It can be guided 200 miles to sea by an aeroplane and launched against an enemy at the end of the run.



Two views of Hammond's wireless plant at Gloucester, Mass.

The surface type has a capacity of double attack. It carries a torpedo which, when the destroyer is in striking distance, can be launched by wireless. If the torpedo strikes the destroyer can be turned around by wireless and sent home. If the torpedo misses, the destroyer, which carries an additional half-ton of explosive, can be sent on to retrieve the error, in which case, of course, it is itself destroyed upon impact.

The beginning of young Hammond's work and the operations of the boat are thus informally narrated by General Erasmus M. Weaver, chief of coast fortifications:

"I went to the operating house on the shore of the bay, where there was a man seated at what appeared to be a telegraph instrument, and out on the water a boat was moving. At that time I did not connect the boat with the building I was in. After a few minutes' conversation Mr. Hammond said: 'If you will give any instruction to that boat it will execute your orders.' Then I realied that the controlling apparatus was on shore and that the apparatus directed was on the boat that I had noted.

"I asked that the boat be made to go to the right. The craft was a very rapidly moving motor boat. The operator touched a button and the boat immediately went off to the right. Then I said: 'Now have it go to the left,' and he pressed a button twice and off it went to the left. That was becoming rather interesting. Then I asked him to have it go around a buoy about 5,000 yards out, and by operating a button it went up to a buoy and then around it one way.

"I asked him to have it go the other way, and it went around in the opposite direction. A schooner was coming in, and I said I would like to have the boat pass in front of the schooner. It made for the schooner and passed in front of it. Then I had it sent around the other way, and I said: 'Bring it in here; I want to see what it is.'

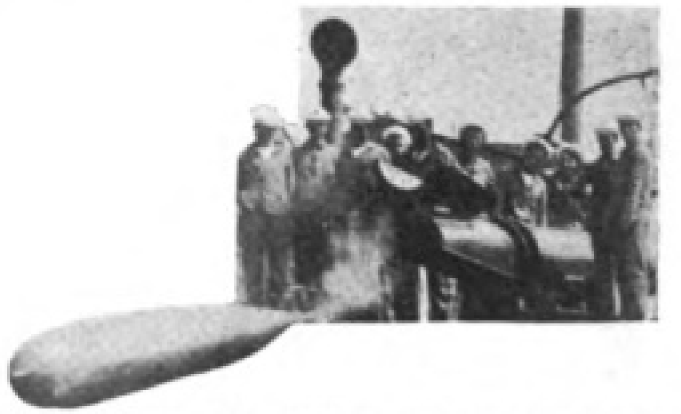
"I went aboard, saw the mechanism and had it explained to me. I was impressed with it. While, of course, the secret components were not evident, still the main operative features were. I was much impressed with its simplicity; that is, it was much more simple that I had any idea it could be, and based on that exhibition alone I made up my mind that Mr. Hammond had accomplished a thing that was really practicable.

"I have no doubt that it can be more accurately directed than we can direct the fire of guns. The possible scope is beyond anything we have ever had in mind before, and it is difficult to see to what limits it might not be extended."

As to the method of control, Mr. Hammond explained that a wireless station of special design is located out of range of enemy fire. This is connected by land wire lines with a series of concrete turrets stretched along the coast and each occupied by a single observer. Each observer is able to operate through the wire connection a wireless transmitter at the wireless plant. Each operator controls enough energy to send out one torpedo.

"In order to have the system flexible," added Mr. Hammond, "the torpedo is started from its base, goes out into the radius of observation of controller No. 1, is passed along to controller No. 2, and so on to whatever controller in whose radius of vision the enemy is located. Then this observer takes up the direct control of the torpedo and steers it toward the enemy."

Besides this feature of having one or more observers control in turn the movements of a torpedo as the circumstances may dictate, Mr. Hammond has provided against the enemy's being able to assume control of the boat. When he began work he found there were two things to guard against. One was the question of interference by wireless energy from the enemy; the second was the attempt to destroy the torpedoes or boats by gunfire from enemy ships. The second question, in the judgment of Mr.



The wireless controlled torpedo hits a bamboo pole at three miles

Hammond, is settled by the speed. The chances of hitting a small object such as this boat, traveling fifty miles an hour, are regarded as negligible.

The first problem stated, that of preventing wireless interference, has been solved, according to Mr. Hammond, by an arrangement of selective transmission.

"I have evolved a system," says Mr. Hammond, "which when there is interference present in the way of wireless energy coming from an enemy, will cause the torpedo to turn around and face that source of energy. The torpedo will move toward it."

Lieutenant Styles M. Decker of the Coast Artillery, with Captain J. B. Beahr, was detailed for two years to watch Mr. Hammond's experiments. Lieutenant Decker tells the following story of the destroyer's accuracy:

"While we were circling around the harbor we pitched over a cane pole, an ordinary old-style fishing pole, which had a light weight on the bottom and a disk of ordinary burlap about twelve inches in diameter around the upper part, which acted as a target. I should estimate we were within a distance of something like three miles from the operator on shore.

"He took charge of the boat and brought us to within about one and a half miles of shore, and then turned us around and started us for the target. In the meantime the tide was taking the target out at a great rate, and it was getting farther and farther away.

"We ran right square into the target the first trial, turned around and came back 200 or 300 yards. We were then steered for the target and struck again, and kept repeating this form of target practice, until it became quite monotonous, because the boat never missed at all." As to the question of keeping the invention for the exclusive use of the United States, Mr. Hammond said:

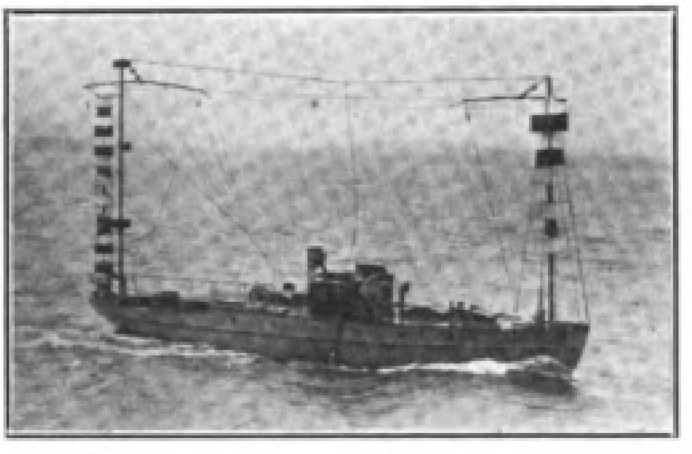
"In my own laboratory, where this thing has been developed, I can say there is only one man besides myself who understands the complete mechanism. I have differentiated the work so as to place one man on one line and another on another line, and none of these men knows the combination of the thing. Only one man under me knows the combination of all these things. The same method could be observed in the way the army handles it.

The terms upon which Mr. Hammond offers to sell his invention exclusively to the United States are these, proposed to the War Department in a letter:

He will assign all patents to the United States Government for the sum of $530,000, plus ten per cent. of the cost of installing each radio station, whether ashore or aboat, plus $10,000 royalty for each destroyer built. This is based on an order of not less than three units, a unit consisting of one station and ten destroyers. If the government builds only two units, the lump sum is to be $630,000. If it builds only one unit, the lump sum is to be $730,000.

In addition, Mr. Hammond will give his time and his services to the government in installing and developing the system, so long as the War Department wants him. As an alternative proposition, in the case the government does not want the exclusive rights, Mr. Hammond will sell the manufacturing rights for the United States alone for $350,000.

The destroyers themselves may be built even more rapidly than the control stations, which will require nine or ten months in construction. The type of boat favored by Mr. Hammond for the surface destroyer is the sea sled, which has demonstrated its tremendously high speed in motor-boat racing.



The Hammond boat at sea

INSURANCE FOR MARCONI EMPLOYEES

(Continued from page 535)

meantime, however, under the agreement made with The Travelers Insurance Company this insurance is effective as of April 1, 1916 upon all in the active service of the company on that date, whose period of service entitles them to receive such insurance.

In consummating this arrangement, it gives us pleasure to acknowledge the high order of intelligent and zealous service which has characterized the work of our employees in the past and we have every confidence that it will be continued in the future.

With every good wish for the greater success and happiness of all,

Very truly yours,

E. J. NALLY,

Vice-President and General Manager.

The foregoing was received enthusiastically by those in the Marconi service. This fact was evidenced by a number of letters sent to the company's offices in New York, expressing appreciation of the boon.

The First of the Mississippi Barges Equipped

Barge No. 1 leaving Jeffersonville, Ind., on her trial trip

BARGE No. 1, owned by the Inland Navigation Company, one of the thirty-six power vessels which the Marconi Wireless Telegraph Company of America contracted to equip with radio apparatus, is the first of the craft to be fitted out. Following her trial trip, which took place recently on the Ohio River, near Jeffersonville, Ind., she proceeded to the Mississippi River and when near St. Louis, her operator established communication with a vessel in the Gulf of Mexico.

No. 1 is equipped with a 2 k.w. 500 cycle panel type Marconi quenched gap set. Her masts, which are self-supporting, stand eighty-five feet from the load line and are built in telescope form. The top mast, which is made of wood, can be let down into the lower steel section, permitting the barge to pass under bridges. The aerial is of the T type and when the crane is in operation, either aft or forward, the vertical part of the aerial can be thrown over the crane and again connected with the wireless apparatus, permitting the radio equipment to be in use, regardless of the position the hoisting machine may be in. Located on the starboard side, directly under the crane, the wireless cabin is the largest compartment on the barge, not excepting the captain's.

The vessels which the Marconi Company contracted to equip for the Inland Navigation Company are designed to travel on regular schedules on the Mississippi River between Minneapolis and New Orleans, with stops at all important points on the river and its tributaries. There are many attractive features surrounding the post of wireless operator on these barges, for they have the conveniences of an ocean liner with the exception of a gymnasium.

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 an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

H. P. G., Portsmouth, Va., inquires:

Ques.—(1) What should be the specific gravity of the electrolyte for the electrolytic detector?

Ans.—(1) It is the general practice to employ a 20% solution of nitric acid. Fair results will be obtained with a similar solution of sulphuric acid. A supersaturated solution of caustic potash has often been successfully employed.

Ques.—(2) Should the positive pole of the battery be connected to the fine point of this detector or to the larger electrode?

Ans.—(2) In the Fessenden type of electrolytic the fine wire point is connected to the positive pole of the battery.

Ques.—(3) What are the relative merits of this detector? What additional apparatus is necessary to make it function?

Ans.—(3) It is sensitive and will give good results when properly handled. The potentiometer should have resistance from 300 to 400 ohms and the battery connected to it a potential of about 4 volts. The fine wire electrode should be about 1/10,000ths of an inch in diameter, adjusted to just make contact with the liquid. The detector is stable in operation, particularly when the fine wire electrode is sealed in glass, making it independent of vibration. Severe impulses of atmospheric electricity will burn off the fine platinum electrodes when it is not protected by the glass coating.

Ques.—(4) What is the correct value of resistance for the telephones employed in connection with the vacuum valve detector?

Ans.—(4) The telephones generally have resistance of from 2,000 to 3,000 ohms, although the matter is not so important with this type owing to the potential of the local battery. Very good results can be obtained with telephones of 75 ohms resistance. Keep in mind that it is not the resistance of telephones which determines their sensibility; it is the over-all construction that must be taken into consideration.

* * *

B. H. N., Fort Monroe, Va., inquires:

Ques.—(1) I have a tube for the primary winding of an inductively-coupled receiving tuner which is 18 inches in length and 8 inches in diameter. The secondary tube is 18 inches in length and 7 inches in diameter. The tuner is to be used with an aerial of 750 meters wave-length, but the circuits are to be raised to a wave-length of 12,000 meters. The secondary winding will be shunted by a condenser of .005 microfarad capacity. What dimensions are required for the loading coil?

Ans.—(1) Wind the primary tube with No. 24 S. S. C. wire and tap it at intervals of ½ inch for variation of the inductance value. The secondary winding is preferably covered with No. 32 S. S. C. wire and will respond to the wave-length of 12,000 meters with small values of capacity at the .005 microfarad condenser. The wave-length of the primary winding may be raised by connecting a variable condenser of small capacity in shunt to it. The secondary winding should be tapped at intervals of 2 inches.

* * *

B. J. B., Philadelphia, Pa., inquires:

Ques.—(1) What is the wave-length of my aerial which is 44 feet in length, 35 feet in height, with a 10-foot lead-in? It is of the inverted L type.

Ans.—(1) Assuming it to be of four wires with the usual spacing, the fundamental wave-length is approximately 130 meters.

Ques.—(2) Give diagram or description of a 110-volt buzzer to be used for transmitting experiments.

Ans.—(2) A buzzer of special construction is required to be operated at a pressure of 110 volts D. C. The resistance of the windings should be at least 110 ohms. There are several methods for exciting an antenna by a buzzer. For example: A condenser of fairly large capacity, say .05 microfarad, may be connected in series with the antenna and the terminals of the condenser connected across the contacts of the vibrator on the buzzer. This has been found to be an efficient method for ordinary working. Sometimes the condenser is eliminated and the antenna and earth connections connected directly across the contacts of the buzzer. Another method is to connect a coil of inductance in series with the antenna system, the coil in turn being connected to a bell buzzer and a battery; that is to say, the battery, bell buzzer and coil are connected in series. In this method, when the buzzer is in operation, a change of the lines of force takes place in the coil, causing the antenna system to be charged, whereupon it will discharge at its own frequency of vibration.

Ques.—(3) Where can I secure or purchase a tikker and what is the average price of one?

Ans.—(3) We are not aware that this type of detector is on sale. You might communicate with the Federal Telegraph Company, at San Francisco, and ascertain if one can be purchased. The slipping contact type of tikker is now generally used. It merely consists of a small wheel with a slight groove cut in it rotated at a speed of approximately 1,500 revolutions per minute. A piece of elastic wire is placed in light contact with the groove in the wheel, the wheel being connected to one side of the receiving detector circuit and the spring contact to the other side. By careful adjustment of the spring a hissing sound of a medium pitch is produced in the head telephone.

Ques.—(4) Will a continuous wave receiving detector respond to damp waves?

Ans.—(4) A vacuum valve receiving set like that described on page 82 of the book "How to Conduct a Radio Club" will respond to either damped or undamped oscillations. The Poulsen tikker or the slipping contact detector will also respond to either damped or undamped oscillations, but the tone from signals of spark stations is very poor. Fair notes are obtained from 500-cycle spark transmitters.

With circuits employing the tikker type of detector it is customary to provide a secondary winding of low damping which is generally constructed of Litzendraht wire.

* * *

C. G., Louisville, Ky., inquires:

Ques.—(1) Can a vacuum valve detector be employed to amplify the signals received on a tikker? That is to say, can an auto transformer be connected in place of the head telephones ordinarily used in shunt to the fixed condenser of the tikker set? And can the connections be led from the transformer to the grid of the vacuum valve?

Ans.—(1) The apparatus will give good results connected in this manner. An auto transformer is not required. The grid of the vacuum valve detector may be connected to one terminal of the fixed condenser and the filament to the opposite terminal of the fixed condenser. A condenser of fairly high capacity should be connected in series with the grid of the vacuum valve.

Ques.—(2) Referring to the book "How to Conduct a Radio Club" should the coils, L-2, L-3, L-4 and L-7, in the diagram on page 82 have taps and if so, how many?

Ans.—(2) The coils, L-3 and L-7, may be tapped every three inches or so throughout their lengths. The coil, L-2, should be tapped every half inch. The coil, L-4, may be tapped every inch since the necessary fineness of adjustment is obtained at the variable condenser, C-2.

Ques.—(3) How many feet of wire are required to wind the coils mentioned in the second query?

Ans.—(3) The coils, L-3 and L-7, are identical. Each requires approximately 1,860 turns of wire or about 2,600 feet. The coil, L-3, has approximately 1,000 turns and requires about 1,400 feet of wire. The coil, L-2, has approximately 540 turns and requires about 760 feet of wire.

Ques.—(4) Where can I purchase cardboard tubes having diameters of 5 inches, 5½ inches and 6 inches?

Ans.—(4) Communicate with Ware & Co., Watt street, New York City.

* * *

W. R., Springfield, Mo., inquires:

Ques.—(1) Referring to page 82 of "How to Conduct a Radio Club," how many taps should be taken from the coils L-3 and L-4?

Ans.—(1) The coil, L-3, should be tapped about every third inch, while the coil, L-4, may be tapped inch by inch.

Ques.—(2) Does it make any difference which pole of the high potential battery is connected to the plate of the vacuum valve bulb?

Ans.—(2) The book states specifically that the positive pole of the high potential battery must be connected to the plate.

* * *

T. P. H., Dubuque, Ia., inquires:

Ques.—(1) Upon what theory is the comparative inefficiency of indoor antennæ based? Has any author taken up this subject to any extent? What have been the results with indoor aerials?

Ans.—(1) The matter can be explained by calling attention to the fact that the usual indoor aerial has not the dimensions of those erected in open space. A slight absorption of energy takes place when an electromagnetic wave is required to pass through an insulating substance, but is not so detrimental as many suppose. Many experiments have been made with indoor aerials and the results obtained by some compare favorably with those obtained from the usual outdoor aerial. We are tempted to believe that the effectiveness of the ordinary receiving aerial would be hindered but a very little by erecting a large wooden building about it.

Ques.—(2) You will observe from the enclosed diagram that an aerial is represented as 800 feet in length, 125 feet in height at the further end and 70 feet in height at the instrument end. What effect has the fact that the chimney is actually lower at its top than the height of the 70-foot end?

Ans.—(2) It will have no appreciable effect on the results obtained. It is possible that when receiving from a given transmitting station, a certain disposition of the aerial in respect to direction, angle of the flat top portion, etc., would give the best results; that is to say, it would receive the maximum of cutting by the electrostatic and electromagnetic lines of force in an advancing wave. However, practically any elevated conductor properly insulated, with the correct values of inductance capacity for resonance will give good results for receiving.

Ques.—(3) Would the aerial I have just described be suitable for long distance reception?

Ans.—(3) Yes.

Ques.—(4) Would I be able to receive from both Atlantic and Pacific coast stations, considering the fact that this aerial is supposed to be directive?

Ans.—(4) Probably the best results will be obtained from stations in a westerly direction, although you will, without doubt, be able to receive signals from either direction during the night hours of the favorable months of the year.

* * *

S. B., Binghamton, N. Y., inquires:

Ques.—(1) What is the natural wave-length of an aerial 75 feet in length, 35 feet in height, consisting of four wires?

Ans.—(1) With the usual spacing of 2 to 3 feet, the natural period of a natural wave-length is approximately 190 meters.

Ques.—(2) Can a condenser be connected across the primary or the secondary winding of an inductively-coupled receiving tuner to increase their capacity to a considerable value above normal, with results equal to those obtained from a loading coil?

Ans.—(2) Connected across the primary winding, the condenser usually has the effect of decreasing the strength of signals, although the wave-length may thus be raised. In this circuit it is preferable to use a loading coil. The actual value of capacity that may be employed in shunt to the secondary winding depends upon the type of detector used. With crystalline and vacuum valve detectors, the capacity in the secondary winding is usually limited to a value lying between .0005 microfarad to .001 microfarad. Rather than increase this value, it is preferred to insert a loading coil in series with the secondary winding.

Complete information for the building of a receiving set responsive to undamped oscillations appears in the book "How to Conduct a Radio Club," published by the Marconi Publishing Corporation.

* * *

J. G. S., Wisney, Neb., inquires:

Ques.—(1) What is the fundamental wave-length of a single aluminum wire 200 feet in length, 40 feet in height at the free end and 30 feet in height at the other end.

Ans.—(1) The fundamental wave-length of this aerial is approximately 310 meters.

Ques.—(2) Is it necessary that an aerial point in the direction of a sending station?

Ans.—(2) An aerial of the inverted L type will radiate more strongly in the direction opposite to which the free end points. This, however, is only the case when the flat top portion of the aerial is considerably longer than the vertical portion. Similarly, a receiving aerial receives best when the free end points opposite to the transmitting station.

Ques.—(3) Would the aerial described in Query No. 1 be suitable for the reception of signals from high power stations if a loading coil was used to increase the wave-length?

Ans.—(3) During the night hours with a very sensitive receiving set, such as described on page 82 of the book "How to Conduct a Radio Club," you will be able to hear high power stations, using damped or undamped oscillations, located within the borders of the United States.

Ans.—(4) The wireless telegraph aerial erected on top of the barn will in no wise interfere with the lightning rod. As a matter of fact, if the aerial is "earthed" during the periods it is not in use, it should in itself make an efficient lightning rod.

The stations you heard with the call letters having the prefix are not high-power stations, but are amateur stations located in your district. A copy of the book entitled "Radio Stations of the United States," can be purchased from the Government Printing Office, at Washington, D. C., at a price of fifteen cents a copy. This book gives a complete interpretation of the call letters of amateur and commercial stations. The additional licenses granted from month to month, are given in the monthly bulletin of the National Amateur Wireless Association.

* * *

A. J. T., Whitewright, Tex., inquires:

Ques.—(1) To become a member of the National Amateur Wireless Association must an applicant own a set of wireless instruments?

Ans.—(1) No; it is merely necessary for him to state that he is interested in wireless telegraphy, has some knowledge of the fundamentals and is to a certain extent familiar with the national regulations. The Association will naturally appeal to the owners of amateur apparatus.

* * *

J. E. K., Newport News, Va., inquires:

Ques.—(1) I recently completed the construction of a ½ k.w. transmitting set and as an earth connection employed a single conductor of No. 4 copper wire having a total length of about 25 feet terminating on a water pipe in the wireless room. My station is located on the second floor and when the transmitting set is in operation, sparks can be drawn from the gas of the heating system in any part of the house. As a rule this indicates an earth connection of insufficient carrying capacity, but I cannot believe that this is the case at my station. As an experiment I grounded both the gas and the heating system, but this did not give any relief. Now these sparks are not very harmful, but they are objectionable to the other persons in the house. Kindly give an explantion and remedy for the trouble. I might explain further that I use a very loose coupling in the oscillation transformer.

Ans.—(1) It is likely that the water pipes do not give a good earth connection and being in inductive relation to the steam and gas pipes of your house they set up these potentials by electrostatic induction. A good method for the elimination of this trouble would be to run a piece of copper ribbon, about 2 inches in width, direct from the earth connection of the oscillation transformer to the water mains on the street side of the water meter. It may also be that the gas and water pipes of your house are in the electro-static field of your aerial and in consequence you experience these results. Swing the aerial away from the house and run a special earth connection from the apparatus out of the window to an earth connection in such a manner that it will not be in inductive relation to the pipes of the house.

* * *

B. W. M., Mobile, Ala., inquires:

Ques.—(1) What size of wire is used on the primary and secondary winding of the type F. United Wireless receiving set?

Ans.—(1) The primary and secondary windings are covered with No. 26 S. S. C. copper wire.

Ques.—(2) What is the capacity of the varible condenser con ected across the secondary winding of this set?

Ans.—(2) The maximum value is .001 microfarad.

Ques.—(3) What changes would you suggest in the design of this receiving set to allow it to work properly with a vacuum valve?

Ans.—(3) To get the best results with a vacuum valve detector for the longer range of wave-lengths, say, of 3,000 or 4,000 meters, a loading coil should be connected in series with the secondary winding. In fact such values of inductance should be used at all wave-lengths that only very small values of the secondary condenser are employed. If the capacity of the secondary condenser exceeds .0005 microfarad, the potential to the grid is lowered.

Ques.—(4) If the leads of an umbrella aerial are brought in from the highest point would louder signals result if the lower ribs are all connected together as per the enclosed diagram?

Ans.—(4) Good results will be obtained with either connection, although it is sometimes deemed desirable to connect the lower ends of the umbrella together.

* * *

H. L. S., Fenimore, Wis., inquires:

Ques.—(1) Would an aerial system placed five feet above the earth, extended outward to a distance of 200 to 700 feet, be efficient for receiving purposes?

Ans.—(1) With an aerial of this type messages have been received several hundred miles from stations employing wave-lengths between 6,000 and 9,000 meters. It has been reported in the Proceedings of the Institute of Radio Engineers that with a similar aerial several hundred feet in length messages have been copied on the Pacific coast from high power-stations on the Atlantic coast.

Ques.—(2) What is the wave-length of my aerial, which is composed of 4 No. 14 wires, spaced 2 feet apart? It is 40 feet in height on one end, 50 feet in height on the other and 67 feet in length. It is of the T type.

Ans.—(2) Approximately 120 meters. It is difficult to say just how far the apparatus described will permit messages to be received, but it seems likely that you should have no difficulty in hearing prominent stations, located in the Great Lakes District, during the night hours.

* * *

C. W. D., Indianapolis, Ind.:

Careful consideration of your communication prompts us to give the following advice: If the lead-ins from your aerial lie parallel to the power mains, it will be a difficult matter to protect the lighting circuits of your house. You are advised, if possible, to place the lead-ins at right angles to the power wires or at least remove them to the furthest possible distance. The fact that your protective resistance rods become hot proves that they have an insufficient value of resistance for the potential of the power mains. Try connecting two 1 microfarad condensers in series, grounding them at the middle point. You might also try graphite resistance rods of 4,000 or 5,000 ohms. Although these devices will aid in conducting the induced potentials to earth, complete freedom cannot be expected as long as the aerial wires are allowed to remain in inductive relation to the power wires. The constant blowing of fuses by your high potential transformer would seem to indicate an imperfect design. A closed core transformer, without a magnetic leakage gap, is apt to consume an abnormal value of current, unless the precaution to fit the primary circuit with a reactance coil is taken. The actual dimensions for a suitable reactance coil depend upon the design of the transformer, but you should have no difficulty in devising one that will permit close regulation of the current flowing through the primary circuit.

* * *

N. W. B., Pittsburgh, Pa.:

An aerial of the T type, having the dimensions set forth in your query, has a fundamental wave-length of approximately 150 meters.

A receiving tuner, strictly suitable to the reception of time signals from Arlington, is described in the National Amateur Wireless Association bulletin for January. This tuner can be made responsive to amateur signals by breaking up the continuity of the primary and secondary windings at three different points, i. e., by fitting them with dead-end switches, keeping in mind the dimensions of the usual amateur aerial. Only a very few turns are required at the primary of the oscillation transformer to place the receiving tuner in resonance with the 200-meter wave. The average amateur aerial has a fundamental wave-length in excess of 200 meters, thereby calling for the use of a short wave condenser to place the antenna system in resonance.

If the secondary winding is shunted by a condenser having a capacity of at least .001 microfarad the panel type receiving set, described in the October, 1915, issue of THE WIRELESS AGE will be suitable for the reception of time signals from Arlington.

The fact that the condenser connected in shunt to your secondary winding has no effect on the received signals indicates that there is an open circuit in the connections of the condenser. If the plates of the condenser were in contact the signals would disappear.

* * *

J. B., Jr., Baltimore, Md.:

The receiving tuner described in the bulletin of the National Amateur Wireless Association for January is responsive to wave-lengths of 3,000 meters and is particularly recommended for your requirements.

Your second query is not clear. There is no difference in the connections of an open core or closed core transformer in so far as either the primary or secondary winding is concerned.

The call letters WIE have been assigned to the steamship Edward L. Doheny. The call letters KFI are assigned to the barge I. D. Fletcher.

It is not an easy matter to secure a high spark note from an electrolytic interrupter operated from a 60-cycle source of supply. The spark note can be smoothed out by placing a liquid rectifier in series with the alternating current source of supply, changing it to a direct current. Beyond this we can not offer advice.

* * *

P. D. M., Emens, Pa.:

You will not be able to use the full output of your transformer, rated at 1 k.w. with a 20,000-volt secondary, at the restricted wave of 200 meters. The closed circuit condenser should have a capacity of .008 microfarad. A plate of glass, 14 by 14 inches, covered with foil, 12 by 12 inches, the glass being 1/8 of an inch in thickness, will have a capacity of approximately .002 microfarad each. Eight plates connected in parallel will give a capacity of .016 microfarad, but taking into account that the voltage of the transformer is 20,000 volts, you require 2 banks in series. You should, therefore, connect 8 plates in parallel in each bank and the two banks in series, which will give a resultant value of .008 microfarad.

To take care of the entire output of the transformer, the capacity of the condenser might be increased to .02 microfarad, but the wave-length of the closed circuit with a single turn in use at the primary of the oscillation transformer will be considerably in excess of 200 meters.

With a condenser of .008 microfarad capacity and extremely short connecting leads to the spark gap and oscillation transformer, approximately 2 turns of the primary winding can be included in that circuit. This will be sufficient for the transfer of energy to the antenna circuit.

If two equal banks of condensers are connected in series the resultant capacity is one-half of one bank. But with two unequal banks of condensers connected in series, the resultant value is the reciprocal of the sum of the reciprocals of the separate units, or, in other words,

$$C = \frac{1}{\frac{1}{C\text{-}1} + \frac{1}{C\text{-}2} + \frac{1}{C\text{-}3}\text{, etc.}}$$

Where C = resultant capacity in microfarads.
C-1 = the capacity in microfarads of one bank.
C-2 = the capacity in microfarads of the second bank.
C-3 = the capacity in microfarads of the third bank.

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J. F. R., Philadelphia, Pa.:

An aerial of the inverted L type, 90 feet in length by 40 feet in height, composed of six wires spaced 2 feet apart, has a fundamental wave-length of approximately 240 meters. The distance you may expect to cover with a 1/4 k.w. transformer, depends upon the local conditions surrounding your station and the type of apparatus used at the receiving station. The range of amateur stations varies widely. Reports are often received at this office that even with the restricted wave of 200 meters, from 400 to 800 miles are covered during the night time. The daylight range of the average 1/4 k.w. apparatus does not exceed thirty to forty miles. Similarly, it is difficult to prophesy the range of a receiving equipment, but with the apparatus you describe in connection with the foregoing aerial, you should hear, during the night hours, stations on the Atlantic coast. Your receiving tuner is not quite applicable to the reception of Arlington time signals, but you should hear stations operating on wave-lengths up to 1,600 meters.

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A. D. Middlechurch, Manitoba, inquires:

Ques.—(1) Is the discharge from a transformer with a secondary potential of 25,000 volts as dangerous as a current of that voltage direct from a generator? If not, why not?

Ans.—(1) With similar frequencies, the effect would be identical in either case; both being considered dangerous to human life. We have never heard of a generator that gave a potential of 25,000 volts direct from the armature.

Ques.—(2) Is it possible to use a telephone induction coil or a medical coil for wireless transmission? Which of the two would be the better?

Ans.—(2) If the secondary potential of the coil is sufficient to give a spark discharge, it can be used as a radio transmitter. The one giving the highest voltage should be employed. Special information concerning the diagram of connections, etc., is given in the book "How to Conduct a Radio Club."

J. P. R., Yonkers, N. Y., says that with several amateur aerials of various types connected together he is enabled with ordinary receiving apparatus and crystalline detector to hear the signals from Tuckerton, N. J., between eleven and twelve o'clock each night. In view of the fact that this station operates with undamped oscillations he does not understand why he receives the signals. Our comments on the phenomenon follow:

The Tuckerton station employs the Poulsen arc generator and Goldschmidt alternator at alternate schedules. When the antenna is supplied with oscillations from the arc set the waves are not genuinely undamped; in fact there are slight inequalities in the successive amplitudes of the oscillations which have a slight damping effect on the radiated energy making the signals audible even with crystalline detectors. Again, the phenomenon may be that described in a previous issue of THE WIRELESS AGE. With a certain degree of coupling between the primary and secondary windings of a receiving tuner and the antenna circuit adjusted to resonance with a given station using undamped oscillations, currents of two frequencies may be set up in the associated receiving circuit with just sufficient difference in periodicity to cause the phenomenon of "beats," making audible the signals. Similar effects have been noted in many amateur stations within 100 miles of Tuckerton.

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A. M. L., Jr., Rochester, N. Y.:

The 80-foot aerial raised to a height of 55 feet above the earth has a natural wave-length of approximately 248 meters and a capacitance of .00033 microfarad. The second aerial with the flat top portion 200 feet in length has a natural wave-length of approximately 365 meters, and a capacitance of .0006 microfarad. If joined in parallel at the receiving apparatus the resultant capacitance will be that of one plus that of the other.

An inductively-coupled receiving tuner responsive to wave-lengths between 5,000 and 12,000 meters is fully described in the book "How to Conduct a Radio Club." The apparatus described is particularly designed for the vacuum valve detectors. If it is to be used with a crystalline detector, it is recommended that the inductance value described in that issue be reduced and the necessary wave-length adjustment in the secondary circuit obtained by connecting a large variable condenser in shunt to the secondary winding. A few experiments will reveal the correct ratio of inductance to capacity for the best signals.

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I. D. F., Ashland, Neb.:

The proposed aerial, 3,000 feet in length, will give the best signals from long distance stations located in the United States and abroad. It will have a fundamental wave-length of approximately 4,400 meters.

Concerning the resistance of the telephones for long distance receiving you should be guided by the following rules: If the receiving detector is one of high resistance and makes use of a small local battery current then a high resistance telephone should be provided. However, it is not the resistance of the telephone which determines the sensibility; it is the overall construction as well. The general run of crystalline detectors, with the exception of the crystaloi, require a telephone of about 2,000 ohms. With the three-element vacuum valve detector, telephones of from 75 to 3,000 ohms resistance may be employed. Practically equal results will be obtained with phones of any resistance lying between these values, provided the telephone is well constructed. The vacuum valve detectors generally make use of a considerable value of potential in the local circuit and in consequence the resistance of the telephones is not so important. Keep before you the fact, that the 3,000-foot aerial is not suitable for the reception of signals from stations employing wave-lengths between 600 and 1,600 meters. In fact it is of no value except for stations employing wave-lengths in excess of 4,000 meters.

Regarding the equipment: You already are supplied with a vacuum valve detector and are advised to connect it in the circuits of a supersensitive receiving set such as described in the book "How to Conduct a Radio Club." Duplicate the coils described in that article and after a series of trial experiments you will undoubtedly find that your station will be responsive to signals at a distance of a few thousand miles.

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J. F., Irvington, N. J.:

The information requested concerning the vacuum valve detectors is contained in full in the book "How to Conduct a Radio Club."

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C. S., Indianapolis, Ind., writes:

Ques.—(1) Please advise how to construct a receiving transformer of the navy or rotary type that will tune to 16,000 meters and over. If there are any sliders used please tell me and make a diagram showing connections of the sliders (transformer to be of loose coupled type).

Ans.—(1) See the reply to the query of J. A. M., Milford, Utah, in the Queries Answered department of THE WIRELESS AGE for December, 1914. No sliders are necessary. Use multiple point switches.

Ques.—(2) Would I obtain better results if I used the multiple tuner described in the August, 1915, issue of THE WIRELESS AGE with the transformer referred to and also with a Blitzen loading coil?

Ans.—(2) You would secure a greater degree of selectivity if you used the multiple tuner, but not necessarily increased strength of signals.