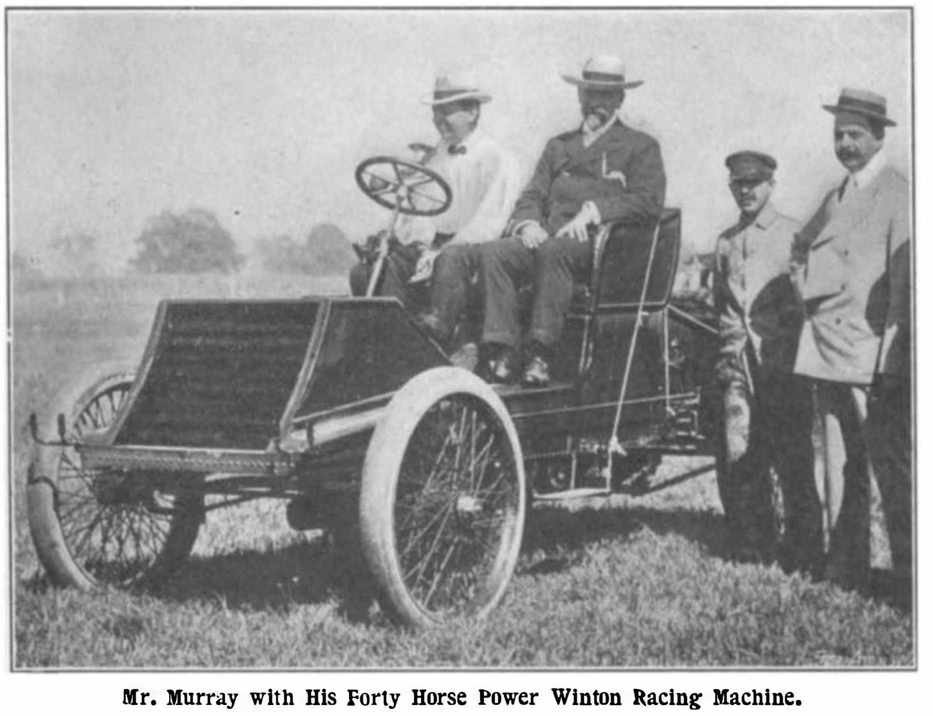
Mr. Keene driving his 60 horse power Mors car and Mr. Bishop his Panhard racer. Mr. Keene obtained a better start and at the end of the half-mile was 75 yards ahead and he continually increased his lead so that by the time he had covered 3⅞ miles he had lapped his opponent and won the race by over half a mile. In the second heat, which was also 5 miles, the contestants were Mr. W. K. Vanderbilt, Jr., who drove his "Red Devil," a Cannstadt-Daimler vehicle of 35 horse power, and his opponent was Mr. Wm. N. Murray, of Pittsburg, who drove a Winton racer of 40 horse power. It must be said for the credit of the American machine that while the "Red Devil" obtained the lead at the start, the Winton machine being slow in getting under way, but finally gained upon his opponent and it was not until 2½ miles had been covered that the "Red Devil" began to pull away. Mr. Vanderbilt won, making the 5 miles in 7.43½, while his opponent was only 44 4-5 seconds behind him. The final heat of 5 miles was run by Messrs. Vanderbilt and Keene. A terrific speed was developed by the "Red Devil," and at the end of the 5 miles Mr. Vanderbilt was an eighth of a mile in the lead, and from that time on he slowly gained until the finish, when he was a winner by 10 3-5 seconds, the time being 7.36¾.

The sixth and last race was the championship for winners in all classes in one heat of 10 miles, for prizes offered by Mrs. O. H. P. Belmont and the Locomobile Company of America. It was won by Mr. W. K. Vanderbilt, Jr.; the best time was 15.23½. The day was an ideal one for a race and the results attained were considered very satisfactory.

Submarine Oil Beds.

For some time past the Russian authorities have been exploring the petroleum producing country round Baku, and the result of these investigations has substantiated the hypothesis of experts that these naphtha beds are not only to be found at Baku, but that they extend for some distance beneath the sea. An attempt to utilize these submarine resources is seriously contemplated, especially on the coasts of Bibi-Eibat and the island of Swjitoi. The depth of water at the former place ranges from 14 to 50 feet, and at the latter to about 39 feet. The most serious problem that confronts the government is how to tap these submarine deposits without endangering the land supplies and public propertyand life. Theplant, such as reservoirs, pumping stations and power stations, must necessarily be similar to those employed on shore. The difficulty of transporting the naphtha is very complex. Small boats could not be employed owing to the large quantities of sand which the fountains invariably throw up, while the utilization of steam vessels in a naphtha-laden atmosphere would be fraught with considerable danger. The only means of solving the problem is by enclosing the area with a sea wall, but as such a reclamation scheme could be only undertaken at tremendous expense, and as the value of the oil beneath is purely supposititious, both in quantity and quality, the completion of such elaborate works might prove unremunerative. As a tentative effort to discover the value of these submarine deposits, the government suggests that Romany Lake, one of the centers of Baku, should be laid dry and the soil tested. Several petroleum firms have made offers for this concession, but as none of them has been deemed sufficiently high, the government intends to empty the lake at its own expense and to let the area thus recovered, in the usual way. If the experiment should prove successful and the oil sufficiently rich and abundant, the other schemes would then probably be undertaken.



Mr. Murray with His Forty Horse Power Winton Racing Machine.

Government Railways in Europe.

Dr. A. von der Leyen, a railroad expert, has published an article in the June number of the German Review, says Science, concerning the management of the government railroads of Prussia, of which Consul-General Günther sends an abstract to the Department of State.

He demonstrates that the example of Prussia in buying the private railroads and running them on government account has contributed to popularize this system in other countries, and states that not only have the other German states followed it, but that almost all other European countries have purchased the existing railroads.

The Austrian government railroad net has to-day a mileage of almost 6,300 miles; that of Hungary, about 8,150 miles. Since 1882 a great change has taken place in Russia; of the then existing 14,000 miles of railroad, only about 40 miles were owned by the government. The total mileage in 1897 was about 24,300 miles, of which 15,780 miles belonged to the government. To this must be added the government railroads in Finland and Asiatic Russia, the Trans-Caspian and the Siberian railroads. The Servian, Roumanian and Bulgarian railroads are owned exclusively by the respective governments. Of the northern European kingdoms, Denmark has a government railroad system of 1,167 miles and 525 miles of private railroads. Norway's railroads belong almost exclusively to the government. Sweden has 2,303 miles of government and 4,387 miles of private railroads. The government has not yet succeeded in acquiring the latter, although efforts have been made to do so. Belgium, in 1898, through the purchase of the Grand Central Belge and some minor private roads, became the possessor of the whole Belgium railroad system. Holland acquired all the remaining private railroads in 1890; they are, however, operated by two private companies. The Italian government purchased all private main railroads of Italy in 1885 and leased them for twenty years to private corporations. Mr. von der Leyen states that both the last countries have had unpleasant experiences with this arrangement. Switzerland, after long discussion, resolved by federal law in October, 1897, to gradually purchase all the private railroads. On January 1, 1901, the first federal railroads were operated by the government. By agreements of 1883, the six large French private railroads had their rights recognized by the government, and no change has been made in the policy in that country. The relatively small government railroad system, located between the Orleans and the Western railroads, has remained intact. As the private railroads, however, have received large subsidies from the government, and as they will revert to the state in the second half of the present century, they can hardly be considered purely private railroads. Of the countries which have a private railroad system exclusively, only England and the United States remain.

Preservation of an Historical Locomotive.

The famous engine "General," which was used by Capt. James J. Andrews and his party of raiders in an attempt to burn the bridges on the Western and Atlantic Railway on April 12, 1862, has been sent by the Nashville, Chattanooga & St. Louis Railroad to be set up in the Union Depot at Chattanooga as a monument to the heroes of that daring raid, says The Railway Review. It will be remembered that the engine and several box cars were stolen from a passenger train while the crew was at breakfast at Big Shanty. The raiders were closely pursued by the conductor and a party of Confederate soldiers in the switching engine. The "General" was finally abandoned and the bridge-burning scheme had to be given up. All of the party, numbering some twenty-two, were captured and eight were executed as spies. The survivors built a monument in memory of the affair in the National Cemetery at Chattanooga.

When the two Hungarian scientists, Messrs. Pollak and Virag, displayed their new telegraphic apparatus at the Paris Exhibition last year, they were invited by the French government to make experiments with it over the lines between Paris and Lyons. On account of the enormous expense, however, the inventors declined the invitation. Since that time, however, they have established a line of their own extending from Buda-Pesth to Fiume, a distance of 375 miles, and have been carrying out a series of tests with their apparatus. A speed of 40,000 words per hour has been attained.

HOW TO CONSTRUCT AN EFFICIENT WIRELESS TELEGRAPH APPARATUS AT A SMALL COST.

BY A. FREDERICK COLLINS.

Since the practical introduction of wireless telegraphy in 1896, great progress has been made, not only in spanning great distances, but in syntonizing or tuning a certain receiver to respond to a given transmitter.

To follow up the intricacies of wireless telegraphy there can be no better method than to build an apparatus and make the additions from time to time as they are published in the Scientific American. To telegraph a mile or so without wires by what is known as the etheric wave or Hertzian wave system is not difficult; indeed, the apparatus required is but little more complicated than the ordinary Morse telegraph, and is so simple that the reader need have no difficulty in comprehending every detail; if on the other hand, one wishes to work out the theory involved, it becomes such a difficult task that the master physicists have yet to solve it. It is the practical and not the theoretical side of wireless telegraphy we have to deal with here.

The instrument that sends out the waves through space is termed the transmitter, and this I shall first describe. It consists of an ordinary induction or Ruhmkorff coil (see Fig. 1) giving a half inch spark between the secondary terminals or brass balls. Such a coil can be purchased from dealers in electrical supplies for about $6. A larger-sized coil may, of course, be used, and to better advantage, but the cost increases very rapidly as the size of the spark increases; a half-inch spark coil will give very good results for a fourth to half a mile over water, and the writer has transmitted messages a mile over this sized coil.

Having purchased the coil, it will be found necessary to supply the oscillators, as the brass balls are termed, since coils of the smaller size do not include them. The brass balls should be half an inch in diameter and solid; they may be adjusted to the binding posts of the secondary terminals by brass wires, as shown in the diagrammatic view, Fig. 2. It will require two cells of Bunsen battery to operate the coil, or three cells of Grenet or bichromate of potash battery will operate it nicely. An ordinary Morse telegraphic key is connected in series with the battery and induction coil, as shown in the diagram. Now when the key, 4, is pressed down, the circuit will be opened and closed alternately—like an electric bell—by the interrupter, 2, and a miniature flash of lightning breaks through the insulating air-gap between the balls or oscillators, 5, and this spark or disruptive discharge sends out the etheric waves into space in every direction to a very great distance.

The oscillators should be finally adjusted so that not more than an eighth of an inch air-gap separates them. The reason the distance between them is cut down from a half to an eighth of an inch is because in wireless telegraphy it has been found that a "fat" spark emits waves of greater intensity than a long, attenuated one. The balls are termed oscillators, since, when the electric pressure at the balls becomes great enough to break down the air between them, the electric wave oscillates or vibrates very much as a string of a musical instrument oscillates when struck; in other words, it vibrates back and forth, very strongly at first, growing lesser until it ceases altogether.

The coil and key may be mounted on a base of wood 8 inches wide by 17 inches long and ¾ inch thick (Fig. 1). This, with the battery, constitutes the wireless transmitter complete, with the exception of an aerial wire leading upward to a mast 30 or 40 feet high, or the wire may be suspended outside a building. At the upper end of the wire a copper plate 12 inches square should be soldered; this is the radiator, and sends out the waves into space; another wire, 8, leading from the instrument is connected with a second copper plate, 9, buried in the earth. The wires are then connected to the oscillators—one on either side, as shown in Fig. 2, 6,6. The aerial and earth wires may be soldered to a bit of spiral spring, as this forms a good connection and one that can be readily removed if necessary. The transmitter may be set on a table or other stationary place, but for convenience it is well to have the coil and key mounted on a separate base.

To the receiving device there are more parts than to the transmitter, and to simply gaze upon the cut, Fig. 3, it would be almost impossible to obtain a correct idea of the connections. To the layman the most mysterious part of the whole system of wireless telegraphy is the most simple and the easiest understood. I refer to the coherer. Fig. 4 is a diagrammatic view of an experimental coherer, one that is suitable for the set in hand, for it is inexpensive, easy of adjustment and quite sensitive. A coherer, reduced to its simplest parts, consists of two pieces of wire, brass or German silver, 1-16th inch in diameter, forced into a piece of glass tubing, with some silver and nickel filings between the ends of the wire at the point, 7.

The brass standards shown, 1, in Fig. 4, together with the set screws and springs, are merely adjuncts attached to the coherer wires to obtain the proper adjustment and to then retain it. The filings may be made from a nickel five-cent piece and a silver dime, using a coarse file. The amount of filing to be used in the coherer can be roughly estimated by having the bore of tube 1-16th of an inch in diameter, and after one wire plug has been inserted, pour in enough of the filings to have a length of 1-16th inch. Before describing the function of the coherer, it will be well to illustrate the connection of the relay, tapper, sounder and coherer, and batteries. As shown in Fig. 3, the tapper—the central instrument back of the coherer—is improvised from an old electric bell, the gong being discarded. The relay, on the right, should be wound to high resistance, about 100 ohms. It is listed as a "pony relay," and like all other parts of the apparatus except the coherer, it may be purchased of any dealer in electrical supplies. The sounder, on the left, is an ordinary Morse sounder of 4 ohms resistance. The tapper magnets should be wound to 4 ohms. All should now be mounted on a base 10 by 16 inches and connected up as the diagram, Fig. 5, illustrates; that is, the terminals of the coherer are connected in series with two dry cells, 2, and the relay, 3. From the relay a second circuit, also in series, leads to the tapper, 6, thence to a battery of three dry cells, 5, and on to the sounder, 4, and finally back to the relay, 3. This much for the two electric circuits. The puzzling part to the novice in wireless telegraphy lies in the wires, 7 and 8, branching from the coherer. These have nothing to do with the local battery circuits, but lead respectively up a mast equal in height to the one at the transmitting end and down in the ground, as before described. These are likewise provided with copper plates. As shown in the engraving, Fig. 3, the connections are all made directly between the relay, coherer, sounder, tapper, and batteries for the very sensible reason that they are connected together with a deal less trouble than by the somewhat neater method of wiring under the baseboard. This, however, is a matter of time, taste and skill.

Now let us see what the functions of each of the appliances constituting the receiver are, their relation to each other, and finally, as a whole, to the transmitter a mile away. To properly adjust the receiver to the transmitter it is well to have both in the same room—though not connected—and then test them out. The relation of the coherer to the relay and battery circuit may be likened to that of a push-button, the bell and its battery. Coherer and push-button normally represent the circuit open. When one pushes the button, the circuit is closed and the bell rings; when the Hertzian waves sent out by the distant transmitting coil reach the coherer, the particles of metal filings cohere—draw closer together—thus closing the circuit, and the relay draws its armature to its magnets, which closes the second circuit, and then the tapper and sounder become operative.

The purpose of the tapper is to de-cohere the filings after they are affected by the etheric waves each time, otherwise no new waves would manifest themselves. The relay is necessary, since the maximum and minimum conductivity of the coherer, when normal and when subjected to the action of the waves, is not widely divergent, and therefore an appliance far more sensitive than an ordinary telegraphic sounder is needed; this is provided by a relay, which, while being much more sensitive, has the added advantage of operating a delicately-poised lever or armature instead of the heavy one used on the sounder. Signals can be read from the tapper alone, but to produce dots and dashes—the regular Morse code—a sounder is essential.

The adjustment of the coherer and its relation to the relay is not as difficult as the final adjustment of the sounder and tapper, but if the following rules are adhered to carefully, the result will be a successful receiver.

First arrange the adjusting screws of the relay armature so that it will have a free play of only 1-32d of an inch, when the armature is drawn into contact with the second circuit connection, just clearing the polar projections of the magnets; have the

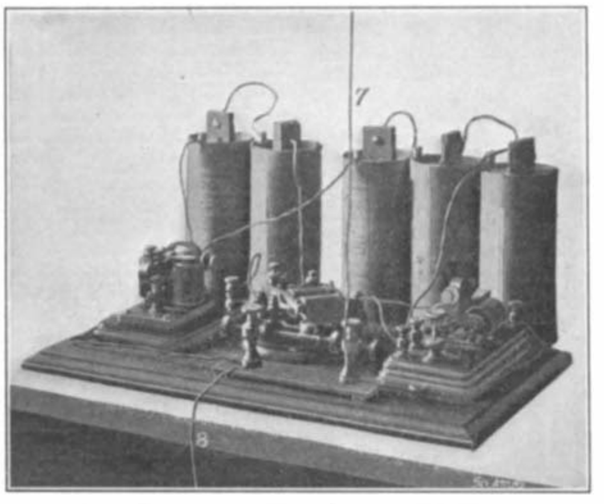
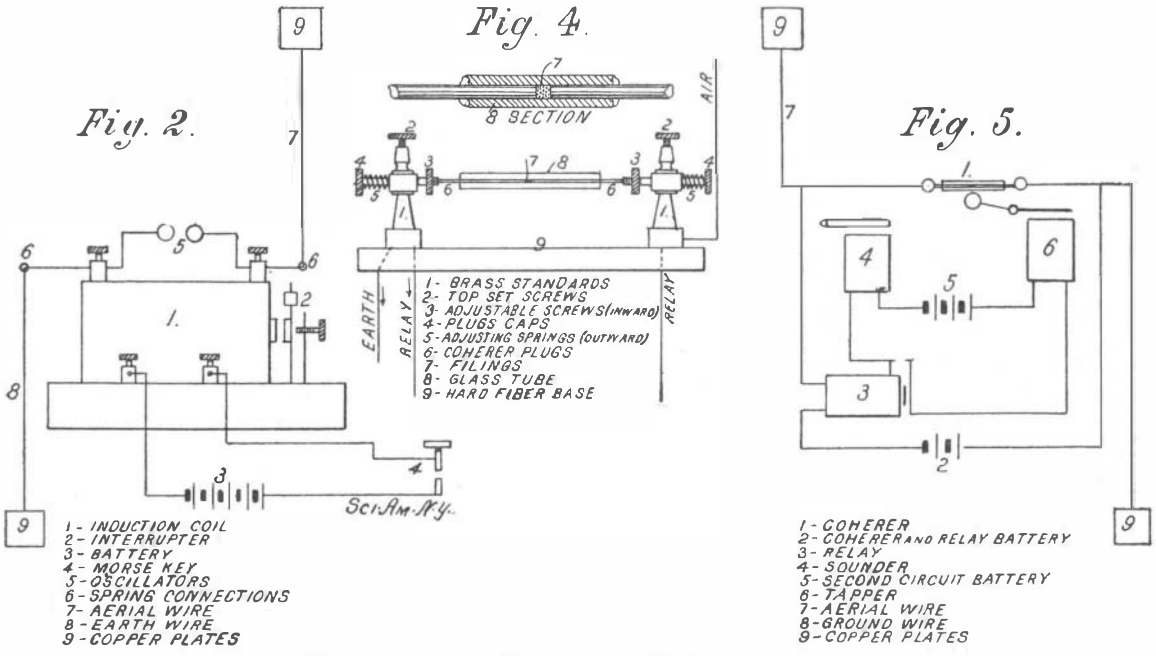


Fig. 3.—SET OF RECEIVING APPARATUS FOR WIRELESS TELEGRAPH.

tension of the spring so that it will have only "pull" enough to draw back the armature when there is no current flowing through the relay coils. Now connect the two dry cells in series with the coherer, Fig. 5. Unscrew one of the top set-screws, 2, Fig. 4, and then screw up the inner screw, 3, until the current begins to flow through the circuit and pulls the armature of the relay to the magnets. Tap the coherer with a pencil while turning the screw of the coherer to prevent premature cohesion, which is apt to occur by pressure. When absolute balance is secured between the coherer and the relay, connect in the battery of the second circuit, which includes the tapper and the sounder. When the relay armature is drawn into contact, closing the second circuit, both the tapper and the sounder should operate, the former tapping the coherer and the latter sounding the stroke. The adjustment of the sounder requires the most patience,



DIAGRAMS OF WIRELESS-TELEGRAPHIC APPARATUS.

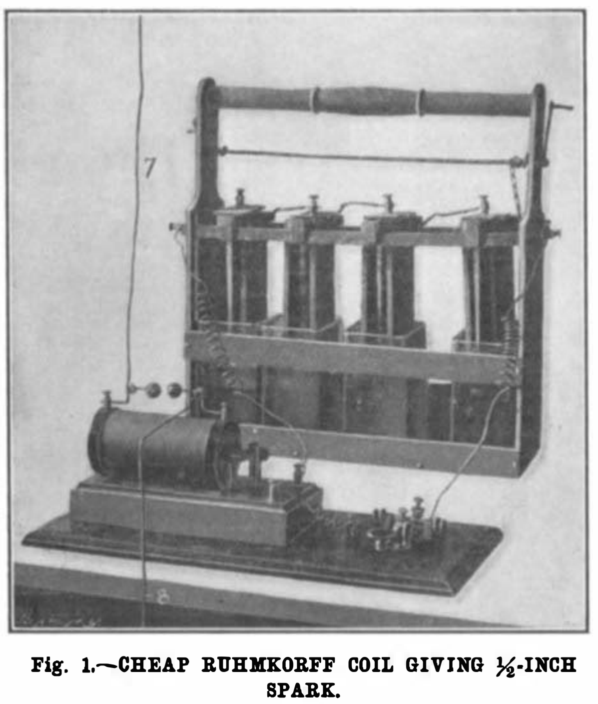


Fig. 1.—CHEAP RUHMKORFF COIL GIVING ½-INCH SPARK.

for it is by the most delicate testing alone that the proper tension is obtained. This is done by the screw regulating the spring attached to the sounder lever.

When all has been arranged and the local circuit of the transmitter is closed, the spark passes between the oscillators, waves are sent invisibly through space by the aerial and earth plates, and radiating in every direction, a minor portion must come into contact with the receiving aerial and ground plates, where they are carried by conducting wires to the coherer, and, under the action of the waves, the filings cohere, the relay circuit is closed, drawing the armature into contact, closing the second circuit when the tapper operates, striking the coherer tube and de-cohering the filings; at the same time the lever of the sounder is pulled down, and, by the law of inertia, it will continue to remain down, if a succession of waves are being sent by the transmitter, assuming the key is being held down, producing a dash, notwithstanding the tapper keeps busily at work de-cohering in response to the continuously closing circuit caused by the waves; but the sounder—sluggish in its action—when once drawn down, will remain so until the last wave is received and the tapper de-coheres for the last time, finally breaking the second circuit for a sufficient length of time to permit the heavy lever to regain its normal position.

All these various actions require a specific time in which to operate, and so the transmitting key must be operated very slowly, each dot and dash being given a sufficient length of time for the passage of a good spark. With the Marconi, Slaby, Guarini and all other systems of wireless telegraphy now in use, only twelve to fifteen words per minute can be sent. It is also well to remember that the higher the wires leading up the mast are, the further the messages will carry. Wireless transmission over water can be carried to about ten times as great a distance as over land.

Wireless telegraphy is very much like photography and everything else worth knowing. To know it well requires care, patience and practice, and the more one keeps everlastingly at it, the greater the results will be.

The Building Edition for September.

The Building Edition for September, 1901, is filled with beautiful engravings and excellent reading matter germane to the scope of the periodical. In addition to a number of artistic houses the Japanese garden of Mr. Nathan F. Barrett is illustrated and described, as well as some of the architectural features of San Francisco's cemeteries. The editorial is entitled "The Attractiveness of the House." There is the usual interesting "Monthly Comment" and "Household Notes." The eighth in the series of "Talks with Architects" is with Mr. S. B. P. Trowbridge on the "City Apartment House and Hotel." The other departments are "New Books," "With Our Correspondents," "New Building Patents," and "Legal Decisions."

The Current Supplement.

The current SUPPLEMENT, No. 1341, contains many beautiful illustrations. The first page engravings show the volcano of Ætna, including the crater. "How to Interpret the Facts of Geology" is a lecture by Prof. Angelo Heilprin. "Sven Hedin's Exploration in Central Asia" is a most graphic description of remarkable travels. "The Progress of Science" is an address of the retiring president of the American Association for the Advancement of Science at the Denver meeting. "The Scale Insects and Mite Enemies of Citrus Trees" is a most interesting article, accompanied by a number of engravings showing the treatment of the orange and other trees by various means. "How Arctic Animals Turn White" is by R. Lydekker. "Electrically-Operated Pumps" is by F. C. Perkins and is accompanied by a number of illustrations.

Contents.

(Illustrated articles are marked with an asterisk.)