A. D. T. LIBBY.

CIRCUIT BREAKER.

APPLICATION FILED DEC. 17, 1904.

1,019,060. Patented Mar. 5, 1912.

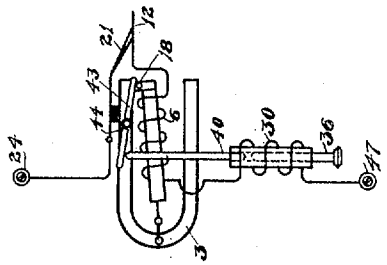

Fig. 3.

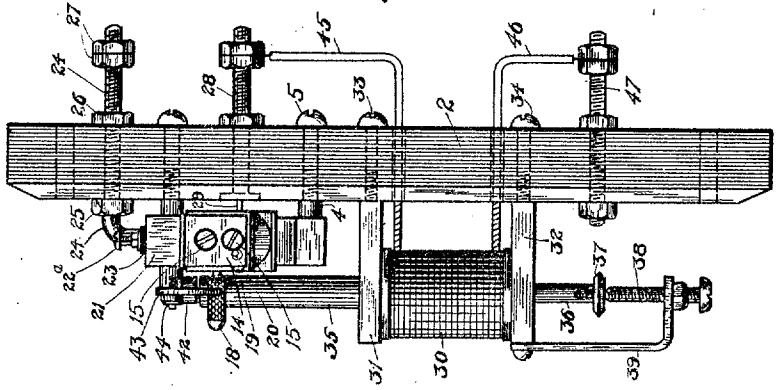

Fig. 2.

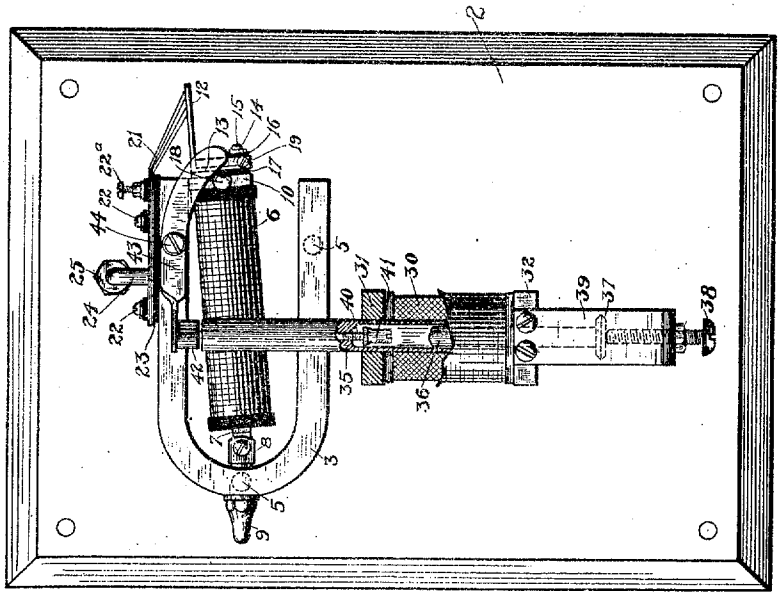

Fig. 1.

Witnesses.
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UNITED STATES PATENT OFFICE.

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CIRCUIT-BREAKER.

1,019,060. Specification of Letters Patent. Patented Mar. 5, 1912.

Application filed December 17, 1904. Serial No. 237,231.

To all whom it may concern:

Be it known that I, ALBION D. T. LIBBY, a citizen of the United States, residing in Elyria, county of Lorain, and State of Ohio, have invented certain new and useful Improvements in Circuit-Breakers, of which the following is a specification.

My invention relates to a circuit breaker and particularly to a device of this class, which is adapted for opening a circuit whenever a current of the reverse direction from that desired flows through the same and whenever an underload or an overload current traverses the circuit.

One object of my invention is to provide a simple and inexpensive piece of apparatus of this type and which shall be efficient in operation.

In its preferred form my invention comprises a permanent horseshoe magnet provided with a pivoted coil carrying a brush at its free end which is adapted in its closed position to make contact with the other brush that is supported upon but insulated from one leg of the magnet. The pole developed at the free end of the coil by the current flowing through the coil will cause said end to be attracted or repelled as the case may be. The permanent magnet is preferably supported in the vertical plane upon any suitable base so that when the current flowing in the pivoted coil ceases or falls below a certain amount the weight of the pivoted coil causes its free end to drop, thereby carrying its brush away from the coöperating brush and opening the circuit. In case the current flowing through the movable coil is reversed in direction from that intended to flow therethrough, the said coil is also moved into its open position thereby opening the circuit and preventing injury to any apparatus that may be in it by such reverse current.

As a further improvement I provide the reverse current and underload device so far described with an overload attachment consisting preferably of a solenoid so arranged that when an overload current flows over the circuit the movable coil is forced into its open position thereby also opening the circuit.

The invention is illustrated by the aid of the accompanying drawing, in which the same reference characters are used throughout the several views to designate like parts, and in which:

Figure 1 is a front elevation of the device; Fig. 2 is a side elevation of the same, and Fig. 3 is a diagram of the circuits involved.

In these figures 2 indicates any suitable base upon which the various parts of the instrument are mounted. These include a permanent magnet 3 of the horse-shoe type supported at a slight distance from the face of the base plate by the preferably copper washers or nuts 4 and clamped in place by the copper or brass screws 5 passing through the plate 2, the copper washers or nuts 4, and tapping into the permanent magnet at the center and near the ends of the two legs as indicated in Figs. 1 and 2.

The coil 6 is supported between the legs of the permanent magnet 3 upon a suitable soft iron core 7, the rear end of which is pivoted in the slotted head 8 of a bolt extending through the permanent magnet and which receives a nut 9 upon its outer end. Upon the forward end of the core an iron plate 10 is secured in any desired manner and forms the pole of the magnet. To the outer side of this plate 10 the lower brush 12 of the switch is secured by an end 13 extending at right angles across the end of the coil, and upon the outer side of which is a copper block 14, which is clamped to the block 10 by means of screws 15 passing through said block 14, the end 13 of the brush and tapping into the plate 10. These screws are insulated from the block 14 and the plate 13 by means of insulating bushings 16 and an insulating plate 17 placed between the plates 10 and 13. A handle 18 of insulating material is threaded into the outer edge of the plate 10 by means of which the switch may be readily opened and closed. A binding screw 19 threads into

the edge of the block 14 and intersects an aperture 20 into which one end of the winding of coil 6 projects and is engaged by the screw 19, thereby electrically connecting the brush 12 with the coil 6. The upper brush 21 is preferably composed of several leaves of sheet copper and is secured to the upper leg of the horse-shoe magnet by screws 22 which are insulated therefrom by suitable bushings, a layer of insulation 23 being interposed between the brush and the upper side of said leg. An adjusting screw 22^a, suitably insulated from the leaf brush, extends through the said brush and engages the end of the upper leg of the permanent magnet. By means of this screw the tension of the said upper brush may be adjusted to any desired degree to cause the opening of the circuit at any desired current within the limits of the device. A copper rod 24 is soldered or otherwise mechanically and electrically secured to the upper brush 21 and is bent toward the rear and extends through the base to provide means for readily securing the conductor of the electric circuit thereto. Nuts 25 and 26 are threaded upon said rod 24 upon each side of the base to hold it rigidly in position. Additional nuts 27 serve as a means for clamping the wire of the circuit thereto. A similar terminal 28 is located near the pivot of the coil and is connected by a flexible conductor 29 with the inner end of the winding of said coil.

Assuming the circuit conductors to be connected with the terminals 24 and 28 it is obvious that when the movable coil 6 is raised as by the handle 18 to its upper position the circuit is complete between the brushes 21 and 12 and the said coil is in circuit therewith. Now if the current is of sufficient strength and is of the proper direction the plate 10 or pole of the same is attracted to the upper leg of the permanent magnet and the circuit remains closed. In case the current falls below the amount necessary to attract said magnet to its upper position it falls by gravity into its lower position and the circuit is opened. Likewise if the current is reversed so that a pole is developed at the free end of the coil 6 of the same character as that at the end of the upper leg of the magnet said coil will be repelled and the circuit will be opened. Also in case mistake has been made in connecting the primary leads to the circuit as sometimes occurs in charging storage batteries, it will be impossible to maintain the circuit closed when the handle 18 is released, thereby saving the storage batteries from injury.

As a further feature of the invention I provide the solenoid 30 supported at its ends upon the base 2 by the plates 31 and 32, which are secured to the base by the screws 33 and 34. The core of the solenoid consists of a copper tube 35 having an enlarged bore throughout the coil in which the movable plunger 36 freely reciprocates and which is furnished with a screw threading into its lower end and provided with an enlarged head 37 at its lower end to provide a stop for the same when it is drawn up into the coil and which normally rests upon an adjusting screw stop 38 carried in the bracket 39 secured to the plate 32. In the upper end of the tube 35 a second plunger 40 is similarly mounted, its lower end being provided with a head 41 which acts as a stop for its upward movement when it is struck and lifted by the plunger 36, its upper end being provided with an insulating head or button 42 which acts as a stop for the downward movement and when it is raised engages the lower side of the inner end of the brass lever 43 which is pivoted upon the copper stud 44 carried upon the edge of the upper leg of the permanent magnet. The outer end of the lever is downwardly turned so as to engage the handle 18 of the coil 6 when in its upper position, whereby when the solenoid is energized and the plunger is lifted the head 42 of the plunger 40 engages the inner end of lever 43 to depress its outer end and thereby to depress the handle 18 of the coil 6, and separate the brushes 12 and 21 to open the circuit of the device. It is thus seen that the instrument as a whole protects the circuit against overload, underload and reverse currents.

The terminal 28 or binding post is connected by conductor 45 with one end of the winding of the solenoid while the opposite end connects by conductor 46 with a similar connector or post 47 covered by the base.

Fig. 3 indicates the electric circuit of the device as a whole, the same being traceable from the upper post 24 through brushes 21 and 12, and thence through coils 6 and 30 to the post 47.

It will be apparent from the foregoing that the device is simple and inexpensive and that it must be efficient in operation.

While but one form of the device has been described it is apparent that it may be embodied in other forms and that various changes and alterations may be made therein without departing from the scope and principle of the invention.

What I claim is:

1. In a device of the class described, a single series electric circuit for the device, a pair of coöperating contacts in series in said circuit, an over-load coil in said circuit, and a combined under-load and reverse current coil in said circuit, means coöperating with said under-load coil to hold said contacts closed, and means controlled by said coils to

sever the connection between said pair of contacts when the current in said circuit varies either below or above pre-determined amounts or reverses its direction of flow, substantially as described.

2. In a device of the class described, the combination with a single pair of coöperating contacts adapted to close and open the circuit, of a pair of series electromagnetic windings, a permanent magnet and one of said windings coöperating to hold said contact closed, said permanent magnet and mechanical means operated by said windings coöperating to open said pair of contacts in case of an under-load, over-load or reverse current in the circuit thereof, substantially as described.

3. In a device of the class described, the combination with a horse-shoe magnet, of a pivoted coil having its free pole between the poles of the magnet, said magnet completing the magnetic circuit of the coil, a switch contact carried by the free end of the coil and coöperating with another spring contact to open and close the circuit through the coil, whereby the free pole of said coil is repelled and the switch is opened when the current in the circuit controlled by the switch is in a reverse direction or whereby the said free pole is repelled by said spring contact when the said current decreases from the normal value, substantially as described.

4. In a device of the class described, the combination with a permanent horse-shoe magnet, of a pivoted electro-magnet having its free end between the poles of the permanent magnet and adapted to be either attracted or repelled by one pole of said magnet, a switch contact movable with the electromagnet, a second contact coöperating therewith to close the circuit through the coil, whereby the free pole of said coil is repelled by the permanent magnet and the switch is opened when the current in the circuit controlled by the switch varies below the normal or flows in a reverse direction, substantially as described.

5. In a device of the class described, the combination with a switch, of a permanent magnet, a release magnet having its coil in the circuit of the switch, one end of the coil being attached to the neutral portion of the permanent magnet and the other end being movable between the poles of said permanent magnet and controlling in its movement the opening and closing of said switch, substantially as described.

6. In a device of the class described, the combination with a permanent magnet, of a movable coil having one end adjacent a pole of the permanent magnet, a switch contact carried by the movable coil, a coöperating stationary contact, said coil being included in the circuit of the switch, whereby the coil is released or repelled and the switch is opened when the current in the coil falls below the normal value or is reversed, and a second magnet also in the circuit of the switch and arranged to open said switch when the current rises above the normal value, substantially as described.

7. In a circuit breaker, the combination with a pair of coils connected in series, of a switch in the circuit of said coils, a permanent magnet coöperating with one of said coils to hold said switch closed, said switch being adapted to be opened by under-load current or reverse current in said coil, and means whereby an over-load current in the other coil will also open said switch, substantially as described.

8. In a circuit breaker, the combination with a single pair of coils connected in series, of a switch in the circuit of said coils, a permanent magnet coöperating with one of said coils to close said switch, means associated with the other one of said coils for opening said switch when the current therein becomes greater than a pre-determined value, and means associated with the first coil for opening said switch when the current therein becomes less than a pre-determined value, said latter means also serving for opening said switch when the current in the latter coil reverses its direction, substantially as described.

9. In a circuit-breaker, the combination with a movable coil, of a stationary coil connected in series therewith, a switch in the circuit of both of said coils controlled by the movement of said movable coil, a plunger as a core for said stationary coil, said plunger being adapted to move said movable coil to aid in the control of said switch, substantially as described.

10. In an automatic switch, a single pair of separable coöperative contacts, a series circuit, a controlling means for said contacts comprising an over-load coil in said circuit, and controlling means for said contacts comprising an under-load coil included in said circuit, and a permanent magnet cooperative with said under-load coil in its control of said contacts substantially as described.

11. In an automatic switch, a single pair of separable coöperative contacts, controlling means for said contacts comprising an over-load coil, and controlling means for said contacts comprising a coöperating under-load coil and permanent magnet, and a series circuit including said coils and said contacts, whereby said coils are energized to cause coöperation between said contacts, substantially as described

12. In a circuit-breaker, the combination with a movable armature, of a coil for magnetizing said armature, a second coil connected in series with the first coil, a switch in the circuit of both of said coils controlled by the movement of said movable armature, a plunger as a core for said second coil, said plunger being adapted to move said armature to aid in the control of said switch, substantially as described.

In witness whereof, I hereunto subscribe my name in the presence of two witnesses.

ALBION D. T. LIBBY.

Witnesses:

WILL VAN MIDDLESMITH,

ROBERT LEWIS AMES.