

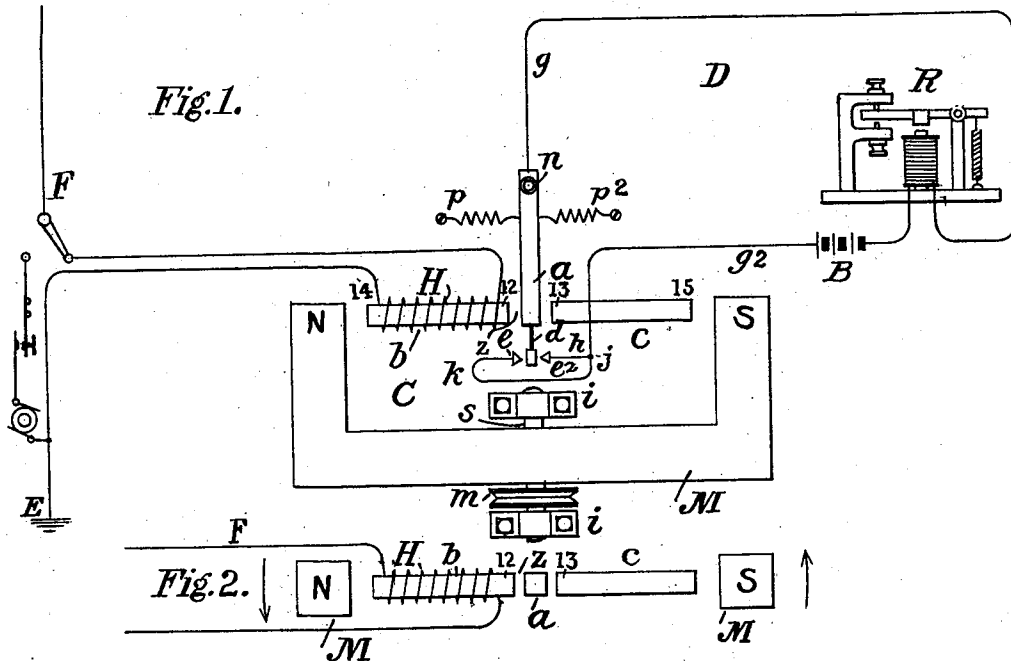
No. 758,468.

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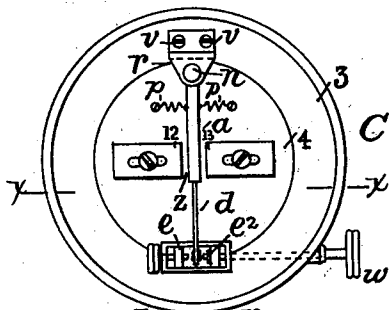
G. W. PICKARD.  
ALTERNATING CURRENT SIGNAL RECEIVING APPARATUS.

APPLICATION FILED FEB. 29, 1904.

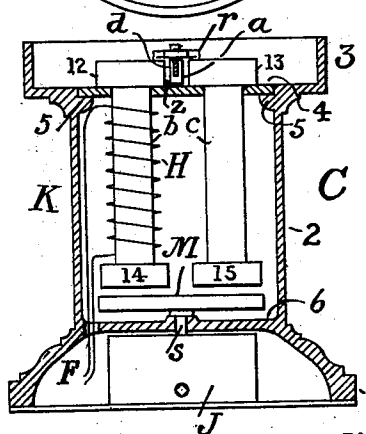
NO MODEL.



*Fig. 3.*



*Fig. 4.*



WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## ALTERNATING-CURRENT SIGNAL-RECEIVING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 758,468, dated April 26, 1904.

Application filed February 29, 1904. Serial No. 195,918. (No model.)

*To all whom it may concern:*

Be it known that I, GREENLEAF W. PICKARD, residing at Amesbury, in the county of Essex and State of Massachusetts, have invented certain Improvements in Alternating-Current Signal-Receiving Apparatus, of which the following is a specification.

This invention concerns receiving apparatus for signaling systems operating with high-frequency alternating or changing currents, current impulses, or electromagnetic waves—as, for example, systems of “wireless” or “space” telegraphy.

The object of the invention is to provide a relay or signal-receiving instrument which while exceedingly sensitive shall be capable of operating with great certainty and effectiveness.

When an alternating current or succession of impulses of high frequency, such as is employed in wireless telegraphy or electromagnetic-wave signaling, is passed through a coil surrounding a permanent magnet, its tendency is to demagnetize the said magnet. If an unmagnetized piece of iron or steel be surrounded by a coil and be subjected to an external magnetizing agency, the process of magnetization will be facilitated by the passage of a high-frequency current through the coil, such action of the current being obviously analogous and comparable to a mechanical jarring of the iron. When an iron rod is placed in a cyclically-varying magnetic field produced, it may be assumed, by means of a slowly-rotating permanent magnet, the magnetization of the rod will lag behind the impressed magnetic induction due to the revolving inducing-magnet. This lag may be greatly decreased by jarring or tapping the rod sharply and at short intervals. This diminution of the amount of lag may, as hereinbefore suggested, be accomplished without recourse to mechanical means if the rod be surrounded by a coil carrying a high-frequency alternating current. Based upon these considerations the invention comprises two iron cores or pole-pieces so relatively placed as to have adjacent ends with an armature-space between; an armature fulcrumed to os-

cillate in said space, the same being centrally held resiliently by springs or otherwise when at rest, but adapted to move or swing toward one pole-piece end or the other, as either may in the normal operation of the apparatus become the stronger; a rotating or revolving inducing-magnet adapted to establish simultaneously-opposed and cyclically-changing magnetizations in the pole-pieces, and to thereby develop a constantly-changing field of force in the armature-space between them, and an exciting-helix or electromagnetic coil or winding encompassing one of said pole-pieces and connected in the circuit-conductor (in space telegraphy the grounded aerial conductor or antenna) of the high-frequency alternating currents or current impulses whose presence is to be manifested. If the electromagnetic coil were not present, the magnetic lag in each pole-piece would of course be the same, the forces acting upon the armature would be in equilibrium, and the armature, held resiliently in an intermediate position substantially equidistant from the ends of both pole-pieces, would remain unmoved; but by providing the said coil and connecting it in the manner stated, so that it receives and is responsive to the action of said high-frequency currents, the lag in the pole-piece it surrounds is materially decreased, or, in other words, the magnetic changes are facilitated and accelerated. The oscillating armature has stops to limit its movement in either direction, either or both of which may be electrical contacts, and the apparatus thus enabled to serve as a relay may control a local circuit containing a sounder or recorder in the usual manner.

In the drawings which accompany this specification, Figure 1 is a diagram illustrating the principle and arrangement of the receiving apparatus constituting the invention, said apparatus being shown as connected with the antenna of a wireless signaling system. Fig. 2 is a plan view of the said arrangement. Fig. 3 is a plan view of a practical form of relay containing the invention, and Fig. 4 a sectional elevation of the same on the line *xx* of Fig. 3.

Referring to the drawings, and especially

for the present to Figs. 1 and 2, the reference-letter C represents the receiving apparatus as an entity,  $b$  and  $c$  being cores or pole-pieces, of steel or hard iron, having their ends 12 13 juxtaposed, as shown, with a sufficient armature-space  $z$  between them, and  $a$  an armature (of soft iron) pivoted or fulcrumed at  $n$  and projecting at its free end into said armature-space, wherein when the instrument is at rest it is held by springs  $p$   $p^2$  or any preferred means resiliently in a central or intermediate position substantially equidistant from the said pole-piece ends 12 13, being, however, adapted to freely swing or oscillate laterally toward one pole-piece or the other, according as either may at any moment become the stronger, and to be brought back by said springs into its central position when the said inequality of attracting power ceases.

The constantly and cyclically changing field of force is supplied by a magnet M, preferably of the permanent type, (although, of course, an electromagnet may be employed whenever desired,) mounted upon a shaft  $s$ , supported and adapted to revolve in bearings  $i$   $i$  and shown as being provided with a pulley  $m$ , to be actuated by a belt from any convenient external source of power. The said magnet is revolved continuously at a slow and uniform speed about the pole-pieces  $b$  and  $c$ , and as the poles move past the ends 14 15 of said pole-pieces they establish therein a corresponding and cyclical rising, falling, disappearing, and reversing magnetization. During this process of cyclical magnetic variation a very considerable magnetic lag behind the impressed induction occurs in both pole-pieces, and the amount of lag in each, so far as the effect of the revolving field is concerned, is the same.

One of the pole-pieces,  $b$ , is surrounded by an electromagnetic coil H, to be connected in the circuit-conductor of the high-frequency currents or impulses to which the apparatus is designed to be responsive, the said conductor being shown as the aerial conductor or antenna F, grounded at E, of a space-telegraphy system.

R is a sounder in the circuit D of the local battery B, the conductors  $g$   $g^2$  of which are attached, respectively, to the armature  $a$  and contact-limiting stops  $e$   $e^2$ , corresponding to the pole-pieces  $b$   $c$  and placed one on each side of the armature extension  $d$ , the conductor  $g^2$  being connected by branches  $h$   $h$  to the said contact-stops, respectively.

In the operation of this receiving apparatus the received impulses or high-frequency alternating currents circulate or surge through the coil H and produce a motion of the armature  $a$  to the left or right, depending upon and according to the position at any given moment of the poles N S of the magnet M. If, for example, the poles N S are receding from the ends 14 15 of the cores  $b$

and  $c$ , the magnetic induction is falling, and a signal impulse received diminishing the lag, and thus accelerating the magnetic change in pole-piece  $b$  will cause the magnetic strength of said pole-piece  $b$  to fall below that at the same instant of pole-piece  $c$ , and the armature will move toward  $c$ , closing the local circuit D at the contact-stop  $e^2$  and producing the appropriate signal upon the sounder R. If, on the contrary, the poles N S are approaching the pole-pieces  $b$   $c$  and the magnetic induction thus rising in value, the action of the incoming high-frequency impulses in the coil H is to expedite the flux of the approaching magnetization and to exalt the strength of the pole-piece  $b$  over that of pole-piece  $c$ , so that the armature moves toward the former and will now close the local circuit at the contact-stop  $e$ , again operating the sounder.

As shown in Figs. 3 and 4, the relay C of this invention may readily be arranged in a practical form suited for commercial use. In such form the bar-cores or pole-pieces may, as shown, be arranged side by side instead of end to end, with the armature  $a$  and armature-space  $z$  at the top of a cylindrical metal casing K, with an enlarged base 7, an open top part 3, containing the core ends 12 13 and the armature  $a$ , and a central part containing the main portions of the pole-pieces  $b$   $c$ , and the revolving magnet M, here shown as a bar-magnet, mounted upon a vertical shaft  $s$ , passing through the floor of the said middle part of the casing and adapted to move in front of the lower ends 14 15 of the pole-pieces. The magnet M in this form of instrument is assumed to be driven or actuated by a spring-motor J, contained in the base portion 7 of the casing. The armature  $a$  is shown as being pivoted at  $n$  in a bracket  $r$  at one edge of the top part of the casing after the manner of ordinary polar relays, and one or both of the contact or limit stops may be adjustable by the screw  $w$ . The ends 12 13 of the iron cores  $b$   $c$  may, if desired, be slotted and attached to their respective cores by screws working in such slots, as shown, thus providing for further adjustment in a manner well understood.

The revolving magnet may be actuated by any small clock or other motor, and satisfactory results have been attained when the magnet has been revolved at a rate of ten revolutions per second.

Since in this invention the energy of the high-frequency changing current is not required to directly move an armature, but is employed merely to control a much greater force, relays containing and realizing the invention are alike sensitive and effective.

The invention is claimed as follows:

1. A receiving apparatus for high-frequency currents or impulses, comprising two pole-pieces or magnetic cores; means for establishing in them simultaneously-opposed and

cyclically-changing magnetizations; means actuated by and responsive to said high-frequency currents or impulses for accelerating the magnetic change in one of said pole-pieces; and an armature mounted with its free end held normally in a position intermediate between said pole-pieces, and adapted to oscillate toward one or the other as either may become the stronger; substantially as described.

2. In a signaling system operating with high-frequency alternating currents or impulses, a receiving apparatus consisting of two pole-pieces or magnetic cores with confronting ends; means for producing a constantly-changing field of force in the space between said ends by subjecting said pole-pieces to opposed and cyclically changing or reversing magnetizations; means actuated by and responsive to the normal high-frequency currents or impulses of said system for decreasing the magnetic lag in one of said pole-pieces; and a pivoted iron armature with its free end normally held resiliently in an intermediate position within the said field of force, and adapted to swing toward one pole-piece or the other, in accordance with the conjoint action of the changing field of force, and the said currents or impulses; substantially as described.

3. In a signaling system operating with high-frequency changing or alternating currents or current impulses, an electromagnetic receiving instrument, consisting of two iron pole-pieces or cores with juxtaposed and confronting ends; means for producing a constantly-changing field of force in the space between said confronting ends by subjecting said pole-pieces to a cyclically-changing magnetic flux; an electromagnetic coil or winding surrounding one of said pole-pieces, adapted to be connected in the circuit-conductor of said currents or impulses, and acting to decrease the magnetic lag in said pole-piece; and an iron armature held resiliently when at rest in an intermediate position between the juxtaposed ends of said pole-pieces, and adapted in operation to swing toward one or the other; substantially as and for the purposes set forth.

4. An electromagnetic receiving instrument or relay for high-frequency currents or impulses, consisting of two iron cores or pole-pieces with juxtaposed ends with an intervening armature-space; a magnet mounted to revolve in inductive proximity to said pole-pieces and adapted to subject the same to a cyclically changing or reversing magnetization and thereby to establish a correspondingly-changing and gradually-reversing field of force in said armature-space; a magnetizing coil or winding surrounding one of said pole-pieces connected or adapted to be connected in the circuit-conductor of said high-

frequency currents, to accelerate the magnetic change of said pole-piece; and an iron armature having its free end extended into said armature-space, and adapted to oscillate therein, in accordance with the unequal magnetizations of said pole-pieces; substantially as described.

5. In a system of electromagnetic wave signaling, the combination substantially as hereinbefore described, in a receiving-station apparatus, of a grounded aerial conductor or antenna; two iron cores or pole-pieces with ends juxtaposed and an interposed armature-space; an inducing-magnet in inductive proximity to said pole-pieces and adapted to revolve past them and thereby to induce in each a cyclically rising, falling and reversing opposed magnetization, and a correspondingly-changing field in said armature-space; an electromagnetic helix or winding surrounding one of said pole-pieces and in the circuit of said antenna; and an iron armature mounted between said pole-pieces to oscillate in the said interposed space in accordance with the currents or wave impulses circulating in said winding.

6. In a relay, the combination of two iron pole-pieces with adjacent or confronting ends and an armature-space between said ends; a pivoted armature having its free end held at the middle of said space, and adapted to swing toward either pole; an electromagnetic coil encompassing one of said pole-pieces; and a magnet adapted to revolve round or past the other ends of said pole-pieces and to induce opposite and cyclically-changing magnetizations in said pole-pieces respectively; substantially as described.

7. A relay adapted to be operated by high-frequency alternating-currents or current impulses, consisting of two iron cores or pole-pieces having juxtaposed ends with an intervening armature-space; an inducing-magnet adapted to rotate or revolve past the other ends of said cores in such wise that when one of its poles is in inductive relation to either core, its other pole shall be in like inductive relation to the other core; a pivoted iron armature mounted to oscillate between limiting or contact stops in said armature-space, and normally held resiliently in an intermediate position; and an electromagnetic coil round one of said cores; substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 26th day of February, 1904.

GREENLEAF W. PICKARD.

Witnesses:

GEO. WILLIS PIERCE,  
JAMES E. LYNCH.