(No Model.) 2 Sheets—Sheet 1.

J. E. WATSON.

RELAY.

No. 383,843. Patented May 29, 1888.

Fig. 1.

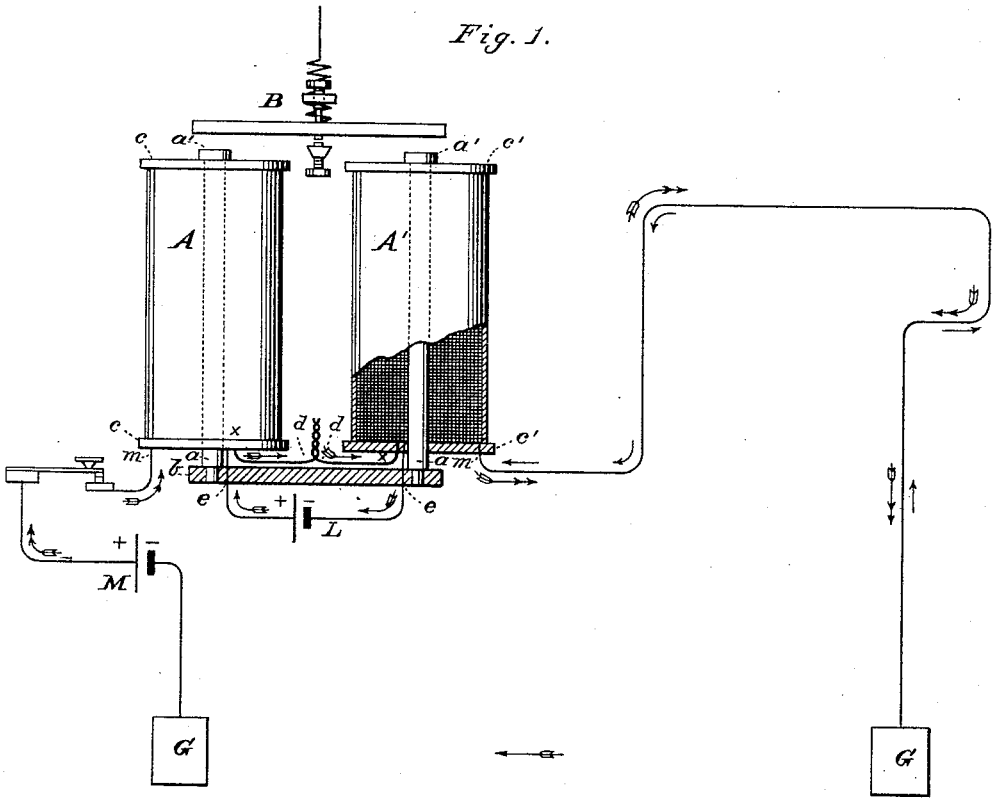
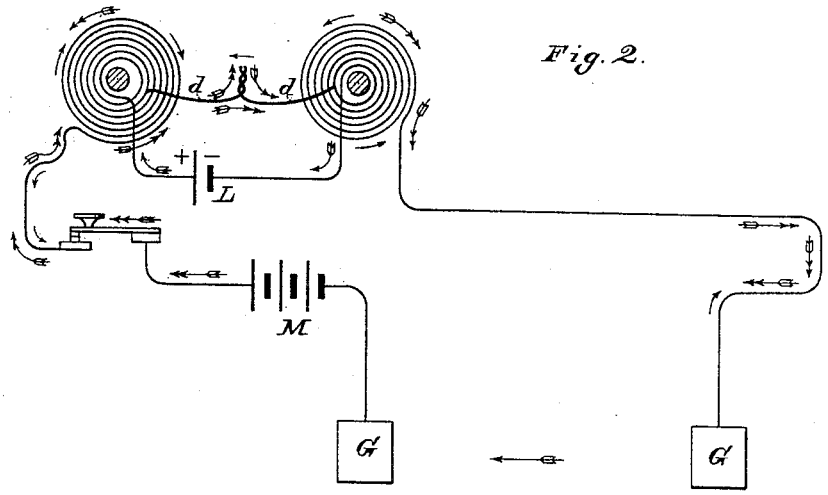


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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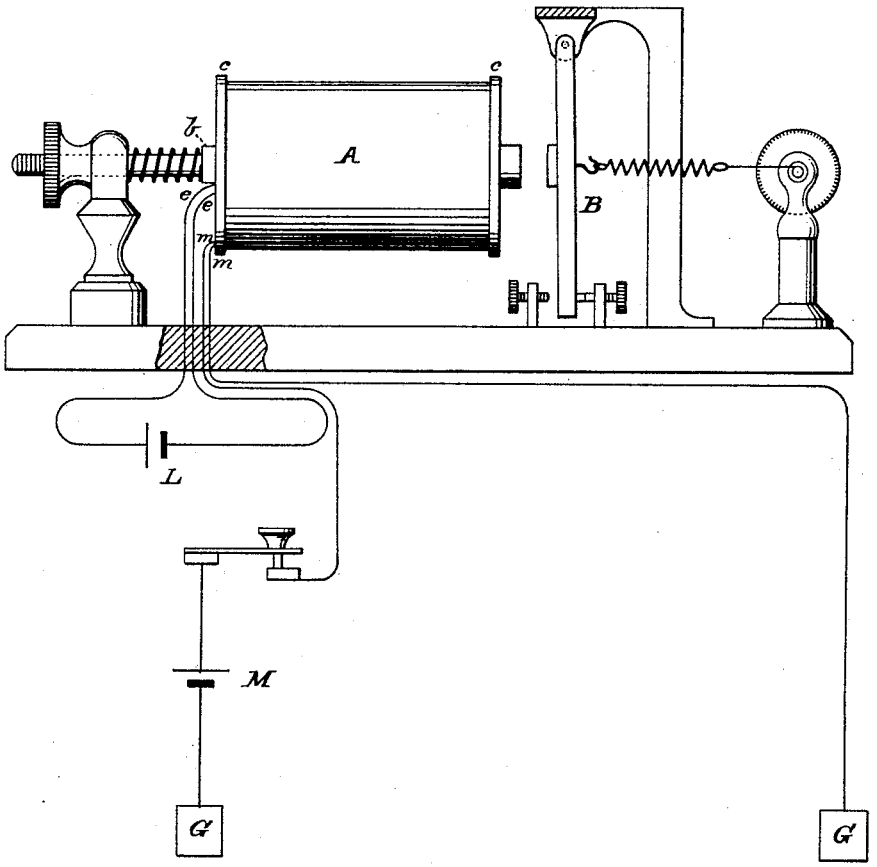
Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN EDWARD WATSON, OF LOUISVILLE, KENTUCKY, ASSIGNOR TO THE INTERNATIONAL ELECTRIC COMPANY, OF SAME PLACE.

RELAY.

SPECIFICATION forming part of Letters Patent No. 383,843, dated May 29, 1888.

Application filed February 1, 1888. Serial No. 262,614. (No model.)

To all whom it may concern:

Be it known that I, JOHN EDWARD WATSON, a citizen of the United States, and a resident of Louisville, in the county of Jefferson and State of Kentucky, have invented certain new and useful Improvements in Relays; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Figure 1 of the drawings is a representation of a plan view, partly in section, illustrating this invention. Fig. 2 is a sectional diagram. Fig. 3 is a side view.

This invention has relation to receivers for systems of telegraphy and telephony, or other forms of electric signaling, and is especially designed to facilitate operations by feeble electric impulses over lines of great length; and it refers to a method of operation wherein an armature is counterpoised by tension against magnetic attraction set up in a portion of the continuously and directly wound coils of the electro-magnet energized by a constantly-closed local battery, and such balance or counterpoise is altered or changed by the hampering action of a reversely-acting main-line current passing in a second portion of the same electro-magnet coils, the separate portions being so arranged that the constantly-acting local current shall operate through a portion forming a coil of low resistance, while the main line shall operate through a portion of the coils of a great number of convolutions or turns of wire forming high-resistance coils in the same continuously and directly wound electro-magnet.

It further provides that, through a hampering or magnetism-decreasing action of the reversely-acting high-resistance portion on the low-resistance portion, said low-resistance portion, by means of its constantly direct-acting local current, shall set up in the high-resistance portion induced currents opposed to any extra or line-induced currents when the key in the main line is closed, or at a time when by a suitable form of transmitting device the strength of current in the main line is strengthened or the resistance of the main line is decreased, or there is any fall of magnetic attraction conditioned upon any change in the said main line; and it is designed in this invention to use the main-line current to hamper or weaken the magnetic attraction set up by the local current passing in the low-resistance portion, so that a tension exterior to the circuit shall close contact in a supplementary circuit to make a signal, and that the main-line current shall not be caused to pass through a helix or helices to effect an attraction of an armature to make a signal, as will be fully understood by referring to the drawings and letters and figures of reference therein.

A A′ designate two helices wound on a core of soft iron between flanges or spool-heads *e e′*, and connected together at their back ends by a yoke of the same material, *b*, secured to the iron cores *a a*, the upper or polar extensions, *a′ a′*, of which may be slightly enlarged to brace the upper spool-heads and allow a wide armature to be used. The wire, commencing next the core and having been suitably insulated, should be wound over and over and around the core until the second layer of insulated wire has been coiled around the core of iron. At this point the silk or cotton insulation should be scraped off, and a branch, *d*, which may be of a slightly larger size of wire, electrically and permanently secured thereto and brought through the lower spool-head near the commencing end, but not in contact therewith, as shown at *x*; but the wire forming the continuous coil is preferably not cut. Then proceed to wind as before until the entire space between the spool-heads is filled up in regular layers, bringing the end terminals out at *m m*. Each of the two helices A and A′ are thus wound in the same direction, and the spools are to be attached and joined together by the iron yoke *b*. After the spools are joined, the two branches *d* are twisted together, and may be, for a more perfect electric contact, soldered. The two terminals *e e* of the commencing ends are the connections to the local battery L, which may be of one or two cells of ordinary gravity battery, this depending on the size of wire used for the best effect. It is not essential that the branch *d* be joined at the second layer; but it may be

brought out at the upper end from the first layer or third layer, or attached to the fourth layer at the back end, the even-number layers coming out at the yoke end and the odd-number layers at the polar end. I prefer having the connections at the back end, and it may also be found in some cases that the two or four outside layers may be conveniently used for the low-resistance coils. Now, the two ending terminal wires indicated at *m m* are the connections for the main battery, (which may be from one to twelve cells of gravity, or sulphate of copper, battery,) the positive pole of the battery being shown connected to the exterior terminal wire of the same coil, having the positive pole of the local battery connected to the interior commencing end; or, as shown in the drawings, the positive pole in the main-line battery connected to one side of the key or transmitting-instrument, and from the other side of the same to the outside wire of the coil, so that the battery-current passes through the key or transmitting device, making it a part of the circuit of the main line, the negative pole of the battery M (main-line battery) being directly connected to the ground or return current, if such be in use. The other outside ending wire of the coil, which will be found in the second helix, is directly connected to line, as in the form of instrument now in use. The direction of the separate current from the separately and oppositely acting batteries M and L can be very easily followed in the sectional diagram, Fig. 2. The double-headed arrows represent the direction of flow of the main-line current and of the coil-induced current set up in the high-resistance portion of the helices by the low-resistance coils, and the small arrows show the direction of the extra current set up by the admission of the battery-current to the line and coils when the key is closed in the main line, or when there is an increase of strength in the main-line current; also when there is a decrease of resistance in main line, and when there is decrease of magnetic attraction which would follow any of the above alterations, as in telephonic transmission. All these changes produce the same direction of induced line current. It will be observed that this induced line current or extra current above mentioned is in an opposite direction to the flow of the main-line current and increases in strength with the length of line and convolutions of wire through which it passes, and unless neutralized would cause a retardation of the signal, and, in fact, is one of the causes why it has been impossible to telegraph over long lines with anything like the same speed as in short lines under the system now employed.

B designates an armature, which may be pivoted in a vertical position, but is preferably suspended from hardened-steel points, with like hardened sockets or cups attached to the upper part of the armature. At the lower end may be affixed to the back of the armature-lever a platinum point to close against a platinum-pointed adjusting-screw. In the front of the armature, opposite the platinum points, should be a hard-rubber stop, which may also be adjustable, as in other forms of relays. Near the axis of the electro-magnets is attached a device for holding the spring or tension, and at the farther end of the spring I provide a suitable form of adjustment for increasing and decreasing the tension, and proper adjustment devices for moving backward or forward the electro-magnet in order to accommodate the armature in balancing the same by its tension against the magnetic attraction of the low-resistance coils. In order to guard against getting the high-resistance portion of the continuously-wound coil too far away from the core and low-resistance portion, that the greatest coil-induction for a given decrease of magnetic attraction may be secured, and also to obtain a maximum hampering effect for a given strength of main-line current, I prefer to have the coils longer and of less diameter than is followed in ordinary electro-magnets, as by such arrangement a still further reduction of main current may be attempted. The evils arising from induction in the older forms of apparatus are not felt in this system, not only because of the feeble currents made use of, but also because the coil-induction is designed to neutralize the extra and line induction.

There are cases, no doubt, where permanent magnetism could be made use of; but at the same time a low-resistance coil at any rate sufficient to keep the magnetism of the permanent magnet from being weakened permanently, if not reversed in polarity, would be necessary; hence I prefer to operate entirely with electro-magnetism.

In the electro-magnet herein referred to, although it is formed with a continuously-wound helix, this is so arranged that two separate currents pass in opposite directions through portions of such continuously-wound helix, said currents consisting, first, of a constantly-acting direct local current passing through one portion, the number of convolutions of which produce a coil of low resistance, and, secondly, of the reversely-acting main-line current passing in the other portion, which consists of a great number of convolutions and serves as a coil of high resistance in its relation to the low-resistance portion above referred to. In its action the high-resistance portion is designed to weaken or hamper the magnetic attraction set up by the low-resistance portion in such a manner that when an armature is counterpoised by its tension against the magnetic attraction this may be lessened to allow the retractile force to preponderate and close a supplementary circuit, or otherwise produce a signal. It is designed, also, to provide in this form of relay or electro-magnet that induced currents in the high-resistance portion set up by the constantly-acting direct local current in the low-resistance portion may pass in the high-resistance portion and main line of which

it is a part in the same direction as the main-line current, and in the opposite direction to extra and other induced currents set up in the main line under the action of the key or transmitter, in order to neutralize such extra and induced currents and assist the main-line current in its hampering action with reference to the magnetizing effect of the direct local current in the low-resistance portion of the helix, to prevent retardation and prolongation of signals.

Having described this invention, what I claim, and desire to secure by Letters Patent, is—

1. In a receiver, an electro-magnet provided with a continuously-wound helix having portions relatively of high and low resistance respectively connected in the main line and constantly-closed local circuit, separate batteries passing their currents in opposite directions in said portions, and an armature normally counterpoised against the magnetic attraction by a tension conditioned upon the reverse action of the main-line current in said electro-magnet, substantially as specified.

2. An electro-magnetic relay provided with a continuously-wound helix having a portion of high resistance connected in the main line, and a portion relatively of low resistance connected in a constantly-closed local circuit passing its current in the opposite direction to that of the main voltaic current in the main-line portion, to set up therein induced currents opposite in direction to the extra or otherwise induced currents of said main line to neutralize the same, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN EDWARD WATSON.

Witnesses:

C. R. FERGUSON,

T. V. WEBSTER.