No. 884,987. PATENTED APR. 14, 1908.

G. MARCONI.

WIRELESS TELEGRAPHY.

APPLICATION FILED FEB. 2, 1903.

Fig. 1.

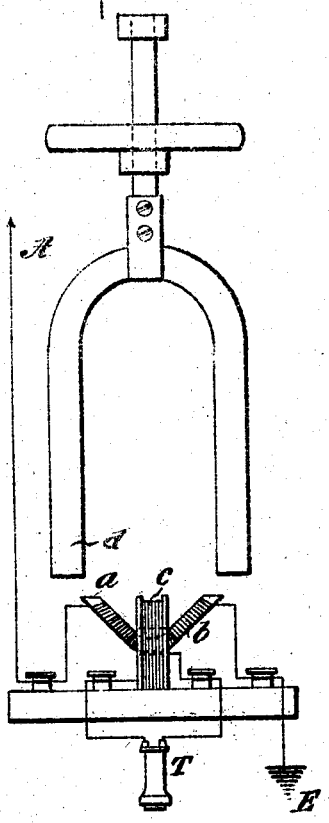
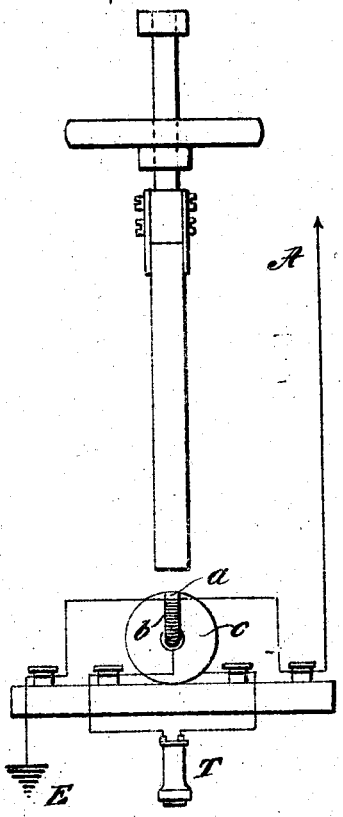


Fig. 2.



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UNITED STATES PATENT OFFICE.

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WIRELESS TELEGRAPHY.

No. 884,987. Specification of Letters Patent. Patented April 14, 1908.

Original application filed November 28, 1902, Serial No. 132,974. Divided and this application filed February 2, 1903. Serial No. 141,398.

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 my invention.

This invention is based upon the discovery, made by me, that a piece of magnetic material, which is not sensibly affected by high-frequency electrical oscillations, such as Hertzian waves, under ordinary circumstances, becomes sensitive to them when placed in a varying or moving magnetic field.

My present theory of the action of the apparatus hereinafter described is as follows, although I intend to claim this apparatus, 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 been shown also 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.

The present application is a division of an application, Serial No. 132,974, filed by me on November 28, 1902, for Letters Patent of the United States.

The apparatus herein described is adapted especially for the detecting of electrical oscillations by means of the method invented by me, which constitutes the subject-matter of an application, Serial No. 141,399, filed February 2, 1903, for Letters Patent of the United States.

In said application, Serial Number 132,974, I have described, shown and claimed a receiving-apparatus for electrical-oscillations said apparatus comprising a metallic member surrounded by a winding which is connected with the receiving conductor, means, independent of received oscillations, for creating a magnetic field in said member, and a receiving instrument adapted to render the received oscillations intelligible, such as a telephone, inductively connected with said field; and I have also described, and shown and claimed a modification of said apparatus, which comprises means for varying said magnetic field independently of received oscillations, and have especially claimed a form of apparatus in which the metallic member is a movable core which is moved through a field created by an adjacent stationary magnet. In addition to said specific form of apparatus, I have also shown and briefly described a second specific form, comprising a fixed core and a movable magnet, for creating a variable magnetic field in the core. It is this specific form of my invention which constitutes the subject-matter of my present application.

Referring to the accompanying drawings, which illustrate one embodiment of the ap-

paratus constituting my present invention, Figure 1 is a front elevation (partly diagrammatic) of a preferred form of device, and Fig. 2 is a similar side elevation of said device.

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 m. m. 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, such as horizontally. A secondary winding, *c*, about .02 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, or the effect of the oscillations may be detected by any other suitable means, such, for instance, as a telephone diaphragm located in proximity to the core so as to be effected thereby, the secondary coil being omitted.

d indicates a magnet, preferably located above the core *a*, and rotated above the same, by clock-work mechanism or otherwise, at—say—one revolution per second or 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 or successive reversals or alternations in the magnetization 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, rapid changes are effected in the iron core, which changes produce induced currents on the winding, and these currents, in their turn, reproduce on the telephone, or other instrument adapted to render the received oscillations intelligible, the signals 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.

I claim:

1. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a magnet for creating a magnetic field, a magnetizable member located in said magnetic field and connected to said conductor, means for moving the magnet to and from the magnetizable member, and a receiving-instrument affected by the changes in magnetism of the magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

2. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a magnet for creating a magnetic field, a magnetizable member connected to said conductor and located in said magnetic field, means for rotating the magnet above the magnetizable member, and a receiving-instrument affected by the changes in magnetism of said magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

3. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a magnet, a magnetizable member connected to said conductor and located in the field created by said magnet, means for moving the magnet to vary the magnetic field, and a receiving-instrument affected by the changes in magnetism of said magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

4. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a movable magnet, a magnetizable member located in the field created by said magnet, a coil for said magnetizable member connected to the receiving-conductor, and a receiving-instrument affected by the changes in magnetism of said magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

5. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a magnet, a stationary magnetizable member located in the field created by said magnet and connected to said conductor, means for creating alternations or reversals of magnetism in the field, and a receiving-instrument affected by the changes in magnetism of said member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

6. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a coil connected to said conductor, a magnet to create a magnetic field, means for varying said magnetic field, a magnetizable member located in the field created by said magnet, and a receiving-instrument affected by the changes in magnetism of said magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

7. At a receiving-station in a wireless tele-

graph system, a magnet, a magnetizable core, means for moving the magnet to and from the core, so as to produce changes in magnetism in the core, an oscillation receiving conductor, a coil surrounding the magnetizable core and connected to the receiving-conductor, and a receiving-instrument affected by the changes in magnetism of the core, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

8. At a receiving-station in a wireless telegraph system, a magnetizable core, a magnet to produce a magnetic field, means for rotating the magnet above the core so as to change the magnetism in the core, an oscillation-receiving conductor surrounding the core, and a receiving-instrument affected by the changes in magnetism of the core, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

9. At a receiving-station in a wireless telegraph system, a magnetizable core, an oscillation-receiving conductor, a coil connected to said conductor and surrounding the core, a magnet located near the core, and means for moving the magnet to vary the field in the core, and a receiving-instrument affected by the variations of magnetism in the core, whereby oscillations received from a distant transmitting station are rendered intelligible as signals, substantially as described.

10. At a receiving-station in a wireless telegraph system, a magnetizable core, an oscillation-receiving conductor, a coil connected to said conductor and surrounding the core, and a movable magnet for creating a movable magnetic field, which includes the core, and a receiving instrument affected by the changes of magnetism in the core, thereby rendering the received oscillations intelligible, substantially as described.

11. At a receiving-station in a wireless telegraph system, a magnetizable core, an oscillation-receiving conductor, a coil connected to said conductor and surrounding the core, a magnet for creating a magnetic field which includes the core, a means for creating reversals or alternations of magnetism of the core, and a receiving instrument affected by the changes in magnetism of the core, whereby oscillations received from a distant transmitting station are reproduced as intelligible signals, substantially as described.

12. At a receiving-station in a wireless telegraph system, a magnet for creating a magnetic field, a stationary magnetizable core included in said field, an oscillation receiving conductor, a coil connected to said conductor and surrounding the core, means for varying the magnetic field, so as to produce changes in magnetism in the core, and a receiving-instrument affected by said changes in magnetism in the core, whereby signals sent from a distant transmitting station are rendered intelligible, substantially as described.

13. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a permanent magnet to create a magnetic field, a stationary magnetizable core located in said field, a coil surrounding said core and connected at one end to a capacity and at the other end to the oscillation receiving conductor, means for moving the magnet with respect to the core so as to produce variations in magnetism in the core, and a receiving instrument affected by the changes in magnetism in the core, whereby signals from a distant transmitting station are rendered intelligible, substantially as described.

14. At a receiving-station in a wireless telegraph system, an oscillation-receiving conductor, a permanent magnet to create a magnetic field, a stationary magnetizable core located in said field, a coil surrounding said core and connected at one end to a capacity and at the other end to the oscillation receiving conductor, means for rotating the magnet adjacent to the core so as to produce reversals or alternations of the magnetism in the core, and a receiving instrument affected by the reversals or alternations in the core, whereby signals sent from a distant transmitting station are rendered intelligible, substantially as described.

15. At a receiving-station in a wireless telegraph system, an oscillation receiving conductor, a magnet to create a magnetic field, a stationary magnetizable core located in said magnetic field, a coil surrounding said core and connected at one end to a capacity and at the other to the receiving conductor, means for rotating the magnet adjacent to the core so as to produce reversals or alternations of the magnetisms in the core, a second coil surrounding the first named coil, and having its ends connected to a telephone receiver, whereby the reversals or alternations of magnetism in the core are reproduced in the telephone, as intelligible signals, substantially as described.

In witness whereof, I have hereunto signed my name, this 27th day of January, 1903.

GUGLIELMO MARCONI.

In presence of:

WILLIAM H. BERRIGAN,
JAMES J. COSGROVE.