

E. A. HALBLEIB.
ELECTRIC INSTRUMENT.
APPLICATION FILED DEC. 16, 1910.

1,011,616.

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Fig. 1.

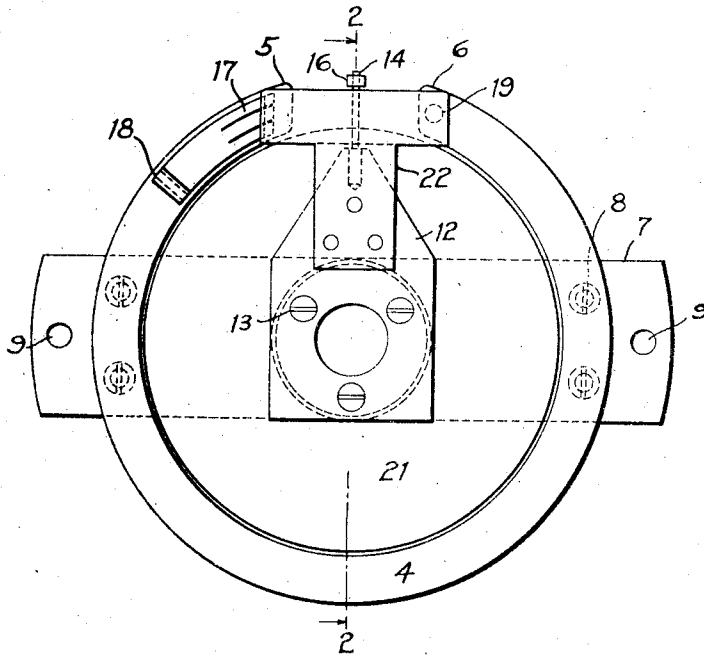


Fig. 2.

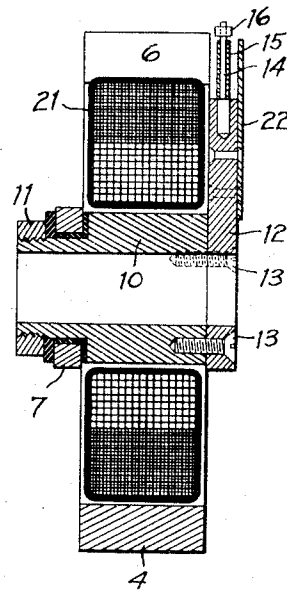
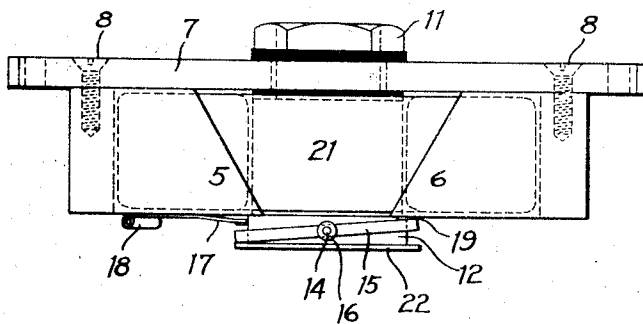


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTRIC INSTRUMENT.

1,011,616.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EDWARD A. HALBLEIB, a citizen of the United States, and resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Electric Instruments, of which the following is a specification.

This invention relates to electric instruments, such as relays, electric valves and the like, of the type in which an armature of soft iron, or of other paramagnetic material, is employed, and in which the armature itself is magnetized and polarized by means of a fixed magnet connected with, or located adjacent to, the armature.

One object of the invention is to produce an instrument of the type in question which is both compact and efficient, and to this end I employ an arrangement in which a loop-shaped permanent magnet surrounds an electromagnet arranged normal to the plane of the permanent magnet, the electromagnet having a polar extension upon which the armature is mounted in a position adjacent the polar extremities of the permanent magnet.

Another object of the invention is to produce an instrument, of the type in question, in which a light and delicately-supported armature may be employed, while at the same time the armature may be powerfully polarized by means of a fixed magnet. To this end I employ, for polarizing the armature, a magnet having a polar extension or extremity arranged adjacent to, but out of contact with, the magnetically-operative portion of the armature, so that magnetic lines of force are transmitted directly to the armature, through a slight air-space, apart from, or in addition to, magnetic lines transmitted through the substance of the armature from its pivotal support.

A third object of the invention is to produce an instrument in which the magnetization of the permanent magnet employed to polarize the instrument may be maintained indefinitely, without suffering the diminution usually resulting in such instruments, from lapse of time or from vibrations in the instrument. To this end I employ, in connection with a permanent magnet and an electromagnet, both of which act upon an armature, a magnetic connection between the

electromagnet and the permanent magnet which is so arranged as to constitute at all times a magnetic bridge or keeper for the latter without the intervention of any air-space.

Other objects of the invention, and the details of construction and operation by which they are secured, will be set forth in connection with the following description of the embodiment of the invention illustrated in the accompanying drawings.

In the drawings:—Figure 1 is a front-elevation of an electric instrument embodying the present invention; Fig. 2 is a section on the line 2—2 in Fig. 1, looking from left to right; and Fig. 3 is a plan-view of the instrument of Fig. 1.

The illustrated embodiment of the invention is an instrument adapted particularly for use as an electric valve, although it is adapted for use also as a relay, by changes in the connections and the winding which will be obvious to those skilled in the art. It is an instrument of the polarized type, having a permanent magnet 4 in the form of an open loop, of which the extremities 5 and 6 constitute the poles of the magnet.

As the illustrated instrument is particularly designed for use in connection with an electric generator, and is inclosed within the casing of the generator, it is not provided with a base or casing, but the permanent magnet is secured to a cross-bar 7 of soft iron, by means of screws 8, and the cross-bar has perforations 9 through which screws, or other fastening devices, may be passed to mount the instrument in place. At the center of the magnet 4 is a core 10 of soft iron, which is secured in place on the cross-bar 7 by means of a nut 11 screwed on the end of the core. The core is insulated from the cross-bar, as shown in Figs. 2 and 3, for reasons which will presently appear. The core is made hollow, as shown, to adapt it for use in connection with an electric generator, but the opening through the core has no function in the operation of the instrument. At the forward end of the core is an upwardly-extending block or polar extension 12 secured to the core by means of screws 13. The block 12 tapers upwardly, and a pivot-pin 14 is fixed in its upper end. Upon this pivot-pin the armature 15 is pivoted, this armature consisting of a plate of soft iron.

The armature is secured upon the pivot-pin by means of a collar 16 fixed on the upper end of the pin.

The armature coöperates with the polar extremities 5 and 6 of the permanent magnet, these extremities being beveled, as shown in Fig. 3, to concentrate the magnetism adjacent the ends of the armature. The armature itself serves as a movable electric contact, and coöperates with a fixed contact in the form of spring-fingers 17 formed at the end of a metal plate, which may be soldered, or otherwise fixed, to the front of the permanent magnet. This plate is provided with a sleeve 18 in which a connecting wire may be soldered. The insulation between the core 10 and the cross-bar 7 is to prevent a short-circuit between the armature and the permanent magnet, and the electrical connections with the armature may be made through the block 12 by soldering, or otherwise attaching, a suitable conductor at any convenient point. The pole 6 of the permanent magnet is provided with a plug 19 of insulating material, to prevent the armature from making contact with this pole of the permanent magnet.

The core 10 is surrounded by a solenoid 21 which is concentric with the permanent magnet and substantially fills the space between the magnet and the core. This solenoid is shown in the drawings as comprising a coarse winding of low resistance and a fine winding of comparatively high resistance. These two windings are employed when the device is used as an electric valve, in a manner well known to those skilled in the art, but a simple winding may be used when the device is to be employed as a relay.

The magnetic lines produced by the flow of current through the solenoid 21 follow a magnetic circuit which embraces the core 10, the cross-piece 7, the block 12, the armature, and also the upper extremities of the permanent magnet. In this manner the armature is polarized with one polarity throughout, that is, in both of its magnetically-operative extremities. According to the direction of flow of current in the solenoid, therefore, the armature tends to swing toward one pole or the other of the permanent magnet, and thus to make or break the circuit controlled by the armature and the fixed contact 17.

An important feature of the invention consists in a device by which the polarization of the armature is rendered more effective than can be accomplished by merely transmitting the lines of force from the block 12 to the armature, and thence through the armature to its ends. To this end I employ a T-shaped plate 22 of soft iron which constitutes a polar extension of the electromagnet. The upper portion of this plate lies directly in front of the armature, and

the magnetic lines flow upwardly and then outwardly in this plate to points adjacent the ends of the armature. From these points the magnetic lines flow directly, through a slight air-space, to the ends of the armature, thus strongly polarizing the armature by magnetic lines flowing independently of the pivotal support of the armature. This device greatly strengthens the operation of the armature, while at the same time permitting the use of a light armature delicately pivoted and freely movable.

The iron cross-bar 7, in addition to the functions hereinbefore described, performs the further important function of a keeper for the permanent magnet. It will be apparent that this bar affords, at all times a metallic path for lines of force from one side of the permanent magnet to the other, or, in other words, it constitutes a short-circuit for the portion of the magnet intermediate the points of connection with the cross-bar. This arrangement tends, as will be apparent to those skilled in the art, to maintain the magnetization of the permanent magnet and prevent the gradual loss which occurs in magnets of which the magnetic circuits are normally open.

The arrangement of the core 10 normal to the plane of the loop-shaped permanent magnet, and the arrangement of the solenoid within the space between the core and the magnet, produce a very compact instrument, which is also efficient owing to the employment of substantially closed magnetic circuits. In this connection it will be obvious that while the circular form of the loop-shaped magnet and of the solenoid is preferable where the instrument is to be employed in a circular space, such as the generator-casing, the invention is not limited to this circular form.

Another advantage of the construction above described resides in the fact that the armature is symmetrical with respect to its pivotal support, and thus the instrument may be employed in any position and will not be substantially effected by vibrations such as are encountered under some conditions of use.

I claim:—

1. An electric instrument having, in combination, two relatively-fixed magnets with opposed adjacent polar extremities, one of said magnets being an electromagnet, and a paramagnetic armature having a portion located directly between said polar extremities and movable from one toward the other alternatively.

2. An electric instrument having, in combination, two relatively-fixed magnets with opposed adjacent polar extremities, one of said magnets being an electromagnet, and a paramagnetic armature pivoted upon, and

polarized by, one magnet and having a portion located directly between said polar extremities and movable from one toward the other alternatively.

5 3. An electric instrument having, in combination, two relatively-fixed magnets with opposed adjacent polar extremities, one of said magnets being an electromagnet, and a paramagnetic armature pivoted upon, and
10 polarized by, the electromagnet and having a portion located directly between said polar extremities and movable from one toward the other alternatively.

15 4. An electric instrument having, in combination, two relatively-fixed magnets, one of said magnets having oppositely-polarized extremities and the other magnet having two extremities of one polarity located adjacent and opposite to the oppositely-polarized extremities, respectively, of the first magnet,
20 and one of said magnets being an electromagnet, and a paramagnetic armature having two portions located directly between said opposed pairs of polar extremities, respectively, the armature being pivoted between its said portions so as to be movable directly toward and from said polar extremities alternatively according to the direction of magnetization of the electro-
25 magnet.
30 magnet.

5. An electric instrument having, in combination, two relatively-fixed magnets, one of said magnets being a permanent magnet and having two oppositely-polarized extremities, and the other being an electromagnet and having two extremities of one polarity located adjacent and opposed to the oppositely-polarized extremities of the first magnet, respectively, and a paramagnetic armature having two portions located between said adjacent pairs of polar extremities, respectively, the armature being pivoted, between its said portions, so as to be movable between and directly toward and
35 from said polar extremities alternatively according to the direction of magnetization of the electromagnet.
40 the electromagnet.

6. An electric instrument having, in combination, two relatively-fixed magnets, one of said magnets being a permanent magnet with oppositely-polarized extremities, and the other magnet being an electromagnet and having two extremities of one polarity located adjacent the oppositely-polarized extremities, respectively, of the first magnet, and a paramagnetic armature having two portions located between said adjacent pairs of polar extremities, respectively, the armature being pivoted, between its said portions,
50 upon the electromagnet so as to be movable between said polar extremities according to the direction of magnetization of the electromagnet.
55 the electromagnet.

7. An electric instrument having, in combination, a fixed magnetic circuit with ad-
65 bination, a fixed magnetic circuit with ad-

jacent opposed polar extremities, a winding for energizing said circuit, and a paramagnetic armature pivoted on and polarized by one pole of said circuit and having a portion located directly between said polar extremities and movable from one toward the other alternatively. 70

8. An electric instrument having, in combination, a fixed magnetic circuit with adjacent opposed polar extremities, having a permanently-magnetized portion, a winding for energizing said circuit, and a paramagnetic armature pivoted on and polarized by one pole of said circuit and having a portion located directly between said polar extremities and movable from one toward the other alternatively. 75

9. An electric instrument having, in combination, a permanent magnet, an electromagnet having extremities at one pole located adjacent both polar extremities of the permanent magnet, and a paramagnetic armature having portions located between the polar extremities of both magnets, the armature being pivoted between its said portions so as to be movable between said polar extremities. 80

10. An electric instrument having, in combination, a permanent magnet, an electromagnet having extremities at one pole located adjacent both polar extremities, respectively, of the permanent magnet, and a paramagnetic armature having portions located between the polar extremities of both magnets, the armature being pivoted between its said portions and upon said pole of the electromagnet so as to be movable between said polar extremities. 85

11. An electric instrument having, in combination, a permanent magnet, an electromagnet connected magnetically, at one pole, with the permanent magnet at a point intermediate the poles of the latter, and a paramagnetic armature pivoted on the other pole of the electromagnet at a point intermediate the ends of the armature, said ends being adjacent to, and cooperating respectively with, the poles of the permanent magnet. 90

12. An electric instrument having, in combination, a loop-shaped permanent magnet, a paramagnetic core fixed within and normal to the plane of said magnet, a solenoid lying within the magnet and surrounding the core, a polar extension from one end of the core directed toward the polar extremities of the magnet, and a paramagnetic armature pivoted upon said extension with its extremities adjacent and movable toward and from the polar extremities. 95

13. An electric instrument having, in combination, a loop-shaped permanent magnet, a paramagnetic core fixed within and normal to the plane of said magnet, a solenoid lying within the magnet and surrounding the core, a polar extension from one end of the 100

core directed toward the polar extremities of the magnet, a paramagnetic armature pivoted upon said extension with its extremities adjacent and movable toward and from the polar extremities of the permanent magnet, and a paramagnetic yoke connecting the other end of the core with said magnet.

14. An electric instrument having, in combination, a loop-shaped permanent magnet, a paramagnetic core fixed within and normal to the plane of said magnet, a solenoid lying within the magnet and surrounding the core, a polar extension from one end of the core having extremities adjacent the polar extremities of the permanent magnet, and a paramagnetic armature pivoted upon said extension and extending between the polar extremities of said extension and said permanent magnet.

15. An electric instrument having, in combination, a permanent magnet, an electromagnet connected magnetically, at one pole, with the permanent magnet at a point intermediate the ends of the latter, and provided, at its other pole, with extensions projecting, respectively, toward the poles of the permanent magnet, a paramagnetic armature lying alongside said projections, with its ends adjacent to, and cooperating respectively with, the poles of the permanent magnet, and a pivotal support for the armature at a point intermediate its ends.

16. An electric instrument having, in com-

bination, a loop-shaped permanent magnet, a paramagnetic member magnetically connected with the permanent magnet at two points intermediate the poles of said magnet so as to provide a magnetic bridge or keeper for the magnet, a winding upon said paramagnetic member whereby it may be polarized to produce a free pole remote from said points of connection, and an armature located adjacent to said free pole and similarly polarized thereby at both of its ends, the armature being pivotally supported intermediate its ends and with its ends adjacent to, and cooperating respectively with, the poles of the permanent magnet.

17. An electric instrument having, in combination, a loop-shaped permanent magnet, a paramagnetic member comprising a cross-bar magnetically connected, at its ends, with the permanent magnet at points substantially equidistant from the poles of the magnet, and an extension from said cross-bar toward the poles of said magnet, a paramagnetic armature pivotally mounted at its middle upon said extension and having its ends extending into proximity with the poles of said magnet, and a winding upon said paramagnetic member for polarizing the armature.

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Witnesses:

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