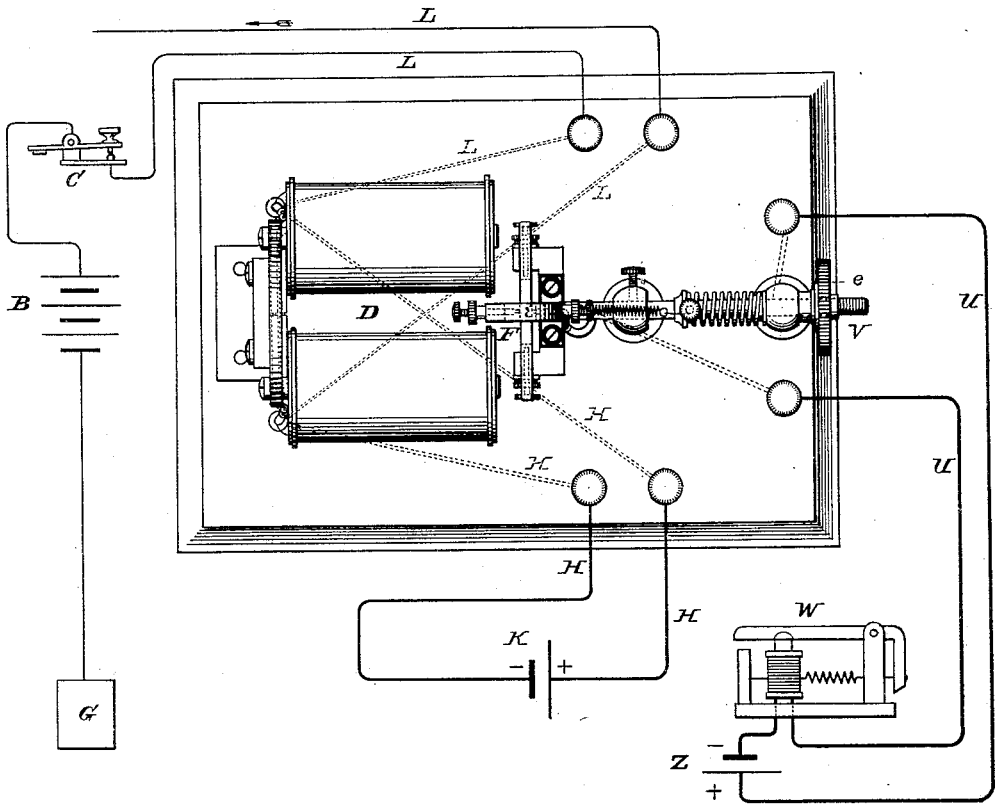
(No Model.) 4 Sheets—Sheet 1.

J. E. WATSON.

RELAY.

No. 384,222. Patented June 5, 1888.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

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Fig. 2.

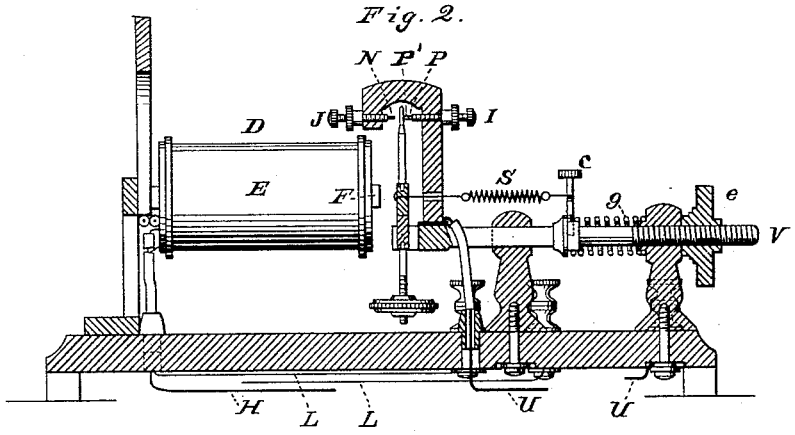
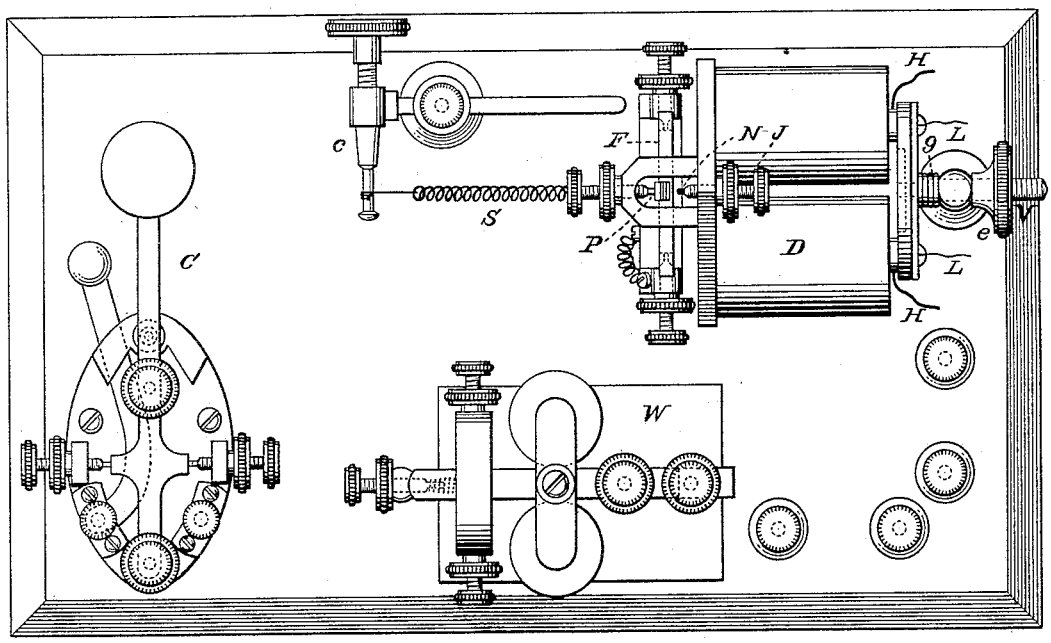


Fig. 3.



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(No Model.) 4 Sheets—Sheet 3.

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RELAY.

No. 384,222. Patented June 5, 1888.

Fig. 4.

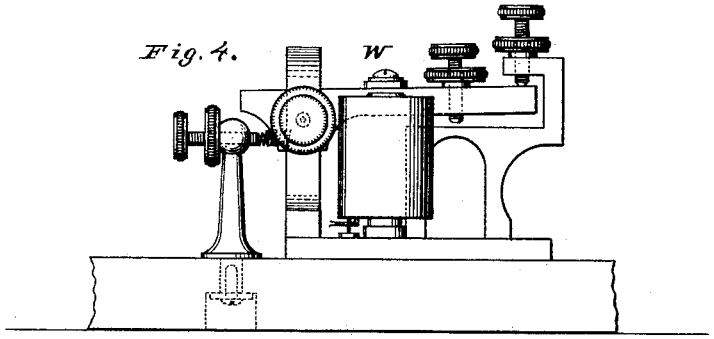
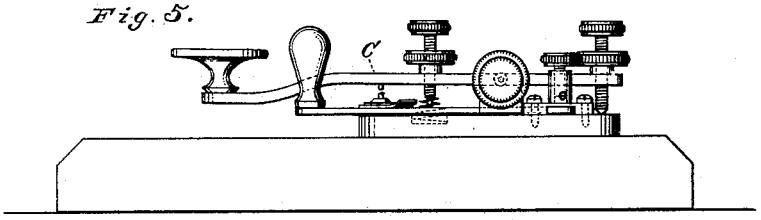


Fig. 5.



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RELAY.

No. 384,222. Patented June 5, 1888.

Fig. 6.

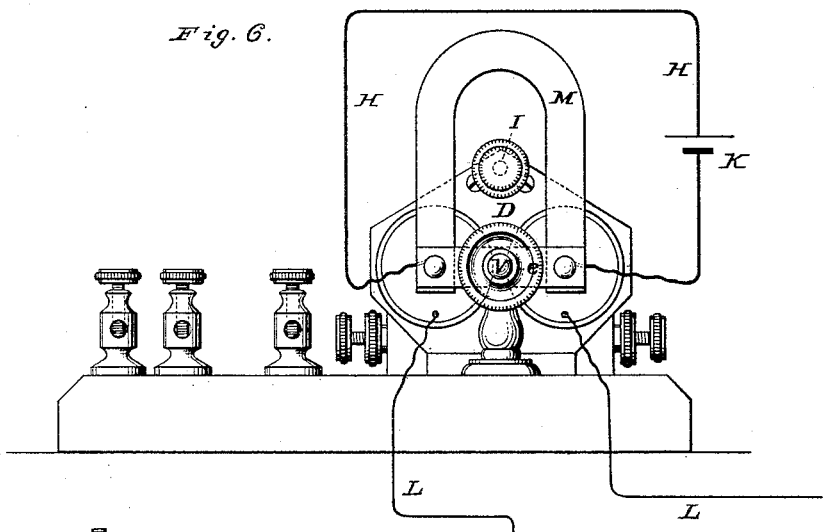


Fig. 7.

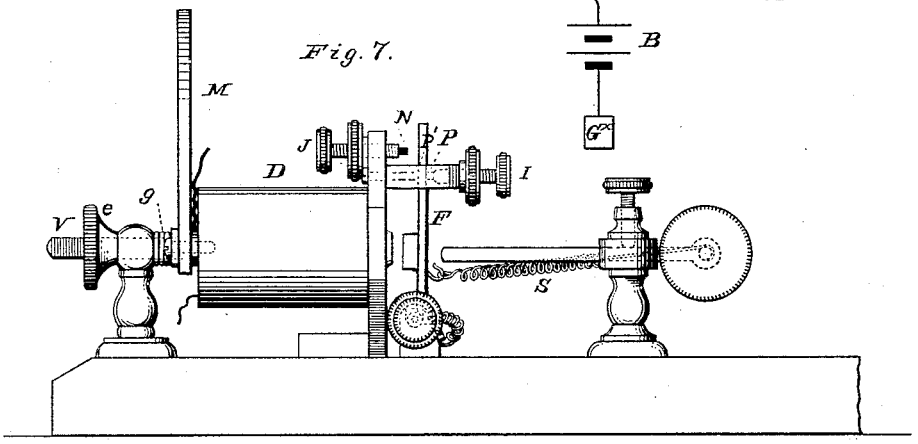
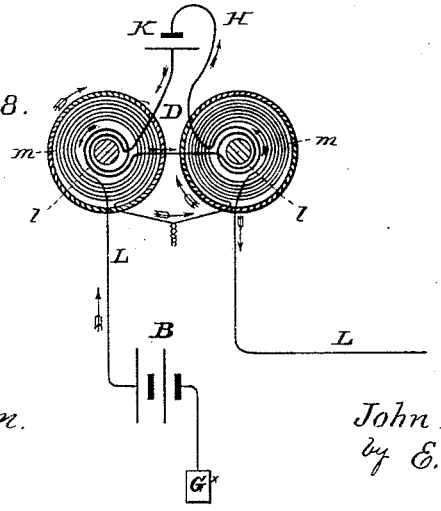


Fig. 8.



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UNITED STATES PATENT OFFICE.

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

RELAY.

SPECIFICATION forming part of Letters Patent No. 384,222, dated June 5, 1888.

Application filed April 11, 1887. Serial No. 234,369. (No model.) Patented in Belgium April 12, 1887, No. 77,046.

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 of a relay under this invention. Fig. 2 is a sectional view of the same. Fig. 3 is a plan view of a modified form of relay, showing permanent magnet, also sounder and key. Fig. 4 is a side view of sounder. Fig. 5 is a side view of key. Fig. 6 is an end view of relay. Fig. 7 is a side view of relay. Fig. 8 is diagrammatic cross-section of helices of relay.

The object of this invention is to facilitate electrical communication by means of feeble currents over submarine and land lines, especially those of great length; and it involves the overcoming or neutralization of extra currents set up in the main line by means of opposing coil-induction effects in the relay-instrument, the armature of such relay-instrument being normally counterbalanced or poised by tension against the magnetic attraction of its electro-magnet, which involves two helices on the same core relatively of high and low resistance, and respectively connected in the main line and a constantly-closed local circuit, said main line passing its current in reverse direction to the current of the closed local circuit.

In this invention the low-resistance helix is designed to be energized by a local battery, the current from which is constantly acting to produce magnetic attraction on the armature, which is, however, counterpoised by the tension hereinbefore referred to. The high-resistance coil is connected in and a part of the main line or circuit, including its key and battery, the latter, however, passing its current in the high-resistance coils, opposite in direction to the local current passing in the low-resistance coils, so that a hampering or weakening effect is produced in relation to the magnetizing power of the low-resistance coil, allowing the tension to preponderate and retract the armature to close a sounder or indicator-circuit, while, when the main-line current ceases or is decreased, the magnetizing action of the low-resistance coils rises and attracts the armature, opening said sounder or indicator-circuit, the operation being such that, owing to the oppositely-acting voltaic currents in the helices, induced currents are set up in the high-resistance coils when the key is closed by the variations of current in the low-resistance coils, and the consequent variations of magnetism in a direction opposite to the extra current in the line, but in the same direction as the voltaic line-current, not only neutralizing said extra currents, but assisting the main-line current in the hampering effect. On opening the key in the main line the reverse action takes place, for the helix which constantly magnetizes the core being of low resistance induced currents from the line cannot affect it; but the inducing power of the low-resistance helix can and does affect the high-resistance coil, and powerful induced currents are set up thereby therein, which assist the local current in its magnetizing action. In this manner prompt action of the armature is secured, so that it rapidly and effectively responds to changes in the line-current effected by the key, the evils of prolongation and retardation of signals being overcome.

In the accompanying drawings I have illustrated a form of relay which is constructed to show the principle of this invention in a plain and satisfactory manner. Yet the construction may be varied in many ways by those skilled in the art without departing from the principle.

The letter L indicates the main line, and B its battery.

H represents the local relay-circuit, and K its battery, and U is the sounder or indicator circuit, having a battery, Z; or the relay may alone serve as the sounder or indicator. In any event the relay D is essential. The core or cores of this magnet are wound with a great many turns of fine wire duly insulated and forming the helix or helices of the main line,

as indicated at *m*. This electro-magnet is also wound with layers of coarse wire duly insulated and forming the helix or helices *l* of the local circuit. When the cores of the electro-magnet are the poles of a permanent magnet, M, the coarse wire is wound and the battery applied to make the electro-magnetic poles of polarity corresponding to those of the permanent magnet, and thereby regulate the magnetism of said permanent magnet.

Usually I prefer to arrange the layers of coarse wire or wire of low resistance next the core, and the turns of fine wire or wire of high resistance outside of the layer or layers of coarse wire, but this arrangement may be reversed; and it is explained that the main and local currents are oppositely involved in the relay-magnet, for while the local battery is applied to make the electro-magnetic poles constant in one direction by a circuit which is always closed, the main current is passed in the opposite direction, or so that its magnetic influence in the fine-wire helices is reversed or opposite to that of the local current in the coarse-wire helices, and tends to subtract from the latter, and in this way weaken the attractive power of the relay-magnet with reference to its armature. When, however, the main current ceases, the full magnetic influence of the coarse-wire helices promptly acts to attract the armature F. The magnetic influence of the main current is thus exerted on the same side of the armature with that of the local circuit through its coarse-wire helix, but said influence is reverse or opposite. The function of the main current in this relay is therefore not to do mechanical work, but to weaken or hamper the magnetizing influence of the local circuit in the coarse-wire coils. Without such hampering or weakening the relay-magnet is competent to attract or counterbalance the armature.

To counterbalance the attractive power of the relay-magnet some tension is required. Usually I employ a slight spring, as at S, or the weight of the armature itself may be sufficient, and I prefer to make the tension adjustable, as shown in the drawings, where a winding spindle, *c*, carries a thread or connection of the spring S, and I may arrange the electro-magnet so that its poles can be moved toward or from the armature, a screw, V, and spring *g* serving for the purpose, or the armature itself may be made adjustable. I and J are adjusting-screws for the points P and N.

P′ represents the contact-point or platinum stud of the armature. When the armature is moved back or away from the magnetic poles, this contact-point is designed to touch the contact-stop P, which is in the receiver or sounder circuit U, the sounder being indicated at W, and as the armature is in the receiver-circuit when the stops P′ and P are in contact the sounder or other receiver acts. When, however, the armature is attracted by the electro-magnet, the sounder-circuit is opened.

N indicates the rest-stop, which is of non-conducting material.

The transmitter or key C is in the main circuit, and when the key is closed down to make a record or signal the main current weakens the relay-magnet, so that it no longer counterbalances the armature, which at once moves back, because of its gravity or tension device, and contact is made with the stop P, closing the sounder or receiver circuit. When, however, the key is raised, the main line is open, and the relay-magnet, relieved from the hampering influence of the high-resistance helices, instantly, through the action of the local or low-resistance coils, attracts the armature away from the contact P, breaking the local sounder-circuit.

Considerable latitude is allowable in winding the helices or the relay-magnet. For the high-resistance helices some eighteen thousand turns of No. 37 Birmingham wire gage have given proper results when the low-resistance layers consisted of about two hundred and fifty turns of No. 26 wire, same gage, and for the local circuit a battery of from one to two volts will serve an excellent purpose. If the battery is proportionally stronger, the point of equilibrium of the armature will be farther from the poles of the magnet, and the instrument will be more delicate.

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

1. A relay having an electro-magnet provided with a helix of low resistance connected in a constantly-closed local voltaic circuit passing its current in one direction, a permanent magnet with its poles in the magnetic field of said helix, and a helix of high resistance connected in the main voltaic circuit passing its current in the opposite direction, whereby the magnetizing influence of the low-resistance helix is hampered by the main-line current, substantially as specified.

2. An electro-magnetic relay provided with a permanent magnet and having a coil of low resistance on the same core with its main-line helix and included in a constantly-closed local voltaic circuit passing a current of similar polarity to that of the permanent magnet in the opposite direction to that of the main voltaic current in the main-line helix 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 E. WATSON.

Witnesses:
THEO. MUNGEN,
PHILIP C. MASI.