No. 884,989. PATENTED APR. 14, 1908.

G. MARCONI.

WIRELESS TELEGRAPHY.

APPLICATION FILED FEB. 9, 1904.

Fig. 1.

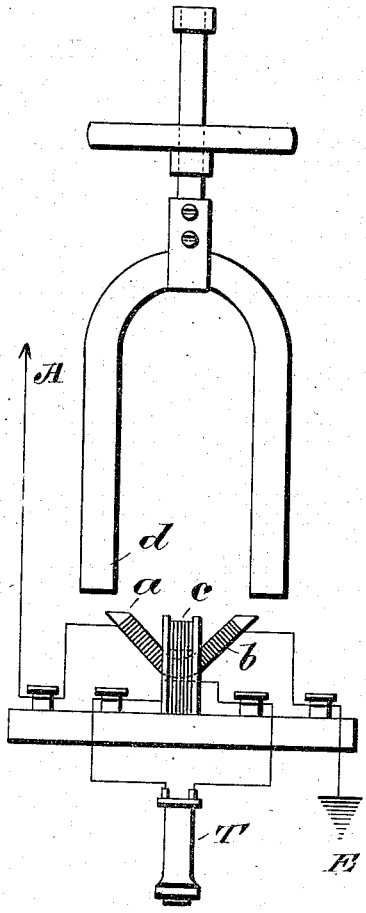
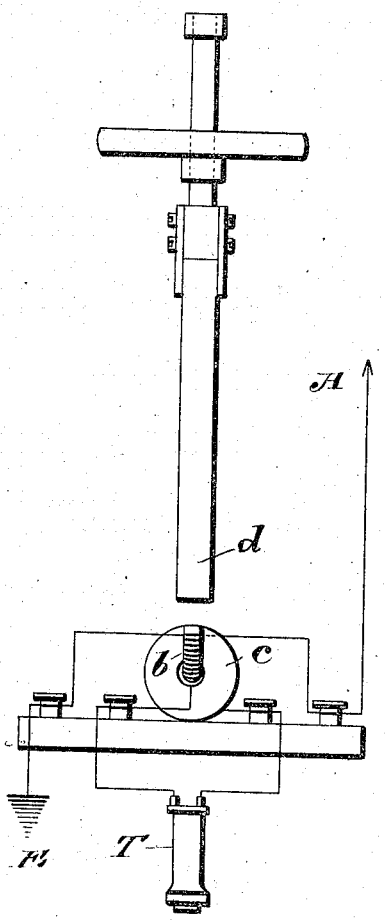


Fig. 2.



Witnesses
C. H. Benjamin
Wm. H. Davis

Inventor
Guglielmo Marconi.
By his Attorneys
Bakewell Church Brown & Bakewell

UNITED STATES PATENT OFFICE.

GUGLIELMO MARCONI, OF LONDON, ENGLAND, ASSIGNOR TO MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA, A CORPORATION OF NEW JERSEY.

WIRELESS TELEGRAPHY.

No. 884,989. Specification of Letters Patent. Patented April 14, 1908.

Original application filed November 28, 1902, Serial No. 132,974. Divided and application filed February 2, 1903, Serial No. 141,399. Again divided and this application filed February 9, 1904. Serial No. 192,739.

To all whom it may concern:

Be it known that I, GUGLIELMO MARCONI, a subject of the King of Italy, and a resident of London, England, have invented certain new and useful Improvements in Wireless Telegraphy, of which the following is a full and true description, reference being had to the accompanying drawings, showing one form of apparatus adapted to carry out my invention.

The present application is a division of an application, Serial No. 141,399, filed by me on February 2, 1903, for Letters Patent of the United States, which application was a division of my application Serial No. 132,974, filed by me on November 28, 1902, for Letters Patent of the United States.

My present invention relates to the system of wireless telegraphy in which Hertzian waves or oscillations of high frequency are produced at a transmitting station by means of an abrupt electrical discharge in the natural medium, whence the oscillations are propagated to a distant receiving station without the use of any conductor or connecting wires.

My present theory of the method hereinafter described is as follows, although I intend to claim this method, whether this theory is correct or not:—It is a well known fact that after any change has taken place in the magnetic force acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is completed. If the applied magnetic force be either subjected to a gradual increase followed by an equally gradual diminution or caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind, Prof. Ewing has given the name magnetic hysteresis. It has also been shown by Gerosa, Finzi, and others that the effect of alternating currents or high frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysteresis, causing the metal to respond much more readily to any influence which tends to alter its magnetic condition. The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint (or viscosity) in which they are ordinarily held, diminishing their retentiveness and consequently decreasing the lag in the magnetic variation taking place in the iron. I, therefore, anticipated that the group of electric waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to the slowly varying magnetic force, produce sudden variations in its magnetic hysteresis, which variations would produce others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron, instead of slowly following the variations of the magnetic force applied, would at each spark of the transmitter suddenly diminish its magnetic lag caused by hysteresis. These jerks in the magnetic condition of the iron would cause induced currents in a coil of wire of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or perhaps even read on a galvanometer. The jerks in the magnetic condition of the iron might also be detected by a telephone diaphragm applied directly thereto.

In carrying out my present improvements, I avail myself of the discovery made by me that if at a receiving station a magnetic field be created independent of received oscillations, and a receiving instrument be connected with said field, the received oscillations may be utilized to vary the current of the circuit of the receiving instruments so as to render the received oscillations intelligible as signals.

The drawings show a form of apparatus adapted to carry out the method of my present invention, which apparatus was shown and described in my application Serial No. 132,974, and also in my application Serial No. 141,399.

In the drawings, Figure 1 is a front elevation (partly diagrammatic) of a preferred form of my receiving device, and Fig. 2 is a similar side elevation of said device.

In this apparatus *a* is a core, the ends of which may be bent upwards; it may consist of say thirty hard drawn iron wires of about 5 mm. in diameter. Over this, a primary winding of one or more layers of thin silk covered wire *b* is placed, and one end of the winding is connected to a capacity E, which may be the earth, and the other end of the winding connected directly, or indirectly, to

a receiving conductor A. The receiving conductor is shown as an elevated vertical conductor, but obviously this conductor may be otherwise disposed, as horizontally, or any of the different forms of receiving conductors developed in the progress of wireless telegraphy may be used. A secondary winding *c*, about .002 cm. in diameter, preferably surrounds the winding *b*, and a sufficient number of turns of it is used to give a resistance about equal to that of the telephone T to which its ends are connected.

d indicates a magnet, preferably located above the core *a*, and rotated about the same by clock-work mechanism or otherwise, at, say, one revolution per second, or at other suitable speed.

In practice, the movement of the magnet will move or vary the magnetic field, and when the magnet is mounted to revolve, as shown, it causes a constant change of successive reversals or alterations in the magnetism of the core. It is found that if electrical oscillations of suitable period are sent from a transmitting station, according to the now well known methods, changes are effected in the magnetism of the iron core in addition to the changes in magnetism of the core produced by the rotation of the magnet, and these changes produce induced changes on the windings, and these currents in their turn reproduce on the telephone or other instrument adapted to render the received oscillations intelligible, the signal sent from the transmitting station.

The telephone or other proper instrument may be connected to the ends of the winding *b* nearest the iron, and the winding *c* omitted; or the iron core *a* may be placed in close proximity to a telephone diaphragm, and the sudden changes of magnetism in the core can then be detected by sounds produced by the diaphragm. In this case also, no second winding is required on the core.

It will be seen that in my apparatus a magnetic field is created by the magnet *d*. In this field the coil *b*, connected to the aerial conductor, is located, and the received oscillations passing through this coil serve to modify the field of the magnet *d*. The modifications of this field set up currents in the coil *c*, and these currents cause sound waves to be set up in the telephone. In order to localize the field in proximity to the coils *b* and *c*, the core *a* is inserted, this core being of magnetic material, and having a magnetic permeability greater than that of air.

The arrangement described forms a magnetic circuit composed of the movable body *d*, the stationary body *a*, and the gaps between the ends of these two bodies. Owing to the fact that the elements comprising this circuit are of different magnetic permeability, a movement of one of these elements relatively to the others causes a variation of the magnetic flux through the circuit. Thus, the rotation of the movable body *d* causes a variation of the magnetic flux through the stationary core *a*. This constantly varying flux is further abruptly modified by the received oscillations, and these abrupt modifications are utilized to create intelligible signals.

My new method may be carried out by other forms of apparatus than those described and shown, and I do not, therefore wish to be understood as limiting my invention thereto.

I have shown and described an apparatus in which the magnet, which creates the field independently of the received oscillations, is movable, and the core is stationary, but I do not intend to limit my claims to this specific form of the invention as many forms of said invention will be obvious to the skilled mechanic.

The scope of my invention is indicated by the following claims:

1. In a wireless telegraph system, the method of detecting electrical oscillations of high frequency, which consists in creating a rotating magnetic field at a receiving station, abruptly varying said field by the received oscillations, and utilizing the variations in said field to create intelligible signals.

2. In a wireless telegraph system, the method of detecting electrical oscillations of high frequency, which consists in creating a rotating magnetic field at a receiving station, partially localizing said field at a point within the same, varying the magnetism of the localized portion of the field by the received oscillations, and utilizing such variations to create intelligible signals.

3. In a wireless telegraph system, the method of detecting electrical oscillations of high frequency, which consists in creating a magnetic field at a receiving station, localizing said field by a stationary member having a magnetic permeability greater than that of air, varying the flux through said stationary member by the movement of a magnetic body, modifying said flux by the received oscillations and utilizing such modifications to create intelligible signals, substantially as described.

4. In a wireless telegraph system, the method of detecting electrical oscillations of high frequency, which consists in creating a magnetic field at a receiving station, localizing said field by a stationary member having a magnetic permeability greater than that of air, varying the flux through said stationary member by the movement of a magnetic body in proximity thereto, abruptly modifying said flux by the received oscillations and utilizing said abrupt modifications to actuate a telephone, substantially as described.

5. In a wireless telegraph system, the method of detecting electrical oscillations of

high frequency, which consists in creating a magnetic field at a receiving station, localizing said field by a stationary member having a magnetic permeability greater than that of air, varying the flux through said stationary member by the movement of a magnetic body in proximity thereto, abruptly modifying said flux by the received oscillations, and utilizing such abrupt modifications to induce current pulsations in a telephone circuit, substantially as described.

In witness whereof, I have hereunto set my hand this 25th day of January 1904.

GUGLIELMO MARCONI.

In presence of—
HENRY WILLIAM ALLEN,
HERBERT KERCHANE.