No. 753,918. PATENTED MAR. 8, 1904.

M. C. RORTY.

POLARIZED RELAY.

APPLICATION FILED JUNE 18, 1903.

NO MODEL.

Fig. 2.

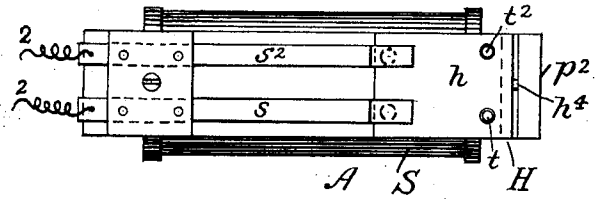


Fig. 3.

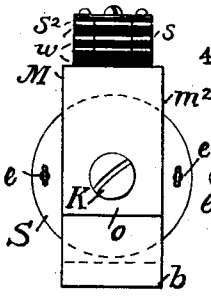


Fig. 1.

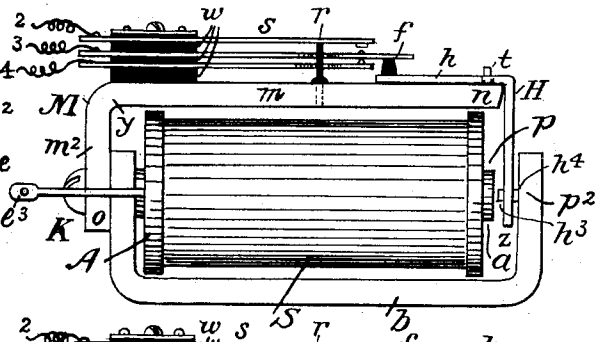
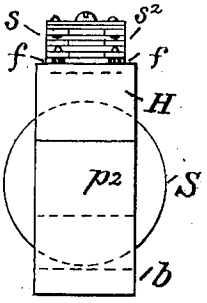


Fig. 4.



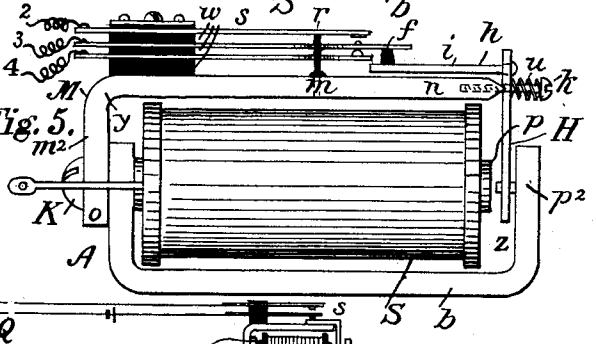


Fig. 5.

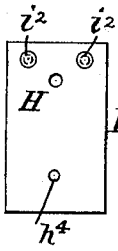
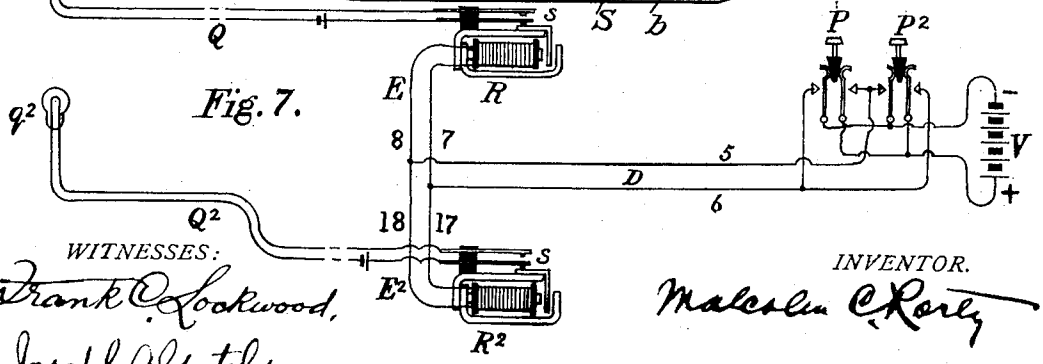


Fig. 6.

Fig. 7.



WITNESSES:

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 753,918. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

MALCOLM C. RORTY, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

POLARIZED RELAY.

SPECIFICATION forming part of Letters Patent No. 753,918, dated March 8, 1904.

Application filed June 18, 1903. Serial No. 162,109. (No model.)

To all whom it may concern:

Be it known that I, MALCOLM C. RORTY, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Polarized Relays, of which the following is a specification.

The present invention is an improvement in relays, and particularly in that class of polarized relays which are employed in association with telephone-switchboards to control the display of signals, to connect and disconnect the original circuit-terminals, and generally to afford a convenient means for the automatic effectuation of simple circuit changes.

The object of the invention is to provide an exceedingly compact relay device which shall be simple in construction and certain and efficient in operation.

To this end the operating-armature is poised or fulcrumed upon one pole of a permanent magnet and is suspended and arranged to swing or oscillate in an armature-space between confronting poles of an electromagnet having an exciting-coil wound over or surrounding one only of its limbs and having its heel secured to the other pole of said permanent magnet. The armature-pole of the permanent magnet is formed at its end into a bevel or knife edge on which the armature is adapted to rock, the said armature being attached to the magnet in such manner that the freedom of its movement shall not be impeded and formed with an angular attachment or continuation extending backward over the said permanent magnet and adapted to engage and operate contact-springs of local circuits for the control of their reciprocal relations or for the establishment or disestablishment of contact between them.

The invention may readily be comprehended by reference to the drawings which accompany this specification, wherein—

Figure 1 represents a side elevation of the relay constituting the invention in a preferred form. Figs. 2, 3, and 4 are respectively a plan view and rear and front elevational views thereof. Fig. 5 is a side elevation of a relay containing the invention, but with a modified armature-lever attachment and modified means for securing the armature to the permanent magnet-pole; and Fig. 6 is a front view of the armature associated with the relay so modified. Fig. 7 is a diagram of signal-circuits involving the employment of the said relay and illustrating the operation thereof.

A is the electromagnet, with confronting poles p and p^2.

M is the rectangular permanent polarizing-magnet, arranged with its straight stem m parallel to the limbs of the electromagnet and its poles n and o in such relation to the electromagnet that both poles of said electromagnet are magnetized by one of them, o, while the other, n, is held opposite the armature-space between the confronting poles $p\,p^2$ of said electromagnet.

H is the armature, fulcrumed on the polar end n of the permanent magnet, which may be formed with a bevel edge, as in Fig. 1, or a knife-edge, as in Fig. 5, for this purpose, being held in place by a suitable screw or screws and suspended from said pole within the armature-space z. The said armature H is provided with a continuation angle-piece h, extending backward over the stem of the permanent magnet, the armature and its continuation conjointly constituting a lever whose fulcrum is the beveled pole n of the permanent magnet.

It will be seen that the main function of the permanent magnet M is to impart an initial magnetization of the same sign to the two confronting poles of the electromagnet A and of opposite sign to the armature H, which hangs between them. The said armature being thus between two like poles is normally subject to like attraction by both, but is held toward the pole p^2 by the pressure of the spring f on the angle-piece h; but when the pole p is strengthened and the pole p^2 neutralized or correspondingly weakened, which condition is brought about by transmitting through the coil S an electric current of appropriate direction, the armature is attracted by and

moves toward the strengthened pole p and is thus enabled to operate the circuit-changing springs s s^2.

One or more banks of contact-springs s s^2, forming terminals of circuit-conductors 2 3 4, are conveniently mounted within range of the free end of the armature continuation h and are adapted to be engaged thereby, so that their normal contact relations may be altered and the several possible arrangements of contact established and disestablished by the movements thereof as the armature is attracted toward one or the other of the electromagnet-poles.

Referring for the present more especially to Figs. 1, 2, 3, and 4, the electromagnet A is composed of an iron core having two limbs or constituent cores. The constituent core a is a straight bar terminating forwardly in the pole or polar end p, and the other or complementary constituent core, b, is a bar formed with its middle portion or stem straight and both ends turned at an angle in like direction to overlap the ends of the straight core a. The angular end of the complementary core b, which overlaps the rear or heel end of the straight core a, is secured directly thereto by the screw K, while the stem part, extended forward over and closely adjacent to the exterior of the coil S, brings the other end to a position beyond the pole p of the straight constituent core, where its forward angular end is enabled to confront said pole at a short distance therefrom, forming the pole p^2 of the electromagnet and producing the armature-space z between the poles.

The electromagnet A has, preferably for economy of space and on the score of compactness, a single exciting helix or coil, and the said coil S is wound over or surrounds the straight core a.

The terminal wires of the electromagnetic spool emerge through holes e in the rear head thereof and are provided with rigid attachments e^3 for connection with the circuit-wires.

The permanent magnet is a rectangular bar of permanently-magnetized steel bent at the point y to a right angle, with a long arm m and a short arm m^2. The short arm m^2 is rigidly attached at its pole o to the heel of the electromagnet, whose two limbs thus become continuations of one of the permanent magnet-poles, and is secured thereto in any preferred manner, as by screws. As shown in Figs. 1 and 3, the screw K may be utilized not merely to unite the two limbs of the electromagnet, but also to unite both to the said short arm m^2 of the permanent magnet. The longer arm m of the permanent magnet extends forward over the coil or spool S of the electromagnet toward the poles of said electromagnet, its pole n being arranged to overhang the armature-space z thereof and beveled to form a rocking edge or fulcrum, whereon the armature H may be poised. The said longer arm m occupies the same position vertical to the periphery of the exciting-coil on one side thereof that the straight middle portion or stem of the complementary core b occupies on the other side, and the said coil may therefore be described as surrounding or encircling the straight core a of the electromagnet A and fitted between the stem of the complementary core b of said magnet and the longer arm m of the permanent magnet M in close contiguity to both, thus forming an exceedingly compact electromagnetic organization or mechanism.

The armature H is poised on the bevel edge of the pole n of the permanent magnet and is suspended, as shown, in the armature-space z between the poles p p^2 of the electromagnet. It may be provided with front and rear stop-pins h^3 h^4 to prevent it from striking the poles p and p^2 or from approaching them too closely. To secure the said armature from displacement without interfering with its freedom of motion or oscillation, screws t t^2 pass through holes in the angular extension h and engage threaded holes in the magnet-pole n, the said holes in the armature extension being made large enough for the loose and free admission of said screws and the heads of said screws when in place being out of contact with the surface of said extension and held sufficiently far away therefrom to insure the free play thereof.

Two banks of contact-springs s and s^2 are shown as being mounted within range of the armature continuation or lever attachment h, which in the present instance consists of a plate integral with and similar in width and thickness to that which forms the armature itself, being, however, turned back substantially at a right angle therewith. Each bank comprises three springs connected with circuit-conductors 2, 3, and 4, respectively. The several springs are insulated from one another and from the magnet-stem m by interposed non-conducting washers w, and in each case the middle spring of the three extends sufficiently far toward the armature end of the relay as to rest immediately above the end of the armature continuation h. The two lower springs of each bank are shown as being in normal contact with one another; but by raising the free end of the middle spring such normal contact can be broken and an alternative one formed between the middle and upper springs, so that a circuit previously established between the conductors 3 and 4 is disestablished and a new one between conductors 3 and 2 is completed. A non-conducting guide-stud r may be attached to the back of the permanent-magnet arm m, and a pin extending therefrom projects through suitably wide holes in the two lower springs of the set and impinges against the under side of the uppermost spring to serve as a normal support therefor. Similar studs f may in like

manner be attached to the upper surface of the end of the armature-lever extension directly below the end of the middle springs, and these when the armature is attracted and rocks on its pivot are pressed against said spring to bring about its change of position. Obviously the springs exercise reverse pressure on said armature extension *h* and are thus enabled to serve also as a retracting agency for the armature.

The form of relay particularly shown in Figs. 5 and 6 is not in any material sense different from that already described. It is, however, modified in the following respects: The polar end *n* of the permanent magnet, on which the armature H is poised, is beveled on two sides instead of on one only, as in Fig. 1, being thus formed into a veritable knife-edge on which the said armature may oscillate.

The armature extension or continuation *h*, constituting the operative end of the lever fulcrumed on said knife-edge, instead of being a plate of width equal to that of the armature itself and made in one piece therewith consists of two pins *i*, of brass or similar suitable metal, riveted or otherwise attached to the armature at the points i^2 and extending, respectively, below the two banks of contact-springs *s* s^2. Under these conditions the armature H does not obtain any support from the back of the stem *m* of the permanent magnet and is held in place upon the knife-edge by a screw *k*, which enters a threaded hole bored into the apex of said knife-edge, elasticity being imparted to said knife-edge by a helical spring *u*, surrounding said screw.

The diagram, Fig. 7, illustrates one application of the relay of this invention. Two such relays R and R^2 are connected in different branch circuits E E^2, both connected with a main circuit D, associated with a source of current V and two keys or push-buttons P P^2, adapted to connect said source with the said main circuit D. The key P when operated connects the plus-pole of the said source V with conductor 6 and the minus-pole thereof with conductor 5 of the circuit, and the operation of the key P^2 establishes the connection in reverse order. The direction of the current in the circuit D and its branches E E^2 thus depends upon which key is depressed. In one case, that wherein key P is operated, 6 and its branches 7 and 17 are the outgoing conductors and 5 and its branches 8 and 18 are the return conductors. In the other case when the key P^2 is the one operated 5 and its branches 8 and 18 are the outgoing conductors and 6, 7, and 17 the returns. The relays R R^2 are oppositely polarized or oppositely connected, which of course amounts to the same thing, and actuate separate sets of contact-springs *s*, which control separate local circuits Q and Q^2, containing, respectively, signal-lamps *q* and q^2. Thus the pressure of the key P will result in the operation of one only of the relays—say R—and the consequent display of signal *q*, while the operation of the key P^2 will in like manner bring about the operation of the relay R^2 alone and the display of signal q^2.

Having fully described the invention, the features thereof claimed as new are—

1. The hereinbefore-described relay, comprising an electromagnet with confronting poles; a permanent polarizing-magnet mounted parallel to the limbs of said electromagnet and having its poles in juxtaposition to the heel and poles respectively thereof; contact-springs mounted upon said permanent magnet; an armature suspended between the confronting poles of said electromagnet and poised or fulcrumed on the permanent-magnet pole nearest thereto, and having an attachment or continuation extending backward over said permanent magnet; said armature and attachment constituting a lever actuated by said electromagnet and adapted to engage said contact-springs for the control of their reciprocal relation.

2. In a relay, the combination of an electromagnet with confronting poles; a permanent polarizing-magnet mounted parallel to the limbs of said electromagnet and having one pole attached to the heel and the other extended forward into contiguity to the poles thereof; contact-springs of a controlled circuit mounted upon said permanent magnet; an armature poised or fulcrumed upon the said forwardly-extended permanent-magnet pole to be polarized thereby, and suspended therefrom between the poles of said electromagnet; and an attachment or continuation of said armature extending backward therefrom over said permanent magnet beneath said contact-springs and constituting conjointly with said armature a lever actuated in both directions by the poles of said electromagnet, and adapted thereupon to establish or disestablish the contacts of said springs; substantially as set forth.

3. In a polarized relay, the combination of an electromagnet with one limb only surrounded by an exciting-coil and the other extended forward adjacent to said coil, and having the pole of the latter limb turned at an angle to confront that of the former with an armature-space between; a rectangular permanent polarizing-magnet mounted parallel to said electromagnet having one pole secured to the heel and the other extended forward into juxtaposition to the poles thereof; contact-springs of a controlled local circuit mounted upon and supported by said permanent magnet; and a rectangular lever poised or fulcrumed upon the forward pole of said permanent magnet and having one end suspended from said permanent magnet in the said space between the poles of said electromagnet to form the armature thereof, and the other extended rear-

wardly over said permanent magnet, and beneath and in engagement with the said contact-springs; substantially as and for the purposes described.

4. The combination in a polarized relay, of a straight iron core; a complementary iron core with a straight stem and both ends turned at a right angle to overlap the ends of said straight core, one being secured to the heel end, and the other constituting a pole arranged to confront the pole end thereof, with an intervening armature-space; a rectangular permanent bar-magnet having one pole secured to the heel of said cores, and the other extended forward to a point opposite the armature-space thereof and formed at its end into a bevel or knife edge; the stems of said bar-magnet and cores being all parallel to one another; an exciting-coil surrounding the said straight core, and fitted between the said permanent bar-magnet and the stem of said complementary core; an armature suspended in the space between the poles of said cores, and poised or fulcrumed to swing on the knife-edge pole of said permanent magnet; and electrical contacts controlled by said armature; substantially as specified.

5. The combination in a polarized relay, of an electromagnet comprising a single exciting-coil, and an iron core having two limbs one surrounded by said coil and the other extended forward adjacent to the exterior thereof and having its polar end prolonged beyond the pole of the interior limb and turned at an angle to overlap and face the same at an appropriate distance to form an armature-space between said poles; a rectangular permanent polarizing-magnet having one pole secured to the heel and the other extending to the said armature-space of said electromagnet, and terminating in a beveled or knife edge; and an armature secured to said permanent magnet, balanced on the knife-edge pole thereof, and suspended in the armature-space between the poles of said electromagnet; substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 15th day of June, 1903.

MALCOLM C. RORTY.

Witnesses:
GEO. WILLIS PIERCE,
JOSEPH A. GATELY.