THE WIRELESS AGE

JANUARY
1916

A LITTLE BRIEF AUTHORITY

A Fiction Story which features Wireless in Military surroundings.

IN THIS ISSUE

FIFTEEN CENTS

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.

JANUARY, 1916

When the Zeppelins Came to London

By George H. Fischer, Jr., Marconi Operator on the Georgian

ACCOUNTS of air raids on London have been published in the newspapers from time to time, but owing to strict censorship, few details of the attacks ever reach the public. This is the way in which they are usually reported:

> OFFICIAL NEWS
> Sunday Evening.
>
> A raid was attempted by Zeppelins last (Saturday) night on the east coast. Bombs were dropped but there were no casualties and no serious damage is reported.

I happened to have the good fortune to be able to witness two of these raids and I can truthfully say that much occurs which folk outside of the raided district rarely hear of. The newspaper accounts cannot give any idea of what these raids are really like.

London is far from being a defenseless city and every possible precaution has been taken against these dangerous visitors. All lights which are not absolutely necessary are extingushed and those which of necessity must be lit are shaded so as to shine downwards only. There are hundreds of civilians serving as special constables whose duty it is to see that these regulations are carried out. In some of the outlying districts notices are sent about requesting anyone who had a police whistle in his possession to blow it immediately a hostile air-craft is sighted as a warning to his neighbors.

The Admiralty has placed numerous anti-aircraft guns and powerful searchlights in various parts of the city. Every evening at about eight o'clock these searchlights are given a thorough try out and their powerful rays can be seen far away as they sweep across the black sky. The beams of the lights were plainly visible from the deck of our vessel in the Thames, thirty miles away.

Most important of all means of defense is the Royal Flying Corps. I have it on good authority that there are nearly a hundred of their armored machines about the city of London. With such a defense it would seem to be impossible for a Zeppelin to fly over the city and get away again; yet this feat has been accomplished not only once, but several times in succession.

The first attack that I had an opportunity to observe came at fiften minutes to twelve o'clock on the night of September 8. It was a very dark night and conditions were favorable for a surprise. At Millwall, where our ship was docked, every light was out. We were not even allowed a lamp at the gangway; and, as we had inflammable cargo, we were tied out in the river and had to climb over a sort of pontoon bridge made of barges. At about half-past ten we heard a crash, and as everyone was expecting "Zepps" we immemdiately jumped to the conclusion that the noise was a bomb. When we got on deck, however, we found that our chief officer had lost his way climbing across the barges and fallen into the river. After some effort we managed to get him aboard and were joking him on his appearance when another crash sounded; this time it was the forerunner of an aerial attack.

There were five terrific explosions in our immediate vicinity, one breaking the electric light lamps on the dock near us. We later found that the bomb which worked this destruction had dropped more than a hundred yards away. We were unable to see the machines, but the whirr of their engines could be heard very plainly as they passed overhead. I must admit that at the moment this war machine we could not see was driving over us, I had a strong yearning to be safe in the shadow of the Statue of Liberty. For some reason the searchlights were rather slow in coming into action, and when they did, the Zeppelins were well under was in a northeasterly direction. Several shells whistled after the rapidly disappearing craft, but they were ineffective.

All of the victims of the raid were civilians, as far as I could find out, and numbered about fifty—mostly women and children. The bombs had been dropped on workingmens dwellings in the neighborhood of the docks and in one street three houses were totally destroyed. Another bomb fell on a baker's shop, and, passing through the roof, ceilings and counter, crashed through to the basement without exploding. Yet it worked considerable damage to the shop by its force alone. The next morning the proprietor hung out a sign with the British war motto, "Business as Usual," and beneath were the words, "Don't give us sympathy, give us an order." Several incendiary bombs failed to explode. These were promptly taken possession of by the police.

The following night at ten minutes after eleven o'clock another and more disastrous raid took place. I was walking down Fenchurch street to the station on my way to the ship when I heard an explosion somewhat similar to those of the previous evening, but of far greater force. Four bombs fell. Before the last had exploded the searchlights were thrown on and directly overhead could be seen the huge yellow cigar-shaped form of the Zeppelin. Everyone was sure that it could not possibly escape now, as there were several batteries in that district. These immediately opened fire. A deafening noise followed. Guns boomed everywhere, even the cruisers at the docks taking pot shots at the tempting target which had not moved since we first sighted it. Every shell that broke near the Zeppelin brought cheers from the spectators in the streets and several persons declared that the machine had been hit. But the big raider still hung in the air as if in defiance of the guns.

Then, like a swarm of bees, the British aeroplanes went up and the Zeppelin gradually began to rise and glide away into the clouds. The aeroplanes themselves were not visible to us at such a height, but the orange flashes of their guns could be seen distinctly against the black sky. The Zeppelin also fired machine guns. This fight in the sky lasted for not more than ten minutes. After that both the Zeppelin and the aeroplanes were soon lost to view.

I was so entralled with the sight I had witnessed that for some time I stood gazing at the sky where a few minutes before the aerial skirmish had taken place. Then the sound of fire bells brought me to my senses. Engines were dashing down the street, and, turning in the direction in which they were headed, I saw another sight to be remembered. The sky was lit up with a brilliant red glow, many tall buildings being silhouetted against it. St. Paul's Cathedral stood in the brightest spot. The glare crept higher and higher in the sky every minute.

The bigness of the events filled me with awe. This was immediately dispelled by the remark of a young man standing near me. "Awfully exciting, don'cher know," he said. "I hope that's my tailor's place. I owe him a beastly awful bill!"

In the morning I went to see what damage had been done and found the flames still smouldering. One building, which I was informed had been a church, was totally destroyed. Another bomb had dropped on a motor bus in front of Liverpool street station and blown it to bits. Windows in this district had been smashed and in another street an entire block of shops had been wrecked. The streets were roped off and no one was allowed to see too much, but it was evident that there had been a large property loss. There had also been several small fires. The casualty list showed the names of fifty-two civilians and two soldiers. The attack was made by three dirigibles, but I only saw one.

That was enough.

BOOK REVIEWS

EXAMPLES IN ALTERNATING CURRENTS. *By Prof. F. E. Austin.*

No one desiring valuable information regarding the fundamental theories of alternating-currents can afford to be without this book.

There are two classes in particular to whom the volume will appeal, and whom it will greatly assist: students of electrical subjects who are unable to pursue regular college courses, and those engaged in practical work who desire working information relative to alternating-currents. Those pursuing correspondence courses as well as regular college students will also find the book of great value.

The immense amount of labor and time which has been put into working out the examples, will save just that much in time and labor of others. The technical information is given in such clear and simple English as to be readily comprehended by the ordinary high-school student.

Those who desire to construct apparatus or to clearly understand the fundamental principles underlying the transmission of power or of wireless telegraphy, will find the text of considerable assistance.

The fundamental information relative to coils and condensers is the most complete ever written; while the various tables of mathematical and physical data are arranged for easy and quick reference.

Copies bound in flexible leather may be purchased from Book Department The Wireless Age, 450 Fourth Avenue, New York, $2.40 postpaid.

THE BOOK OF WIRELESS. *By A. Frederick Collins.*

For the absolute novice who knows little or nothing of electricity in a fundamental way, this book is particularly appropriate. From cover to cover it concerns itself solely with how to make simple equipment; it tells in turn how to make a small outfit, describing sending equipment receiving aquipment and aerial at a total cost of material of eleven dollars; and then describes better equipment to be constructed as progress is made, costing about four times the sum, but good up to 100 miles' transmission and capable of much greater distances in receiving. A dozen pages cover the necessary information on how wireless works and a short chapter deals with code practice. Government regulations for amateurs and twenty pages of definitions of terms and generally useful information make the book complete for the field it seeks to provide for.

In the third part the construction of a half-inch induction coil and half-kilowatt transformer are fully described. Every step is covered in such a manner that the directions can be followed by any schoolboy, 219 illustrations facilitating the work greatly. Written solely for beginners, this book is as good, if not a trifle better, than its predecessors. Sold by Book Department, The Wireless Age, 450 Fourth Avenue, New York, at $1.00.

ANOTHER FORD CAR STORY

There seems to be no end to the uses of a Ford car. It was a Ford which helped in getting Galveston in wireless communication with the outside world, after the big August storm.

A report forwarded to the New York office of the Brush Electric Co. of Galveston, the tall chimney of which was used as a wireless tower after all other wireless stations had been blown down, tells the story of how the Ford helped. The electric company managed to keep a dynamo running to furnish current for the operation of the wireless, and the manager reported as follows:

"To keep the plant running, boiler water was hauled in cans from the ice company's well, and fuel oil was pumped to the plant from the storage reservoirs, by belting one rear wheel of a Ford to the oil pump. The aerial was stretched from the top of the stack to the nearest pole, and the other apparatus was set up in a room in the basement. Monday morning the electric plant and Galveston were successfully communicating by wireless with the rest of the world."

Private Davis, whose duty it was to pick up the wire reeled out by the motorcycle and conceal it from the enemy

Above, operating the combined telephone and wireless buzzer. At the right, motorcycle to carry wire for the combined telephone and wireless buzzer system

Receiving orders on the firing line by wireless. Corporal Oberland is shown in the photograph

The Portable Set in Mimic Warfare

How It Was Employed By the Massachusetts National Guard in a Preparedness Demonstration

IN these days when wireless telegraphy occupies a prominent place in plans for war preparedness there is especial interest in the announcement that the Massachusetts National Guard at its demonstration camp held recently on Boston Common, successfully employed a field radio equipment. Those who have closely followed the history of wireless in connection with military affairs, will recall that experiments with equipments of the portable type began in 1902.

The transmitter of the first Marconi cavalry equipment differed only slightly from the later type except that the latter was not so convenient for operation and the original apparatus required the protection of a tent when rain fell. A dynamo driven by a pedal gear, which was made to fold into a case for transportation, provided the power.

Three horses were used at first to carry the station, but afterwards the number was increased to four. More elaborate cart stations were designed, a range of almost 100 miles being obtained by them in 1910 in Italy. The stations were taken to Switzerland where communication was established between different points, notwithstanding the difficulties to be overcome.

It goes without saying that the members of the Massachusetts National Guard were not confronted with the same difficulties in their demonstration that faced those who carried on the tests in Switzerland. The Signal Corps, Ambulance Corps, several machine gun companies and a company of infantry took part in the demonstration in Boston. The exercises of the Signal Corps included the setting up of a field wireless station, in which a motor tricycle cart was used. The demonstration was carried on as though actual war conditions prevailed, the line being reeled out and concealed. Operators worked in the rear of the firing line and at headquarters.

THE WAR

How Wireless Is Being Employed in the Hostilities

A dispatch from Athens, Greece, says that an S O S call reached Athens on the morning of December 4 from an unnamed American ship, the message stating that she was being attacked by an Austrian or a German submarine south of the Island of Crete. Subsequent efforts to communicate with the vessel were fruitless.

The American Legation in Athens sent a report regarding the matter to Washington.

Marconi wireless was employed to a considerable extent on Henry Ford's peace ship, the Oscar II, during her recent trans-Atlantic voyage, messages being sent by wireless to each monarch in Europe. They read in part as follows:

"We do earnestly entreat you and the rulers of all the other warring nations to declare an immediate truce. Let the armies stand still where they are. Then let the negotiations proceed, so that the soldiers may be delivered from another bitter winter in the trenches, and sent back to their labors and their firesides. As there is no other way to end the war except by mediation and discussion, why waste one more precious human life?"

A wireless message was also sent to Washington, asking support for the peace mission. Newspaper correspondents on the Oscar II used the Marconi wireless service to send reports of the events occurring on the ship and the progress of the voyage.

A wireless message sent on December 11 to C. W. Bowring & Co., of 17 Battery place, New York City, shipping agents, said that the British freighter Tyninghame, which had left Pier 4, Erie Basin, Brooklyn, N. Y., for Liverpool, with 5,000 tons of sugar for the British Government, was on fire in No. 4 hold and was returning to port. Captain David Jones in his message requested that assistance be sent immediately and the fireboat Seth Low met the burning steamer after she had been anchored between the Statute of Liberty and Staten Island.

When the Seth Low went alongside the hatches were taken off and several hundred tons of water were pumped down onto the burning sugar for three hours until the blaze was subdued. By that time the fire and water had ruined several thousand bags of sugar valued at more than $75,000.

While the Tyninghame was being loaded in Erie Basin on December 5, fire started in No. 4 hold and caused $20,000 damage before it was got under control. Th esecond fire was in the same hold, and started among the new sugar shipped to take the place of the sacks that were destroyed in the first fire.

Several fires have been started by bombs or chemicals hidden in the holds of ships since the outbreak of the European war.

A representative of the United States Navy Department came to Baltimore, Md., on December 14, and dismantled the wireless apparatus on the Hamburg-American steamer Bulgaria. After the antenna had been removed a wax seal was placed at the point of removal to insure against a reattachment.

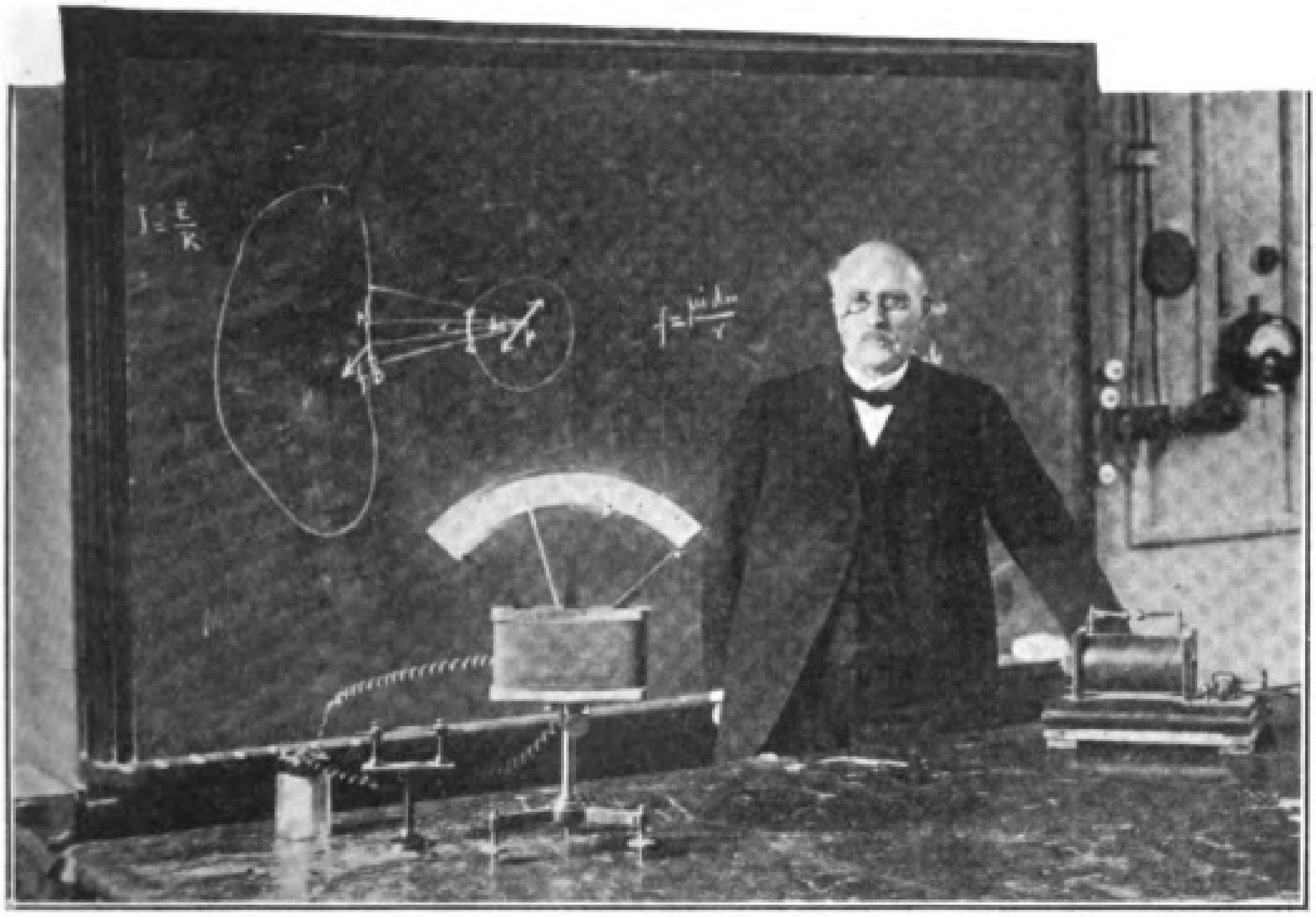
It is reported that the wireless station at Cocos Island which was destroyed by the German cruiser Emden, is again in operation.

SIGNALLING CORPS ON MOTORCYCLES

Arrangements are being made for the organization of a motorcycle corps to be added to the Thirteeenth Regiment, Coast Artillery. It is intended to have the corps composed of twenty-four enlisted men who will be trained in all kinds of signalling, such as heliographing, searchlight, acetylene, wireless, ardois and wigwagging. The reason for mounting the men on motorcycles is because of the considerable distances that may have to be covered in reaching the various coast batteries.

Those Wireless Bomb-Exploding Devices

What An Authority Thinks of Inventors' Claims



Dr. Edouard Branly

IT is just possible that gullible newspapers and pseudo-scientific journals will now drop a certain type of story which has been bobbing up serenely on an average of once a month over a period of some three years. That is the bomb-exploding-by-wireless inventor who has just devised a death dealing machine that with fiendish glee will sink all the navies afloat. You know the yarn: Ezra Dogstory, who has devoted a lifetime, etc., etc., demonstrates in an open field how explosions can be directed by the insidious wireless spark. The great principles discovered by Ezra are to be applied to the destruction of mighty vessels and impregnable fortresses, the crafty spark being propagated from great distances and directed with unerring accuracy to the powder magazines of said armaments. Of course the government alone shall have the benefit of Erga's great discovery, he is not seeking financial reward, it is the greatest pleasure of his life to be of service to his country—and so on. With photos of the genius in picturesque and unassuming poses, the story invariably looks good to the City Desk.

But Ezra's nice little publicity dodge, good for publication in five languages, will serve no longer.

No less an authority than Dr. Edouard Branly says what these self-confessed inventors purpose doing is an impossibility. And for those who don't know Dr. Branly, it may be mentioned that he is the inventor of the "coherer" which was featured so prominently in the reception of wireless signals in the early days of the art. Besides this, Dr. Branly has the degrees of Doctor of Physical Science and Doctor of Medicine; he received for his exhibit of radio-conductors the *grand prix* awarded by the International Jury of Superior Precept Instruction, and the order, Chevalier of the Legion of Honor, for his valued aid in the discovery of wireless telegraphy. Many other French honors have come to Dr. Branly in the 71 years of his lifetime, but those just detailed are sufficient to establish his standing with wireless men. Next time the obscure bomb-exploding inventor breaks into print, recall what the voice speaking with authority remarks here:

"The human species," Dr. Branly says, "is paying a sufficiently large tribute to science in this war; it is scarcely worth while to discuss the visionary powers that are attributed to it. It has increased the flow of blood and the enormity of ruins, making international conflicts more horrifying, but there are things it cannot accomplish, unfortunately. Science sends the Lusitania to the bottom of the Atlantic with more than a thousand human souls, but it is powerless, contrary to some pretensions, to cause the destruction at a distance by electric current of the engine which by the will of man caused a disaster hitherto reserved to the wrath of the elements. Neither can it reach by radiating waves the destructive engines of the air.

"The false notion of those who pretend to transmit destructive power through space arises from the fact that wireless telegraphy is accomplished through the production of a minuscule spark at the receiving station. That spark being sufficient to produce an effect upon extremely sensitive instruments at great distance, they concluded that at a limited distance, of a mile for instance, a much stronger spark could be produced; as that spark is supposed to go through all sorts of obstacles they inferred that it could also pierce the steel shell of engines of war. In the first place no available power could produce a spark of sufficient intensity; there isn't the slightest caloric power in the wireless spark at the receiving end. In the second place it would be necessary for it to strike with absolute precision a joint or fissure in the plates in order to get into contact with the explosive. Different accidents erroneously attributed to the wireless current may have put some of these visionaries on this track. It was discussed whether the Volturno was not fired at sea and if the explosion of the French battleship Jena at Toulon was not provoked by wireless sparks.

"The Eiffel Tower wireless transmitting station produces most formidable sparks, yet not the slightest accident has ever been caused in the vicinity. To produce explosions at a distance something different from wireless electric currents must be found. Most of the inventions for this purpose that have come to my notice when thoroughly investigated were found to be connected with concealed clockwork, and in no case when powder was brought in by disinterested parties were they able to provoke an explosion.

"There are a great many 'chevaliers d'industrie,' or what you might call confidence men, in English, who have not hesitated to make profit out of the tension of the public mind by exploiting pretended inventions of this kind, but no scientist worthy of the name makes such pretensions. If there were means of blowing up the Eiffel Tower from Berlin everyone would know it, yet people are frequently swindled by supposed appliances for transmitting energy—even available for industrial enterprises, without a conductor. They all want a great deal of money; one asked for the modest sum of 28,000,000 francs. One man who made the mistake of consulting me afterward instead of before, paid 200,000 francs for an interest in an invention of this kind."

Radio Frequency Changers*

By Alfred N. Goldsmith, Ph.D.

Part II (Conclusion)

WE pass to the methods of frequency change involving the use of electrolytic cell rectifiers. If we study the behavior of an electrolytic cell employing a solution of alum as the electrolyte and carbon and aluminum as the electrodes, we discover that it permits the passage through it of current only in one direction, namely, from the aluminum to the carbon. In Fig. 9 is shown an application of such a cell to a frequency changer. V_1 and V_2 are two such electrolytic cells; and S_1 and S_2 are the primaries of two transformers of which S′ and S″ are the secondaries. It will be noticed that V_1 and V_2 are connected with opposite polarity in their respective circuits, and that in consequence current can flow through S_1 only in one direction and through S_2 in the opposite direction. Furthermore, coil S_1 is wound in the opposite direction to coil S_2. On the other hand, S′ and S″ are wound in the same direction. In Fig. 10, curve a shows the current passing through S_1, and the consequent magnetic flux through the corresponding transformer core. Curve b shows similarly the induction in the core of the second transformer. The total magnetic induction for both transformers is shown in curve c. It will be seen

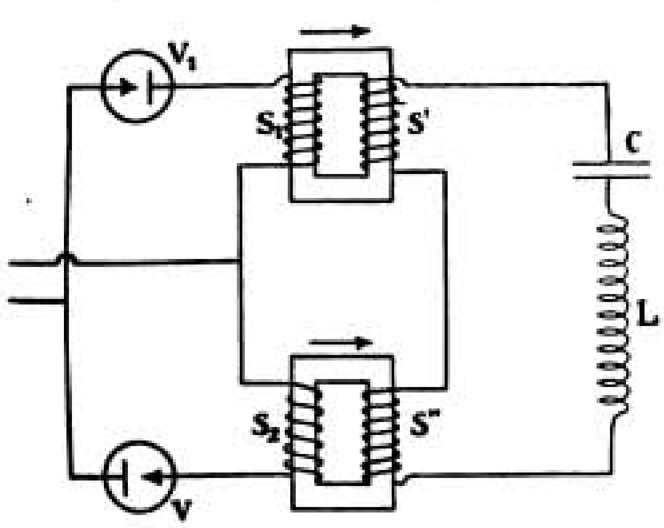


Fig. 9

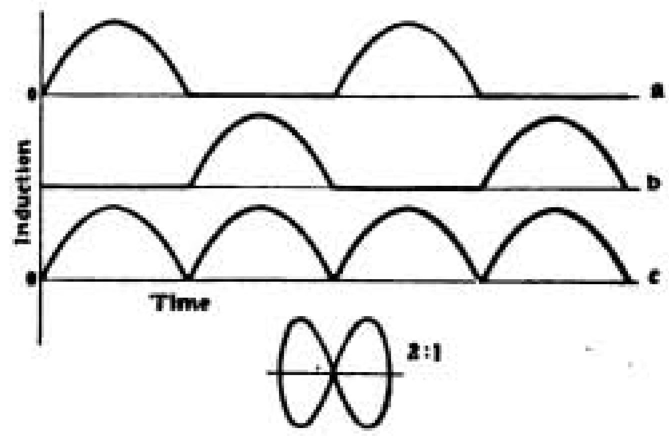


Fig. 10

that during the time of a single alternation of the supply current there are two maxima and two minima of the magnetic induction in the transformer cores. It is therefore clear that there will be produced in the circuit containing the two secondaries a current of double frequency although the wave form of this current will be noticeably distorted in view of the non-sinusoidal character of the magnetic induction.

If it is desired to draw any appreciable amount of energy from the frequency changer, the inductance L and the capacity C are connected in series with the two secondaries, thereby bringing that circuit to resonance with the double frequency. Zenneck has done a considerable amount of valuable work along these lines and has found these cells to be usable at radio frequencies. However, the passage through them of considerable energy is attended with certain difficulties based on excessive heating and deterioration of the electrodes. Using a cell having lead and aluminum electrodes

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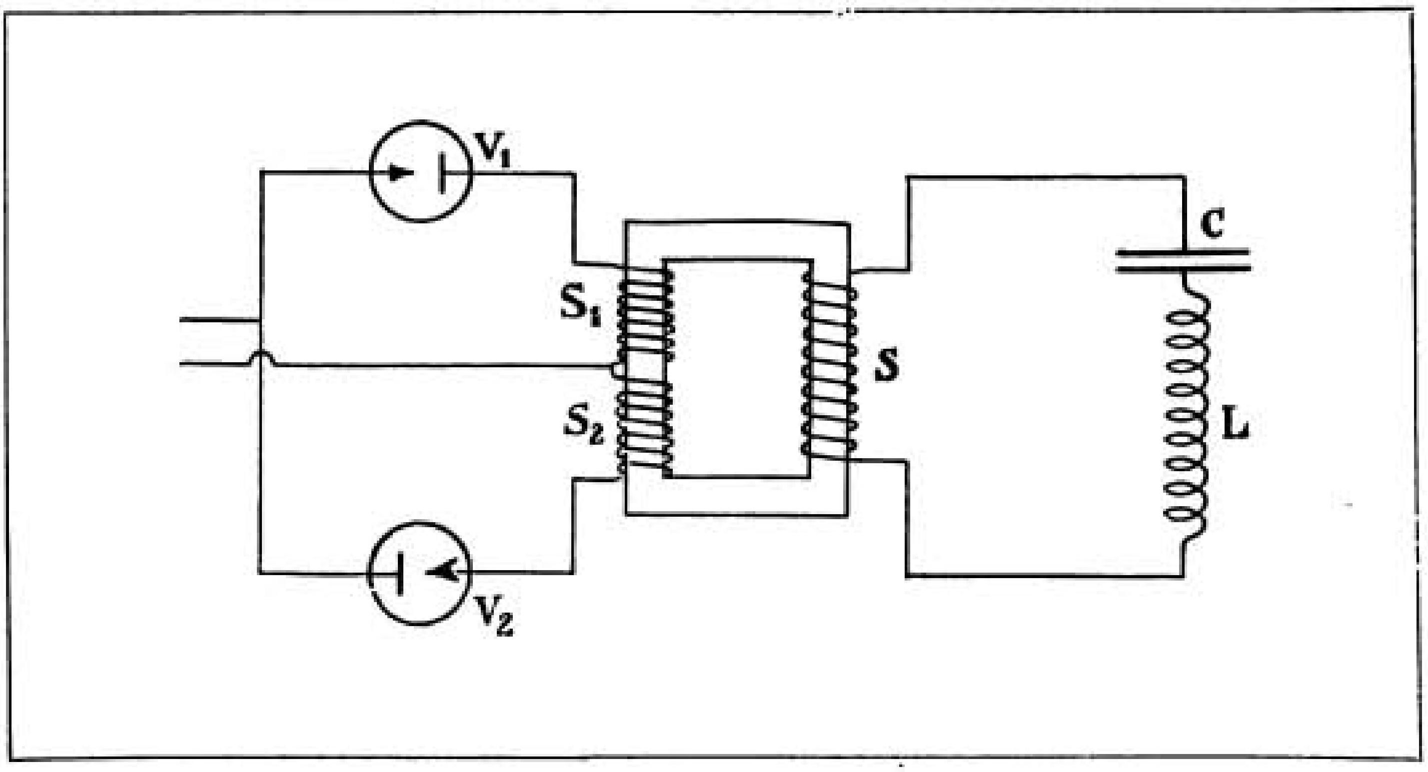


Fig. 11

in a 5 per cent. solution of ammonium phosphate, Zenneck has demonstrated the production of the double frequency in an admirably clear way by the Lissajous figures. A Braun tube oscillograph was employed. Near the cathode stream were placed two mutually perpendicular coils, one of which was connected to the primary circuit of the frequency transformer and the other to the secondary circuit thereof. The familiar Lissajous "figure of eight," which signifies a ratio of frequencies of two to one, immediately appeared on the screen (Fig. 10).

Among the other circuit arrangements suggested by Zenneck are those shown in Figs. 11 and 12. In Fig. 11 only a single transformer is used, and in spite of the interaction between S_1 and S_2 in that case, a double frequency secondary current is obtained. In Fig. 12 a transformer with but a single winding on both primary and secondary is employed. The current path during a half cycle in this case is through the path $V_2S_1V_3$. During the second path of the cycle the current path is $V_1S_1V_4$.

Continuing the consideration of frequency changes without moving parts, we come to a method for tripling the frequency directly by taking advantage of certain characteristics of an ordinary alternating current arc. It is well known that the potential difference at the terminals of an alternating current arc may have the form shown in Fig. 13. So greatly deformed a wave form naturally suggests the existence of strong upper harmonics. It is in fact found that if we decompose this curve into component waves of the fundamental and other frequencies, the third harmonic is very prominent. In Fig. 14, curve *a* represents fairly accurately the potential difference at the terminals of the arc. Curve *b* shows one of its components; namely, that of the fundamental frequency. Curve *c* shows the component of triple frequency; in fact, curve *a* is merely the sum of curves *b* and *c*. A circuit arrangement which can be employed to advantage under these conditions is given in Fig. 15. The circuit L C is tuned to the triple frequency, and the inductances D prevent to a certain extent the triple frequency current from getting back to the alternator. The arrangement shown further permits obtaining the fifth, seventh, ninth and so on, frequencies, provided the circuit L C is tuned to the appropriate frequency. In fact, Rukop and Zenneck have done considerable work for the case where the frequency of the circuit L C was 300 times the fundamental frequency. For details of this investigation, the reader is referred to their article in "Annalen der Physik," 1914, Volume 44, page 97.

We consider now the extremely important cases wherein stationary frequency changers are employed, their operation being dependent on electromagnetic induction and the peculiar properties of iron. In Fig. 16, is shown a typical B-H (magnetizing force-induction) curve for iron. Let us suppose that the magnetization of the iron has been brought to the point x. If now, by means of a superposed alternating magnetizing force, equal increments and decrements be added to the magnetizing force, the magnetic induction will increase during the positive half of the cycle by the small amount e f. On the other hand, during the negative half of the cycle, the induction will diminish by the considerably larger amount x d. The explanation of this phenomena is to be found in the well known magnetic saturation qualities of iron. In other words, a marked deformation from a sinusoidal variation of magnetic induction will occur when nearly saturated iron cores are employed. Such a deformation always leads to the production of upper harmonics, and it is upon this principle that the entire series of frequency changers employing iron is based.

A modification of the method just mentioned, and one of a highly ingenious sort, has been devised by Dr. R. Goldschmidt. It will be remembered that Rutherford first showed that remanent magnetism in iron could be destroyed by an alternating current field of high frequency. Furthermore, the hysteresis loop of iron for a magnetic cycle is much diminished in area if the iron is at the same time placed in a weak high frequency field.

Consequently it follows that if a piece of iron be magnetized longitudinally by a direct current field and transversely by an alternating current field, any slow variations in the direct current field will show only small hysteresis effect. A rough physical explanation of this phenomena is given by the consideration that the transverse magnetization keeps the elementary magnets of the iron in a mobile condition and thereby permits the longitudinal field to control them accurately and instantaneously. The large "static friction" between them is replaced by a much smaller "dynamic friction." Furthermore, if a direct current transverse field be employed, the effective permeability of the iron for the longitudinal magnetization will be diminished, and the hysteresis loop therefor will be changed in slope. We have here the interesting situation that two mutually perpendicular coils may react on each other through the influence of the medium between them, and in spite of their apparent zero mutual inductance.

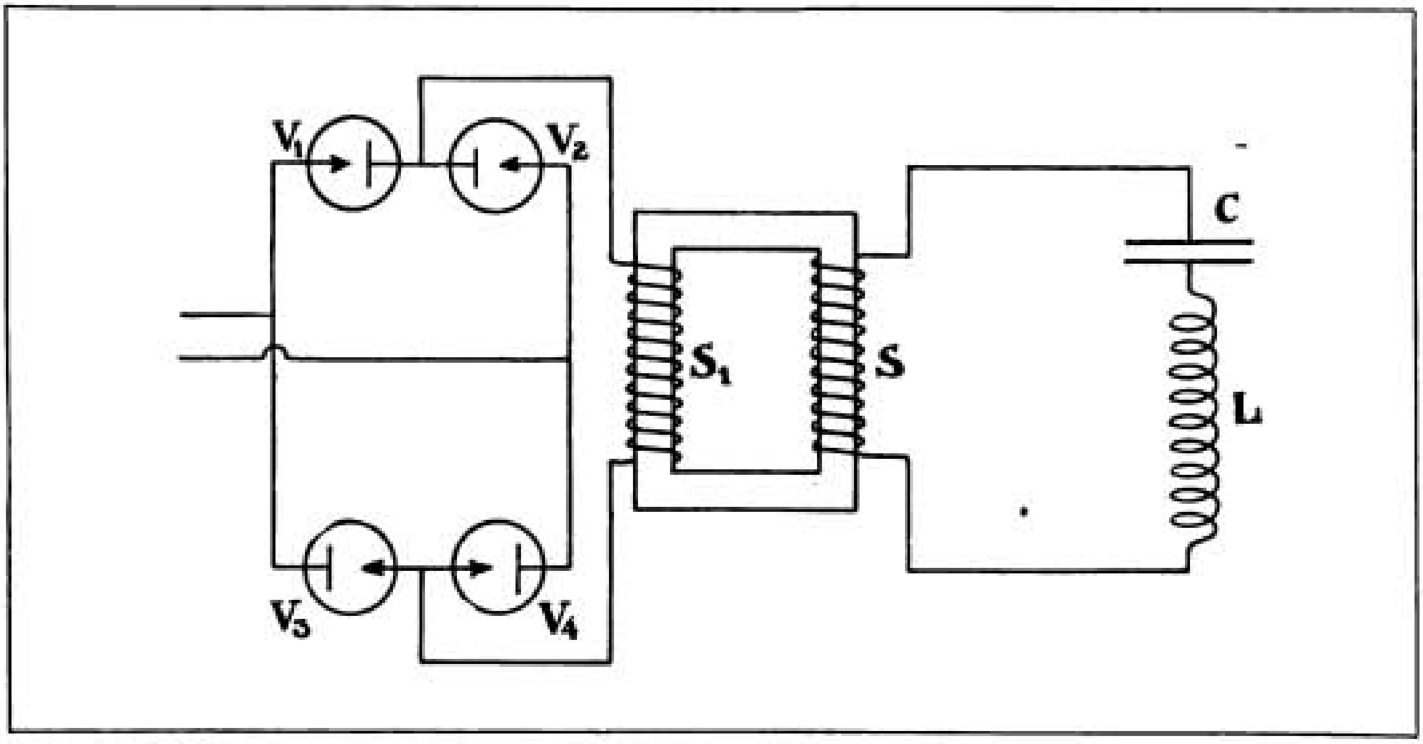


Fig. 12

The arrangement used by Goldschmidt is given in Fig. 17. The iron tube r is magnetized longitudinally (axially) by means of the coil *a* and is magnetized transversely by means of the coil *b*. If the longitudinal magnetization is produced by direct current and the transverse magnetization by alternating current, both the positive and the negative maxima of the alternating transverse field will cause minima in the strength of the longitudinal field. These variations in the longitudinal field have, therefore, a frequency which is twice that of the alternating current supplied to the transverse field.

If now we connect across the terminals of coil *a* a condenser, whereby coil *a* and the condenser are resonant to the double frequency, and if we simultaneously place in the large choke coils direct current supply lines to the coil *a* to prevent alternating current getting back to the direct current source, we shall be able to draw considerable amounts of double frequency energy from the terminals of coil *a*.

By a further artifice we may carry the process of frequency transformation forward any desired number of steps. If we have a direct current as well as an alternating current flowing in the transverse magnetizing coil *b*, the double frequency current in coil *a* will produce a quadruple frequency current in coil *b*. The next step will give us a current of eight times the fundamental frequency in coil *a*, and the process may be continued through any desired number of steps. Any of the upper frequencies may be brought to resonance and energy absorbed at that frequency by appropriate tuning. The limitations of the process as to energy output are based on the small amount of iron which is available in any arrangement of this sort and the consequent overloading thereof.

The method next described was shown by Epstein in 1902 (German patent 149,761), and has since been worked out and amplified in detail by Joly in 1910, and by Vallauri in 1911. The circuit arrangement employed is shown in Figure 18. As will be seen, an alternating current source A sends its current through the primary P_1 P_2 of two transformers. These primaries may be either connected in series or in parallel. They are wound oppositely. A direct current source B supplies two auxiliary coils M_1 M_2, which coils are wound on the transformer cores. These direct current coils are also wound oppositely. The secondaries of the transformers S_1 S_2 are wound in the same direction and connected as shown.

The operation of this device is as follows: The direct current magnetization of each of the transformer cores is such that it is working at the knee of the magnetization curve. If we consider Figure 19, curve a, we shall have a representation of the varying magnetic flux or induction in one of the transformers.

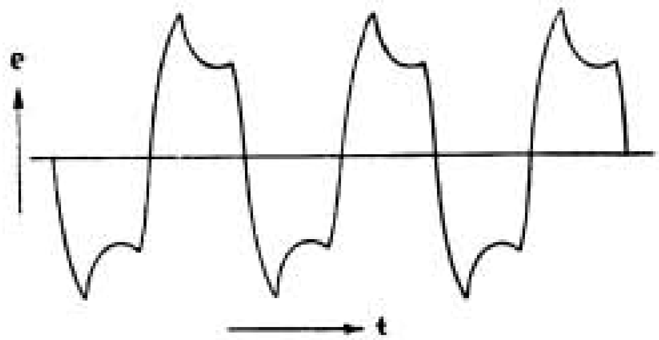


Fig. 13

The dotted horizontal line represents the constant direct current induction, the full line represents the resulting induction. It will be seen that when the positive half of the alternating current cycle is taking place, there is only a small increase in the magnetic induction, whereas when the negative half cycle is taking place, there is a large diminution in the induction. It will be noticed that the direct current coils and the alternating current coils on the two transformers are wound so that during the positive half cycle they assist each other on one transformer and oppose each other on the other. From this it follows that the induction in the second transformer is given by curve b, which lags practically 180 degrees behind curve a. The resulting total induction is given by curve c, and is seen to have a double frequency. In Figure 20, oscilligrams of the phenomena mentioned are shown. The voltage at the terminals at one of the transformers is given by E_1; that at the ter-

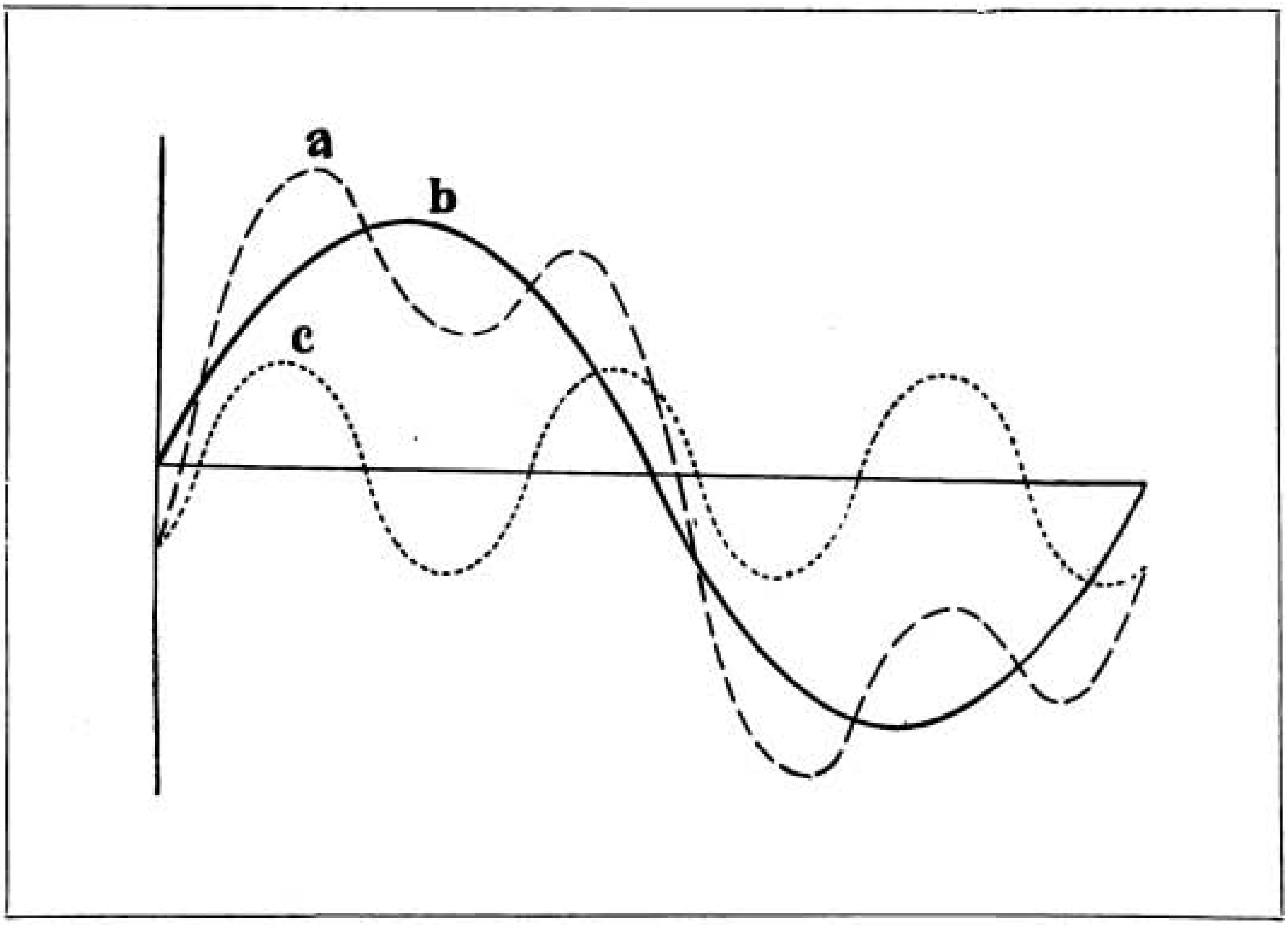


Fig. 14

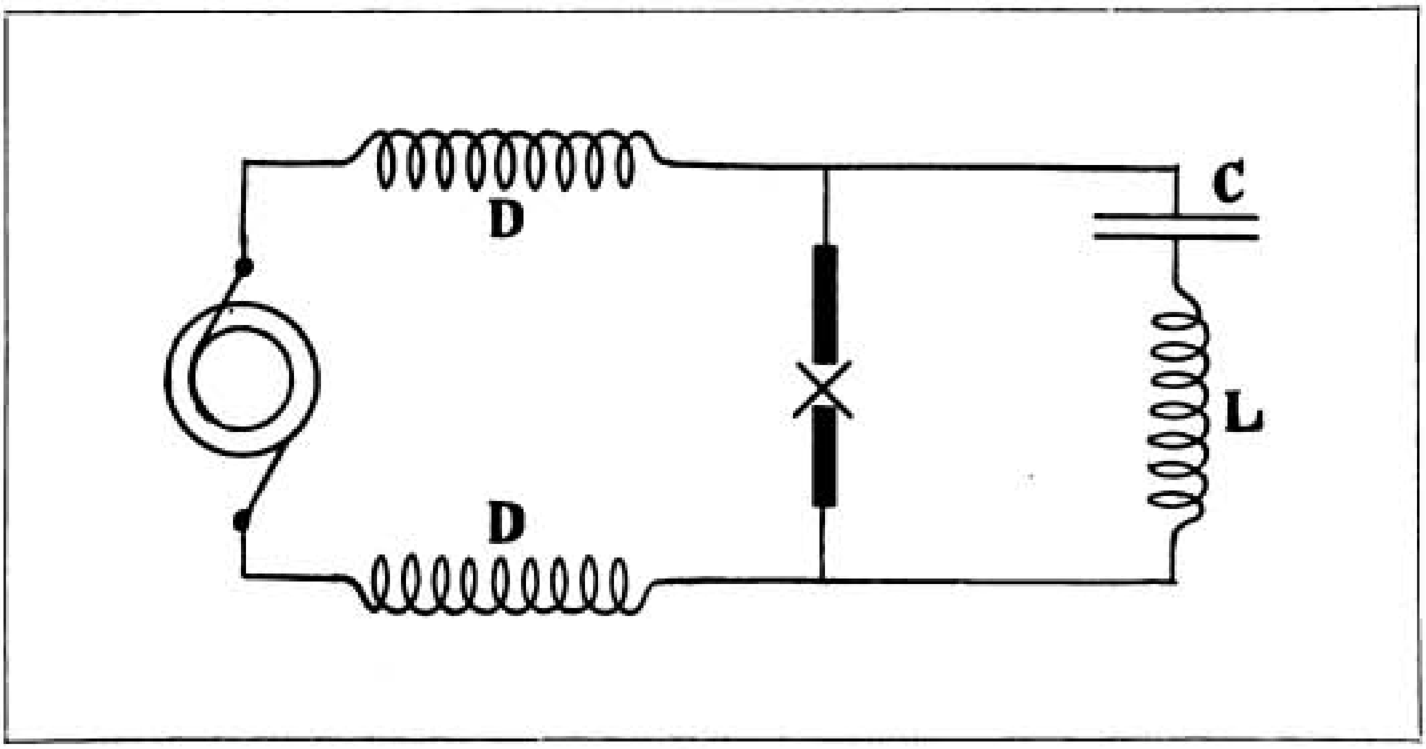


Fig. 15

minals of the other transformer by E_2, and there is also shown the resultant voltage, namely E_1-E_2. This latter is seen to be of double frequency.

A simplified modification of the circuits shown is given by Vallauri, and is illustrated in Figure 21. It will be seen that only a single transformer is used, and that a special small auxiliary transformer T is employed, whereby the double frequency alternating current which is induced in the direct current circuit is neutralized and suppressed. All the arrangements described are readily adaptable to use with two phase and polyphase currents. Some interesting data is given by the inventor. Using a 0.5 kilowatt transformer without tuning capacity, and with fairly large leakage, an efficiency of 0.75 was obtained. It was possible to increase this efficiency still further by making the alteration in flux density considerably larger than in the usual transformer. In all frequency changers of this type, the secondary voltage leads the primary current considerably, and the device works at a low power factor; say under 0.5.

Joly has described a method for directly tripling the frequency, using iron core transformers. It depends upon the following principles. If we send an alternating current through the primary of a transformer, and arrange that at the maximum current point of the cycle the iron core shall still be working far below saturation, the induction curve will be a peaked curve such as is shown in curve c of Figure 22. On the other hand if we work the iron at saturation value for the maximum current point of the cycle, we shall obtain a very flat-topped induction curve as shown by curve b of the same figure. If two such primaries, of the classes mentioned, are connected in series in opposite directions on two trans-

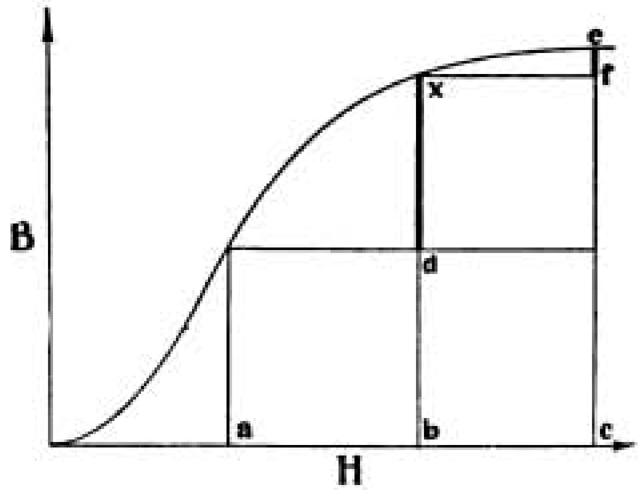


Fig. 16

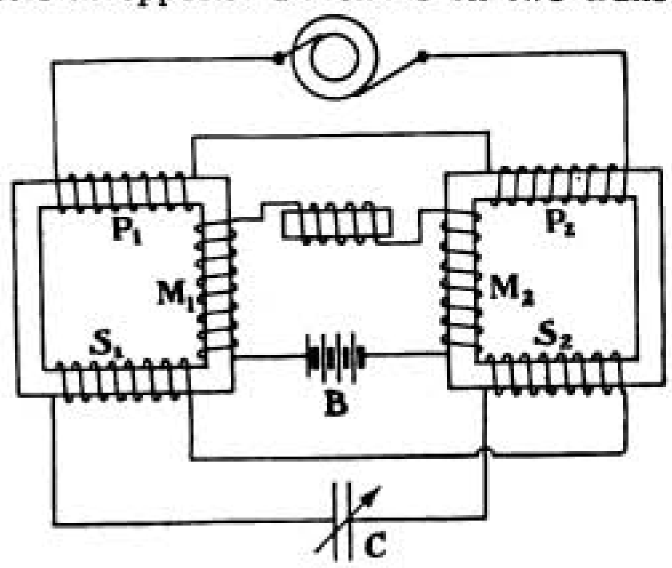


Fig. 18

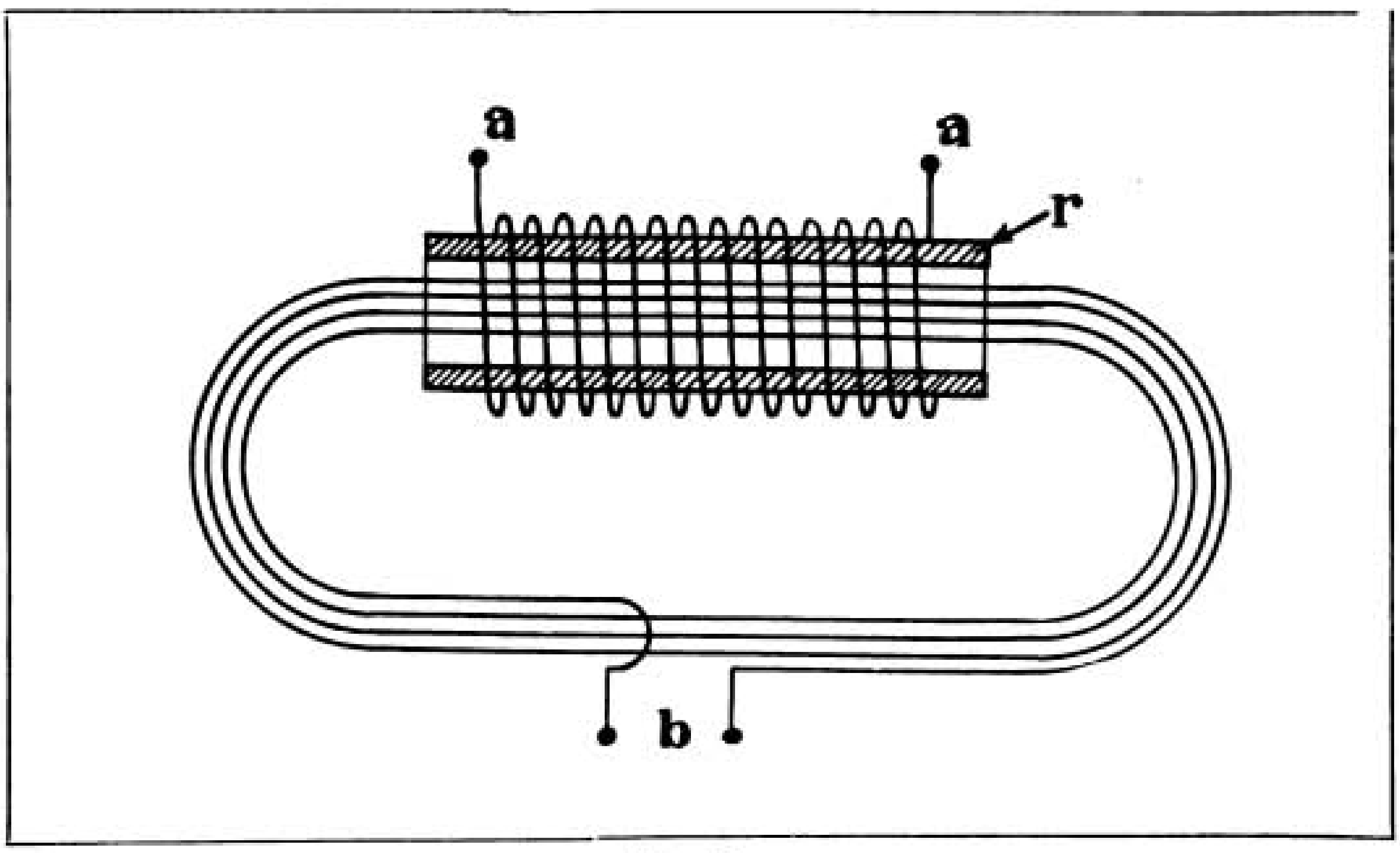


Fig. 17

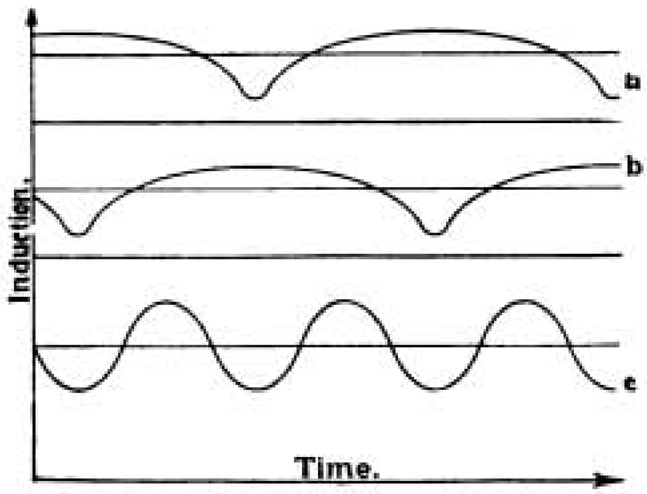


Fig. 19

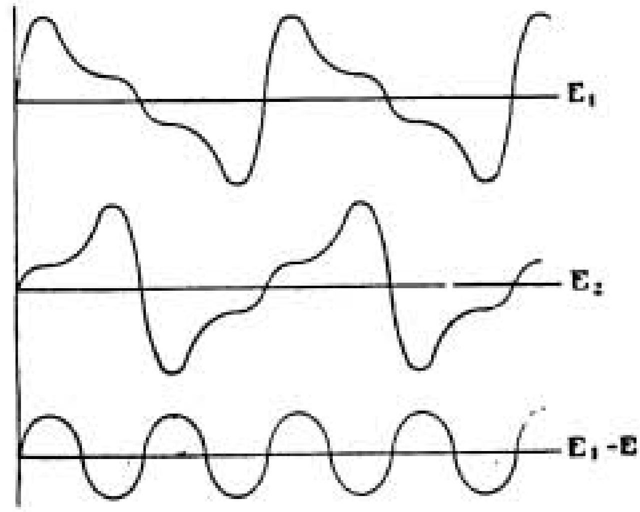


Fig. 20

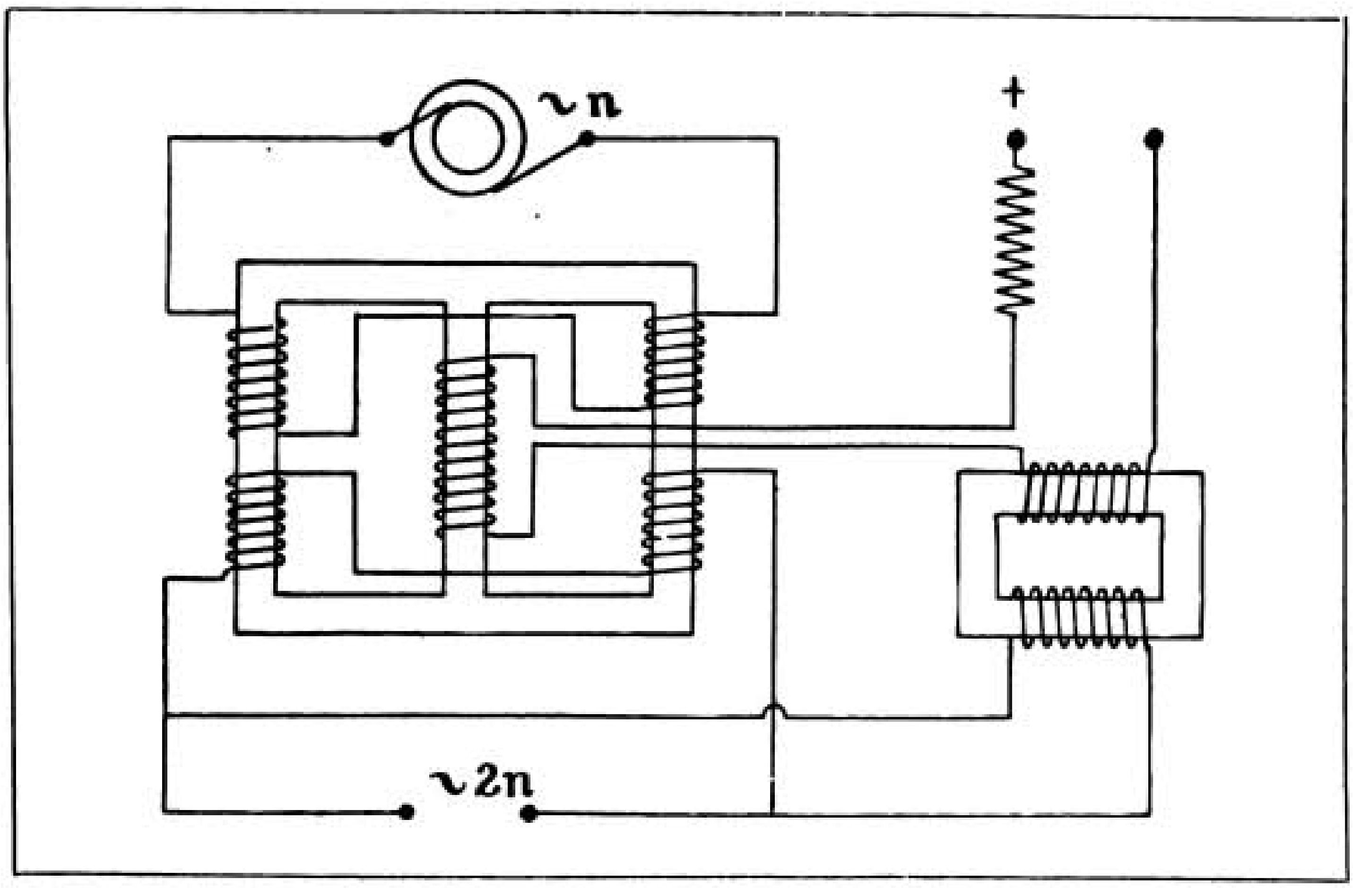


Fig. 21

formers, as shown by S_1 S_2 of Figure 23, the resulting secondary electromotive force will be of triple frequency. This is clearly seen from curve d in Figure 22, which curve represents the difference of the two induction curves in the separate transformer. It will be noted that the secondaries, S′ and S″, are wound with appropriate numbers of turns, so as to compensate for the inequalities in the number of turns of S_1 and S_2. Furthermore the secondary circuit is carefully tuned to the triple frequency. Needless to say a very rapid multiplication of frequency can be obtained by this method. For example, the frequency can be raised 81 times in only 4 steps. In the foregoing, the author has utilized among many other sources, discussions on the subject of radio frequency generation and multiplication by Professor B. Glatzel and Dr. F. Kock.

It is our belief that the most fruitful results in the field of radio telephony may well be obtainable by the use of one or the other of the frequency changers which have been herein described. One of the difficulties in practical long distance radio telephony, and it is a very serious difficulty, is the control or modulation to speech form of the outgoing energy by an ordinary microphone transmitter. Up to the present time, it has not been possible to replace the ordinary

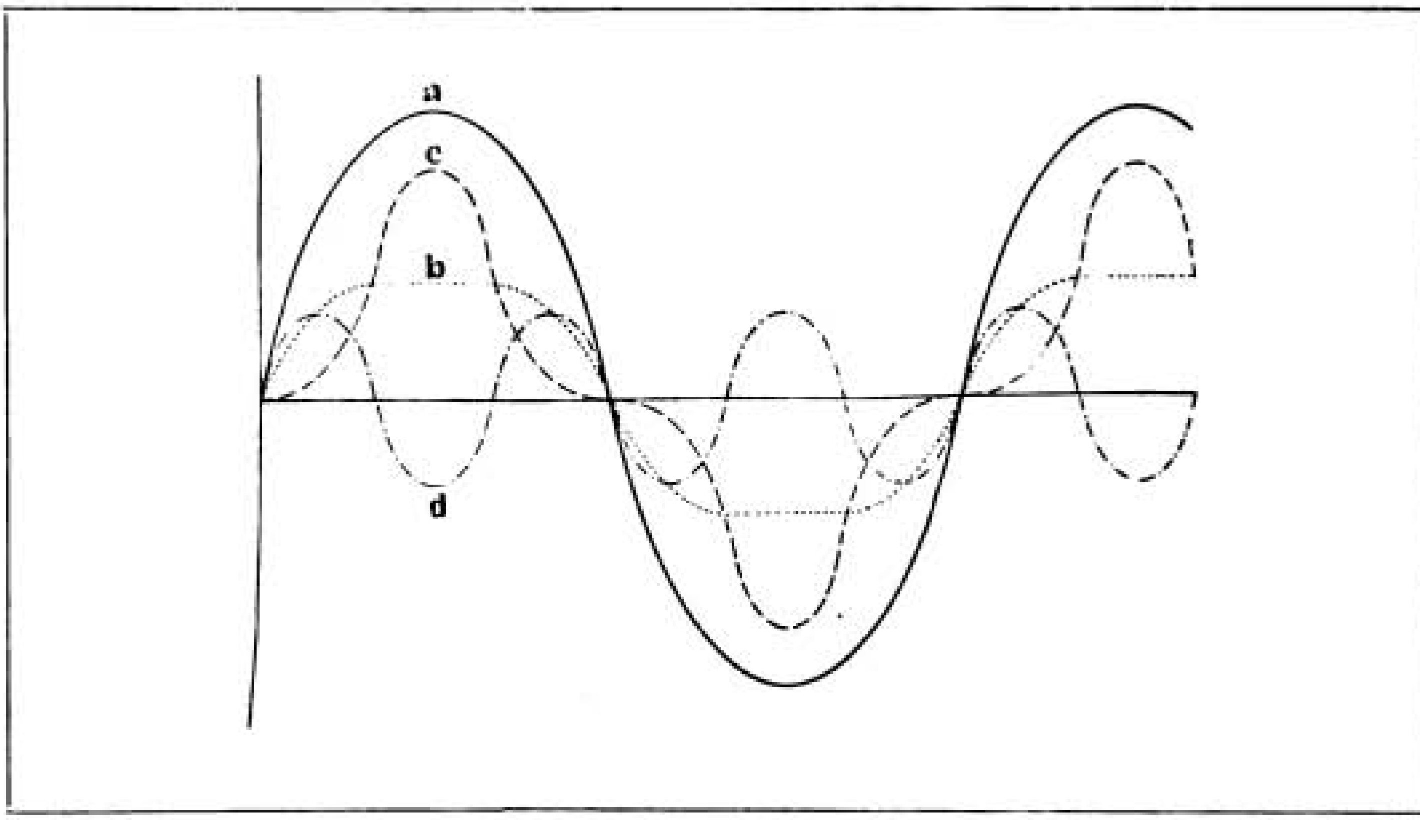


Fig. 22

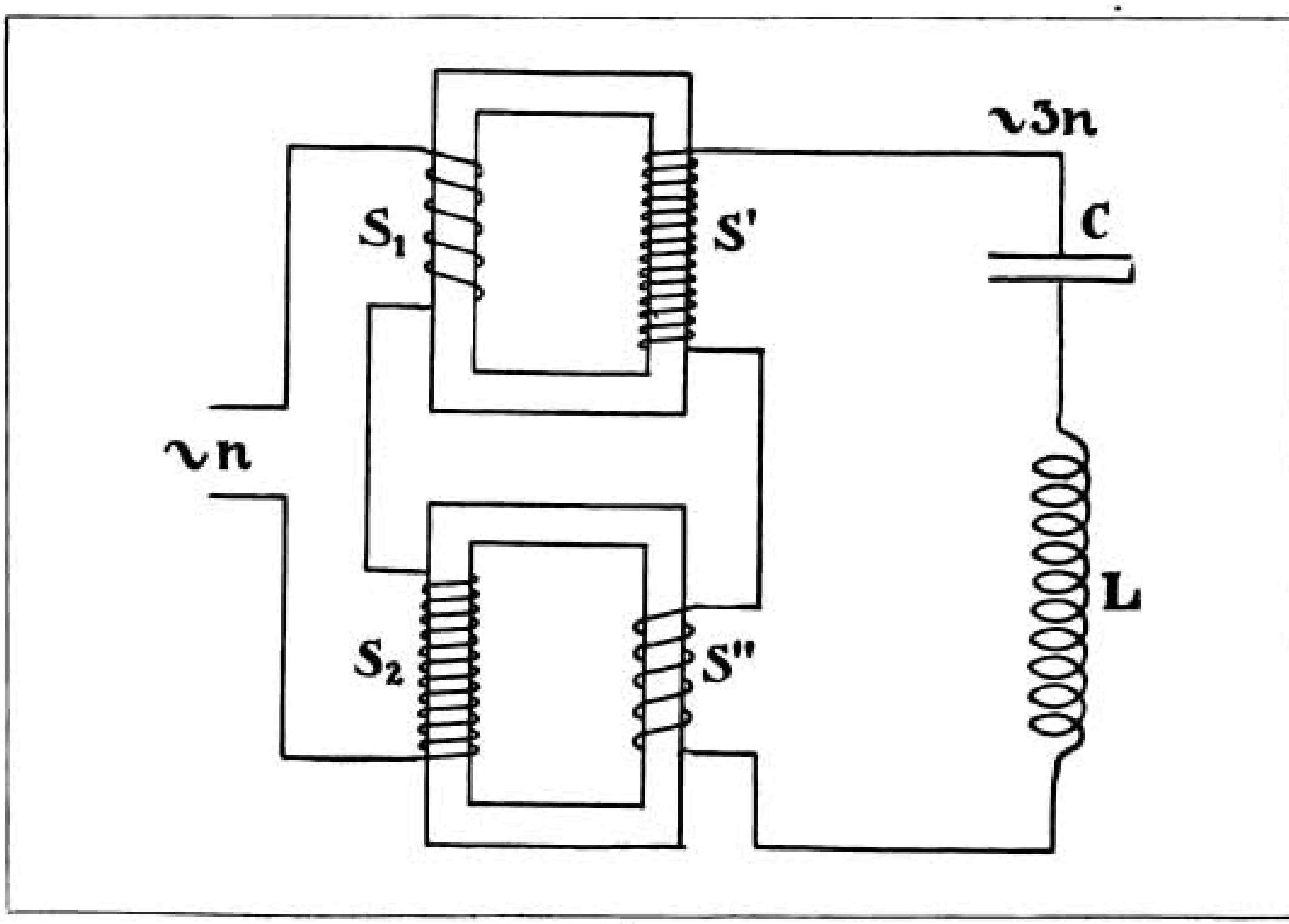


Fig. 23

transmitter by any simple and at the same time reliable device. We are, therefore, driven to use some method of trigger control whereby small changes in the resistance of the microphone transmitter, such as are caused by speech, will produce proportionate but highly magnified change in the amount of radiated energy. The various frequency changers described lend themselves admirably to different forms of trigger control of output. For example, many of them are very sensitive to a small change in tuning in one of the intermediate steps. If, therefore, we shunt one of the tuning condensers in the iron core type of frequency changer by either one or more microphones, we are given a ready means of controlling the output to a certain extent. Still another possibility is given in some of these types of transformers just described if we cause the microphone to vary the direct current magnetization which brings the iron cores to the saturation point. Since the proper operation of the Joly frequency transformer is largely dependent on an accurate adjustment of the core magnetization, it is clear that microphone control thereof should be successful in practice.

It seems to the writer that the apparent trend of high power radio design is in the direction of the moderately high or even radio frequency alternator, employed in conjunction with one or more of the frequency changers. So far as radio telephony is concerned, this direction of development should be highly favorable to success.

Another Route to the Valley of the Yenesei

Pressed by the urgent need to develop the immense resources of timber, minerals and foodstuffs which lie unused in the vast district between Lake Bikal and the Ural Mountains, the Russian government has established a line of wireless stations to make possible navigation to the mouths of the Ob and Yenesei. The steamship route from Tromsoe, Norway, to the Yenesei runs through the Arctic Ocean eastward to Vaigatch Island, which blocks the pass between Nova Zembla and the mainland, thence through the straits north or south into the desolate, ice-swept Kara Sea, where, to the eastward, lie the rivers that flow out from Mongolia. Steamships only can move freight from this land-locked territory—the cost of railroad transportation is prohibitive. Two years ago the 2,000-mile run from Tromsoe required twenty-three days; now the round trip can be made in nineteen days, thanks to the wireless.

Two of the three radio stations command the straits west of the Kara Sea. One is located on the island of Vaigatch to cover the Kara Strait to the north; the other, from Yugorski, guards the Jugor Strait to the southward, while the third lies at Cape Mara Sale on the mainland on the eastern shore of the Kara Sea. These stations observe the movements of the summer floe and warn vessels of the presence of dangerous ice. Later, with the assistance of fast sea planes, they will be able to follow the movements of the ever-changing lanes and channels, through which Nansen picked his way to the "farthest north" aboard the staunch Fram. Nansen himself assisted in establishing the route and the Fram carried the party.

Wireless Aids Storm-Bound Trains

The value of wireless in railroading was driven home during a recent blizzard. After the wires had been blown down on the Delaware, Lackawanna and Western Railroad, the Marconi wireless equipment was employed for train despatching, the Hoboken (N. J.) tower keeping in communication with snow-bound trains.

A wireless station was recently erected at St. Lucia, the West Indies.

A Trip to Sayville

Being the Record of the Momentous Pilgrimage of Chris. M. Bowman, Wireless Enthusiast

WHEN you purchase your ticket to Sayville and return, the Long Island Railroad's ticket-man will, on request, give you a schedule which purports to carry on one side a map of Long Island. What you haven't learned up to this point about the geographical location of Sayville will, even with the aid of the map, still remain enshrouded in mystery.

But having abounding faith that the train has a definite acquaintance with your destination, you suffer yourself to experience a breath-taking rush through the East River Tubes, followed by an interesting dash by many factories and a sudden entrance into the well-kept truck farming sections. Then come the commuters' towns in great numbers, heralded by scores of inviting signboards. You are surprised at the allurements these hold forth, so you turn to the passenger who shares your seat and inquire: "How can these houses and lots be so cheap, yet so near New York?" The answer is returned in one word: "Mosquitos!"

About half-way into the second hour the train draws up at Sayville. Of course you have been sitting on the right hand side, since nobody told you not to, and as you alight your first question is concerned with the whereabouts of the wireless station. You are advised to look up the railroad in the direction you have just come, whereupon you see three giant spires rising half a thousand feet in the air. This, then, is your first glimpse of the great WSL station you have so often heard in your own 'phones at home.

Soon after you reach the great station. Its new system of eleven great towers covers a tract of half-mile square and encircling the property is a wire fence. Just back of this are many impressive "Danger" signs.

Upon the gate posts, scrawled in pencil is the old slogan: "Hoch der Kaiser," and below it are the signatures of various Karls, Hanses and Heinrichs.

Just back of the gate stands a little shed, for all the world like a sentry box, sheltering a true son of the Fatherland who promptly but courteously inquires your business in a broken German accent. There are a number of these lookouts posted throughout the day, and five of them at night. They are not U. S. Government men, but are employed by the Atlantic Communication Co. These watchmen, with true German industry, seem to keep the idle moments occupied, as attractive little flower gardens are seen about their sheds.

You may have come with a letter of introduction from the Governor of your State, also one from your Congressman, both personally acquainted with the highest naval authorities in charge; but these will profit you little, as far as seeing into the innermost portals is concerned. You are kindly but firmly informed that at such times as these, it is necessary to have a personal permit from the Secretary of the Navy himself, as well as one from the Atlantic Communication Co., the owners, and signed by Mr. Boehme personally. It is needless to say neither of these are to be found about your person. If you are fortunate, however, you will meet Lieutenant Clark, in charge, who is very interesting and courteous.

The operating buildings, the great concrete guy-anchors, the original mast of the old station, the new steel masts with their peculiar spiral construction, five hundred feet high, and terminating in a point below, the complicated aerial system, extending to the eleven masts embracing the new station, the tents of the U. S. Navy Censors, all furnish a picturesque and interesting sight, well worth the trip to Sayville.

But Young America desirous of visiting the German station, hoping to get an opportunity to "listen in" to just hit off a dot or dash or two on her key, or have a look at the new 100 k. w. continuous wave transmitter, will be sadly disappointed. The several dollars' carfare charged to Sayville will be better invested in apparatus to improve those smaller stations at home.

How to Conduct a Radio Club

General Advice on Communication Between Amateur Radio Stations

Specially Prepared for the National Amateur Wireless Association

By Elmer E. Bucher

Article XIX

AN outstanding problem of amateur radio associations is the establishment of wireless telegraph communication between club or privately-owned stations located in widely separated districts. One of the factors entering into the question is the 200-meter wave which restricts the capacity of the condenser in the closed oscillatory circuit, permitting no more than ¼ to ½ k.w. consumption of energy when the transmitter is operated from a sixty-cycle source of current supply. Increased primary input can be obtained by the use of 500-cycle current, but since the average amateur station cannot avail itself of energy at this frequency, commercial frequencies must be resorted to and a high spark note obtained by the use of a non-synchronous rotary gap.

In view of the fact that the usual amateur aerial, excited by sixty-cycle apparatus and operated in full compliance with the United States restrictions, does not have more than one or two amperes of current in the antenna system, and, furthermore, keeping in mind the fact that the maximum efficiency of the modern radiating aerial seems to have been attained, it is necessary to look in another direction for the solution of the problem. The search naturally leads to the receiving apparatus which, within the past several months, has attained such a remarkable degree of sensibility as to suggest new possibilities in amateur radio communication.

The statements regarding the limited distances that can be covered do not apply to the amateur station located far from the zone of commercial interference, for in that case the United States authorities will allow a license for increased wave-lengths, thereby permitting the use of increased primary power. In an instance of this kind a 1 or 2 k.w. set operated at a wave-length of, say, 600 meters, is recommended, although it might prove more desirable to employ a wave-length of 450 meters to avoid the setting up of interference with commercial radio stations. At night-time, during the favorable months of the year, apparatus of this capacity can transmit 1,000 or more miles over land, thus making amateur intercommunication a solid fact rather than mere fancy.

The amateur station restricted to the 200-meter wave often does not attain the maximum possible range owing to improper design of the circuits of radio frequency. Frequently these circuits represent an undesirable value of high frequency-resistance, mainly due to the use of copper conductors in the circuits which have insufficient capacity for the heavy effective value of current flowing. A second error is lack of resonance between the open and closed oscillatory circuits, or an excessive value of coupling.

A somewhat positive indication of improper design of the radio frequency circuits is the action of the hot wire aerial ammeter when the transmitting key is depressed. If a large change of inductance is required in either circuit to effect an increase or decrease of antenna current, it may be considered a manifestation of dissonance, i.e., forced oscillations, or perhaps excessive damping in the circuits. In the antenna system the latter effect may be due to an imperfect earth connection or perhaps leakage at the aerial insulators. In the closed circuit an excessive value of secondary voltage may require a spark gap of abnormal length. Again, there may be losses in the condenser, such as brush discharge or dielectric losses by direct conduction through the insulating medium. Occasionally the spark discharge assumes the nature of an arc which is bound to result in imperfect oscillations.

Let the reader, then, give his attention to a transmitting apparatus possessing the features of an efficient amateur equipment. For the 200-meter wave the dimensions of the aerial must be kept within certain limits. If of the inverted L type, consisting of four wires, spaced two feet apart, the flat top portion should not exceed 60 feet in length, and the height should not be more than 40 feet. An aerial of these dimensions possesses a fundamental wave-length of about 160 or 170 meters, but when the secondary winding of the transmitting oscillation transformer is connected in series, the wave-length will be raised to normal value. Other aerials having the same fundamental wave-length should be constructed as follows: The flat top portion may be 50 feet in length by 40 feet in height, of 70 feet in length by 30 feet in height.

The apparatus of this station should include a ½ k.w. sixty-cycle transformer with a secondary voltage of from 15,000 to 20,000 volts. It may be of the open or closed type. If of the latter type it should be fitted with a magnetic leakage gap. A condenser, to be operated on the 200-meter wave suitable for this transformer, can in no case exceed .01 microfarad capacity. In the event that one of this value is employed the connecting leads to the spark gap and primary winding of the oscillation transformer must be extremely short. It might, therefore, be more desirable to reduce the capacity of the condenser to .008 microfarad, allowing the use of longer connecting wires or perhaps additional turns at the primary winding of the oscillation transformer. To a certain extent oil condensers are practical, but in the event of puncture they are undesirable for obvious reasons. In commercial stations the copper plated leyden jar is the order of the day and the amateur experimenter will do well to follow the set example. A second essential in the transmitting condenser is the use of a good grade of glass which should be free from lead or other metallic substances to avoid leakage. The plates of the condenser should be not less than ⅛ of an inch in thickness.

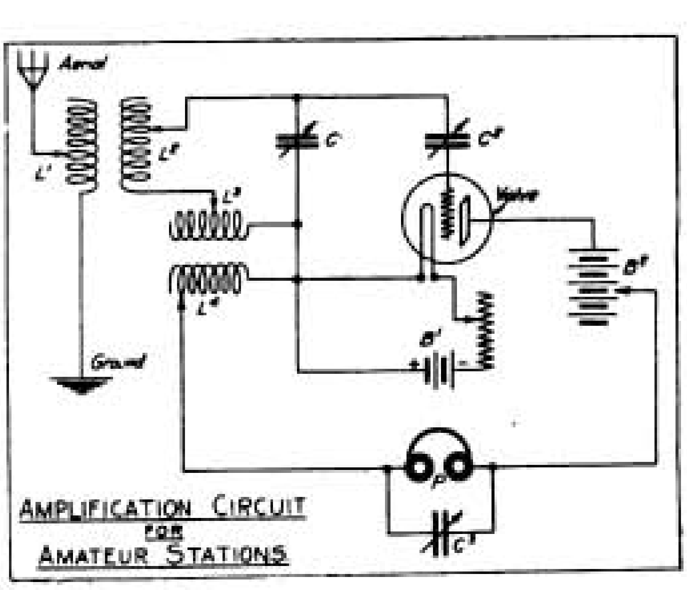


Fig. 1

The oscillation transformer may be of the helix or flat spiral type. Care should be taken that the adjacent turns are sufficiently spaced to prevent sparking between them. It makes no difference whether this transformer is constructed of brass, or copper ribbon, or of stranded D.B.R.C. wire, provided there is sufficient conductivity to take care of the current.

To secure a spark note of musical characteristic, the transmitting set should be fitted with a rotary gap having a disc approximately 8 inches in diameter. It should be fitted with eight or ten discharge electrodes re-

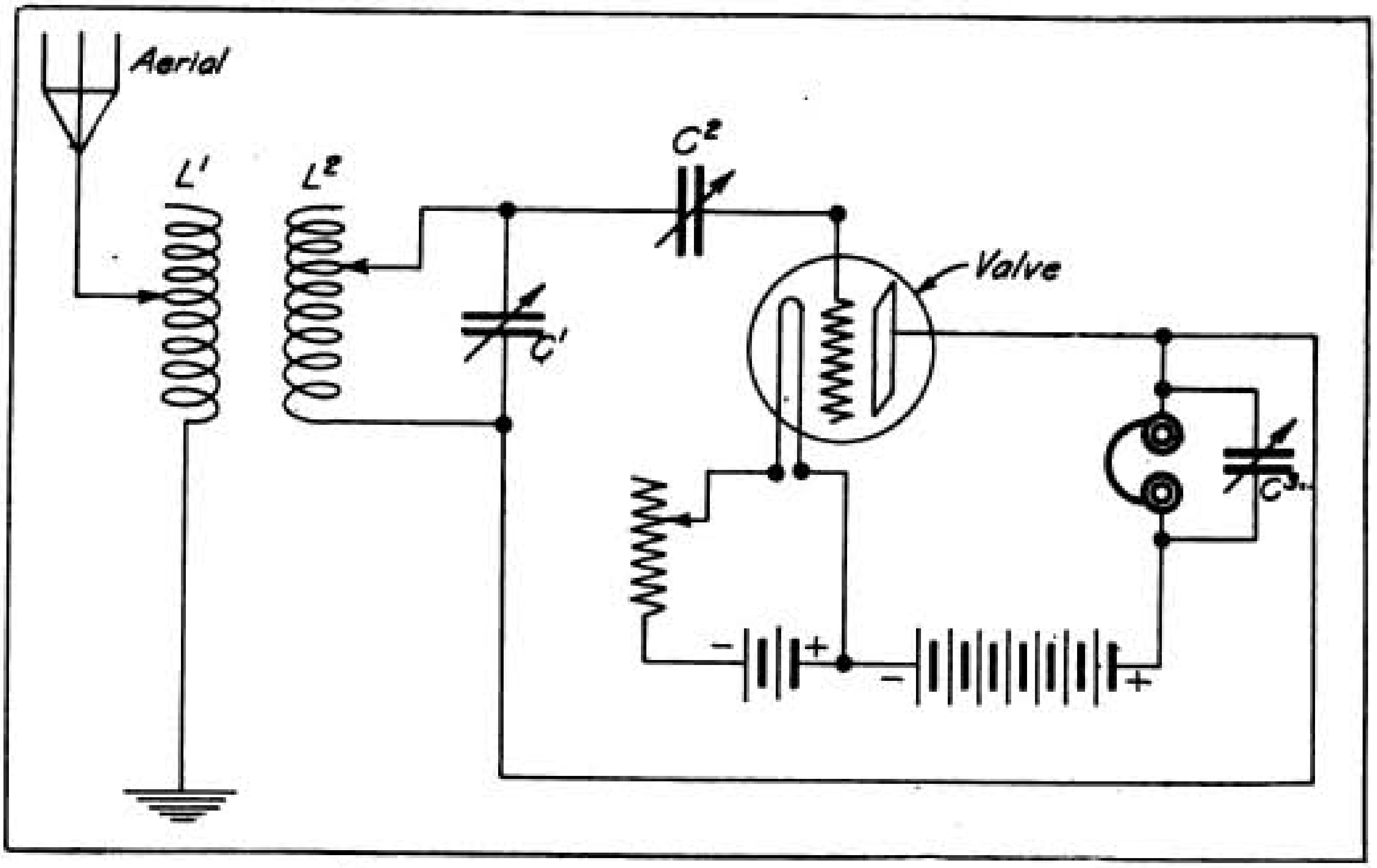


Fig. 2

volving at a speed of from 2,400 to 3,000 R.P.M. By experiment it is not found advisable with a sixty-cycle source of current supply to produce more than 300 to 400 spark discharges per second. Hence no advantage is derived in excessive disc speed; in addition, a desirable factor of safety is introduced at the lower speed.

The apparatus referred to must be mounted compactly, the component parts of the radio frequency circuits comprising the condenser, the spark gap and the oscillation transformer being connected together with excessively short leads; otherwise the wave-length of the spark gap circuit may be in excess of the United States restriction. The foregoing statements should receive careful consideration because the adoption of equipment constructed according to the directions given will insure success at the outset.

Receiving apparatus which will increase the range of the average amateur station comes next in the order of discussion. Remarkable developments in this respect have taken place during the last few years; in fact amplification circuits have been evolved which permit most unusual distances to be covered. A particular circuit of this type described in certain United States patents is shown in Fig. 1 where the incoming signals on a single vacuum valve detector are repeated back to the secondary or grid circuit and considerably amplified. Although applicable to longer wave-lengths, good results have been obtained on the 600-meter wave when the coils of Fig. 1 have the following dimensions: The primary winding of the oscillation transformer, L-1, is 4¼ inches in length by 4 inches in diameter, wound closely with No. 26 S.S.C. wire. The coil, L-2, the secondary winding of the oscillation transformer, is 5 inches in length by 3⅜ inches in diameter, wound closely with No. 30 S.S.C. wire. The coil, L-3, the secondary winding for the coil, L-4, may be 5 inches in length by 4 inches in diameter, wound closely with No. 26 S.S.C. wire. The coil, L-4, is constructed so that it may be telescoped inside of L-3, i.e., placed in variable inductive relation. L-4 is 4½ inches in length by 4 inches in diameter, wound closely with No. 26 S.S.C. wire.

The complete circuit further includes

the condenser, C-1, the maximum value of which need not exceed .0005 microfarad. The condenser, C-2, is one of small capacity, not more than .0001 microfarad, and in place of the ordinary small variable condenser two concentric brass tubes of very small dimensions may be employed. The condenser, C-3, connected in shunt to the head telephones, P, should have a maximum value of .001 microfarad.

For the most sensitive operating conditions, the primary and secondary windings of the receiving transformer should be adjusted to resonance and to the incoming wave. The procedure of course involves careful adjustment of the filament voltage and also of the high potential battery, B-2, connected in series with the head telephones. The foregoing adjustments are followed by a certain critical degree of coupling between the coils, L-3 and L-4, and corresponding variations of the capacity of the condenser, C-3. When the proper values are selected throughout considerable amplification of the received signals is obtained, often from ten to fifty times the intensity possible with ordinary circuits. If the circuit lacks proper adjustment, hissing tones which interfere with the reception of signals will be produced, but if in correct adjustment the head telephones will be fairly quiet except for the sounds produced by atmospheric discharges. At wave-lengths above 600 meters increased amplifications are obtained if a suitable coil of inductance is inserted in series with the coil, L-4.

A modification of the foregoing circuits employed at certain commercial and experimental stations is shown in Fig. 2. In this instance the local circuit of the vacuum valve is electrostatically coupled to the secondary winding of the oscillation transformer. The dimensions of the tuning coils may be identical with those given in Fig. 1, but the condenser, C-3, connected in shunt to the head telephones should have a value of .003 microfarad. The apparatus indicated will function on the lower wave-lengths particularly well, giving a fair degree of amplification provided the vacuum valve is set into stable oscillation. The condenser, C-2, is used at very small value of capacity, likewise C-1, depending in the latter case upon the wave-length employed.

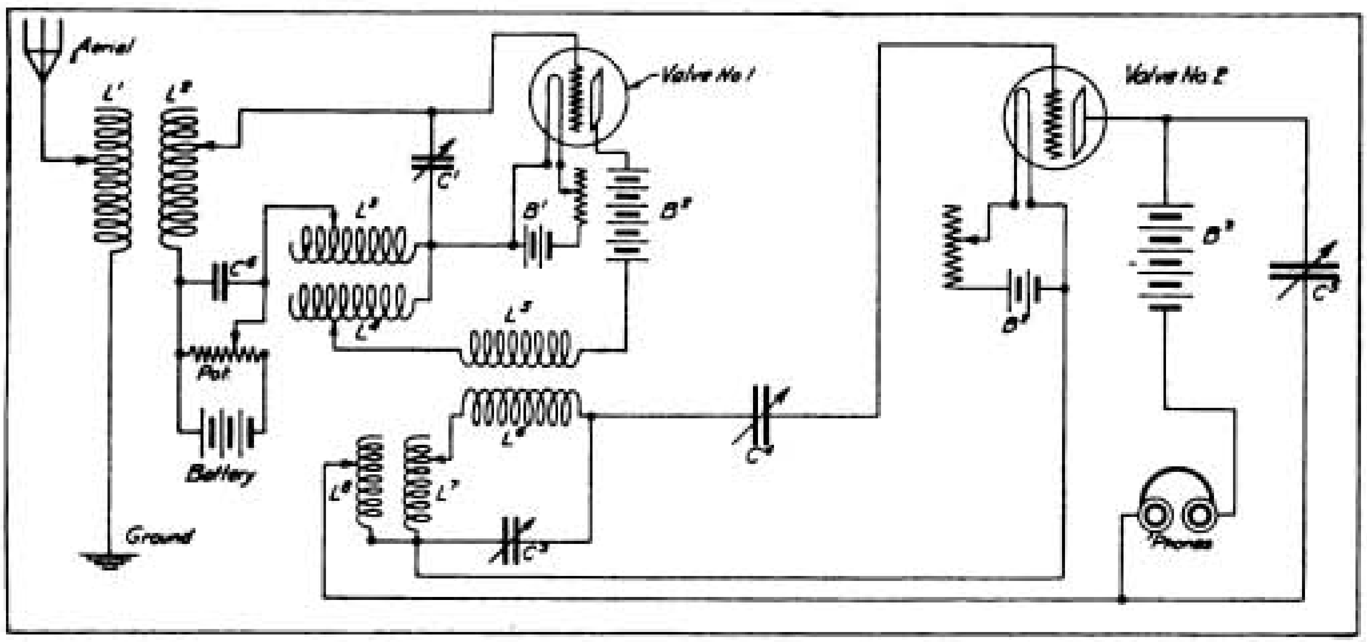


Fig. 3

An amplification circuit for currents of radio frequency, somewhat similar to that described in proceedings of the Institute of Radio Engineers, is shown in Fig. 3. Here the currents of radio frequency in the secondary circuit of the first vacuum valve are repeated to the local battery circuit and reinforced by coupling the local circuit back to the secondary circuit. The oscillations of radio frequency thus produced and amplified are transferred from the first vacuum valve to the second vacuum valve by means of a radio frequency transformer comprising the coils, L-5 and L-6. The coils, L-6, L-7 and L-8, have the same dimensions as the coils, L-2, L-3 and L-4, in the first system. The condenser, C-3, is identical in capacity with C-1. The condenser, C-4, is operated at exceedingly small values of capacity. The telephone circuit of the second vacuum valve is shunted by the condenser, C-5, in series with which is connected the inductive coil, L-8, inductively coupled to the coil, L-7. The effectiveness of this circuit is increased by the use of the potentiometer and battery connected in shunt to the condenser, C-6. This condenser has a capacity of .003 microfarad. The potentiometer, Pot, may have a resistance of 400 ohms, while the battery, Bat, has available a potential of two or three volts. The secondary circuit of the first vacuum valve and its corresponding local circuit must be adjusted to resonance and also to resonance with the circuit comprising the coils, L-6 and L-7 (Fig. 3). Careful adjustment is then made of the condenser, C-5, and a certain critical value of coupling employed between the coils, L-8 and L-7. Corresponding careful adjustment is made of the high voltage batteries in either circuit with a certain degree of incandescence at the filament. It is preferable in this system that the local circuit of the second vacuum valve be set into undamped oscillation, while the first valve is employed to amplify the current of radio frequency. Circuits of this type have been successfully employed at a wave-length of 600 meters, but they are more stable in operation at longer wave-lengths. The author would be pleased to hear from junior experimenters regarding the results obtained with a circuit of this type operating at the lower range of wave-lengths, in order that effectiveness may be compared with the circuit shown in Figs. 1 and 2.

With a receiving apparatus of the foregoing type properly connected and carefully adjusted, even at wave-lengths of 200 meters, the range of amateur radio stations can be increased considerably and distances heretofore only possible under the most favorable conditions can now be covered without difficulty. In connection with this apparatus it is recommended that receiving telephones of a certain type now in the market be obtained. The receiver in question has a micanite diaphragm, which is connected through a small rod to another diaphragm, the latter being actuated by the electro-magnets of the receiver. Laboratory tests show that this telephone has a degree of sensibility from ten to twelve times greater than that of the ordinary type supplied to the amateur field, particularly at the higher range of spark frequency.

An important consideration often overlooked in the experimenters' wireless stations is the need for an aerial switch which will allow of a quick change from transmitting to receiving apparatus. In connection with the vacuum valve detector it is recommended that the aerial switch be constructed so that the high potential battery circuit to the telephones is broken during the period of receiving. The filament should be allowed to burn steadily during the periods of transmission in order that the oscillating state of the vacuum valve may be restored immediately when the high potential battery circuit is closed. Stations fitted with rotary spark gaps requiring a considerable length of time to slow down should fit the rotor with a mechanical or electrical brake to bring it to a quick stop.

The ordinary shunt wound direct current motor can be brought to a quick stop in the following manner: The connection from the armature to the shunt field winding should be brought out to the blades of a double pole switch so that the circuit to the armature may be broken, leaving the shunt field winding connected in shunt to the D.C. line. A sudden interruption of the circuit to the armature will cause the flux of the field coil to place a powerful braking effect on it, bringing it to a very quick stop.

When the requirements of a first rate radio station are known the problem of intercommunication and overland relay work resolves itself into one of ascertaining the best equipped amateur radio stations in the various states of the United States and finally selecting those which are separated by distances of from thirty to fifty miles. It is recommended that regular watches be observed at these stations by licensed amateur operators capable of copying signals in the continental code at a speed of at least twenty words per minute. If the relay stations are manned by operators possessing the qualifications referred to a large amount of unnecessary interference will be prevented, allowing the messages to be dispatched from point to point without undue delay. The operators in the amateur stations in the immediate vicinity of the relay station also will be saved from the annoyance of unnecessary interference. It is recommended that the greater part of the relay work be carried on at night as the majority of the amateurs cannot remain on watch during the day time.

As the National Amateur Wireless Association continues to expand, the government undoubtedly will allow special wave-lengths for the relaying of messages between licensed amateur stations; for the time being, however, it is advisable to carry on this work with the restricted wave in order that there may be no possibility during the night-time of interference with commercial stations located in the Great Lakes district, or on the Pacific or Atlantic coasts.

Prominent radio organizations can be of considerable assistance to the National Amateur Wireless Association by aiding in the collection of information concerning the apparatus in use, the probable over-all efficiency and the maximum range of certain amateur stations located near them. Such data will be tabulated and filed at the association headquarters for immediate or future reference. At a later period selections will be made from these lists and certain stations will be officially known as an N. A. W. A. relay stations. They will perform the duties which the title involves. Regular hours of watch will be maintained and private communications will be relayed from point to point.

Comments, suggestions for improvement and descriptions of methods for increasing the possible range of amateur stations will gladly be received.

(To be continued)

AMATEUR OPERATORS IN WAR

It is worthy of note in connection with the mobilization of American radio enthusiasts under the auspices of the National Amateur Wireless Association that in Europe amateur operators have been doing their bit and earning well-deserved decorations for distinguished service. The British admiralty alone reports the enlistment of 5,250 wireless operators up to date, and this report takes no account of the wireless men among the land forces. Among the naval men four have received Distinguished Conduct medals, one the Cross of the Legion of Honor, and one the Victoria Cross.

WORKED A DISTANCE OF 2,614 MILES

Marconi Operator G. L. Brundage, detailed on the steamship Toyohashi Maru, has reported that he recently communicated with San Francisco, Cal., while 2,614 miles away. The vessel is equipped with 120-cycle ½ k.w. Marconi set.

A Little Brief Authority

A Fiction Story

By Warren H. Miller

"A PRETTY mess!" snapped the Colonel commanding, angrily. "Here we are expecting the Blue Fleet any night and you say the wireless is down and out. That leaves us with no communication whatever with our own scouts—" he snapped his fingers impatiently and bit his mustachios. This thing galled him: he was the only regular in the manoeuvers and his reputation was, in a way, at stake. "Well, bring in your infernal Dutchman and let's hear your charges, then," he concluded.

Kahler was led in between the provost sergeant and one of his men. They advanced abreast, saluted, and stood at attention. The Colonel confronted them, his adjutant at his right and the accusing lieutenant on the left. To the casual war correspondent it was a funny little group in a sham campaign already full of hilarious mistakes. The Colonel, the only regular present, was bored and angry, the adjutant fussy and excited, the young lieutenant quaking with nervousness, Kahler definant, and the guards awkward and too abashed to remember their parts as set down in the Regulations.

"Proceed with your charges, Mr. Brooks," said the Colonel stiffly to the young lieutenant.

"I went to the wireless station," he began in a shaking voice, "and found Mr. Kahler——"

"There's no such person in the fort," declared the Colonel peremptorily.

"And found Kahler had——"

"When?" interjected the Colonel, cutting him short again.

"This afternoon—as I said, he had the——"

"Kindly prefer your charges in a more formal manner, Mr. Brooks," gritted the Colonel, twirling his mustachios under a concealed smile, "State when, how, and where, if you please."

"This afternoon I went to the wireless station and found Mr.——:"

"There is no such——"

"Pardon—found Kahler had the wireless down, so I told him this was no time to be monkeying with it and to get going again at once——"

"Dot's nod so," broke in Kähler, eagerly, "he comes by der vireless——"

"Silence! Hold your tongue, Kahler. Proceed, Mr. Brooks."

"So he starts to give me a song-and-dance about an equalizer or something and I had to start 'em up myself——"

"That will do, Mr. Brooks," broke in the Colonel impatiently, "Did he refuse duty?"

"He did."

"That's sufficient. Now Kahler."

Kahler suppressed a snort and began defiantly. "Vell, these man Brooks, he coom bei my vireless——"

"There's no such person in this fort!" vociferated the Colonel.

"Meester Brooks, den," resumed Kahler with difficulty, "he coom by der vireless ven I vas fixin' up a ekvaliser, *zwischen* der No. 1 und No. 2 mashines——"

"Why?"

"Pecause ve ain't got der power to reach our scouts now, midout two dynamos, efen mit ungedampte wibrations——"

The Colonel nodded his head perplexedly. This was getting in technically deep waters for him. Confound this wireless, anyhow! "Proceed!" he ordered.

"Vell, Yimmy, here——"

"You mean Mr. Brooks?"

"Yaw—Mees'r Brooks, der tufel take

him!—he vant der bot' mashin's started opp vidout ekvaliser, 'n I tell him dot he doan know 'nuff to run a ten feet steam launch, an' den he order me to start opp der mashin's an' I tell him to go bei der hell——"

"That'll do—that'll do," interrupted the Colonel testily. "Well?"

"Vell, den I go on vit my vork, an' vatch Mr. Vise Guy start 'em opp himself. First he get No. 1 up to voltage an' put her on der bus; den he get oop No. 2 an' look vise for a bit an' den he t'row her in, too, vidout no ekvaliser! Yimminy Crissmus! dere iss a flash an' a crash, an' de bot' maschin's iss on der fritz. Dot's all."

"So you refused duty, did you, Kahler?" inquired the Colonel icily.

"Yaw—der tam fool——"

"Silence! Your actions were a disgrace to the service you represent. Two days in the guard house and two hundred hours' sentry duty. Take him away!" thundered the irate commander. "Mr. Brooks, I'll see you at my headquarters in fifteen minnutes, sir," added the Colonel, dismissing the proceedings.

And the rating that the meddlesome young lieutenant got, in the inner sanctum of the Colonel's private office, while not for public record, will always remain among the worst quarter hours of his whole lifetime.

. . . .

"It's one of the curious coincidences of this citizen-soldiery business," remarked the adjutant, talking over the case later. "You see, Kahler is the chief electrical engineer in the Ohio Steel Works, in private life; absolute boss of a large force of engineers, electricians, firemen, thousands of horse power big gas engines, dynamos that would make you and me stand at a respectful distance and view them with awe; in a word, a high-salaried autocrat whose word is law in his own domains, and authority the daily breath he breathes. On the other hand, Brooks happens to be a young and popular clerk in the pay department of this same Ohio Steel, getting about a tenth of Kahler's salary, of about a tenth Kahler's general ability; but he has been in the regiment over four years and has gradually risen by election to his lieutenantship. Kahler came in as a recruit, partly for the relaxation of a two weeks' encampment, partly from a sense of duty in these warlike times. . . . Well, you know Brooks—when he gets on his military mood and shoots out orders in that military voice of his! He may sing very small down at the steel works, but here in the regiment he is authority itself, and it doesn't make any difference who the rookie happens to be either! Now, then, Colonel, the question is who's going to rewind those burnt out dynamos; our scouts might as well not be out there so far as getting us any word from the Blue Fleet is concerned. We are down now to plain eyesight and searchlight, and they may attack in force any night."

"Well, one thing is certain," responded the Colonel truculently, "no mere considerations of temporary expediency shall be allowed to relax one jot of the discipline."

The two days went, anxiously enough, with everyone on the *qui vive* within the fortress, and the slender electrical force working overtime on the wrecked wireless. But while the Blue Fleet did not attack, neither did the bell wire men, lamp hangers and conduit fitters, calling themselves electricians among the enlisted men, make much progress with the dynamos. In an ordinary works the solution of the problem would have been simple—order new dynamos rushed to the scene or hire outside electricians; but where Regulations prevail these things cannot be done—unless you want to pay for it out of your own pocket! Orders in triplicate, on the state commissary and quartermaster, to be approved and explained to everyone in the state up to the Governor himself, must be forwarded if any purchases are to be made or persons hired, and the Colonel much preferred to work out his own salvation.

Kahler was released on the evening of the second night and immediately went on sentry duty. His post was at the far western bastion of the fort with

Kahler's eyes stung and smarted from the sharp actinic rays of the blue light, but still he remained at his task the illimitable black sea stretching out from the rocky escarpment, at the foot of the bastion. Somewhere out there was the Blue Fleet, with the tugs and yachts loaned to the militia for "scouts" striving to pick them up and warn the fort by wireless of any intended attack. All of them had feeble, short-distance wireless outfits, capable of picking up a hostile message at long distances and transmitting a message of their own to the fort—some fifty miles. Kahler wondered if the attack would be made that very night; it was a good time for it—pitch black, no moon, inky nor'east clouds, no stars—just a night to rush the fort with a landing party of blue-jackets. That was the way to take it, for the fort was at least equal to the fleet in gun power and range. Even with submarines to help the fort (which it hadn't) a night landing in force stood a good chance of success on such a night as this.

To the west of one section of Kahler's post was a bare rocky hill set with barbed wire and protected from the public by a fence, maybe 300 yards away at the foot of the hill. Just beyond it was the last arc light of the town, standing near the last fire hydrant, at the end of the last street. In times of real war this light would be doused, but in ordinary manoeuvres the city saw no reason to cut its wires. Kahler studied it awhile before returning on his path—and then an idea occurred to him. Three hundred yards! If he could only get away for a time and get under or near that arc light without being yanked up for it! No one had said a word to him about the wireless, but somehow it had seeped in to him at the guard house that it was still down. They had even tried to hook it up to the big searchlight dynamos, a rumor that Kahler had heard with snorts of disdain.

About the third time around he could bear the suspense no longer, and, resting his gun against a bombproof, he vaulted over the parapet, ran down the slope, picked his way through the barbed wire, and soon stood watching under the arc lamp. He waited as long as he dared and then hastily retraced his steps.

"Halt!" cried a voice, "Who goes there!"

"Yaw, dot iss all right—Kahler," rejoined the other, composedly, "'S dot you, Yimmy?"

"Lieutenant Brooks to you, Kahler. What were you doing off post?" inquired Brooks sternly.

Kahler, peering into the darkness, observed that Brooks was carrying the rifle which the former had placed against the bomb-proof.

"What you doin' der Napoleon act vit my gun for? What iss der matter wit' you, Yimmy, anyways?" retorted Kahler.

"I said 'What were you doing off post?' Did you hear me? If so, answer'" gritted Brooks stonily.

"I—I—I heard a noise down yonder. I t'ink he vas a spy, maybe," invented Kahler hastily.

"You did; why didn't you take your gun along and challenge him then?"

Kahler made no reply and Brooks laughed. "Kahler, you'll never make a soldier; you haven't the first idea of it. Well, I won't report you this time, but —he warned—"let me catch you off your beat again, and it will go hard with you!"

"Yaw? Yust you tells dot to der next sentry—he's easy," muttered Kahler whimsically.

"What's that?" inquired the lieutenant harshly.

"Ah—what!" exploded Kahler, turning contemptuously on his heel. The lieutenant fumed. Here was a flagrant breach of discipline—but yet—the Colonel, he had noticed, was getting very tired of these petty cases and was openly hinting so. So he decided not to push the matter further at present and went back along the picket posts.

Kahler turned again to watch the arc lamp. Surely, even at that distance he could discern a slight flicker! With a muttered curse at Brooks and all his like, he vaulted the parapet, raced down the slope, and took the barbed wire in a high hurdle, whipping out a note book and pencil as he neared the arc. And he was just in time. Flickering, in long and short wavers, it was spelling out a jagged and half-legible message. Time rushed by, Kahler's eyes stung and smarted from the sharp actinic rays of the blue light, but still he remained at his task, never missing a single one of the faint flickers that would, to the ordinary observer, be almost unnoticeable. Page after page of the dots and dashes grew in his note book; the point of his pencil wore down to an illegible scratch, but still he kept on. And then—a slender hand that shook with anger was placed on his shoulder.

"Consider yourself under arrest!" screamed a high throaty voice in his ear as the thin talons dug into his flesh, "Didn't I tell you on no account to leave your post—and here you are practicing Morse under an arc light, writing a spy message for the enemy, for all I know. Give me that note book and come along with me!"

"Yimmy, you bodder me mooch more, an' I spank you good, yust as I would do if ve were home," retorted Kahler, never taking his eyes off the lamp. "Roon along now an' tell the Colonel I got something for him."

"Hand over that note book, I say," demanded Brooks, drawing his sword and snatching at the book.

"Git oud—*potz tausend,* I knock you——"

"Give me——"

There was a thud of bone on bone, a hard wooden crack, that could be heard a hundred yards, and the lieutenant lay stretched out across the curb. Kahler jotted down the last few dots and dashes, made sure by translation that they were a signature, and fled the scene. What he wanted was light, light to see and translate, and he wanted it quick, with no interference, for the message was of the utmost importance. He ran along the dark parapets of the fort looking for a lighted bomb-proof—any place where he could sit still a few minnutes and see what he was doing. Into the empty barracks kitchen he finally dashed, turned on an incandescent, and busily set to work making a translation of the message. The result of his efforts was twice checked over before he set out for the Colonel's headquarters.

As he neared it there seemed to be a hubbub of excitement within. Orderlies came and went, the provost guard was turning out, hoarse orders were being shouted in the far distances of the fortress. That all this might concern him never entered Kahler's head and, as he pushed open headquarters door, it was with considerable surprise that he found himself gripped by the orderly on duty. The room was filled with excited officers, all of whom were talking at once. Kahler's arrival increased the babel.

It required fully a minute for the Colonel to thunder them into silence. "If you will let Brooks and his indignities rest for a vile and read diss you'll see everything is all right," said Kohler as soon as quiet had been restored. The Colonel looked his disbelief in the statement, but he took the copy of the translation which Kohler thrust into his hand and read it aloud:

"Flagship Alaska, Blue Fleet; disposition for attack on Fort Meade.

"All ships of First Division will assemble, in cutters; landing parties of 300 men each, five cutters in tow of each launch. All ships of Second Division, except colliers and supply ships, will make similar disposition. Third Division of destroyers and torpedo boats will cover landing party. Launches will start at full speed for shore promptly at eleven P. M. No gun will be fired nor any great gun fire permitted until ordered from flagship. First Division will attack west front and Second Division north front of fort. All enemy scout ships in our hands. Coast is clear. R. N. Benton, Rear Admiral, Comm'nd'g."

"Dot means dot we vill have approximately 5,000 men on our hands, Colonel, in less than an hour and der chance of our lives to surprise 'em," lamented Kahler as soon as the Colonel had looked up from the paper.

"Excuse me, Kahler, please forget that you are in the power house of the Ohio Steel Works. Where did you get that message?"

"Off der Blue flagship, of course."

"No; *how* did you come by the message, I mean?"

"I took it off der arc light down bei der vest end of der fort. I got it all except the vords 'Rear Admiral' ven I haf to soak Yimmy Brooks, here, for buttin' in."

"*Mister* Brooks, if you please. We'll let that pass for the present. Has any body here any proof that this is nothing more than a clever invention to save this man from further guard house duty?"

"I don't believe a word of it, for one," spoke up Brooks, promptly.

"Nor I—nor I— The man's lying, Colonel—he wrote it up himself to get out of more trouble," broke in the members of the staff.

"Gentlemen, *gentlemen!*" shouted Kahler, raising his voice above the din. "Doesn't anybody here know enough to know dot an arc light iss sensitif to powerful vireless vaves? Any goot electrician could do vat I did—take down Morse off der flicker of der arc—dot's all dere iss to it, Colonel, but you take my atvice you trow on all your searchlights a liddle after eleven an' load all your beeg guns mit shrapnel; also muster every regiment under arms, an do it qvick."

The Colonel brooded a while, looking at Kahler with a frown. "Six days in the guard house. Take him away," said he wearily. "I've got to hand it to you, Kahler, for misplaced inventive genius; you ought to be writing fiction—"

Shots, hoarse hails, shouts and the running of feet by the building interrupted this speech. Scattering volleys blazed from the fort parapets and presently drums and bugles sounded the general alarm and assembly. The Colonel pushed back his chair and sprang to his feet, "It's the attack all right!" exclaimed he. "Gentlemen, to your posts! Kahler, you come along with me!"

They rushed outside in a body. The uproar was tremendous—men and officers running wildly to and fro, whole companies of sleepy militia turning out of their tents and endeavoring to find their arms, while the incessant tattoo of the drums made the night a bedlam of sound. Kahler and the Colonel dashed for the parapets, followed on a run by the aides and umpires who had been hastily sent for at the first alarm. A young lieutenant of the signal corps had already gotten together a squad of men and the cover had been ripped off one of the great searchlights of the main salient. Its powerful rays shot out over the sea on the instant of throwing the switch, disclosing to their eyes long lines of naval cutters as far as the eye could sweep along the sea front.

"One, two three, four, twenty!— there are at least twenty launches, each towing a string of cutters!" exclaimed the adjutant, "and there's a whole squadron of torpedo boats and destroyers behind them. They'll make a landing in less than five minutes if we don't open fire!"

Even as he spoke, bright flashes spit from the fourteen pounders on the destroyers and the nearest umpire threw the searchlight switch, enveloping the whole scene in total darkness. "Sorry, sir," he explained to the Coloned, "but they'v put your searchlights out of business."

The Colonel raged. "And, of course, we have no illuminating rockets!" he swore bitterly. "We must have light! Forsythe, for God's sake hurry up at least a battalion here—they'll be on us before we know it."

He was interrupted by the drumming fire from machine guns on the landing launches, which all opened fire as if at a signal, sweeping the parapet like a hail of bullets. Kahler grabbed the Colonel's arm and dragged him down, but too late. "Sorry, sir," the umpire informed him, "but you are out of action, sir; no living being could have exposed himself to that fire, as you have just done, and survive."

The Colonel cursed impotently. "Here, Kahler," he exclaimed desperately, "take my cap and cloak and run the show. I appoint you aide. Pretend you're back at the steel mill and go to it."

"Can't. You're dead already, Colonel!" interposed the umpire.

"His dying vords," grinned Kahler solemnly, "besides, Mr. Umpire, you have no rules that cover this case. Here!" he called to a great gun squad which was rushing by to their station, "Neffer mind der beeg guns—ve can't use dem now—pull down dot truck shed and build a fire qvick!"

"Who's going to pay for it?" snapped the umpire.

"I vill," said Kahler quietly. "Der

dam t'ing aind't vorth more dan twenty dollars—an' I vould pay dot mooch ter see der funs."

The Colonel grinned. "What he says goes, boys; rip her down and be quick about it."

Fifty hands tore the shed asunder and soon a flame arose; but while they were at it the machine guns had ceased firing and the rush of the sailors storming up the rocky slopes could plainly be heard above the din within the fort. Battalions rushed to the fire without orders, as the one visible rallying point, and fell into line as quickly as might be. Then a blare of brilliant white rockets arose from the launches as the sailors, in three-high formation, scaled the parapet walls all along the line. Heads by the hundreds and thousands appeared simultaneously over the green revetment, rifles were levelled as the naval men fell forward on their faces, and a tremendous volley of rifle fire was poured into the undisciplined militia.

"Now, den, poys! Gif it to 'em!" shouted Kahler as the militia opened up their return fire, while the umpire ran up on the embankment holding up his signal flag that would give one or the other side the right to advance.

But there was no holding back the bluejackets. That twelve-foot parapet did not stop them a second, and there were thousands below coming on and swarming up over the wall far faster than the militia fire could pick them off. The umpire's flag fell as the tars drove in on the disordered guardsmen; battlion after battalion was checked out of the fight; while from both wings poured in the assaulting columns of the Blue Fleet, driving everything before them. In ten minutes the fight was over and the defenders had surrendered or been put out of action. The surprise attack had been a complete success and not a great gun had been fired from fort or fleet.

The Navy sent up three blue rockets, which were presently answered from the flagship far at sea, and then Captain Nelson, commanding the storming party, came up to commisserate with the Colonel, who was still sitting where the umpire had put him out of action. "Our orders were to board the fort in a seamanlike manner, sir." chuckled the Captain, as the two officers shook hands, and we done it," as Jack Tar would say.

"But what I want to know is," put in the Colonel, "how in the devil did you people pull off that atttack at ten instead of eleven, as ordered?"

"How did you know there was to be any attack at all!" exclaimed the Captain surprisedly, "Our third Division nabbed all your scouts, and the Admiral changed the time to ten by Ardois in case anyone *might* pick up.

"Here's the man that did it," cut in the Colonel, pushing Kahler forward, "read him your message, Kahler—he got it off that arc light yonder."

"Why, hello, Mr. Kahler!" shouted the Captain excitedly. "Say, man, I haven't seen you since I was checking up armor plate down at your works."

The Colonel shrugged his shoulders, "What a country!" he murmured, "Fancy anything like this in undemocratic, militaristic Europe!"

"Oh, Lieutenant McAllister!" the Captain was calling, "Come here, I want you to meet Mr. Kahler of the Ohio Steel——"

"Dere's no such person in der fort!" declared Kahler, grinning quizzically at the Colonel, "I'm yust plain Kahler, under arrest for general monkeydidoes an' a lot of other tam foolishness."

"Got our orders off an arc lamp, you say!" chimed in McAllister, wonderingly, "you must tell us some more about that, Mr. Kahler."

"Vell, poys, it hass been a fine game. But let me tell you, if dis country effer plays it in dead earnest, dere vill be a lot more stranger tricks dan dot played on you military fellers—don't you mistake me!"

"And to learn some of them before they are played will be our only salvation, too, I'm thinking," muttered the Colonel seriously. "Forsythe," he added to his aide, "Battalion's dismissed. Captain, suppose you give your men shore leave for the rest of the night, with our boys to show them around!"

"Refund Requested by Return Mail"

Something About Undelivered Messages

By Harold H. Gallison

THE method by which wireless messages are handled from the sender to the addressee is not generally known, whereas the details of other methods of communication are familiar to all. In wireless, as in wire telegraph and the cable, a message now and then will go astray and naturally the sender makes complaint to someone, demanding immediate return of his money. But instantaneous action is, of course, impossible. After an investigation has been made and the telegraph or wireless service is found in any way at fault, a refund of the money paid for the transmission of the message is made. What few can appreciate is that investigations necessarily take time—in some instances two or three months—and rare, indeed, is the complainant who, after a wait of two weeks or less, does not become, at least, irritable. He knows his message did not reach the person to whom it was addressed; why not take his word for it, send him a check at once, and investigate afterwards?

Here is the reason:

To begin with, all radio stations open to public service, both coastal and those on shipboard, are operated under license from the various governments, according to the jurisdiction in which they are located, ship stations being licensed by the governments whose flags they fly. The stations must work in accordance with certain rules and regulations adopted at the International Radiotelegraph Convention, held in London during 1912, and agreed to incidentally by practically every government in the world. This convention was ratified by the United States and a proclamation issued to that effect by President Wilson on July 8, 1913.

The Convention stipulates the method of exchanging traffic between stations and states what rates may be applied to ship and shore stations, the shipboard rate, for instance, not to exceed 40 centimes (8 cents) a word with a ten word minimum.

I do not purpose explaining the various regulations of the London Convention for this would take up much more time and space than I have at my disposal. My object can as well be achieved by showing how the ordinary wireless message is delivered (or fails of delivery as the case may be) from the sender to the addressee.

We will suppose Mr. Williams is returning to New York from Havre on the French liner La Provence. In midocean he files with the wireless operator a ten-word marconigram addressed to "Williams, 1290 Broadway, New York," for which he pays 36 cents per word, receiving from the wireless operator a cash receipt in acknowledgment of the monies received and giving the name of the wireless company receiving it. The first coastal station with which communication is established will be, we will say, Cape Race, the message in due course being received by that station. The Cape Race plant is owned by the Newfoundland Government, be it remembered, and is operated on behalf of that government by the Canadian Marconi Company. The message received, Cape Race in turn transfers it to the Western Union Company for land line transmission and delivery to destination.

Mr. Williams arrives home and learns that his wife did not receive his message, so he looks up the New York address and writes the Marconi Company of America an indignant letter demanding the immediate return of his $3.60. He receives prompt acknowledgment of his letter.

Now for the investigation:

The wireless apparatus of the office of origin, a French steamer, is owned and operated by the French Marconi Company which has its headquarters in Paris, and if the vessel has left New York on her return voyage before Mr. Williams' complaint has been received, it must be referred to Paris. There is no record of the message in New York and the particular shore station through which transmission was made is not known to the Marconi Company in New York.

The French company, upon referring to its records, learns that the message was forwarded to Cape Race. The complaint is therefore referred to the Canadian Marconi Company in Montreal for further investigation. The Montreal office ascertains that Cape Race correctly received the message and transferred it to the connecting land lines, and the company owning the land lines is now requested to explain why delivery was not made to Mrs. Williams.

Meantime what has become of Mr. Williams' $3.60?

The company operating the station on the La Provence keeps 80c as its proportion and passes on the remainder to the Canadian Marconi Company, which in turn takes $1.70 for its share and that of the Newfoundland Government, remitting the balance, $1.10, to the land line company.

Eventually a report is received from the land line system, stating that the message was delivered to the hall boy of the apartment house at such and such a time, and the hall boy upon being interviewed remembers giving the message to a member of the Williams household, said member still carrying it around with him and having departed for parts unknown.

And there you are! Mr. Williams, not being entitled to refund, loses—and doesn't like it.

Then there are, of course, many instances in which delivery is shown to have been made to the addressee, whose signature on the messenger delivery sheet is held in acknowledgment of proper service performed. In a case of this kind the sender as a rule—having failed to hear from the addressee of his message immediately—jumps to the conclusion that the message was not delivered; whereupon he writes a letter to the Marconi Company demanding the prompt return of his money. And it isn't always easy to convince this fellow that there has been no error anywhere.

A word or two about censorship. At the commencement of the war all telegraph, cable and wireless routes of communication in the belligerent countries were seized by their representative governments and permitted to operate only under very strict censorship regulations. The wireless stations in particular, suffered in this respect. A message filed on board a Dutch steamer and transmitted to the British Post Office station at Crookhaven, we will say, is stopped by the censors. No notice of any such action is sent to the office of origin. In the course of events—since the vessel was bound for this country—a complaint from the sender is received by the Marconi Company in New York. Non-delivery is alleged and a demand is made for refund of his money by return mail, always!

As in the case of Mr. Williams, the complaint is referred abroad. An advice is duly received, stating that "under existing censorship regulations it is regretted that the investigation cannot be continued by the British Post Office." This is the polite method of saying that the message was stopped by the censors and that refund cannot be allowed. Occassionally the reason for which the message was censored is given.

The money paid by the sender has in the regular way been divided up, meanwhile, so much to the ship station and so much to the shore station. The company operating the ship station, holding that the wireless service has been correctly performed in that the message was transmitted to the shore station, will not refund its proportion of the tolls; this company has no proof of non-delivery. The Government administration operating the shore station through which the message was transmitted refuses to investigate—see their letter of such and such a date—and so the matter ends. But not with the sender. He still believes that the Marconi Company in New York has all his money and that no attempt was ever made by anyone to deliver his message.

Vessels Recently Equipped With Marconi Apparatus

Names	Owners	Call Letters
Clan Buchanan	Clan Line.	ZBC
Clan Maclachlan	Clan Line.	ZBB
Armonia	R. Lawrence Smith, Inc.	VES
Dochra	Barber & Co.	KGL
Uganda	Barber & Co.	ZGA
Munamar	Munson Steamship Line	KUI
Somerset	Standard Oil Co. of N. J.	KSU
Bayway	Standard Oil Co. of N. J.	KSR
Motano	Standard Oil Co. of N. J.	KSB
Bradford	Standard Oil Co. of N. J.	KNG
Iaqua	Union Iron Works Co.	WLI
Virginia	Harby Steamship Co.	KFR
Tamesi	Freeport and Tampico Fuel Oil Transportation Co.	WTE

THE CANADIAN COMPANY'S REPORT

In the annual report and statement of accounts of the Marconi Wireless Telegraph Company of Canada it is declared that during the six months which elapsed before the outbreak of the war, the business of the company continued to make satisfactory progress. The range of the Cape Race station has been greatly increased by the equipment of that important station with steel masts, 250 feet high to replace the 160 foot wooden spars. The establishment of a well-equipped factory in Montreal with excellent shipping facilities has been amply justified.

It is impossible at this time fully to relate the important services the company has rendered to the naval authorities. Calls for assistance have been received almost daily, operators required at short notice for special duty and apparatus for urgent requirements installed practically on demand. The directors of the company have submitted appropriate claims to the naval authorities to compensate for the reduced revenue of the various coast stations.

Practically the whole of the mercantile marine of Canadian and Newfoundland registry has now been equipped with Marconi wireless telegraph apparatus. The Newfoundland Government has enacted legislation providing for the compulsory wireless equipment of all vessels engaged in the seal fishery.

There was a net profit for the year of $50,020, and a surplus of $5,727.

THE SHARE MARKET

New York, December 22.

There are no developments of special note in the market for Marconi shares. During the month trading has been quiet, with prices moving in a narrow margin.

Bid and asked prices to-day:

American, 3⅜-3⅝; Canadian, 1⅜-1⅝; English, preferred, 8, none offered; English, common, 9, none offered.

THE MARCONI CHRISTMAS LUNCHEON

The members of the office force of the Marconi Wireless Telegraph Company of America enjoyed a luncheon and entertainment given by the company on the thirty-fifth floor of the Woolworth Building on December 24. The invitations were delivered in the form of a facsimile marconigram. Edward B. Pillsbury, general superintendent of the Trans-Oceanic Division, and Miss T. N. Brown, were in charge of the arrangements for the event. Among those who received the guests were Edward J. Nally, vice-president and general manager of the company; John Bottomley, vice-president, secretary and treasurer, and George De Sousa, traffic manager. After the luncheon a magician entertained with sleight of hand tricks. Dancing followed. About a hundred persons were present.

Letter to the National Amateur Wireless Association

Secretary Daniels' Views Regarding the Organization

Navy Department
Washington, Dec. 11, 1915.

Sir:—I beg leave to acknowledge the receipt of a letter from you, a copy of which has just been brought to my attention by the Superintendent of Naval Radio Service.

I am in entire sympathy with the object of the proposed association which plans for the banding together of the thousands of amateur wireless operators in this country so that they may all be actuated by a common desire and impulse to uphold the laws relating to radio communication, to strengthen the hands of the Federal authorities in their endeavors to see that the radio stations of this country shall not be used for unfriendly or unneutral purposes, and further to promote a clear understanding of mutual rights by which radio communication at times of peace may be made effective and reliable by the elimination of unnecessary interference. Further, I can see in such an organization a means by which those young operators can play a considerable part in the large scheme of National Defense. It must be admitted that the reliable and rapid transmission of information constitutes a very important element in National security and defense, and if properly organized with some such object in view, I can conceive of great possibilities from the banding together of the many amateur operators in this country.

As to the acceptance of a post of honorary vice-president in such an organization, I feel that under present circumstances I must decline to accept, following a line of policy which has guided my actions since my advent into public life, and I am sure you can appreciate the reasons which prompt me to take this action.

With this declination, however, I beg to be allowed to suggest some ideas which may redound to the benefit of the government, if the policy of the organization is so shaped as to allow it, and your interest in practical plans for national defense may be enlisted. Some office of the proposed organization will undoubtedly be charged with the duty of recording the names and addresses of such amateurs as join the association. The Naval Radio Service will be particularly anxious to increase its operating personnel in time of public peril, when it would undoubtedly be called upon to man many more shore and ship stations than at present, and it may happen that many of the amateurs would desire to enlist in the naval service at such time for duty, thereby showing their desire to voluntarily serve their country in a way for which they are best fitted. Could I then request that the names and addresses of such amateur operators that may join your association be furnished to the Superintendent of Naval Radio Service who will be charged with the duty of communicating with them to obtain an expression of their desire or willingness to serve their country in time of need, and who will furnish them with information that will make easy the manner of expressing their willingness to thus become a factor in the large scheme of national defense?

Very truly yours,
(Signed) Josephus Daniels.

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

A Suggested Design for a Wireless Piano

The interest of the amateur field was keenly aroused a little more than two years ago by the published accounts of the wireless piano installed on the Prince of Monaco's yacht, the Hirondelle. After examining the diagrams which were published the average experimenter concluded that apparatus of this type was too expensive and too complicated in construction for his use. However, a study of the conditions to be fulfilled in a system of this type will enable the amateur to gain a clear idea of the apparatus I recently designed.

In Fig. 1 a simplified circuit of the Von Lepel system on the Hirondelle is given, wherein an arc gap composed of revolving copper discs is connected to a source of 1,500 volts direct current through two choke coils. The usual inductance and capacity are shunted around the arc and the frequency of oscillation is determined by the constants of the closed oscillatory circuit. In addition, the arc gap is shunted by an inductance coil and eight condensers of different capacity, each of the latter being connected to a telegraph key or circuit closer. When the arc is in normal operation undamped oscillations flow through the closed oscillatory circuit, but if either of the condenser keys indicated in Fig. 1 is closed the energy of the closed oscillatory circuit is diverted to the latter circuit which discharges at an audible frequency across the arc.

Thus the energy of the antenna system is altered in accordance with the discharges of audible frequency through the arc gap and consequently a musical note having a characteristic dependent upon the inductance of the coil, L, and capacity of the key condenser in use is produced. In this manner, pure, musical tones which are highly pleasing to the ear are obtained. By proper selection of capacities the scale of an octave can be reproduced and single note music sent through space to other radio stations. The method just described is somewhat similar to that of the singing or musical arc the circuit for which is shown to the right of Fig. 1. In this instance condensers of large capacity are shunted across the arc gap and if the proper values are employed the arc will emit pure, musical notes.

Knowing that apparatus of the Von Lepel type is beyond the reach of the experimenter I designed a small wireless piano set which I believe will be a source of considerable amusement to the junior experimenter. The apparatus completely assembled is shown in Fig. 2 where it will be observed that a keyboard with eight circuit closing keys, a special high frequency interruptor, a storage cell, spark coil and an aerial tuning inductance are conveniently mounted for operation. In this apparatus variable tones are obtained from the spark coil by means of a specially constructed interruptor, a side view of which is shown in Fig. 3

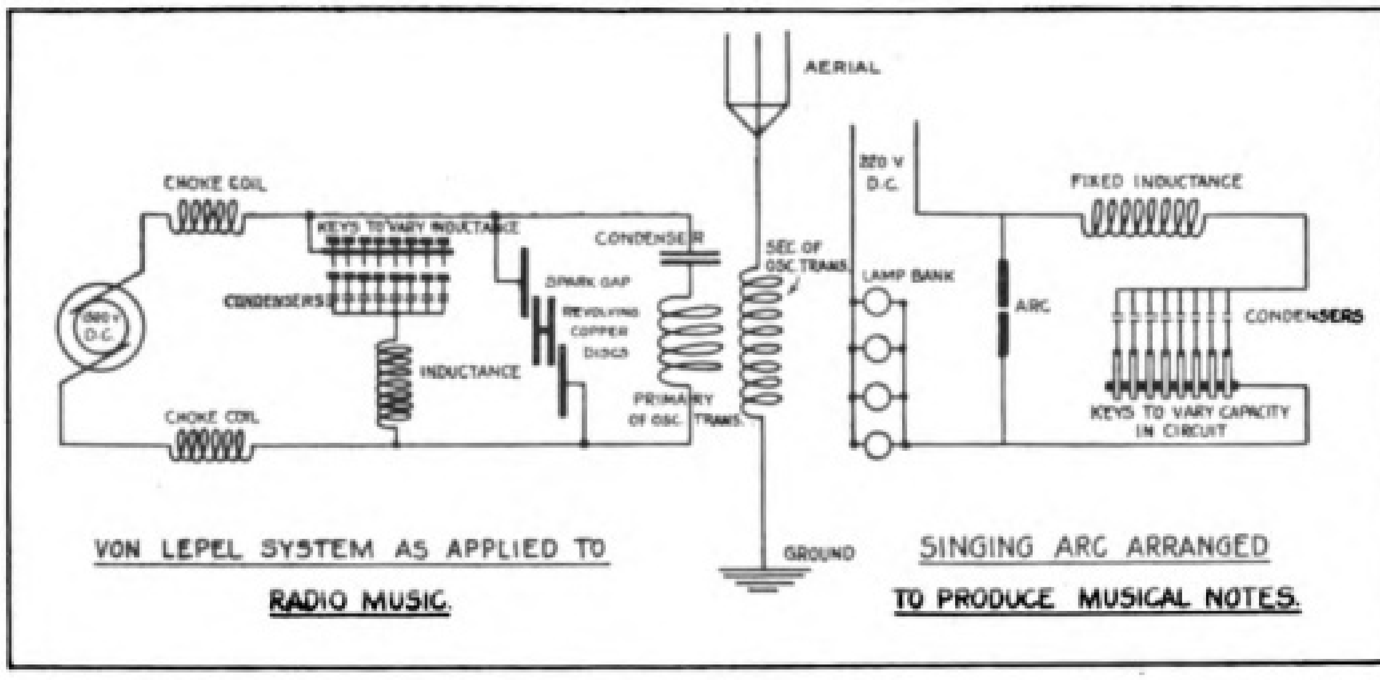


Fig. 1, First Prize Article

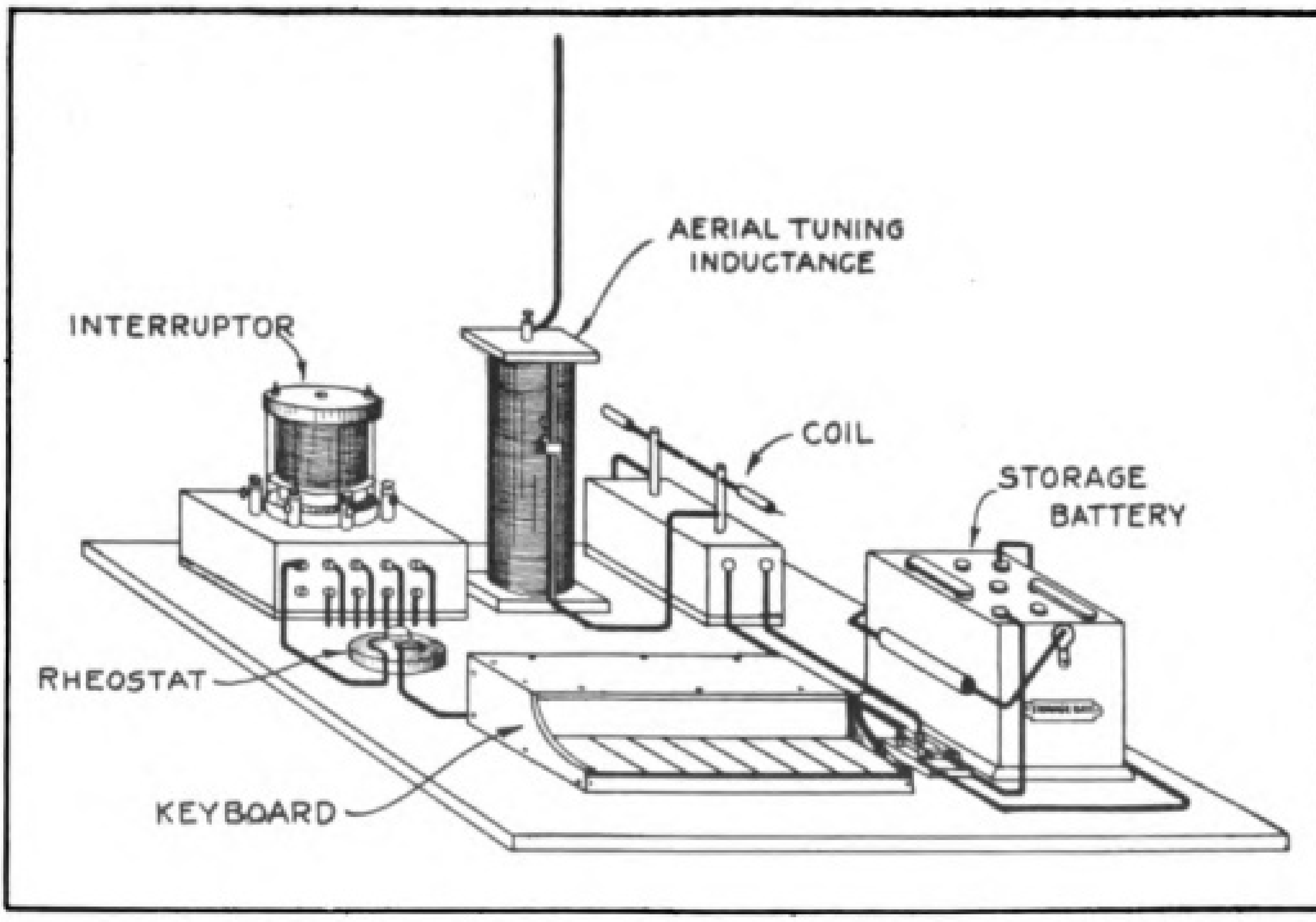


Fig. 2, First Prize Article

and a top view in Fig. 4. The apparatus consists essentially of a vertical electro magnet surrounded by eight vertical steel wires upon which are mounted contact points through which the circuit to the primary winding is completed. When the storage battery is connected to the circuit, interruptions take place at either of the wires at a certain frequency, depending upon the tension. By careful adjustment the tone of all wires can be altered so that the notes of an octave are faithfully reproduced.

The complete interruptor comprises a shallow box 6½ inches square outside and 1½ inches in depth. A top of hard rubber, ¼ of an inch in thickness, has a 4-inch hole cut in its center. On a circumference ¼ of an inch from the edge of the hole, eight holes are drilled to pass 8/32 screws. These are, of course, equally spaced around the circle. In these are mounted eight binding posts, 1 inch in height, which

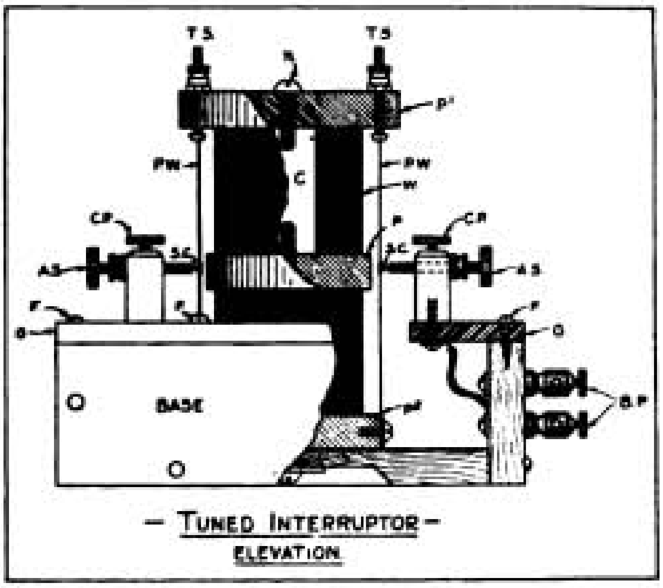


Fig. 3, First Prize Article

take the piece, AS, having the platinum contact point, SC. Each of the posts are connected to separate binding posts mounted on one side of the box.

The core for the winding of the magnet is made of two soft iron rods, ¾ of an inch in diameter, each of which is 1¾ inches in length. The head or

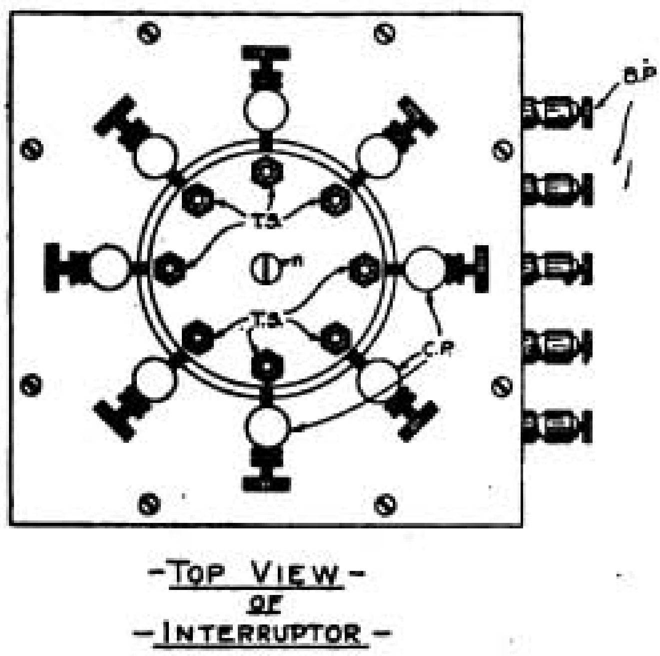


Fig. 4, First Prize Article

the top, P', is of soft iron, ½ of an inch in thickness and 3 inches outside diameter. Eight holes are bored ¼ of an inch from the edge, large enough to pass 8/32 machine screws. In addition a hole is bored in the center for a 10/32 screw to take the bolt, N.

The pole piece, P, is also of soft iron ½ of an inch in thickness and 2¼ inches in diameter. This has a hole bored and threaded for a 10/32 screw. Be sure to place the holes exactly in the center of these pieces in order to show a good fit throughout. It is a good plan to bore the holes before turning up the piece on a lathe. In this manner the builder is assured that all parts will be true. The bottom pole piece, P-2, of soft iron, is ½ of an inch in thickness and 2½ inches in diameter. Eight holes for 8/32 screws are bored around its circumference, as indicated.

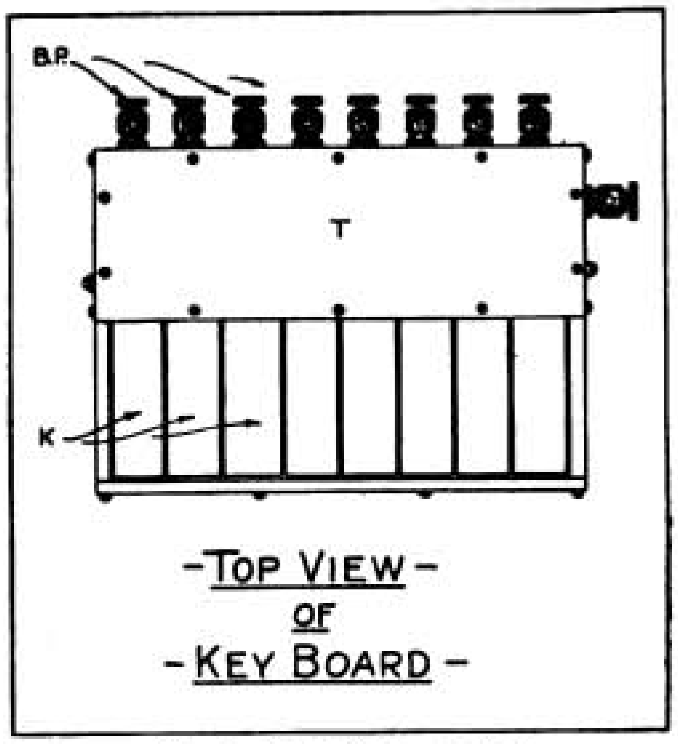


Fig. 5, First Prize Article

The cores are then wound with No. 16 D.C. copper wire, in opposite directions, so that the center piece will be of one polarity while the ends will be of opposite polarity. One terminal of the winding is fastened to a binding post and the other terminal is soldered to the core.

As mentioned previously, the vibrating member consists of eight 6-inch lengths of piano wire. One end of the wire is soldered to a 1¼-inch brass screw, 8/32 thread; about 1¾ inches from this screw a piece of fine silver wire is tightly wrapped around the steel wire to form a contact. This should be at least ⅛ of an inch in length so as to allow for a slight movement of the contact up or down while the tautness of the wire is being adjusted. The silver should be so attached to the set screws that the contact points will come opposite the pole piece, P. It is vital that the screws in the top of bottom pole pieces be exactly in line; otherwise the wires will be thrown out of the proper position for making contact. The wires being in position, fasten the coil in the exact

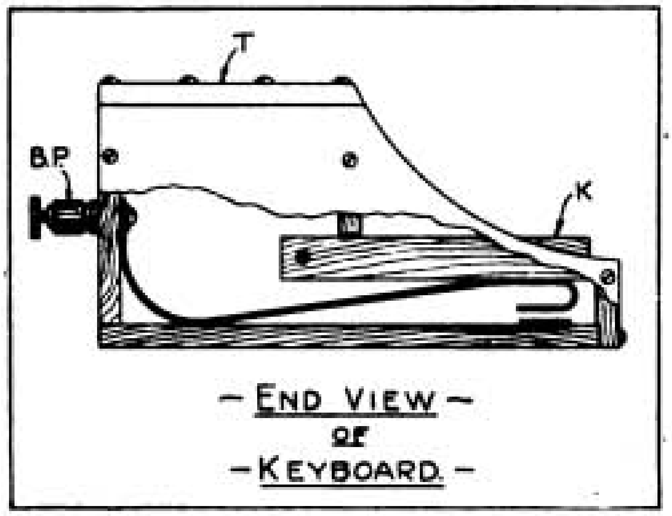


Fig. 6, First Prize Article

center of the box and make everything secure. The interrupter is now ready for adjustment, but before trying it out it is advisable to construct the accompanying keyboard, the parts of which are indicated in Figs. 5 and 6. Of course the dimensions indicated may be altered if desired, but those given should be duplicated if possible. The keyboard is 6 inches in width by 9 inches in length over-all. The back is 3 inches in height and the top 3 inches in width, while the front has a height of 1 inch. The keys are 3½ inches in length, 1 inch wide and ½ of an inch in thickness. A hole is bored through each key ¼ of an inch from the back end to fit a ⅛-inch brass rod. This rod is supported by holes through the end of the box, 1 inch in height from the bottom and 3⅝ inches from the front edge. The ends of the rod are threaded and the nuts placed. The keys are strung on this rod with a 1/16-inch washer between them. The back stop is just 1½ inches in width and when the key is up it will be parallel to the base.

A strip of 1/16-inch brass, ½ of an inch in width, is fastened to the bottom of the box (which, by the way, should be of ¼-inch stock throughout) ¼ of an inch from the front inside edge. This is connected to the binding post mounted on one end of the box. The springs shown consist of strips of 1/16-inch brass, ½ of an inch in width and 7 inches long. These are bent to the form shown and one end of each is clamped under the screw of a binding post, while the other end should be placed just over the brass strip. The keyboard is now finished, but a condenser may be mounted under the top of the box and connected to the circuit, as shown in the diagram of connections (Fig. 7). This condenser is not absolutely necessary as the one usually mounted in the base of an induction coil may be employed instead.

The keyboard should now be wired to the interruptor and careful adjustment made of all the vibrating strings. The tautness of the wires should be carefully adjusted until the notes produced by the spark gap imitate the successive tones of an octave. This may be found a tedious operation but will well repay the labor involved.

It will be observed that the spark gap of the induction coil is connected in series with the antenna system but if desired an

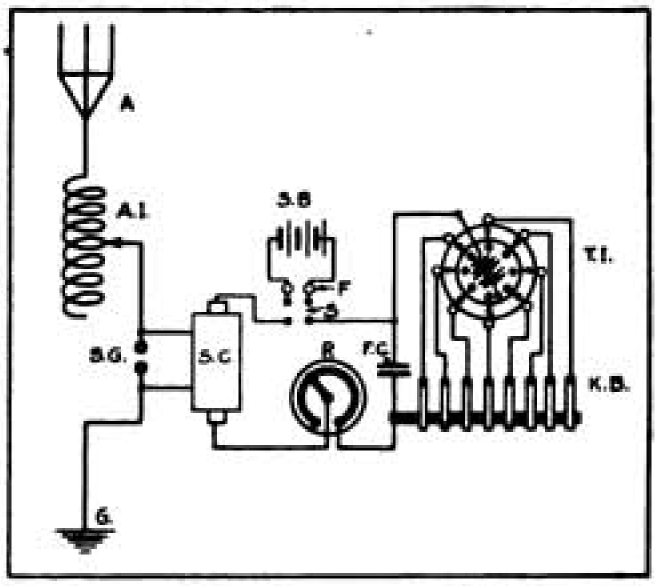


Fig. 7, First Prize Article

oscillation transformer may be employed in the regular manner.

My advice to the amateur experimenter is that he keep neighboring amateurs ignorant of the fact that a device of this kind is under construction. After a little preliminary adjustment and practice he may proceed to call all those within range and en-

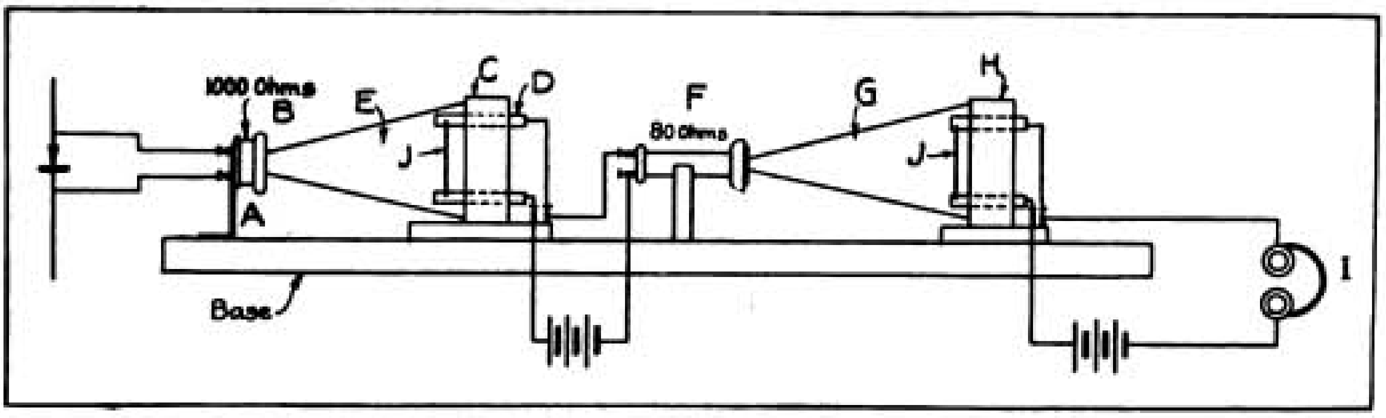


Fig. 1, Second Prize Article

tertain them with simple musical "skits." He should then be prepared for an onslaught of queries, for the entire neighborhood is bound to be curious concerning the origin of this mysterious music and the manner in which it is produced.

THOMAS W. BENSON, *Pennsylvania.*

SECOND PRIZE, FIVE DOLLARS
An Amplifier Used with Home-Made Receiving Apparatus

The amplifying apparatus about to be described has been used for the last six months with extremely satisfactory results. In conjunction with home-made receiving apparatus comprising an inductively-coupled receiving tuner, fixed condenser, galena detector and a pair of Murdock 2,000-ohm head telephones, connected to an aerial 125 feet in length by 50 feet in height at both ends, I am enabled to copy Arlington, Sayville, Duluth, and Key West with the head telephones at a distance of five feet from the ears. I also hear Atlantic coast stations at a distance of at least four feet from the receivers.

As indicated in Fig. 1, a 1,000-ohm wireless receiver is mounted on a brass upright so that the center of the hole in the diaphragm will be three inches above the base. C is a side view of the microphone while the front view is indicated in Fig. 2. The base of the microphone is 3 inches by 6 inches by ½ of an inch. The upright is mounted in the center of the base, having the dimensions given in Fig. 2. D and D^1 are ½-inch electric light carbons, 3 inches in length. J is a ¼-inch flash light battery carbon, 3 inches in length, both ends of which are filed to a point. A small hole is bored in D and D^1 that the carbon can just fit in and be a little free to move. A wire is taken from D and D^1 and connected to an 80-ohm telephone receiver with two or three old dry cells connected in series.

A pasteboard megaphone constructed to make a tight fit over the 5½-inch disc, having a thickness of ⅜ of an inch is shown in Fig. 2. The small end is glued over the hole in the telephone receivers. The second microphone is of similar construction to the first and the megaphone extends from it to the 80-ohm receiver. Two old, dry cells are connected in series with the second microphone and when all the foregoing connections have been made the amplifier is ready for operation. After the microphone has been in use for about one month a slight diminution in the strength of signals may be noticed. This can easily be remedied by spinning the movable carbon in each microphone.

FRANCIS J. BRENNAN, *Pennsylvania.*

THIRD PRIZE, THREE DOLLARS
An Aerial Mast of Substantial Design Which Costs Little

Many an amateur ambitious to increase the range of his station recognizes the need of a well elevated aerial, but he finds it difficult to find a mast of considerable height at a small expense. Confronted with a similar problem, I solved it in the following manner: A complete diagram for a mast I erected is given in the accompanying drawing. The drawing is largely self-explanatory and gives all the necessary dimensions. It will be noted that the mast consists of three sections of iron pipe which slide into each other and are prevented from telescoping by a ⅜-inch rod iron bolts passing entirely through the pipe. Reducing couplings are worthless for joining the sections as they snap while the pole is being raised. Bolts 1 and 2

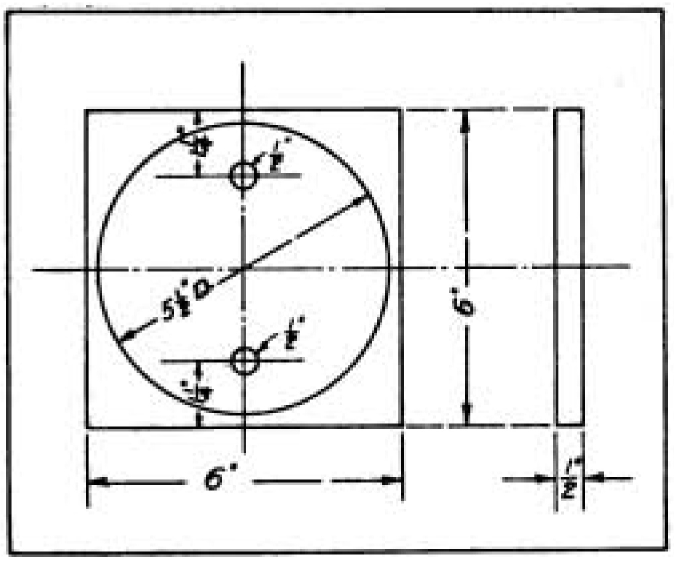


Fig. 2, Second Prize Article

must be at right angles to the strain exerted by the aerial so that the sections can swing slightly on them as an axis, thus reducing the strain.

The three guy wires are galvanized stranded iron wire looped around the pole. These are prevented from slipping down by the bolt No. 2 which projects several inches from both sides of the pipe.

It is advisable to use turn buckles on the guy wires. The open end of the top section should be plugged to keep the inside of the pole from rusting and the outside of the mast should be given a good coat of white lead paint.

The mast may be raised by any of the methods commonly employed. As the center of gravity is low, the operation is not extremely difficult. Excellent anchors for the guy wires may be made by burying two short pieces of pipe crossed like a plus sign about 3½ feet in the ground with plenty of rock ballast on top.

The advantages of this type of mast are strength, small surface exposed to the wind, permanence and good appearance.

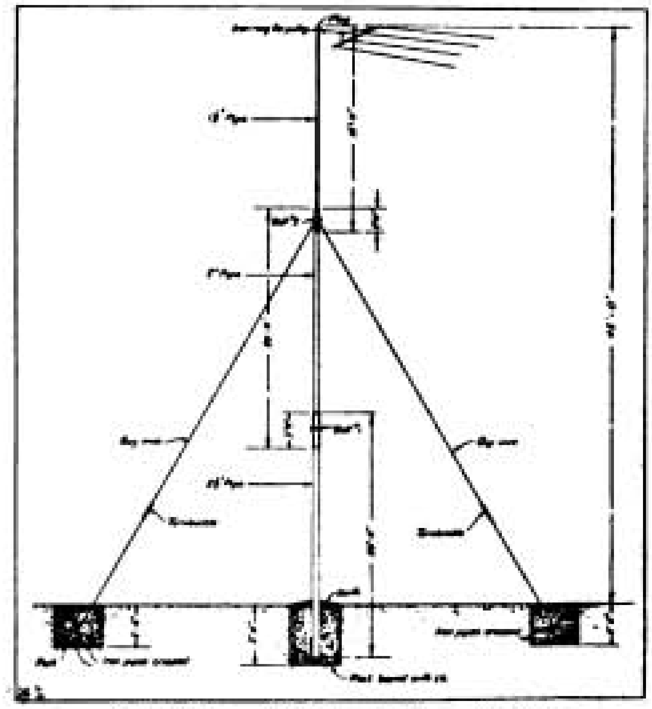
S. B. YOUNG, *Massachusetts.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Receiving Detector Which Gives No Trouble in Adjustment

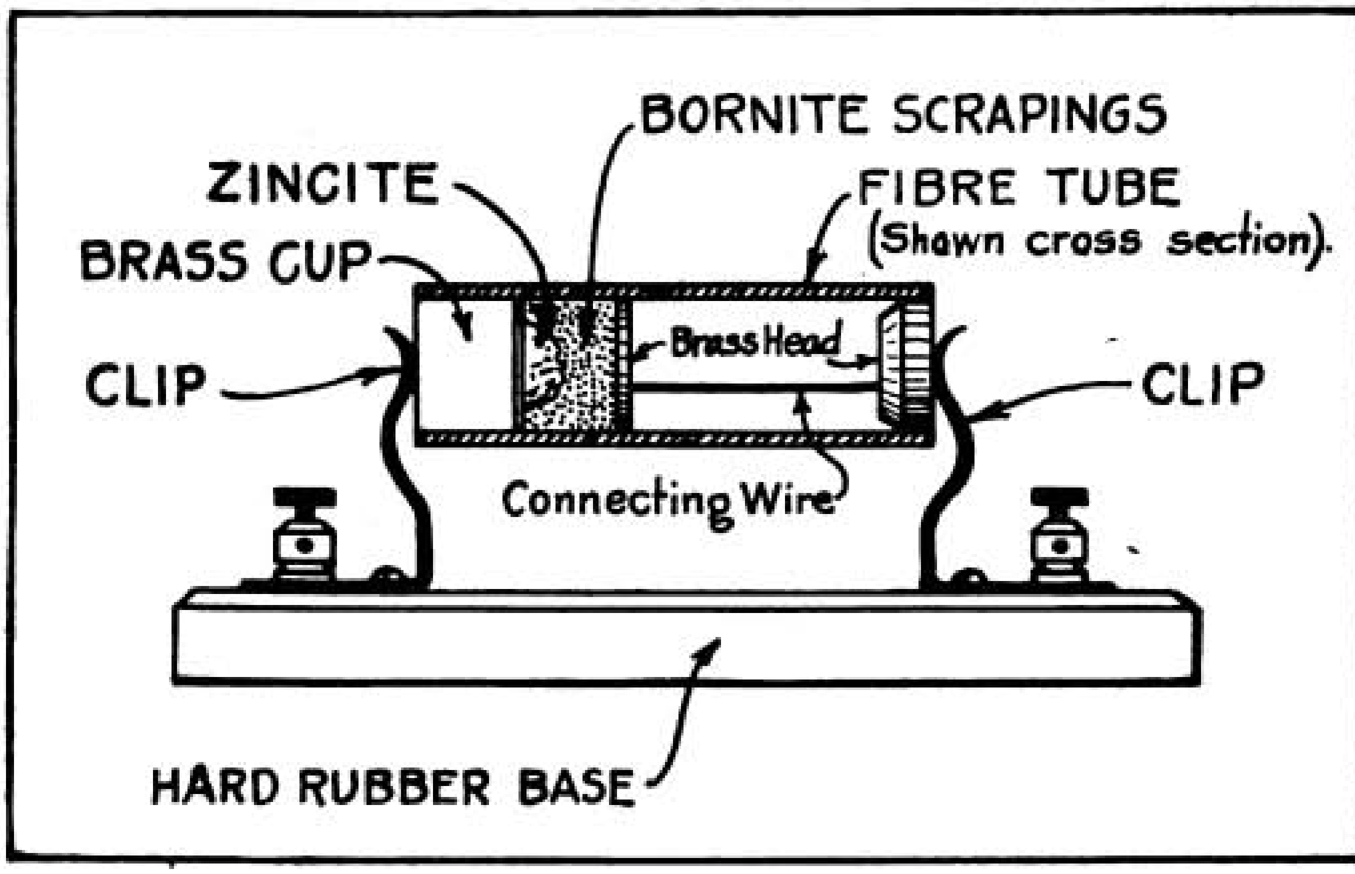
The receiving detector about to be described has been in use at my station for a period of four months and during this time has given no trouble whatsoever in adjustment. After a series of experiments with various crystals I have decided that for all around amateur work the "Perikon" detector is to be preferred, but I also find it difficult to maintain it in a sensitive state of adjustment. I therefore investigated various types of construction until I hit upon the following design which, I believe, will interest the amateur field.

The complete detector is covered in Fig. 1 and is constructed in the following manner: The cup which holds the crystal is made from a brass fuse cap about ½ of an inch in diameter. This



Drawing, Third Prize Article

cup is filled almost to the edge with soft metal in which is placed a piece of good, sensitive zincite. While the soft metal is still warm rub a piece of ordinary paraffine over it, leaving the metal covered with a thin insulating layer of wax. This completed, push the cup into the end of a fibre tube ½ of an inch inside diameter, taking care not to remove or loosen the paraffine coating. Leave the end of the brass cup flush with the end of the fibre



Drawing, Fourth Prize Article

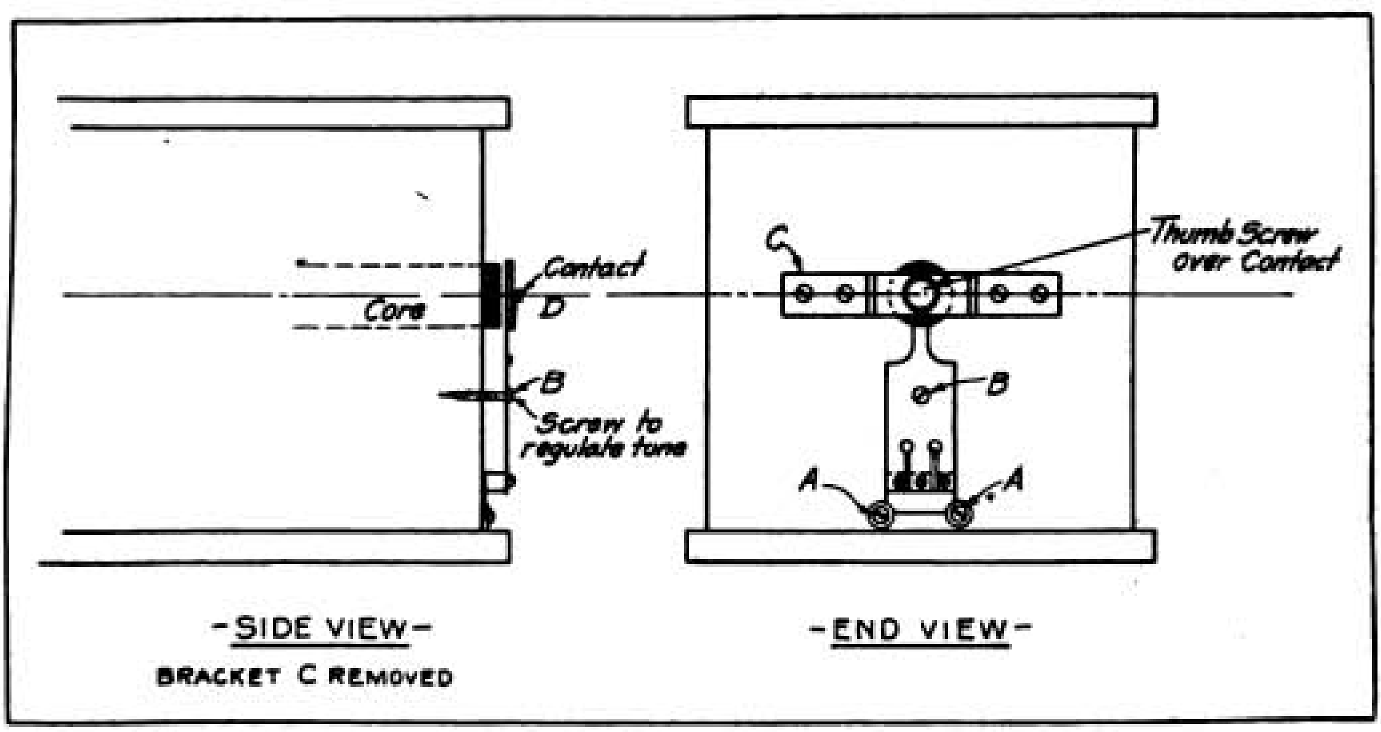


Fig. 1, Honorary Mention Article, G. K. Barnes

tube. Next take a piece of bornite and scrape off a quantity of filings. Pour these filings into the tube until the zincite is covered. Next place a brass disc in the tube to hold the filings in place. Take a piece of brass ½ of an inch in diameter and work it into the end of the tube, connecting it to the other brass disc by a piece of wire. The detector is now ready for use.

A detector base may be made, as indicated in Fig. 1. The holder consists of two brass clips mounted on a hard rubber base, each clip in turn being connected to a binding post. The detector may then be placed between the two clips and, of course, quickly removed whenever necessary.

If desired, a crystal of silicon, galena or carborundum may be substituted for the zincite and brass filings for the bornite scrapings. Suitable soft metal for mounting the crystals can be made by mixing an ounce of mercury with tin-foil until it forms a very stiff mass.

I trust that other amateurs will be able to obtain results similar to those I have obtained.

OLIVER M. BLACK, *Massachusetts.*

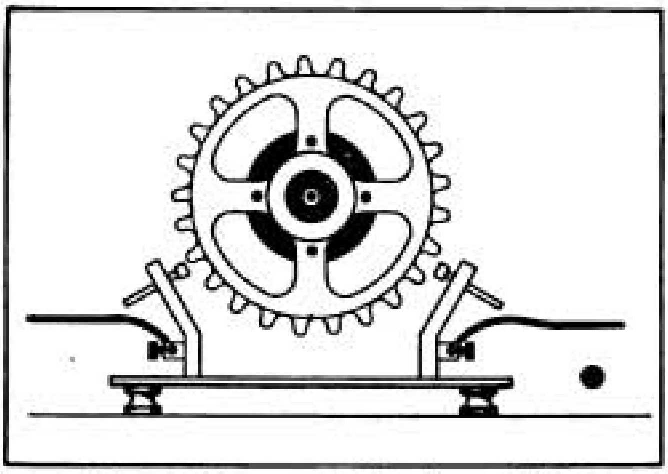


Fig. 1, Honorary Mention Article, Samuel W. Place

HONORARY MENTION

Having experienced considerable trouble with the vibrator on my spark coil, I improved its action and the resulting note. The vibrator spring shown in the accompanying drawing is a part of the J. B. master vibrator, fastened by means of washers at A. The armature shown should be about 1/8 of an inch from the end of the core before the screw, B, is put in place.

If the screw, B, is attached to the vibrator, as shown, and careful regulation of it is made, an extremely pleasing note is produced which, I believe, will satisfy many amateurs who have had my experience.

G. K. BARNES, *Connecticut.*

HONORARY MENTION

An efficient rotary spark gap can be constructed at small expense in the following manner:

The sprocket wheel of an old bicycle is employed as the rotor, while the stationary electrodes are of zinc mounted on a piece of 3/8 of an inch square brass motor an extremely high pitched spark rod, bent as shown in the accompanying drawing. I have found that a sprocket wheel 8 inches in diameter with 25 teeth works admirably. It is mounted on the shaft of a small A. C. or D. C. motor as follows:

Turn out a disc on a lathe about 4 inches in diameter and 1/2 inch in thickness. Drill a hole at the center of the disc large enough to take a bushing to fit on the motor shaft. Slide the disc on the bushing and clamp it tight; then fasten the bushing to the shaft with a set screw. The disc, of course, is preferably of hard rubber, bakelite or fibre.

The sprocket wheel has a hole in the center, about an inch and a quarter in diameter, and it would be well when turning out the disc to make a projection or shoulder at the center of the disc of the same diameter as the sprocket wheel. In this manner the sprocket wheel can be fitted over the

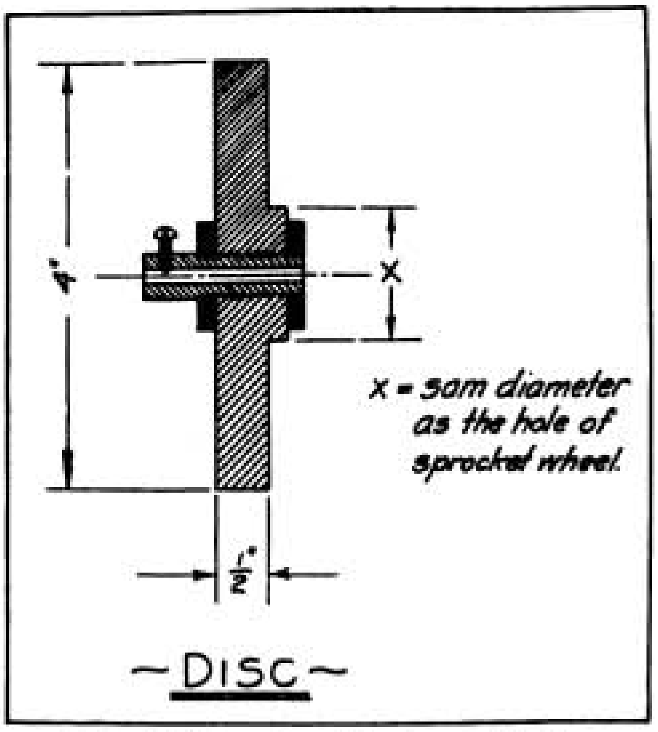
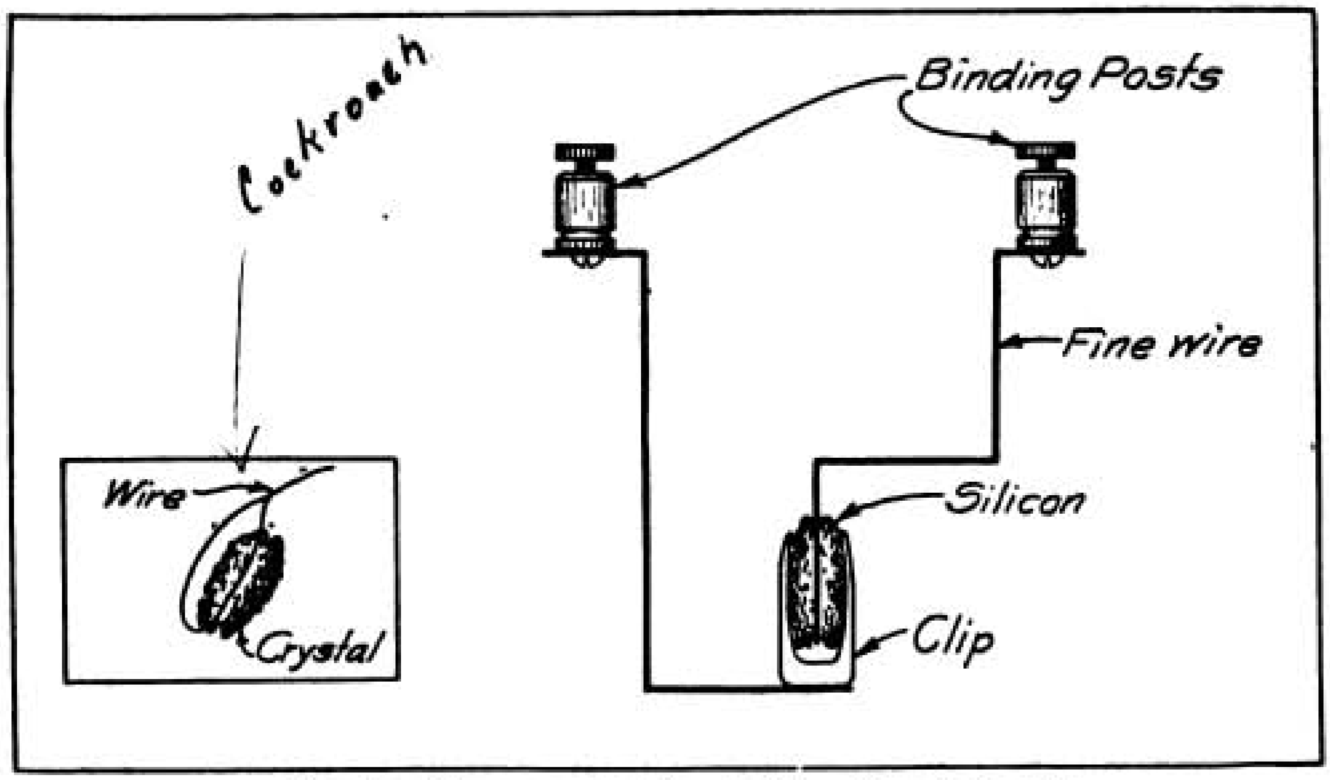


Fig. 2, Honorary Mention Article, Samuel W. Place

projection, eliminating the necesssity of trueing up the wheel. Several holes are drilled in the sprocket wheel, which is then fastened to the disc by means of machine screws. Two electrodes may then be placed on either side of the wheel and connections from the closed oscillatory circuit made to them. I find that by using a very high speed note is produced which, as all amateurs know, is desirable.

If the motor revolves at a speed of 4,000 R.P.M., there will be 1,600 sparks per second, the equivalent of an 800-



Drawing, Honorary Mention Article, Vern F. Santar

cycle spark. Unless the motor is rather powerful, it is doubtful whether this speed can be obtained, but in my own experiments I have found that a 1-30th h.p. A. C. motor will drive the sprocket wheel at a speed of from 2,000 to 2,500 R.P.M., the equivalent of a 400 or 500-cycle spark.

At this frequency it is advisable to decrease the capacity of the condenser, because, owing to the rapid rate of interruptions at the gap, the condenser formerly employed with this set cannot be fully charged and discharged.

SAMUEL W. PLACE, *Pennsylvania.*

HONORARY MENTION

I have tried a great many types of crystalline detectors, but the majority of them will not remain in adjustment for any length of time.

I therefore evolved a method for making the adjustment of a silicon detector permanent. The procedure is as follows: First, secure a piece of sensitive silicon and cut two notches on opposite sides of the crystal. Then wrap a piece of fine wire in the notches and extend the wire to the binding post, as in Fig. 1. Next secure a good clip and set the crystal in it, taking care to allow the wire and the clip to come in contact. Then light a candle and let the melted paraffine drop on the crystal until it is completely covered at the point where the wire is wound. Take connections from the clip and from the winding to binding post. The complete crystal should then be enclosed in a small box.

I have used a detector of this type for some time and it positively does not jar out of adjustment.

VERN F. SANTAR, *Florida.*

HONORARY MENTION

As a general thing the amateur wireless operator who must depend upon a vibrator for the production of high potential current has many troubles to bear. In order to obtain a heavy spark at the secondary winding, vibrators are stiffened by pieces of paper, etc., fitted back of the vibrator spring. A coil when so adjusted gives an "overload" spark. I found by experiment that the sluggishness in vibrators is not always due to the design of the vibrator nor the spring itself, but may be accounted for by the fact that the button of soft iron at the end of the spring is more or less hard and therefore to some extent magnetized.

I experienced difficulty with an interrupter of this type and found later by experiment that this button possessed sufficient residual magnetism to pick up small tacks, etc., I removed it from the end of the spring and heated it slowly to a red heat, allowing it to cool in a similar manner. After it had been so treated, the action of the vibrator was considerably improved and the secondary spark much clearer.

L. BARRIETTE, *New York.*

A Station in the Far North

The Marconi Link at Ketchikan, Alaska. Its Equipment and Points of Interest

By A. A. Isbell

LOCATED in Alaska—a region where a glamour born of the wilds prevails to a certain degree, the Ketchikan station of the Marconi Wireless Telegraph Company of America equals in interest any of the links in the company's system. The majority of persons are attracted first by the aerial-carrying structures of the station. The towers at Ketchikan are four in number, each 300 feet high to the head of the steel. Stepped on top of each tower is a wooden topmast projecting fourteen feet, on top of which are mounted 80,000-volt, triple-petticoat porcelain insulators carrying the receiving aerial, which is also used as a transmitting aerial for the 5-kw., marine station. The towers stand at the four corners of a rectangle, 300 feet by 600 feet, the long axis of which points directly towards Astoria, Oregon. A twenty-wire antenna is supported on two triatic stays between the towers, and all twenty wires are carried to the steel power-house, located approximately 300 feet from the first two towers and exactly on an extension of the long axis of the rectangle mentioned.

The ground system consists of some 3,000 pounds of zinc plates buried in a circle about the steel power house, with three strips four feet wide, running out on the beach to mean low tide levels. One of the three strips runs for 100 feet in the bed of a small creek before reaching the beach. Owing to the excessive rainfall the ground plates are always wet.

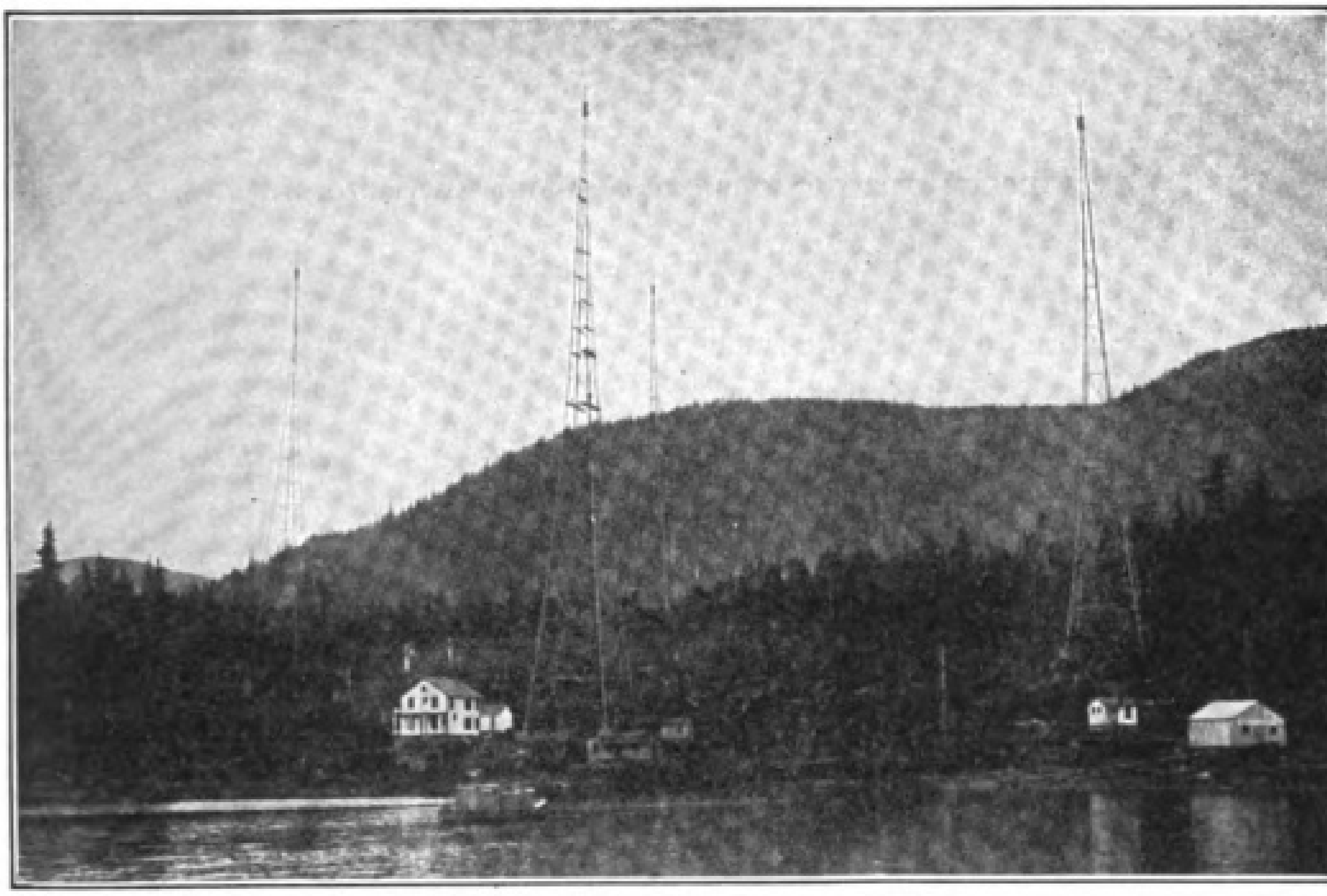
Power at 2,300 volts and a frequency of sixty is obtained from Ketchikan, about two miles away,. At a point 300 feet from the power-house the current enters an underground conduit and is taken to the high-tension switchboard; from there it is distributed to the heating, lighting, and power transformers, according to standard methods.

In the power-house, constructed of steel and concrete, are located the high and low tension switchboards; a rotary converter for furnishing direct current for operating solenoid keys; side disc motors, remote control oil switches, all power transformers, a 25-k.w. condenser bank of thirty tanks, an oscillation transformer for a 25-k.w. plant, and a solenoid key operated from the office seventy-five feet distant. The rotary converter referred to also drives the 25-k.w. disc.

The 25-k.w. station has transmitted to San Francisco in daylight and can be copied on a typewriter at Bremerton Navy Yard, Puget Sound, Washington, and at Juneau, Alaska; Cordova, Alaska, reports that very strong signals have been received from Ketchikan.

The wooden office building contains the 5-k.w., sixty-cycle Marconi plant for communicating with ships. It has worked with the following stations at midday: Unalga, near Dutch Harbor, Alaska; Kodiak, Alaska; Cordova, Alaska; Sitka, Alaska; Tatoosh Island, off Cape Flattery, Washington; North Head, Washington, and Table Bluff, California. The first and the last on the foregoing list are approximately 1,200 miles away from Ketchikan. All of the Canadian stations on the Pacific coast can be communicated with in daylight. The 5-k.w. station is equipped with a non-synchronous gap, working normally at 240 sparks a second. Its regular wave-length is 1,700 meters, but at times it works on 3,000 meters, and, of course, complies with the law with reference to three hundred and six hundred meters.

In addition to the ship station the office building contains all controls for the 25-k.w. station. Without moving his chair, the operator can start and operate either the 5-k.w., or the 25-k.w. station. There are two tuners, one having a range



This photograph shows the picturesque location of the Ketchikan station. Its four towers are generally the first features of the plant to catch the visitor's eye

of from 100 to 4,000 meters and the other from 100 to 7,000 meters. On the latter the Marconi Honolulu station can be copied at any time during daylight. Bolinas can be copied on either tuner with a typewriter.

The main hot wire ammeter of the 25-k.w. plant cannot be seen while an operator is transmitting at the office. Therefore, the writer devised a method for operating a small auxiliary hot wire ammeter which is located in the office in view of the operator. This shows when anything is wrong with the 25-kw. apparatus.

The two-flat dwelling, which has been well furnished by the Marconi Company, contains all modern conveniences. Water is supplied from a reservoir having approximately 12,000 gallons' capacity. It is located on high ground back of the first right-hand tower. All of the buildings at the plant are connected by substantial board walks. A board walk leading from the plant to Ketchikan provides a thoroughfare for pedestrians.

NEW RECEIVING STATION IN MAINE

A new wireless receiving station has been erected at Deering, a suburb of Portland, Maine, and will be operated as a branch of the station at Tuckerton. One of the men connected with the management of the Tuckerton station said that the decision to build the receiving station in Maine was reached after a series of experiments carried on in co-operation with United States naval officers, and they were in favor, from a scientific standpoint, of placing the receiving station farther north. The Tuckerton station has been operated for a considerable time under the supervision and control of the United States Naval Radio Service. The Deering station will also be operated under the control of the Radio Service.

WIRELESS TO ARGENTINA

The Argentine Government, it was announced recently in a newspaper, has granted a concession for the erection of a high-power wireless station at Buenos Aires, plans having been completed for establishing a radio service between the United States and the South American republic. A station will also be built near New York City.

Marconi Decremeter No. 24

(Special Instructions to Marconi Inspectors)

PART II (Conclusion)

FOR convenience in making calculations of a wireless telegraph circuit, a table is attached (Fig. 10), giving certain corresponding values for wave-lengths from 100 to 5,000 meters, viz.: the wave-length, the wave-length squared, the corresponding frequency, oscillation constant (square root of the inductance times the capacity), oscillation constant squared, product of the inductance by the capacity, and the difference in one meter wave-length at all wave-lengths as noted.

For example: Should the wave-length of an oscillatory circuit be measured and found to be 200 meters and if the capacity value of that circuit is definitely known, the value of inductance may be determined by dividing the value, $L \times K$, corresponding to 200 meters, by K, the known capacity.

The constants of an oscillatory circuit are related as follows, the symbols used being the same as given in the table:

$$\lambda = 59.6 \sqrt{LK} \qquad (1)$$

$$N = \frac{5.033 \times 10^6}{\sqrt{LK}} \qquad (2)$$

$$\lambda = \frac{3 \times 10^8}{N} \qquad (3)$$

It will thus be seen that λ is proportional to the $\sqrt{LK}$ and accordingly λ^2 proportional to LK; furthermore, N, the frequency, is inversely proportional to the oscillation constant or the $\sqrt{LK}$. By careful consideration of the fundamental relations numerous calculations may be quickly performed.

The wave-length of an oscillatory circuit of the type encountered in receiving sets may be determined as per Fig. 4. The circuit of unknown wave-length, LK, is set into excitation by the buzzer and battery.

The complete decremeter circuits are indicated to the right of the drawing. Owing to the feebleness of the oscillations emitted by the buzzer excitation system, a sensitive crystal detector is switched into the decremeter circuit. For preliminary trials, the coil, L, of the decremeter is placed in close inductive relation to L′ and adjustments made at the variable condenser, K, also at the crystal detector, D, until a resonant response is secured.

For some accurate determination L is moved at a distance from L′ until the signals are just audible.

When taking such observations it is important that the buzzer contacts be free from all sparking, as otherwise the constants of the wave-meter circuit are seriously altered.

The wave-length of the closed oscillatory circuit of a wireless telegraph transmitter is obtained as per Fig. 5. Here the inductance coil, L, of the wave-meter is placed in inductive relation to L′, the primary winding of the oscillation transformer. The galvanometer of the decremeter is connected in the circuit.

The capacity of the wave-meter, condenser, K, is altered until a maximum deflection is secured in the galvanometer; the two circuits are then in electrical resonance and the wave-length is read directly from the condenser scale.

Care should be taken that the coil, L, is at a sufficient distance from L′ to prevent the galvanometer from burning out.

Determination of the Wave-Length of an Aerial System

The fundamental wave-length of a complete aerial system is obtained as per Fig. 6. The spark gap, S, in series with the antenna is connected to the secondary winding of a high potential transformer or induction coil. The inductance coil, L, of the wave-meter is placed in inductive relation to the earth lead of the aerial system. The capacity of the condenser, K, is altered until the maximum

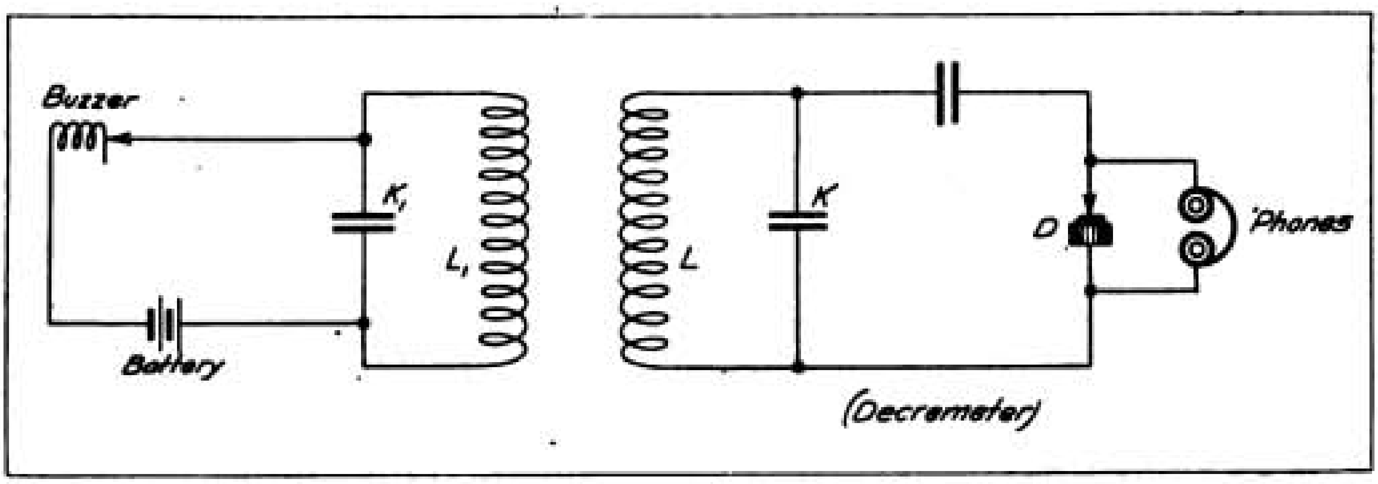


Fig. 4

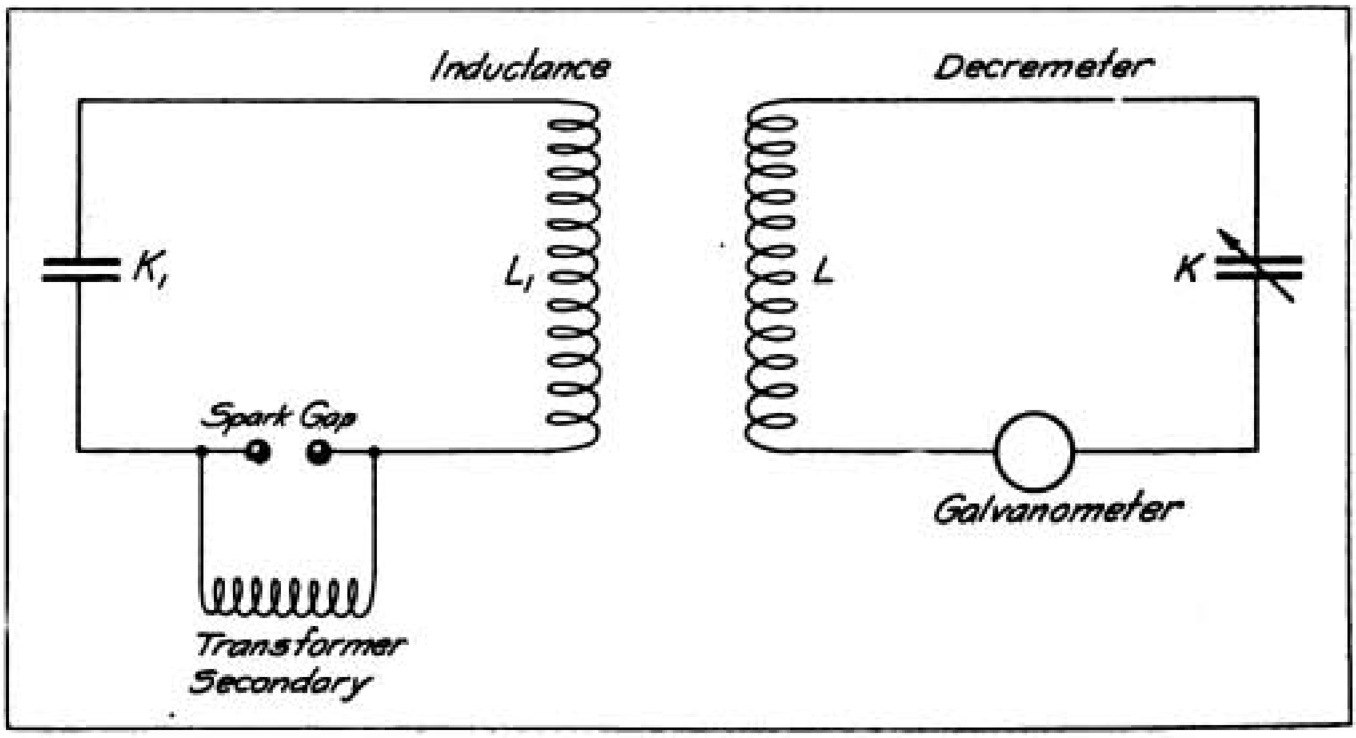


Fig. 5

deflection is secured in the galvanometer, indicating resonance between the aerial circuits and the wave-meter. If desired, the galvanometer may be disconnected from the circuit and the conditions of resonance obtained by means of a crystalline detector and head telephone as previously mentioned.

The wave-length of a Marconi aerial may be obtained by means of the connections shown in Fig. 6-A. Here the antenna system set is set into oscillation by means of a properly adjusted buzzer in connection with the battery as shown. When the buzzer is set into operation a change in the lines of force of the inductance coil, L′, takes place; consequently the aerial system is charged and discharged at its own natural period of vibration.

The oscillations thus produced act upon the coil, L, of the wave-meter and resonance is indicated by means of the crystal detector and head telephones. For accuracy the coil L should be very loosely coupled to L′.

When the closed and open oscillatory circuits of a wireless telegraph transmitter are so related that energy is transferred from one to the other, they are said to be coupled. It is a matter of importance in such circuits that the exact value of coupling be known. This value may be determined by the resultant wave-lengths or frequencies produced in the circuits. Referring to Fig. 7: When the inductance coil, L-2, is placed in inductive relation to L-3, energy is transferred in the well-known manner. If the coil, L-3, is placed in close inductive

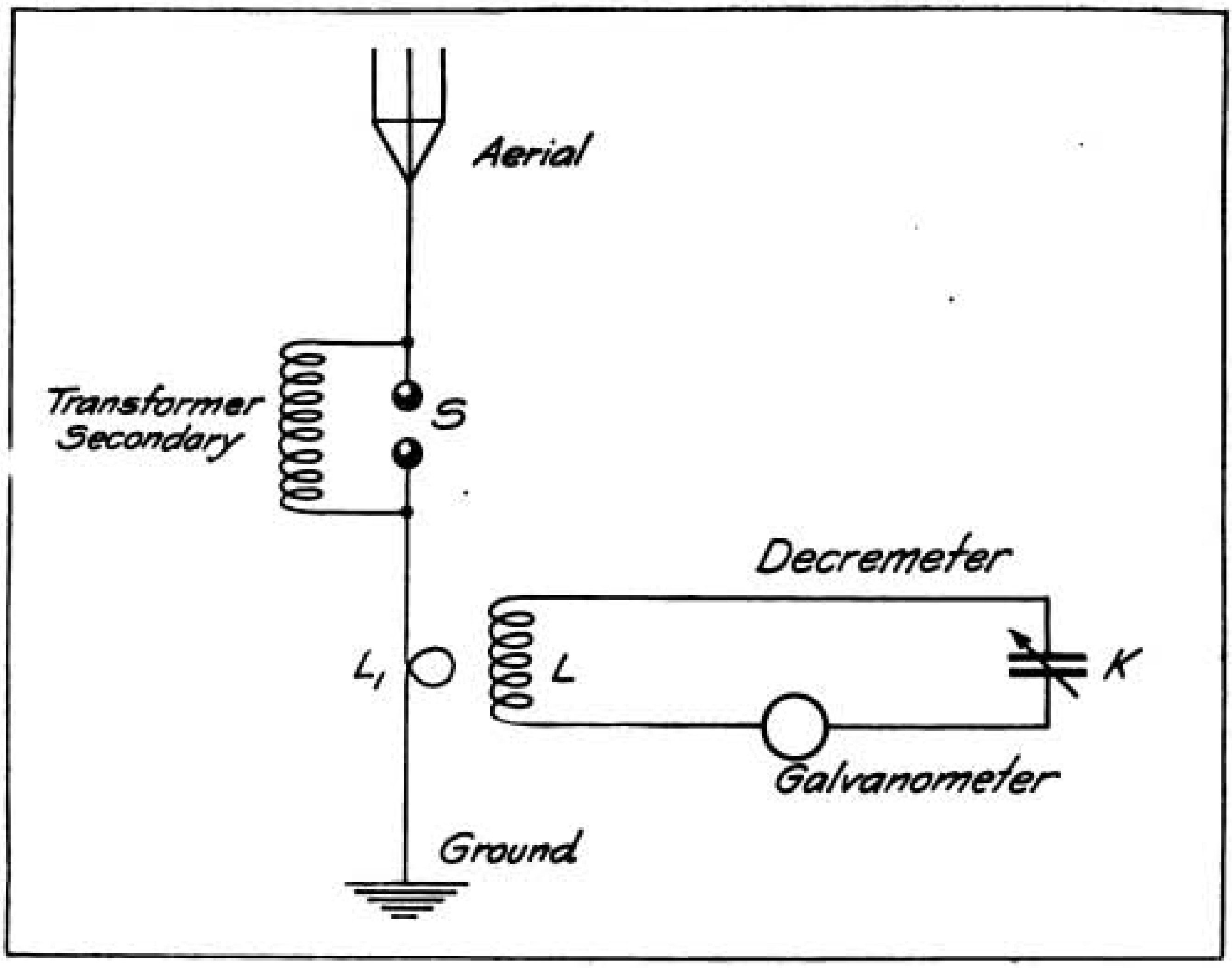

Aerial
Transformer Secondary
S
Decremeter
L_1
L
K
Galvanometer
Ground

Fig. 6

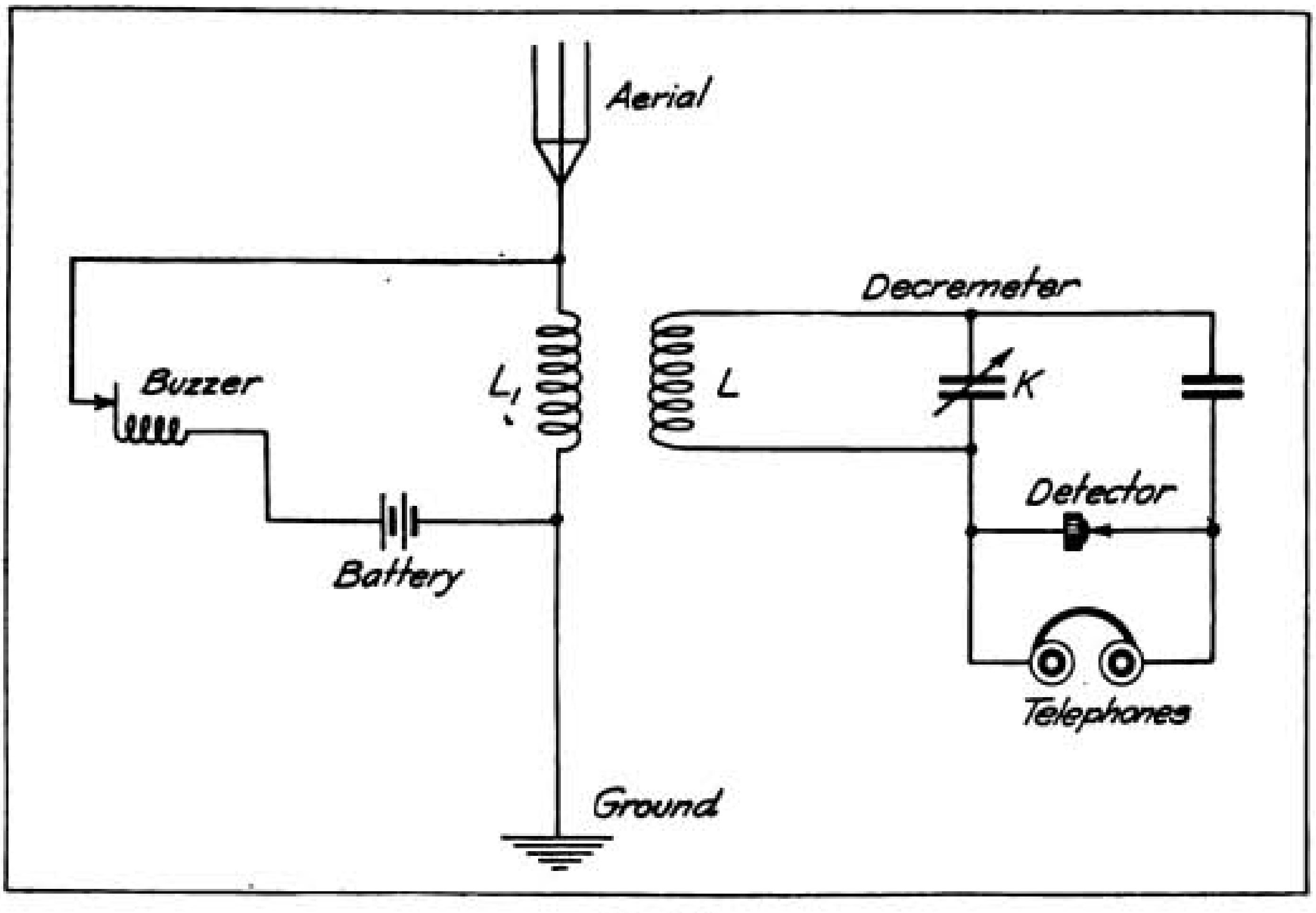

Aerial
Decremeter
Buzzer
L_1
L
K
Detector
Battery
Telephones
Ground

Fig. 6A

relation to L-2 two resultant wave-lengths widely separated are set up. If, however, the coil, L-3, is drawn away from L-2 the two frequencies tend to approach unity.

The transmitter being set into operation, the inductance coil, L, of the wave-meter is placed in inductive relation to L′, a single turn of wire connected in series with the earth lead; the capacity of the condenser of the wave-meter, K, is altered and two points of maximum deflection are noted on the galvanometer.

where K = coefficient of coupling.

If the galvanometer readings thus obtained are plotted against the corresponding wave-length readings, a complete curve will result showing two maxima. This curve is known as a coupling curve.

If K has a value near to zero, there will be only one maximum in the resultant curve and the emitted wave-length will be practically that of the independent circuits.

When two oscillatory circuits of radio frequency are magnetically coupled the

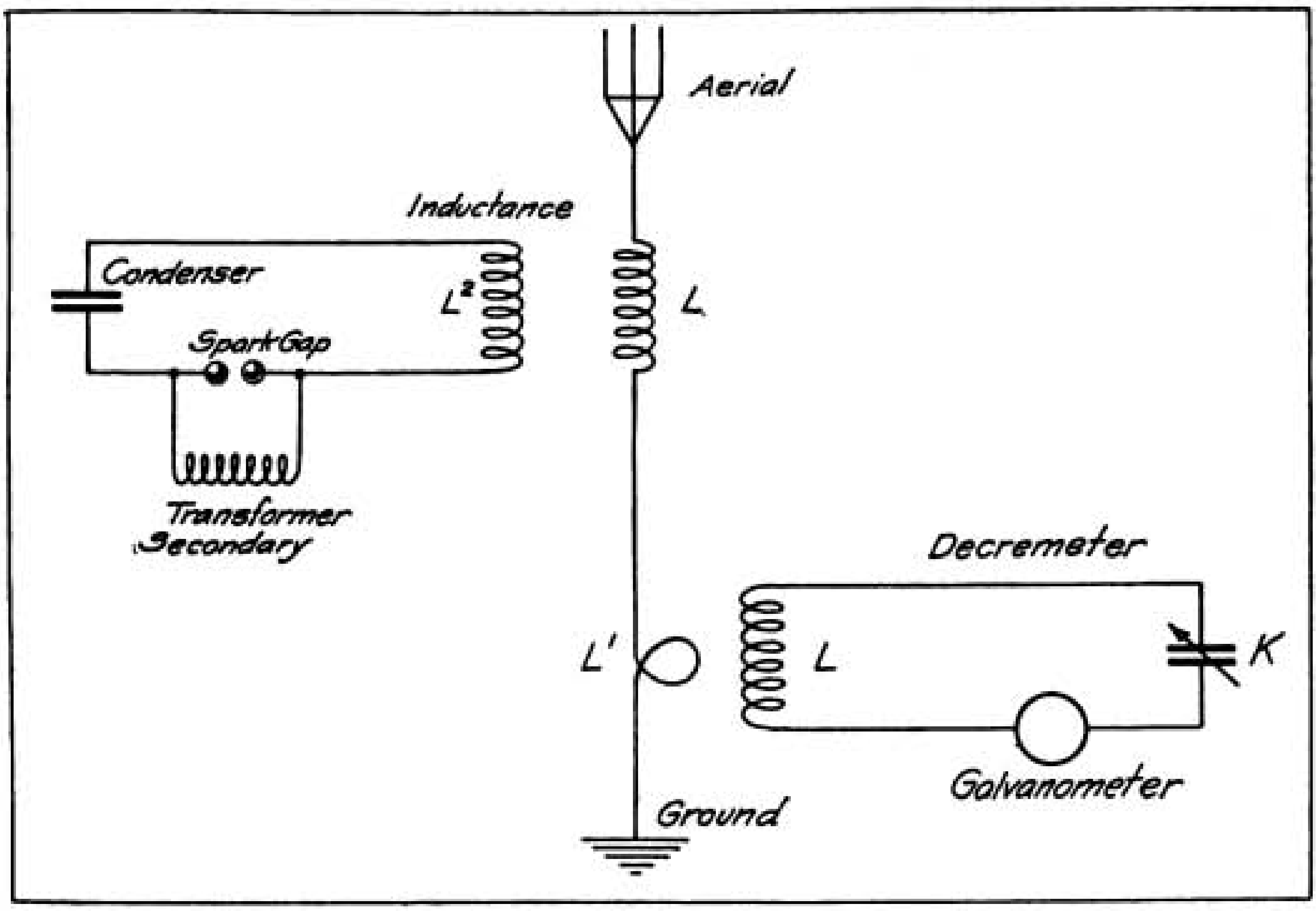


Fig. 7

The corresponding wave-length readings are then substituted in the following formula:

$$K = \frac{\lambda_1^2 - \lambda_2^2}{\lambda_1^2 + \lambda_2^2} \qquad (4)$$

where λ equals the longer wave-length and λ_2 the shorter wave-length.

If the wave-length (λ) to which both circuits have been independently adjusted is known, then the following formula will give sufficiently accurate values of the resultant coupling, namely:

$$K = \frac{\lambda_1 - \lambda_2}{\lambda} \qquad (5)$$

combined decrement value is obtained from the following formula:

$$\delta_1 + \delta_2 \pi = \left(1 - \frac{\lambda}{\lambda_r}\right) \frac{a}{\sqrt{A^2 - a^2}} \qquad (6)$$

Where, in this particular application,

δ_1 = the decrement of the circuit under measurement;

δ_2 = the decrement of the decremeter circuit;

λ_r = the wave-length at resonance;

λ = the wave-length at a frequency a certain percentage off resonance (not over 5 per cent.)

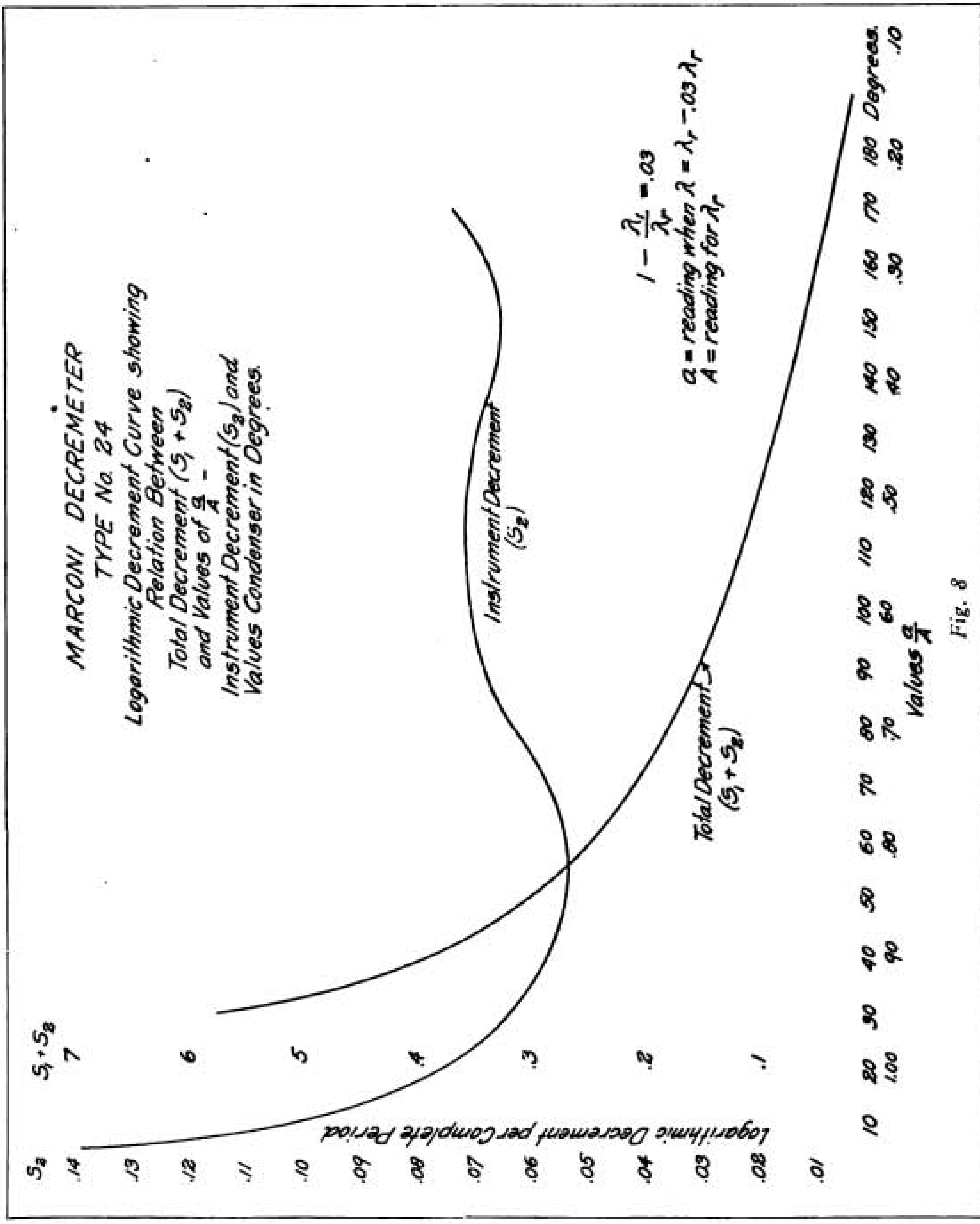


Fig. 8

A = the corresponding current reading at the galvanometer of the wave-meter when the latter is adjusted to λ_r;

a = the galvanometer reading corresponding to λ.

If we substitute X for the expression:

$$\left(1 - \frac{\lambda}{\lambda_r}\right)$$

and Y for $\frac{a}{A}$ then Formula No. 6 becomes

$$\delta_1 + \delta_2 = 3.1416 \times \frac{y}{\sqrt{1 - y^2}} \quad (7)$$

If the decrement of the decremeter circuit is definitely known at various capacities of the variable condenser, this value may be subtracted from that given in equation No. 7, and the result is the decrement of the circuit under measurement.

To determine the decrement of the emitted wave of a wireless telegraph transmitter, the inductance coil of the decremeter is placed in inductive relation to the earth leads of the aerial system as shown in Fig. 7. The capacity of the wave-meter condenser is then altered until resonance is obtained as indicated by the galvanometer.

Let the wave-length found be λ_r and the corresponding current reading A. Then set the condenser of the decremeter at a point so that X or $\left(1 - \frac{\lambda}{\lambda_r}\right)$ equals

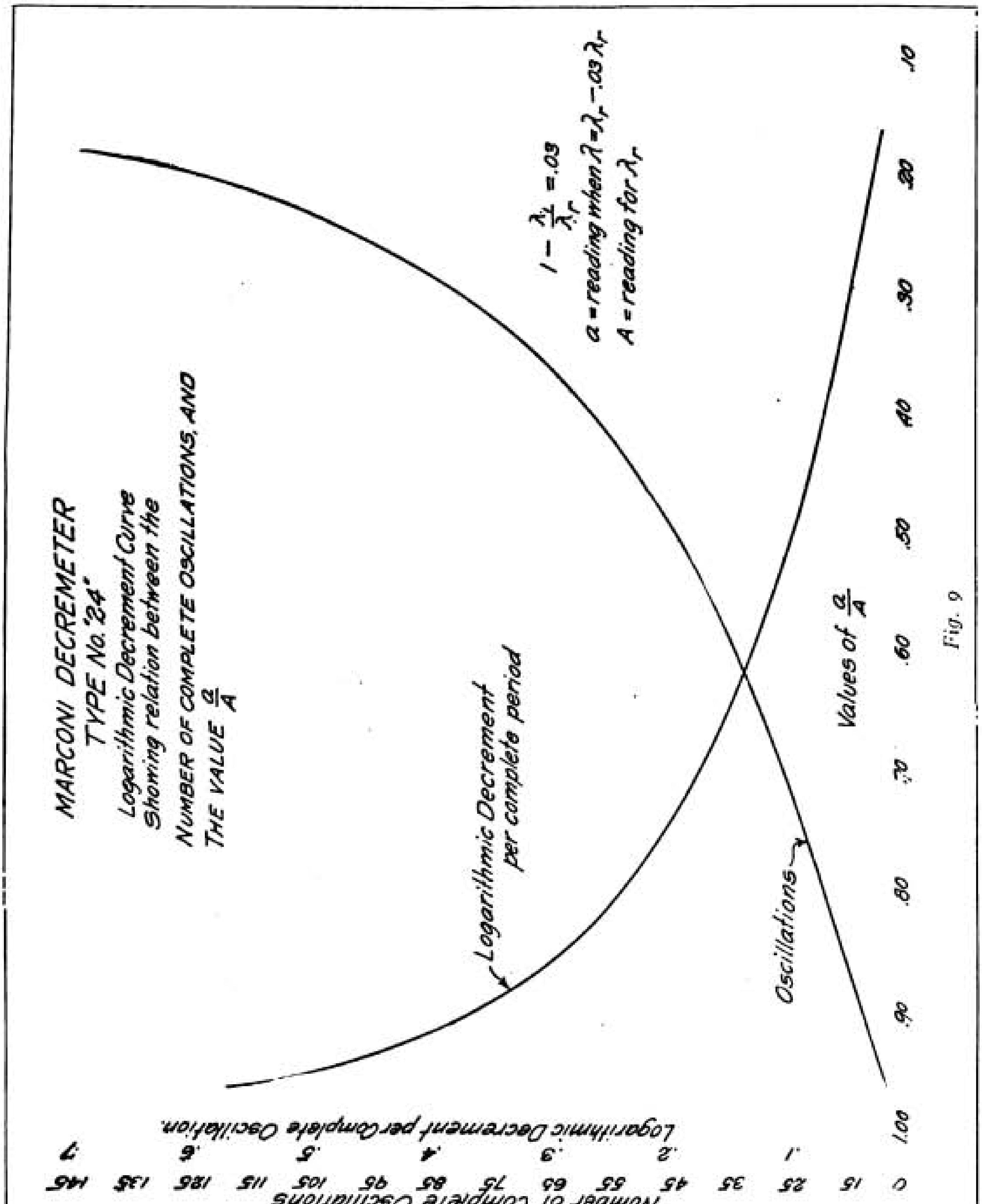


Fig. 9

one, two, three, four or five per cent., as desired, and let the corresponding current ratio be y or $\frac{a}{A}$. Substitution of these values in formula No. 7, the combined decrement of the circuit under measurement is obtained.

For accuracy, several values of

$$\left(1 - \frac{\lambda}{\lambda_r}\right)$$

should be selected and corresponding ratio of $\frac{a}{A}$ noted. A mean of these readings is taken to obtain the value of $\delta_1 + \delta_2$. The value of δ_2 being known, the value of δ_1 is quickly obtained.

If a number of decrement values for given values of $\left(1 - \frac{\lambda}{\lambda_r}\right)$ and corresponding ratio of $\frac{a}{A}$ are calculated, the resultant data may be plotted in curve form for rapid determination of the decrement of a circuit by means of the current readings from the galvanometer alone.

A curve of this character is given in Fig. 8, which, when used in connection with decremeter No. 24, allows determination of the decrement to be made as follows:

The decremeter is adjusted to resonance with the circuit under measurement and the inductance coil of the wave-meter placed in such position or relation to the circuit under measurement as to give a reading on the hot wire galvanometer of 100. The condenser of the wave-meter is then adjusted to a point three per cent. off resonance and the corresponding deflection on the galvanometer noted. In this manner the ratio $\frac{a}{A}$ is quickly determined and by reference to Fig. 8, the corresponding decrement value obtained. The value of δ_2 being indicated directly upon the decremeter scale, it may be subtracted from the combined value just obtained to find the value of δ_1.

It is frequently observed that the resonance curves of an oscillatory circuit are non-uniform and in consequence it is well to take decrement readings 3 per cent. above resonance as well as below resonance. A mean of the two readings gives the final decrement value.

The value of δ_1 having thus been obtained, the number of complete oscillations per wave train can be determined from the curve (Fig. 8), or by the following formula:

$$N = \frac{4.605 \times \delta_1}{2\,\delta_1}$$

Where N = the number of oscillations taking place before the last one is reduced to 1 per cent. of the first, and δ_1 is the decrement of the circuit being measured.

The value of δ_1 can also be determined from the capacity values of the variable condenser, as follows: Adjust the variable condenser for resonance and vary the inductive relation between the decremeter and the circuit under measurement until the galvanometer reading is 100. Then decrease the capacity until the galvanometer reads 70.7 and note the corresponding capacity of the condenser. Let this capacity be represented by C; next increase the capacity of the condenser at a point beyond resonance until the galvanometer again reads 70.7 and note the corresponding capacity. Let this capacity be C'. If the capacity of the condenser when adjusted for resonance is C_r, then

$$\delta_1 = \left(\frac{C_1 - C}{C_r} \times \frac{\pi}{2}\right) - \delta_2.$$

Where δ_2 is the decrement of the instrument taken from the scale marked δ_1 when the condenser pointer is adjusted for resonance.

In the Fig. 9 two curves are given, one curve being the ratio of $\frac{a}{A}$ plotted against the values of $\delta_1 + \delta_2$, the total decrement. In the second curve the degrees of the condenser scale are plotted against δ_2 the decrement of the instrument. These curves can be employed for determination of the decrement in place of the curves given in Fig. 8.

NO. 24 WAVEMETER TABLES.

λ = Wave-length in Meters.

λ^2 = Wave-length Squared.

n = Number of oscillations per second.

O = L.K. and is called the oscillation constant.

K = Capacity in Microfarads.

L = Inductance in Centimeters—1,000 Cent. = 1 Microhenry.

D = Difference of L.K. for 1 meter.

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
100	10,000	3000000	1.68	2.82	.042
110	12,100	2727272	1.80	3.24	.084
120	14,400	2500000	2.02	4.08	.067
130	16,900	2307600	2.18	4.75	.077
140	19,600	2142600	2.35	5.52	.083
150	22,500	2000000	2.52	6.35	.081
160	25,600	1874800	2.68	7.16	.096
170	28,900	1764600	2.85	8.12	.10
180	32,400	1666600	3.02	9.12	.105
190	36,100	1578800	3.19	10.17	.112
200	40,000	1500000	3.36	11.29	.11
210	44,100	1428400	3.52	12.39	.123
220	48,400	1363500	3.69	13.62	.128
230	52,900	1304200	3.86	14.90	.134
240	57,600	1250000	4.03	16.24	.131
250	62,500	1200000	4.19	17.55	.146
260	67,600	1153800	4.36	19.01	.15
270	72,900	1111000	4.53	20.52	.157
280	78,400	1071300	4.70	22.09	.163
290	84,100	1034300	4.87	23.72	.158
300	90,000	1000000	5.03	25.30	.174
310	96,100	967700	5.20	27.04	.18
320	102,400	937400	5.37	28.84	.185
330	108,900	909100	5.54	30.69	.18
340	115,600	882300	5.70	32.49	.197
350	122,500	857100	5.87	34.46	.20
360	129,600	833300	6.04	36.48	.208
370	136,900	810800	6.21	38.56	.215
380	144,400	789400	6.38	40.71	.206
390	152,100	769200	6.54	42.77	.226

No. 24 Wavemeter Tables

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
400	160,000	750000	6.71	45.03	.23
410	168,100	731700	6.88	47.33	.237
420	176,400	714300	7.05	49.70	.228
430	184,900	697700	7.21	51.98	.248
440	193,600	681800	7.38	54.46	.254
450	202,500	666700	7.55	57.00	.26
460	211,600	652200	7.72	59.60	.265
470	220,900	638300	7.89	62.25	.255
480	230,400	625000	8.05	64.80	.277
490	240,100	612200	8.22	67.57	.282
500	250,000	600000	8.39	70.39	.288
510	260,100	588200	8.56	73.27	.277
520	270,400	576900	8.72	76.04	.299
530	280,900	566000	8.89	79.03	.305
540	291,600	555600	9.06	82.08	.311
550	302,500	545400	9.23	85.19	.317
560	313,600	535700	9.40	88.36	.303
570	324,900	526300	9.56	91.39	.328
580	336,400	517200	9.73	94.67	.334
590	348,100	508500	9.90	98.01	.340
600	360,000	500000	10.07	101.41	.324
610	372,100	491800	10.23	104.65	.35
620	384,400	483900	10.40	108.15	.358
630	396,900	476200	10.57	111.73	.362
640	409,600	486800	10.74	115.35	.346
650	422,500	461500	10.90	118.81	.373
660	435,600	454600	11.07	122.54	.380
670	448,900	447800	11.24	126.34	.385
680	462,400	441200	11.41	130.19	.391
690	476,100	434800	11.58	134.10	.373
700	490,000	428600	11.74	137.83	.403
710	504,100	422500	11.91	141.86	.407
720	518,400	416700	12.08	145.93	.414
730	532,900	411000	12.25	150.07	.394
740	547,600	405400	12.41	154.01	.426
750	562,500	400000	12.58	158.27	.430
760	577,600	394800	12.75	162.57	.426
770	592,900	389600	12.92	166.83	.443
780	608,400	384600	13.09	171.35	.432
790	624,100	379800	13.25	175.57	.453
800	640,000	375000	13.42	180.10	.459
810	656,100	370400	13.59	184.69	.464
820	672,400	365900	13.76	189.33	.472
830	688,900	361400	13.93	194.05	.448
840	705,600	357100	14.09	198.53	.482

No. 24 Wavemeter Tables

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
850	722,500	352900	14.26	203.35	.489
860	739,600	348800	14.43	208.24	.493
870	756,900	344800	14.60	213.17	.469
880	774,400	340900	14.76	217.86	.504
890	792,100	337100	14.93	222.90	.511
900	810,000	333300	15.10	228.01	.516
910	828,100	329700	15.27	233.17	.492
920	846,400	326100	15.43	238.09	.527
930	864,900	322600	15.60	243.36	.534
940	883,600	319100	15.77	248.70	.538
950	902,500	315800	15.94	254.08	.545
960	921,600	312500	16.11	259.53	.518
970	940,900	309300	16.27	264.71	.567
980	960,400	306100	16.44	270.38	.552
990	980,100	303000	16.61	275.90	.567
1000	1000,000	300000	16.78	281.57	.543
1010	1020,100	297030	16.94	287.00	.570
1020	1040,400	294120	17.11	292.70	.590
1030	1060,900	291260	17.28	298.60	.590
1040	1081,600	288450	17.45	304.50	.60
1050	1102,550	285710	17.62	310.50	.56
1060	1123,600	283010	17.78	316.10	.61
1070	1144,900	280370	17.95	322.20	.61
1080	1166,400	277780	18.12	328.30	.62
1090	1188,100	275230	18.29	334.50	. 59
1100	1210,000	272730	18.45	340.40	.63
1110	1232,100	270270	18.62	346.70	.64
1120	1254,400	267850	18.79	353.10	.64
1130	1276,900	265480	18.96	359.50	.65
1140	1299,600	263150	19.13	366.00	.61
1150	1322,500	260860	19.29	372.10	.66
1160	1345,600	258610	19.46	378.70	.66
1170	1368,900	256400	19.63	385.30	.68
1180	1392,400	254230	19.80	392.10	.67
1190	1416,100	252100	19.97	398.80	.64
1200	1224,000	250000	20.13	405.20	.69
1210	1464,100	247930	20.30	412.10	.69
1220	1488,400	245900	20.47	419.00	.70
1230	1512,900	243900	20.64	426.00	.66
1240	1537,600	241930	20.80	432.60	.71
1250	1562,500	240000	20.97	439.70	.72
1260	1587,600	238090	21.14	446.90	.72
1270	1612,900	236220	21.31	454.10	.69
1280	1638,400	234370	21.47	461.00	.73
1290	1664,100	232560	21.64	468.30	.74

No. 24 Wavemeter Tables

λ	$λ^2$	n	O or $\sqrt{L.K.}$	L.K.	D.
1300	1,690,000	230760	21.81	475.70	.74
1310	1,716,000	229010	21,98	483.10	.75
1320	1,742,400	227270	22.15	490.60	.72
1330	1,768,900	225560	22.31	497.80	75
1340	1,795,600	223870	22.48	505.30	.77
1350	1,822,500	222220	22.65	513.00	.78
1360	1,849,600	220590	22.82	520.80	.73
1370	1,876,900	218970	22.98	528.10	.78
1380	1,904,400	217390	23.15	535.90	.79
1390	1,932,100	215830	23.32	543.80	.80
1400	1,960,000	214380	23.49	551.80	.80
1410	1,988,100	212760	23.66	559.80	.76
1420	2,016,400	211260	23.82	567.40	.81
1430	2,044,900	209790	23.99	575.50	.82
1440	2,073,600	208340	24.16	583.70	.82
1450	2,102,500	206900	24.33	591.90	.79
1460	2,131,600	205470	24.49	599.80	.83
1470	2,160,900	204080	24.66	608.10	.84
1480	2,190,400	202700	24.83	616.50	.85
1490	2,220,100	201340	25.00	625.00	.80
1500	2,250,000	200000	25.17	633.50	.81
1510	2,280,100	198680	25.33	641.60	.86
1520	2,310,400	197360	25.50	650.20	.88
1530	2,340,900	196070	25.67	659.00	.87
1540	2,371,600	194800	25.84	667.70	.83
1550	2,402,500	193540	26.00	676.00	.89
1560	2,433.600	192310	26.17	684.90	.89
1570	2,464,900	191060	26.34	693.80	.90
1580	2,496,400	189860	26.51	702.80	.90
1590	2,528,100	188670	26.68	711.80	.86
1600	2,560,000	187500	26.84	720.40	.91
1610	2,592,100	186340	27.01	729.50	.92
1620	2,624,400	185190	27.18	738.70	.93
1630	2,656,900	184050	27.35	748.00	.93
1640	2,689,600	182930	27.52	757.30	.89
1650	2,722,500	181820	27.68	766.20	.94
1660	2,755,600	180730	27.85	775.60	.96
1670	2,788,900	179640	28.02	785.20	.94
1680	2,822.400	178570	28.19	794.60	.91
1690	2,856.100	177510	28.35	803.70	.97
1700	2,890,000	176460	28.52	813.40	.97
1710	2,924,100	175440	28.69	823.10	.98
1720	2,958,400	174420	28.86	832.90	.93
1730	2,992,900	173410	29.02	842.20	.98

No. 24 Wavemeter Tables

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
1740	3,026,600	172410	29.19	852.00	1.00
1750	3,062,500	171430	29.36	862.00	1.00
1760	3,097,600	170450	29.53	872.00	1.00
1770	3,132,900	169490	29.70	882.10	.95
1780	3,168,400	168540	29.86	981.60	1.02
1790	3,204,100	167600	30.03	901.80	.92
1800	3,240,000	166670	30.20	912.00	1.03
1810	3,276,100	165750	30.37	922.30	1.04
1820	3,312,400	164840	30.54	932.70	.98
1830	3,348,900	163940	30.70	942.50	1.05
1840	3,385,600	163040	30.87	953.00	1.04
1850	3,422,500	162160	31.04	963.40	1.06
1860	3,459,600	161290	31.21	974.10	1.00
1870	3,496,900	150430	31.37	984.10	1.07
1880	3,534,400	159370	31.54	994.80	1.08
1890	3,572,100	158730	31.71	1005.60	1.08
1900	3,610,000	157890	31.88	1016.40	1.02
1910	3,648,100	157060	32.04	1026.60	1.09
1920	3,686,400	156240	32.21	1037.50	1.10
1930	3,724,900	155440	32.35	1048.50	1.14
1940	3,763,600	154630	32.55	1059.90	1.07
1950	3,802,500	153840	32.72	1070.60	1.05
1960	3,841,600	153060	32.88	1081.10	1.12
1970	3,880,900	152280	33.05	1092.30	1.12
1980	3,920,400	151510	33.22	1103.50	1.14
1990	3,960,100	150750	33.39	1114.90	1.07
2000	4,000,000	150000	33.55	1125.60	1.15
2010	4,040,100	149250	33.72	1137.10	1.25
2020	4,080,400	148520	33.89	1149.60	1.05
2030	4,120,900	147780	34.06	1160.10	1.16
2040	4,166,600	147060	34.23	1171.70	1.10
2050	4,202,500	146340	34.39	1182.70	1.17
2060	4,243,600	145630	34.56	1194.40	1.18
2070	4,284,900	144930	34.73	1206.20	1.18
2080	4,326,400	144230	34.90	1218.00	1.18
2090	4,368,100	143540	35.07	1229.80	1.14
2100	4,410,000	142850	35.23	1241.20	1.20
2110	4,452,100	142180	35.40	1253.20	1.21
2120	4,494,400	141510	35.57	1265.30	1.21
2130	4,536,900	140840	35.74	1277.40	1.15
2140	4,579,600	140180	35.90	1288.90	1.22
2150	4,622,500	139540	36.07	1301.10	1.23
2160	4,665,600	138880	36.24	1313.40	1.23
2170	4,708,900	138240	36.41	1325.70	1.24
2180	4,752,400	137610	36.58	1338.10	1.17
2190	4,796,100	136980	36.74	1349.80	1.26

No. 24 Wavemeter Tables

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
2200	4,840,000	136360	36.91	1362.40	1.25
2210	4,844,100	135740	37.08	1374.90	1.26
2220	4,928,400	135130	37.25	1387.50	1.19
2230	4,972,900	134530	37.41	1399.40	1.28
2240	5,017,600	133930	37.58	1412.20	1.29
2250	5,062,500	133330	37.75	1425.10	1.29
2260	5,107,600	132740	37.92	1438.00	1.22
2270	5,152,900	132160	38.08	1450.20	1.29
2280	5,198,400	131570	38.25	1463.10	1.31
2290	5,244,100	131000	38.42	1476.20	1.31
2300	5,290,000	130430	38.59	1489.30	1.31
2310	5,336,100	129870	38.76	1502.40	1.32
2320	5,382,400	129310	38.93	1515.60	1.25
2330	5,428,900	128750	39.09	1528.10	1.33
2340	5,475,600	128200	39.26	1541.40	1.33
2350	5,522,500	127660	39.43	1554.70	1.34
2360	5,569,600	127120	39.60	1568.10	1.27
2370	5,616,900	126580	39.76	1580.80	1.37
2380	5,644,400	126050	39.93	1594.50	1.35
2390	5,712,100	125520	40.10	1608.00	1.45
2400	5,760,000	125000	40.27	1621.80	1.45
2410	5,808,100	124480	40.45	1636.30	1.21
2420	5,856,400	123960	40.60	1648.40	1.39
2330	5,904,900	123450	40.77	1662.30	1.38
2440	5,953,600	122950	40.94	1676.10	1.39
2450	6,002,500	122450	41.11	1690.00	1.33
2460	6,051,600	121950	41.27	1703.30	1.40
2470	6,100,900	121450	41.44	1717.30	1.41
2480	6,150,400	120960	41.64	1731.40	1.40
2490	6,200,100	120480	41.78	1745.40	1.43
2500	6,250,000	120000	41.95	1759.70	1.36
2510	6,300,100	119520	42.11	1773.30	1.42
2520	6,350,400	119050	42.28	1787.50	1.45
2530	6,400,900	118580	42.45	1802.00	1.44
2540	6,451,600	118120	42.62	1816.40	1.46
2550	6,502,500	117650	42.79	1831.00	1.38
2560	6,553,600	117190	42.95	1844.80	1.46
2570	6,504,900	116730	43.12	1859.40	1.46
2580	6,656,400	116280	43.29	1874.00	1.47
2590	6,708,100	115830	43.46	1888.70	1.39
2600	6,760,000	115380	43.62	1902.60	1.49
2610	6,812,100	114940	43.79	1917.50	1.48
2620	6,864,400	114510	43.96	1932.30	1.51
2630	6,916,900	114070	44.13	1947.40	1.42

No. 24 Wavemeter Tables

λ	$λ^2$	n	O or $\sqrt{L.K.}$	L.K.	D.
2640	6,969,600	113640	44.29	1961.60	1.50
2650	7,022,500	113210	44.46	1976.60	1.51
2660	7,075,600	112780	44.63	1991.70	1.53
2670	7,128,900	112360	44.80	2007.00	1.53
2680	7,182,400	111940	44.97	2022.30	1.43
2690	7,236,100	111530	45.13	2036.60	1.54
2700	7,290,000	111110	45.30	2052.00	1.54
2710	7,344,100	110700	45.47	2067.40	1.56
2720	7,398,400	110290	45.64	2083.00	1.47
2730	7,452,900	109890	45.80	2097.70	1.54
2740	7,507,600	109490	45.97	2113.10	1.58
2750	7,562,500	109090	46.14	2128.90	1.58
2760	7,617,600	108700	46.31	2144.70	1.48
2770	7,672,900	108300	46.47	2159.50	1.57
2780	7,728,400	107920	46.64	2175.20	1.59
2790	7,784,100	107530	46.81	2191.10	1.59
2800	7,840,000	107140	46.98	2207.00	1.60
2810	7,896,100	106760	47.15	2223.00	1.62
2820	7,952,400	106380	47.32	2239.20	1.52
2830	8,008,900	106010	47.48	2254.40	1.62
2840	8,065,600	105630	47.65	2270.60	1.63
2850	8,122,500	105260	47.82	2286.90	1.62
2860	8,179,600	104890	47.99	2303.10	1.54
2870	8,236,900	104530	48.15	2318.50	1.64
2880	8,294,400	104170	48.32	2334.90	1.64
2890	8,352,100	103810	48.49	2351.30	1.50
2900	8,410,000	103450	48.66	2366.30	1.80
2910	8,468,100	103090	48.83	2384.30	1.47
2920	8,526,400	102740	48.99	2399.00	1.77
2930	8,584,900	102390	49.16	2416.70	1.69
2940	8,643,600	102040	49.33	2433.60	1.67
2950	8,702,500	101700	49.50	2450.30	1.58
2960	8,761,600	101350	49.66	2466.10	1.69
2970	8,820,900	101010	49.83	2483.00	1.70
2980	8,880,400	100660	50.00	2500.00	1.71
2990	8,940,100	100320	50.17	2517.00	1.61
3000	9,000,000	100000	50.33	2533.20	1.69
3025	9,150,625	99170	50.75	2575.60	1.71
3050	9,302,500	98560	51.17	2618.40	1.72
3075	9,455,625	97560	51.59	2661.50	1.74
3100	9,610,000	96770	52.01	2705.10	1.75

No. 24 Wavemeter Tables

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
3125	9,765,625	96000	52.43	2748.90	1.76
3150	9,922,500	95230	52.85	2793.10	1.78
3175	10,080,625	94490	53.27	2837.80	1.79
3200	10,240,000	93750	53.69	2882.70	1.80
3225	10,400,625	93020	54.11	2927.90	1.83
3250	10,562,500	92310	54.53	2973.70	1.83
3275	10,725,625	91600	54.95	3019.60	1.84
3300	10,890,000	90910	55.37	3065.80	1.87
3325	11,055,625	90220	55.79	3112.60	1.87
3350	11,222,500	89550	56.21	3159.50	1.90
3375	11,280,625	88890	56.63	3207.10	1.90
3400	11,560,000	88230	57.05	3254.80	1.86
3425	11,730,625	87590	57.46	3301.60	1.93
3450	11,902,500	86960	57.88	3350.00	1.95
3475	12,075,625	86330	58.30	3398.90	1.96
3500	12,250,000	85720	58.72	3448.00	1.98
3525	12,425,625	85100	59.14	3497.50	1.99
3550	12,602,500	84510	59.56	3547.40	2.01
3575	12,780,625	89310	59.98	3597.70	2.01
3600	12,960,000	83330	60.40	3648.10	2.03
3625	13,140,625	82750	60.82	3699.00	2.04
3650	13,322,500	82190	61.24	3750.20	2.07
3675	13,505,625	81630	61.66	3802.00	2.07
3700	13,690,000	81090	62.08	3853.80	2.09
3725	13,875,625	80540	62.50	3906.20	2.10
3750	14,062,500	80000	62.92	3958.80	2.12
3775	14,250,625	79470	63.34	4012.00	2.16
3800	14,440,000	78950	63.76	4065.00	2.16
3825	14,630,625	78430	64.18	4119.00	2.16
3850	14,822,500	77920	64.60	4173.00	2.20
3875	15,015,625	77420	65.02	4228.00	2.12
3900	15,210,000	76930	65.43	4281.00	2.20
3925	15,405,625	76440	65.85	4336.00	2.24
3950	15,602,500	75950	66.27	4392.00	2.24
3975	15,800,625	75470	66.69	4448.00	2.24
4000	16,000,000	75000	67.11	4504.00	2.28
4025	16,200,625	74540	67.53	4561.00	2.24
4050	16,402,500	74080	67.95	4617.00	2.32
4075	16,605,625	73620	68.37	4675.00	2.28
4100	16,810,000	73170	68.79	4732.00	2.32

No. 24 WAVEMETER TABLES

λ	λ^2	n	O or $\sqrt{L.K.}$	L.K.	D.
4125	17,015,625	72730	69.21	4790.00	2.32
4150	17,222,500	72290	69.63	4848.00	2.32
4175	17,430,625	71850	70.05	4907.00	2.36
4200	17,640,000	71430	70.47	4966.00	2.40
4225	17,850,625	71010	70.89	5026.00	2.36
4250	18,062,500	70590	71.31	5085.00	2.40
4275	18,275,625	70180	71.73	5145.00	2.44
4300	18,490,000	69770	72.15	5206.00	2.40
4325	18,705,625	69370	72.57	5266.00	2.48
4350	18,922.500	68970	72.99	5328.00	2.40
4375	19,140,625	68580	73.40	5388.00	2.52
4400	19,360,000	68190	73.83	5451.00	2.40
4425	19,580,625	67800	74.24	5511.00	2.52
4450	19,802,500	67420	74.66	5574.00	2.52
4475	20,025,625	67040	75.08	5637.00	2.52
4500	20,250,000	66670	75.50	5700.00	2.56
4525	20,475,625	66300	75.92	5764.00	2.52
4550	20,702,500	65940	76.34	5827.00	2.60
4575	20,930,625	65580	76.76	5892.00	2.60
4600	21,160,000	65220	77.18	5957.00	2.52
4625	21,390,625	64870	77.60	6020.00	2.68
4650	21,622,500	64520	78.02	6087.00	2.64
4675	21,855,625	64170	78.44	6153.00	2.64
4700	22,090,000	63830	78.86	6219.00	2.64
4725	22,325,625	62490	79.28	6285.00	2.68
4750	22,562,500	63160	79.70	6352.00	2.68
4775	22,800,625	62830	80.12	6419.00	2.64
4800	23,040,000	62500	80.53	6485.00	2.72
4825	23,280,625	62180	80.95	6553.00	2.72
4850	23,522,500	61860	81.37	6621.00	2.76
4875	23,765,625	61540	81.79	6690.00	2.76
4900	24,010,000	61230	82.21	6759.00	2.76
4925	24,255,625	60910	82.63	6828.00	2.76
4950	24,502,500	60610	83.05	6897.00	2.80
4975	24,750,625	60300	83.47	6967.00	2.84
5000	25,000,000	60000	83.89	7038.00	

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.

W. R. B., Skagway, Alaska:

The majority of your queries are answered in the book "How to Conduct a Radio Club" on sale by the Marconi Publishing Corporation. This volume can be obtained by enrolling as a charter member of the National Amateur Wireless Association. The crystalline detector shown in your diagram is improperly connected to the circuits of the wave-meter. It cannot be placed in series with the elements of the radio frequency circuits because its resistance is too great to permit the free flow of electrical oscillations. It should be connected in series with the head telephones and both connected shunt to the variable condenser of the wave-meter.

The wave-length of a distant transmitting station can be determined at the receiving station in the following manner: The receiving apparatus is adjusted to the maximum strength of signals, making sure that the open and closed oscillatory circuits are in resonance. The wave-meter coil is then set in inductive relation to the earth lead of the receiving aerial and set into excitation by means of a battery and buzzer. The battery and buzzer are connected in series and the two remaining terminals in shunt to the variable condenser of the wave-meter. Connected in this manner, the wave-meter becomes a miniature transmitter, emitting waves of feeble damping. The variable element of the wave-meter is then altered until the maximum strength of signals is obtained upon the receiving apparatus. At this point the wave-meter and the receiving apparatus are in exact resonance. The wave-length of the wave-meter being known, the wave-length of the receiving apparatus must be of identical value.

It is impossible to estimate the wave-length of a wave-meter at various values of condenser capacity unless we know the inductance of the coil with which it is to be employed. If at a certain wave-length the capacity of the condenser is .001 microfarad and it is increased to .004 microfarad, the wave-length of the complete circuit will be increased by the square root of four, or exactly doubled. If the condenser capacity is increased to .005 then the wave-length is increased by the square root of five.

If the wave-length is known at the beginning and at the end of the condenser scale, the intermediate wave-lengths can be obtained if the condenser posesesses a straight line law of capacity, i. e., if the increment of capacity corresponds directly with the increase of degrees on the condenser scale. The average variable condenser is not constructed in this way, making it difficult to calculate intermediate values of wave-lengths. If means are available for determining the capacity of the variable condenser, the intermediate values of a wave-length can be approximated.

* * *

J. W. H., Hyde Park, N. Y., writes that recently he increased the power of his transmitting set from 1/4 k.w. to 1 k.w. with the result that he is not able to cover the distance that he could previously. He then describes the set in detail; it is apparently well designed and should fulfill its purpose. The natural wave-length of the aerial cited is in the vicinity of 260 meters and therefore above the government restrictions.

He says that the hot wire ammeter reads 3 2-5 amperes with fairly loose coupling. With this value of current in the antenna circuit he should be able to cover forty miles without difficulty. Just why he is able to cover less distance with this apparatus we cannot advise, but perhaps there has been some misunderstanding regarding the current flowing in the antenna system with the previous apparatus. We were not given any data on this point. Perhaps there is leakage at the insulators. It may be tested by connecting the spark gap of the transmitting set directly in series with the antenna system and then connecting the terminals of the spark gap to the secondary winding of the high potential transformer. If there is no discharge at the gap with an exceedingly small distance between the discharge electrodes it is a positive indication that the antenna insulators leak. The earth plate described is apparently well placed, but the actual dimensions are not given. It may be of zinc or copper and there should be at least 250 square feet of surface enclosed in moist earth. There is a possibility that the receiving stations in the vicinity of J. W. H. are not attuned to the wave-length of the new set and consequently the signals are not received. Beyond this we cannot give advice.

* * *

I. M. H., Riverdale-on-Hudson, N. Y., has experienced a difficulty which many amateurs encounter in changing from a crystalline detector to one of the vacuum valve type. He says that he is able to receive the signals from Arlington considerably louder with an ordinary galena detector than with a three-element vacuum valve. However, he hears the nearby stations much louder on the vacuum valve than on the crystalline detector, and requests an explanation. The difficulty may be due to two causes: the vacuum valve may not be sensitive or the receiving tuner may be designed improperly for use with it. For adjustment to a given wave-length the vacuum valve detectors require a secondary winding with a condenser in shunt of a very small value of capacity, not more than .0001 microfarad. The average amateur tuner employs a much larger capacity for a given wave-length and in consequence loud signals are not obtained with the vacuum valve. The secondary winding of the receiving tuner should be reconstructed of No. 32 wire, sufficient turns being added so that a wave-length of 2,500 meters can be obtained with an exceedingly small value of capacity in shunt to the secondary winding. Then it will be found that the signals from Arlington will be much louder on the vacuum valve than with the ordinary galena detector. The fact that nearby stations are heard very loudly proves the correctness of our assertions because the stations in the vicinity of New York City operate on lesser wave-lengths than those of Arlington when sending the time signals.

* * *

G. S. G., Paterson, N. J., says that with an aerial 1,300 feet in length he is enabled to read the signals from the Sayville station, which employs undamped oscillations, on a crystalline detector. With an aerial 350 feet in length the signals from this station can be heard faintly; but with a short aerial, one 80 feet in length, the signals disappear. After carefully noting the accompanying sketch showing the location of the aerial, the design of the apparatus, etc., it is evident that the phenomenon observed is undoubtedly that described in the article, "How to Conduct a Radio Club," which appeared in the October, 1915, issue of THE WIRELESS AGE. With a certain degree of coupling between the primary and secondary winding of the receiving tuner waves of two frequencies are set up in the associated circuits, resulting in the production of beats within the limits of audibility.

The Tuckerton station, which he also heard, employs the Poulsen arc transmitter during certain schedules. It has been found possible to receive these arc signals on ordinary crystalline detectors at a distance of from seventy to 100 miles without special design of the receiving circuit. This phenomenon is generally due to inequalities in the arc gap itself which has a slight damping effect, making the signals audible on the ordinary receiving equipment.

* * *

K. B. W., Cairo, Ill., sends a sketch of a vertical aerial which apparently he has designed to operate at a wave-length of 200 meters. He wishes to know the natural wave-length which, after calculation, we find to be 120 meters. It may be increased to 165 meters if the flat top portion, which is now 22 feet in length is increased to, say, 50 feet in length. This aerial with the apparatus described in his second query should make an efficient 200-meter set suitable for his purposes. With a 1 k.w. Thordarson high potential transformer the range of the station should be about twenty miles this depending, of course, upon the type of receiving apparatus in use at the receiving station.

* * *

J. L. A., Houston, Tex.:

Your six-wire aerial, 109 feet in length with an average height of 55 feet, has a natural wave-length of about 350 meters. It is rather long to operate efficiently at a wave-length of 200 meters. The insertion of a short wave condenser in series will reduce the natural period to about 180 meters which may be raised to 200 meters when the secondary winding of the oscillation transformer is connected in series. Four plates of glass, 8 by 8 inches, having an average thickness of, say 1/8 of an inch, covered with tin-foil, 6 inches by 6 inches on both sides, connected in series and then in series with the antenna system, will reduce the wave-length to about this value. For efficiency at a wave-length of 200 meters, we should prefer to decrease the length of the aerial rather than insert a short wave condenser in series. Then the flat top portion need not be more than 60 feet in length.

A high potential condenser suitable for the 1 k.w. Thordarson transformer, having a potential of 20,000 volts, may consist of twenty-four plates of glass, 14 by 14 inches, covered with tin-foil, 12 by 12 inches. Divide them into two banks of twelve plates, connected in parallel, then connect the two banks in series. The resultant capacity will be about .01 microfarad, as you desire. The average thickness of the glass should be about 1/8 of an inch. With a transmitting set of this type, all circuits properly proportioned and in resonance, you should be able to cover a distance of thirty miles.

Past issues of THE WIRELESS AGE have contained a number of diagrams applicable to the receiving apparatus you describe. We see no use for the two fixed condensers. One of them can be connected as shown on Page 743 of the July, 1915, issue of THE WIRELESS AGE. In that diagram the condenser, C_1, which is connected in series with the antenna, can in your case be connected in shunt to the used turns of the primary winding of the receiving tuner. In the event that you do not have a potentiometer and battery, you may connect the head telephones, PH, in shunt to the condenser, C_3.

We do not recommend the use of a 4,000-meter receiving tuner for the reception of amateur signals. Although this apparatus is fitted with dead-end switches, the average switch of this type merely disconnects the unused from the used turns and does not entirely eliminate the effect. With the values of inductance necessary for a wave-length of 200 meters, the unused portions of this tuner represent a considerable value of inductance and distributed capacity and therefore absorb considerable energy unless completely moved from inductive relation to the used turns of the circuit. In the September, 1915, issue of THE WIRELESS AGE a receiving equipment suited strictly to the reception of 200-meter signals is fully described.

* * *

W. L., Horseheads, N. Y.:

The aerial described in your communication has a natural wave-length of about 277 meters and a capacity of .0004 microfarad. With the receiving tuner described, the entire system should be adjustable to a wave-length of 3,500 meters, depending, of course, upon the size of the condenser connected in shunt to the secondary winding. The second described aerial, having a length of 80 feet and a height of 40 feet, has a natural wave-length of about 220 meters.

It is not necessary for a condenser suitable for a 1-inch spark coil to consist of more than a single plate of glass, 8 by 8 inches, covered with foil, 6 by 6 inches. An oscillation transformer, with seven turns probably will be sufficient to place the condenser circuit in resonance with the antenna system. If possible obtain access to a wave-meter and have these circuits accurately calibrated. If your station is located outside the zone of commercial interference, the government authorities will probably allow a license for a plain aerial connection, i. e., the spark gap connected in series with the antenna system. We believe this method will give better results than can be obtained by the use of a condenser and an oscillation transformer.

* * *

R. J. F., Southampton, N. Y., inquires:

Ques.—(1) Please advise how you would guy a mast which has a total height of 85 feet. The lower 50 feet of this mast are of wind-mill tower construction and the remaining 35 feet a piece of 3-inch gas pipe which extends up through the middle of the tower.

Ans.—(1) Although this wind-mill tower is self-supporting and will of itself stand considerable strain, we are inclined to believe that four guy wires composed of No. 8 or No. 6 iron wire, attached to the mast about 8 feet from the top and securely fastened in ground anchors placed at a distance of 50 to 60 feet from the base, will afford a satisfactory support. The sketch accompanying your inquiry indicates that you intend to use two masts with a flat top aerial. It might be desirable to extend an extra guy wire from the top mast near to the point of attachment of the flat top aerial, to an extra anchor, to remove the side strain imposed by the aerial. Insulation of the guy wires with large porcelain knobs such as are employed in telegraph and telephone work also might be desirable.

Ques.—(2) Why cannot I hear the Sayville radio station? Before this station was taken over by the government authorities, its signals could be easily read every evening.

Ans.—(2) The Sayville station formerly employed spark apparatus, but now uses an undamped oscillation transmitter exclusively. You require a special receiving set to receive this energy.

Ques.—(3) How many volts are required to operate a ½ k.w. induction coil and how far may I expect to send under fair atmospheric conditions?

Ans.—(3) The ordinary ½ k.w. induction coil is intended to operate at a primary potential of about thirty volts, if employed in connection with a magnetic interrupter. Fitted to a condenser of correct capacity and an oscillation transformer of the proper dimensions, the entire set to be operated at a wave-length of 200 meters, you should be able to cover a distance of from ten to twenty miles, the distance depending upon the type of receiving apparatus used at the distant receiving station.

* * *

G. D. C., Bessemer, Ala., inquires:

Ques.—(1) Please advise through the columns of your magazine how I can shut out the induction from passing street cars. My station is situated close to the tracks and every time a car passes I find it impossible to receive signals. Is there any piece of equipment which I can purchase to eliminate this difficulty?

Ans.—(1) It is difficult to eliminate the inductive noises caused by sparking at the trolley wheel or at the commutators of the motor. Often the effect can be reduced by the use of an inductively-coupled receiving tuner employing the lowest value of coupling possible during the reception of signals from a given station. We fear that you will have to allow conditions to remain as they are.

We cannot calculate the wave-length of an irregular aerial of the design described.

* * *

H. T. C., Owensboro, Ky., inquires:

Ques.—(1) What is meant by a one to one transformer as an amplifier in connection with the vacuum valve? How can an induction coil secondary be used for this puprose?

Ans.—(1) A one to one transformer has the same number of turns in the secondary winding as in the primary, or at least the secondary is constructed to give the same value of potential applied to the primary winding. In the case of an auto transformer the term refers to one where the primary and secondary circuits include the same number of turns. The secondary winding of an induction coil may be employed for this purpose because it happens to have about the correct values of inductance, i. e., energy-storing ability required for use with the vacuum valve detector. This transformer acts as a temporary storage of energy for the current in the local circuit of the first valve from which it is transferred to the filament and grid of the second valve.

* * *

D. C., Sioux City, Iowa, inquires:

Ques.—(1) Can three wires in an aerial 150 feet in length be connected up so that one wire may be used for transmitting, although the three are connected together for purposes of receiving?

Ans.—(1) Certainly. The high potential end of the wires must be left open and the necessary switches fitted at the station to bring about the desired connections. When the single wire is used for transmitting the two remaining wires should be disconnected from the earth. Please take into consideration the fact that the addition of two wires to a single wire aerial does not greatly increase the natural wave-length of the system.

Ans.—(2) A two-wire aerial, 150 feet in length having an average height of 55 feet with the wires spaced 3 feet apart, has a natural wave-length of about 375 meters. Should the wires be spaced to the distance suggested in your third query the receiving range would not be increased noticeably.

The receiving tuner described in your fourth query is adjustable to wave-lengths of 3,500 meters, provided the seventeen-plate variable condenser described is connected in shunt to the secondary winding.

A government station is located at Fort Leavenworth, Kas. The call letters are WUD and the wave-length 1,800 meters. This station is under the control of the United States army.

* * *

G. R. C., Edgewood Park, Pa., inquires:

Ques.—(1) I have a four-strand aerial, 25 feet in height and 50 feet in length, with a spacing of 2 feet between the wires. What is the wave-length?

Ans.—(1) The natural wave-length of this

will raise the aerial system close to a wave-length of this value.

There will appear in an early issue of THE WIRELESS AGE an article on the Poulsen tikker with accompanying circuits, giving the information you desire.

A receiving tuner having a 10,000 meter secondary winding is described in the book "How to Conduct a Radio Club," published by the Marconi Publishing Corporation. Each charter member of the National Amateur Wireless Association will receive a copy of this volume as a part of his equipment.

* * *

A. E., Chicago:

Adding turns in either the primary or secondary winding of an oscillation transformer has the effect of increasing the length of the wave. If the circuits are in resonance and the number of turns are changed in one of the circuits, they will not be in resonance and there will be little transfer of energy.

Your aerial, 40 feet in height by 50 feet in length, consisting of four wires, has a natural wave-length of about 160 meters. With the oscillation transformer described, the emitted wave will be about 200 meters.

two-inch coil transmitting set should be made of No. 4 stranded copper wire or, of a piece of two-inch copper ribbon.

Ques.—(3) To what extent do trees affect the sending and receiving range? If my aerial was 200 feet away and fifty feet above large oaks, would the range in either sending or receiving be affected?

Ans.—(3) During the period of vegetation, when the trees are filed with sap, considerable energy is absorbed from a passing electromagnetic wave. If the trees are located at a distance from either the transmitting or receiving station, the absorption is not so intense. We believe that the oaks referred to will affect but slightly both the transmission and reception of signals, but the actual amount of absorption can be determined only by experiment.

Correct diagrams for an inductively-coupled receiving tuner, with associated appliances, have appeared in several of the preceding issues of THE WIRELESS AGE. Note the diagram of connections on pabe 743 of the July, 1915, issue of THE WIRELESS AGE. Duplicate it as closely as possible and you will have an efficient circuit.

The aerial described in your fourth query has a natural wave-length of about 410 meters.

* * *

J. R. S., Washington, D. C.:

We prefer wire larger than the ordinary bell wire for the lead-in of a transmitting or receiving aerial. No advantage is derived in spacing the wires of an aerial, as shown in your drawing. If the distance between wires is at least two feet, better results cannot be expected by increased spacing.

* * *

W. L. E., Peekskill, N. Y.:

The wave-length of the aerial described in your communication is about 252 meters. It will be increased to at least 300 meters by the addition of the secondary winding of the oscillation transformer in series. With the condenser described, the closed circuit seems to be considerably out of resonance with the antenna system. We do not believ that the wave-length of the spark gap circuit is more than 180 meters.

The station at Sayville employs an undamped generator of about 100 k.w. capacity. The power at Glace Bay is variable from 70 to 200 kilowatts. The transmitting station at New Brunswick employs 300 kilowatts of energy. The Belmar receiving station is not open for inspection.

We do not understand why you require a choke coil in series with a one-inch spark coil. We cannot see the value of it unless the spark coil is to be operated on alternating current of, say, 110 volts and the choke coil is employed to cut down the input.

* * *

P. S. E., Biddeford, Me.:

Your aerial, 50 feet in height and 68 feet in length, has a natural wave-length of about 219 meters. The constants of an inductively-coupled receiving tuner, for the reception of Arlington time signals, appear on page 73 of the October, 1915, issue of THE WIRELESS AGE, under C. H. S.'s inquiry.

* * *

F. V. H., Brooklyn, N. Y., inquires:

Ques.—(1) Please give the wave-length of an aerial 200 feet in length, 80 feet in height, comprising 4 wires with a lead-in 100 feet in length.

Ans.—(1) The natural wave-length of this antenna is about 490 meters.

Ques.—(2) Please give the wave-length of an aerial 350 feet in length by 80 feet in height, comprising 2 wires and a 5-foot spreader with a 2-wire lead-in 50 feet in length.

Ans.—(2) The natural wave-length of this antenna is about 640 meters.

Ques.—(3) Is it possible to receive on a tin roof 30 by 100 feet?

Ans.—(3) Tin roofs have often been employed as receiving aerials and if placed on wooden buildings will give as efficient results as properly constructed aerials.

Ans.—(4) Your question regarding the dimensions of a loading coil and the probable wave-length to be expected is not clear, and we do not understand the construction of the loading coil described. Regarding the use of loading coils in the primary and secondary windings: It is preferable to insert a loading coil in the secondary circuit as well as in the primary circuit in order to effect conditions of resonance. The mere insertion of two loading coils in series with the antenna circuit would simply raise the wave-length of that circuit and unless corresponding adjustment were made in the secondary circuit a loud response would not be obtained.

* * *

J. E. L., Marquette, Mich., writes:

Ques.—(1) What is the wave-length of an aerial comprising 2 wires, 110 feet in length by 45 feet in height at one end and 75 feet at the other, with a 50-foot lead-in to the middle? The aerial is supported on 3½-foot spreaders.

Ans.—(1) The natural wave-length of this antenna is about 315 meters.

Ques.—(2) Can No. 34 or No. 36 enameled copper wire be used successfully for the secondaries of receiving transformers and variable loading coils?

Ans.—(2) When employing detectors of the vacuum valve type No. 34 or No. 36 wire in the secondary winding is entirely feasible, but for loading coils in the primary circuit somewhat coarser wire should be used. For example: The antenna circuit loading coil should be made of, say, No. 20 wire. Of course, if the secondary winding is of No. 36, the loading coil to be used in connection with it may be of the same size.

* * *

E. H., Oakland, Cal.:

We believe your receiving troubles are outside of the water tank to which your aerial is attached. Some local condition or error in

your receiving apparatus, prevents you from obtaining satisfactory results.

It is somewhat difficult to eliminate induction from near-by high power or high tension lines. The least trouble in this respect is experienced when the receiving aerial is swung at right angles to the power wire. A balancing-out aerial, which will aid in eliminating this effect, is described in the book, "How to Conduct a Radio Club," published by the Marconi Publishing Corporation. This volume is a part of the equipment of each charter member of the National Amateur Wireless Association.

* * *

P. J., Minneapolis, Minn.:

If your receiving apparatus already responds to the signals from the Arlington station, you should have no difficulty during the nighttime in receiving signals from commercial stations located in the Great Lakes district. We are unable to state just why you do not hear the signals from the station in Minnesota. It operates at wave-lengths of 300 and 600 meters and should be heard during the nighttime throughout the favorable months of the year. Perhaps the design of your receiving apparatus is such that it is more suited to the reception of the longer wave-lengths than the shorter wave-lengths, such as are employed by ship and shore stations, namely, 600 meters. There are few spark stations to-day operating at wave-lengths of 2,500 meters. Many naval stations now employ arc transmitters for the production of undamped oscillations which are not audible on the ordinary receiving apparatus. The Arlington station employs more power than any of the remaining spark stations in the United States, with the exception of the Marconi Trans-Atlantic and Trans-Pacific stations. The Marconi station at Bolinas, Cal., employs about 300 kilowatts at wave-lengths varying from 6,000 to 12,000 meters.

* * *

C. W. J., Norwalk, Ct.:

An efficient circuit for use with the vacuum valve detector is fully described in the article, "How to Conduct a Radio Club," published in the October, 1915, issue of THE WIRELESS AGE. Details of another circuit suitable for the Poulsen tikker also are published.

Your two-wire aerial, 300 feet in length by 55 feet in height, has a natural wave-length of about 546 meters.

The receiving tuner described in your third query is adjustable to wave-lengths near to 4,000 meters when the condenser of .001 microfarad is connected in shunt with the secondary winding. Whether the primary winding is suited to this secondary winding depends upon the length of the aerial with which it is to be employed. If it is to be used with the aerial described in your second query, the design is quite correct for the range of wave-lengths obtainable in the secondary winding.

Some difficulty is experienced in the warping of hard rubber. Why not use bakelite or some of the more modern insulating materials now employed for such work?

B. S. H., Louisville, Ky.:

A secondary winding suitable to the primary winding which you already have may be made on an insulating form, 5¼ inches in diameter by 6 inches in length, wound closely with No. 32 wire. The points of this winding may be divided between the taps of a twelve-point switch. If we knew the dimensions of the aerial with which this receiving tuner was to be employed, we could give more specific data.

* * *

O. H., Canton, O.:

The natural wave-length of your aerial is about 295 meters. With the proposed apparatus it should be adjustable to wave-lengths up to 3,500 or 4,000 meters.

Information concerning the construction of a wave-meter is given in the book, "How to Conduct a Radio Club," published by the Marconi Publishing Corporation.

The Sayville station is still in communication with Nauen and operates at a wave-length of about 9,400 meters. The power employed is 100 kilowatts and the system is of the Joly type.

* * *

P. W. H., Fredericktown, O.:

The average amateur three-inch spark coil transmitting set does not cover more than twelve miles. You should therefore be quite satisfied with the results obtained. A glass plate condenser suitable for this coil may consist of four plates, 8 by 8 inches, covered with tin-foil 6 by 6 inches. These plates should be connected in parallel.

NAF is the naval station at Newport, R. I.

* * *

E. C. R., Washington, D. C., inquires:

Ques.—(1) Please state the relative advantages of the open and closed core transformers for amateur work. I note that while the majority of commercial transformers are of the open core type, the new Marconi sets, as described in a recent number of THE WIRELESS AGE, are fitted with a transformer of the closed core construction.

Ans.—(1) The advantage of the open core transformer lies in the fact that it posseses a certain amount of magnetic leakage and therefore the inductance of the primary circuit remains fairly constant under conditions of a variable load at the secondary winding. This is of distinct value, because when the spark gap is dicharging, the secondary winding of the transformer is practically short-circuited and should the entire field of the secondary winding react directly upon that of the primary winding, the effective self-inductance of the latter would be decreased with a corresponding increase of current flow.

The closed core transformer fitted with a magnetic leakage gap has operating characteristics somewhat similar to those of the open core transformers. In the Marconi sets the same effect is produced but in a different manner. In that particular type of equipment the design of the generator is such that there will not be an abnormal rise of current in the primary winding when the secondary winding of the transformer is short-circuited.

With proper design, the open and closed core transformers may be made equally efficient, but generally the open core transformer requires more material and has larger over-all dimensions than the closed core for a given number of kilowatts.

* * *

T. B., Mestyte, Tex., inquires:

Ques.—(1) What is the wave-length of my aerial which has an over-all length of 80 feet and height of 33 feet?

Ans.—(1) Assuming it to be a four-wire aerial with the average spacing, the natural wave-length is about 205 meters.

Ques.—(2) A has a sending set with a range of 2,000 miles; B lives 1,000 miles from A. What size aerial is required at B's station to receive signals from A? What instrument would be required with the aerial described in my first query?

Ans.—(2) We require more data to give a concise answer to this query. What type of transmitting apparatus is used at A.'s station? Does it employ damped or undamped oscillations? What is the wave-length? If the station is fitted with an undamped oscillation generator, a receiving apparatus fitted with a tikker or one of the special vacuum valve detector circuits, must be employed. A receiving circuit suitable for both damped and undamped oscillations is described in United States patent No. 1,113,149; somewhat similar circuits are described in the book, "How to Conduct a Radio Club," published by the Marconi Publishing Corporation. Apparatus of this type is applicable to the aerial described in your first query, as well as the putative aerial referred to in your second query. For reception of wave-lengths between 5,000 and 10,000 meters, we prefer an aerial at least 700 to 800 feet in length. For wave-lengths below 5,000 meters, the aerial need not be more than 300 feet in length. Vacuum valve circuits are also described in the "Proceedings of the Institute of Radio Engineers" for September, 1915.

* * *

H. F. H., Watertown, N. Y.:

Ques.—(1) My station is fitted with an aerial 80 feet in length, 50 feet in height at one end and 25 feet in height at the other. The apparatus consists of a loading coil, loose coupler, fixed and variable condensers and a galena detector; why will not a 2,000 ohm head set give as loud signals when receiving from long distances, as a head set having two eighty-ohm receivers. The apparatus is connected up as shown in the enclosed diagram. The inductively coupled receiving transformer is wound with No. 20 wire in the primary and No. 26 in the secondary.

Ans.—(1) The accompanying diagram is quite correct, but we believe increased strength of signals would be obtained if the head telephones were connected in shunt to the fixed condenser of the local detector circuit rather than in shunt to the detector. Perhaps the 2,000-ohm head telephone set is out of order. The magnets may be weak, or the diaphragm too close or too far from the core of the magnet. With crystalline detectors it is generally found that a 2,000-ohm head set will give better signals than one of lower resistance but it is not alone the resistance which determines its sensibility; the over-all construction should be taken into account.

Ques.—(2) Will the vacuum valve detector pick up the undamped waves emitted from the Poulsen arc transmitter without the use of a tikker?

Ans.—(2) Yes. See the answer to T. B.'s inquiry in this issue. Special circuits are required.

Ques.—(3) Please give a formula for calculating the size of a secondary condenser for transmitting apparatus when the required capacity is known.

Ans.—(3) The following formula is applicable:

$$C = \frac{K\ A\ 2248}{T \times 10^{10}}$$

Where A = the area of the dielectric in use, in square inches,
T = the thickness of the dielectric in inches,
K = the dielectric constant of the insulating medium,
T = the capacity in microfarads.

The value of K generally ranges from 6 to 9.

Ques.—(4) At present I use an electrolytic interrupter, Wehnhelt type, connected to a 110-volt A. C., sixty-cycle lighting circuit. I also employ stationary spark gap, coil and condensers. The spark secured is intense but of variable pitch. How can I raise the pitch of this spark without employing a rotary gap?

Ans.—(4) An improvement might be effected if a chemical rectifier were connected in series with the electrolytic interrupter, the alternating current impulses being changed to direct current before being broken up by the interrupter. If you had available 110-volt D. C., the spark note, of course, would be very high.

* * *

J. W. Crawfordsville, Ind.:

The aerial described in your first query has a natural wave-length of about 290 meters. You should be able to receive the Arlington time signals during the 10 P. M. eastern standard time schedule.

The telephonic conversation at Arlington was carried on at a wave-length of between 6,000 and 7,000 meters. You require apparatus such as described in the book, "How to Conduct a Radio Club," to receive these signals at a considerable distance.

* * *

N. J. G., Toledo, Ohio.:

The wave-length of your 80-foot aerial is about 230 meters.

There are no relaying devices for radio stations in use.

A one-inch spark coil can be heard to a distance of five miles if the receiving station is fitted with sensitive apparatus. Two one-pint Leyden jars have a value of capacity suitable for the average one-inch spark coil, provided they are connected in series.

The call letters of the Illinois Watch Company's station are 9ZS. The wave-lengths employed are 6,000 and 2,000 meters.

* * *

E. W. D., Jersey City, N. J., writes:

Referring to the question asked by H. G. C., of Atlantic City, which appeared on page 138 of the November issue of THE WIRELESS AGE, I wish to state that if he would lower his voltage slightly, he would overcome the arcing of the points on the vibrator, for the reason that an arc cannot be readily formed at voltages below thirty. This will allow the vibrator to work satisfactorily without the use of a condenser of large capacity about the interrupter.

* * *

W. O., Covington, La.:

The time signals are sent out daily from the New Orleans Naval Station at a wave-length of 1,000 meters. This station is also fitted with a 30 k.w. arc set for the production of undamped oscillations.

The receiving aerial you describe has a natural wave-length of about 375 meters. There is no distinct advantage in employing four wires in receiving; equally good results generally are obtained with a two-wire aerial. The receiving set you describe should allow the reception of New Orleans time signals and if they are not actually heard there is some defect in the apparatus.

* * *

O. R. T., Stoughton, Wis., writes that his transmitting apparatus emits an exceedingly broad wave, causing considerable interference He describes his equipment, which is fairly well designed and, provided there are no high resistance joints in the circuits of radio frequency, should function efficiently and in compliance with the United States restrictions as regards a sharp or pure wave.

Calculation of the wave-lengths of the antenna system reveals that the natural wave-length is about 259 meters which is, of course, considerably raised when the secondary winding of the oscillation transformer is connected in series. If it is planned to have this station operated on a wave-length of 200 meters the dimension of the aerial should be considerably reduced. Perhaps the insertion of a short wave condenser in series with the antenna system will permit a fair degree of efficiency at a wave-length of 200 meters. The condenser described in the communication has a capacity of about .01 microfarad which is correct for 200-meter work provided the connections to the closed oscillatory circuit are extremely short.

O. R. T. has experienced conditions found at the average radio station fitted with a plain spark discharger that, namely, when a sharp or pure wave is obtained the current reading in the antenna circuit is somewhat less than can be obtained by a closer degree of coupling. This does not necessarily mean, however, that the station will be less efficient because under conditions of tight coupling two wave-lengths are radiated, while with the lesser coupling the energy radiated is confined practically to a single wave-length which may have the same value of current, or nearly the same value of current, as either of the single wave-lengths when two frequencies are emitted. We suggest that O. R. T. carefully inspect the earth connection. It may be that it does not possess sufficient conductivity or capacity to properly take care of the energy of the antenna system.

Ques.—(2) Which type of aerial is preferable for general amateur use—the "T" or the inverted "L" type?

Ans.—(2) For a given wave-length an aerial of the "T" type will have greater dimensions than those of the inverted "L." That is to say, it will have a greater value of capacity, but decreased value of inductance. The inverted "L" type is generally employed for amateur work, although good results will be obtained with either.

* * *

D. G. C., Grosse Pointe, Mich., inquires:

Ques.—(1) I have an aerial 120 feet in length, 45 feet in height with a ground and a lead-in connection totalling about 50 feet. What is the natural wave-length of this aerial?

Ans.—(1) Approximately 315 meters.

Ques.—(2) How could the aerial referred to be reduced, by condensers or otherwise, to a wave-length of about 185 meters?

Ans.—(2) To be reduced to this value a series condenser of exceedingly small value of capacity would be required in series with the antenna system. From a practical standpoint we consider the dimensions of the aerial too large for 200-meter work. It is suggested that the aerial be reduced so that the flat top portion is not more than 50 or 60 feet in length, thereby obviating the necessity of a short wave condenser.

You have been misinformed concerning the vacuum valve detector. It is just as applicable to short distance work as to long distance communication. Sometimes the most sensitive adjustment cannot be maintained when a transmitting station of high power operation is nearby, but under these conditions it only becomes necessary to adjust the detector to a less sensitive state.

The most sensitive crystalline detectors are the crystalloi, cerusite, galena, silicon, perikon, etc. We suggest that you purchase samples of each kind and make your own tests, thereby satisfying yourself concerning their stability and sensibility.

* * *

J. S., Pittsburgh, Pa., inquires:

Ques.—(1) Can two 1-inch spark coils be connected in parallel to a six-volt forty-ampere hour storage battery? And when so connected can the secondaries of each be joined together in some manner so that the high potential current will jump a gap of 2 inches?

Ans.—(1) For effectiveness the primary windings should be connected in series, the interruptor of one coil screwed up tight and that of the second coil employed to interrupt the current for both coils. Similarly the secondary windings should be connected in series, taking care to connect them so that the secondary voltages will not oppose each other. While the potential of the system will be increased as a whole, you need not expect a 2-inch spark unless similar values of current flow through both primary windings, as would exist in the case of a single primary winding.

* * *

A. J. M., Westfield, N. Y.:

Your first, second and third queries regarding induction motors are beyond the scope of this department. We suggest that you communicate with the makers of the device or with some publication that makes a practice of handling such queries.

Ques.—(4) Why does the spark on my rotary gap which is connected to a sixty-cycle source of supply tend to become a long stringy spark, no matter at what speed the disc is run or how many points there are on the disc?

Ans.—(4) Lacking a detailed description of the complete transmitting apparatus it is somewhat difficult to answer this question. It would seem, however, that the stationary electrodes are spaced too far from the rotary electrodes. The best results are obtained with rotary spark gaps when the stationary electrodes are placed exceedingly close to the movable electrodes, thereby keeping the spark gap length at a minimum.

Ques.—(5) May the Brown telephonic relay be used successfully to amplify radio signals?

Ans.—(5) Yes, very good results indeed have been obtained with it.

* * *

G. F., Davenport, Ia.:

The 3-wire aerial of the "T" type, 100 feet in length, with an 80-foot lead-in has a natural wave-length of about 188 meters. When the secondary winding of the oscillation transformer is connected in series undoubtedly the wave-length is raised above 200 meters. The wave-length of this aerial can be reduced by inserting two condenser plates connected in series and then placed in series with the antenna system. These plates should be 8 by 8 inches, covered with tin-foil 6 by 6 inches. A wave-meter should then be employed and sufficient turns of inductance added at the secondary winding of the oscillation transformer until the antenna system has a natural wave-length of 200 meters. The use of a series condenser at any wave-length is not advised for transmitting purposes, if it can be avoided. As you say, it might be preferable to erect a separate aerial for transmitting purposes and a long aerial for receiving from stations using longer wave-lengths.

The capacity of your transmitting condenser is quite correct for a wave-length of 200 meters, being approximately .008 microfarad.

* * *

J. F. W., Roanoke, Va.:

Ans.—(1) Your query regarding the Darien station, Isthmus of Panama, is fully answered in the "Queries Answered" department of the August, 1915, issue of THE WIRELESS AGE.

Ques.—(2) What does the abbreviation "QSZ" mean, as used by the Arlington station?

Ans.—(2) This abbreviation means, "Repeat each word twice."

Ques.—(3) Does the use of wireless telegraphy by railroads on trains affect the telegraph lines and the train despatching telephones?

Ans.—(3) No; not if properly installed.

Ques.—(4) Will a silicon detector work properly with a 1-step amplifier?

Ans.—(4) Yes, provided it is properly connected up. (See January, 1914, issue of THE WIRELESS AGE).

* * *

E. W. H., Peekskill, N. Y., inquires:

Ques.—(1) Why is it that when my apparatus is switched to a sending position I can hear a few of the nearby stations, including the Brooklyn Navy Yard and the station at Bush Terminals? I am sure that no wires of the transmitting apparatus cross the circuits of the receiving apparatus. I use the following sending apparatus: Namely, a ½-inch spark coil, an oscillation transformer, straight spark gap, glass plate condenser. Can you explain this phenomenon?

Ans.—(1) When your receiving aerial is switched into the sending position it is, of course, directly connected to earth, and consequently oscillations of various stations will flow through it. Some portion of your receiving tuner circuits must be in inductive relation to the open oscillatory circuit of your transmitting set; hence you receive the signals. The editor of this department has frequently received signals at a distance of 180 miles in daylight without an aerial connection to the receiving apparatus.

Ans.—(2) The receiving set you describe should have a range of about 500 miles.

* * *

T. L., North Adams, Mass., has an antenna 57 feet in length, 60 feet in height at one end and 50 feet at the other. It is composed of three strands of No. 14 wire, the lead-in being 30 feet in length and the ground lead 20 feet in length. The wires are spaced 1½ feet apart. He asks for the wave-length of the antenna.

Ans.—The natural wave-length of this antenna is about 210 meters.

It is very difficult to give the range of a receiving set having the apparatus described, but offhand we should say that you should be able to receive at a distance of 200 miles in daylight from commercial stations.

Regarding the effect of a loading coil of 5,000 meters: We advise that this will be of no value whatsoever unless the remaining circuits of the receiving tuner are attuned to this wave-length. Furthermore, we know of no stations operating at a wave-length of 5,000 meters in this vicinity.