July 1, 1930. G. W. O'KEEFFE 1,769,539

PROTECTIVE DEVICE

Filed May 29, 1925

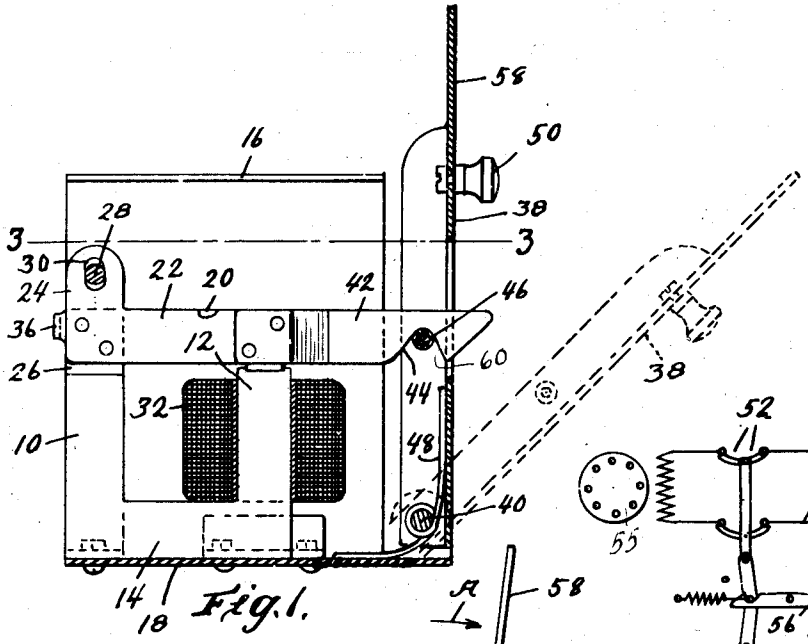


Fig. 1.

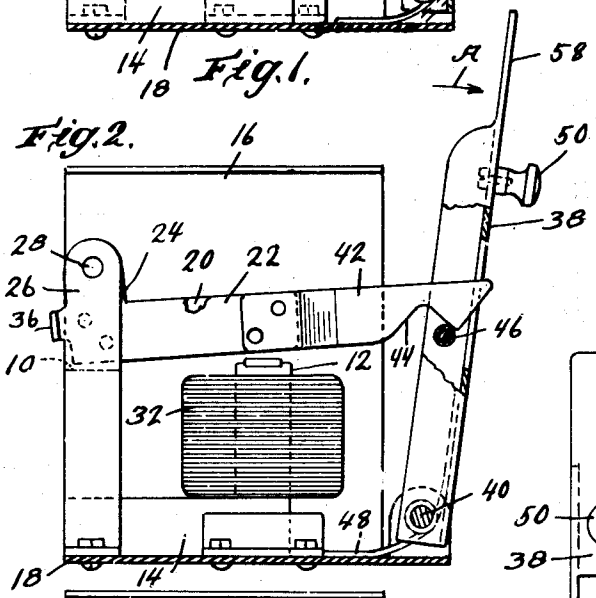


Fig. 2.

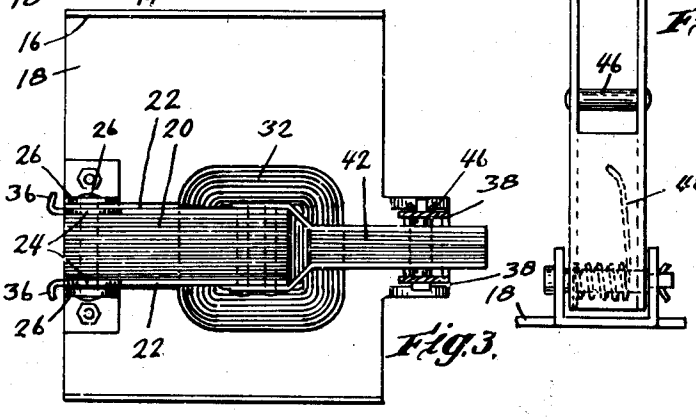


Fig. 3.

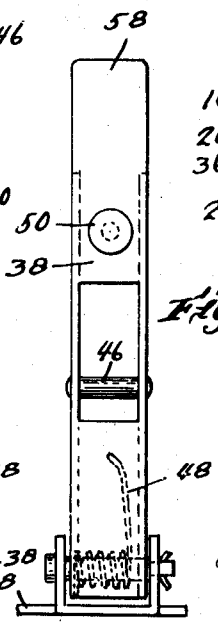


Fig. 4.

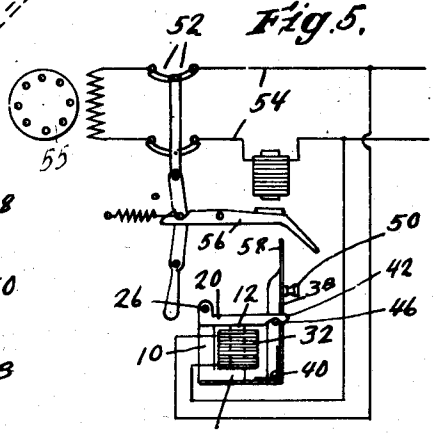


Fig. 5.

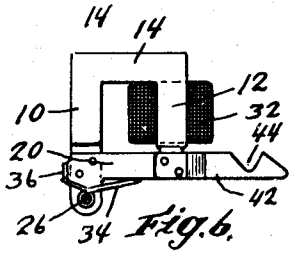


Fig. 6.

Inventor,
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by
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Patented July 1, 1930 1,769,539

UNITED STATES PATENT OFFICE

GEORGE W. O'KEEFFE, OF DORCHESTER, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONDIT ELECTRICAL MANUFACTURING CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

PROTECTIVE DEVICE

Application filed May 29, 1925. Serial No. 33,858.

This invention relates to electro-magnetically operated devices, as under-voltage protective devices especially adapted although not necessarily limited to the control of alternating current circuits.

The usual type of undervoltage device associated with an electric switch, for instance, comprises a magnetic structure including an actuating coil and an armature. The actuating coil ordinarily, is adapted to be continuously energized from the alternating current circuit controlled by the switch. When normal potential conditions exist on the circuit, the armature is adapted to be held in attracted position by the actuating winding. When abnormal conditions exist on the circuit, as when the potential of the circuit fails or is reduced to a predetermined value, the armature is released and falls or moves to an unattracted position and is caused to open the switch. The condition of failure or reduction of potential on the circuit may exist only for a short time and the actuating coil may soon be normally re-energized. Ordinarily, however, the released armature is so far removed from the influence of the actuating coil that it remains in such position when the coil is normally re-energized.

Heretofore, considerable trouble has been experienced with undervoltage or equivalent devices due to the ultimate heating and burning-out of the actuating coil although the coil may be designed to operate indefinitely under normal current conditions therein. I have found that while the coil is under normal current conditions when the armature is in its attracted position, yet when the armature is in an operated or released position, and the coil is energized under normal potential conditions, there is an abnormally high current in the coil, and the coil is overloaded. I have found, further, that the overloading is due to a reduction of the reactance or more correctly the inductance of the coil. When the armature is in its attracted position, the magnetic circuit of the coil is short and, consequently, the reactance of the coil is high and the current consumption is low. When, however, the armature is in its operated or released position, the magnetic circuit is long and has a long air gap, and the reactance and inductance of the coil becomes low, so that the current in the coil is governed largely by its direct current resistance, and is larger than the coil can safely withstand for long periods of time.

It is an object of this invention to provide an electro-magnetically-operated, as an undervoltage or equivalent, device with an actuating coil or winding and means to maintain a high reactance value of said coil at all times when it is normally energized.

A further object of the invention is to provide an undervoltage or equivalent device having an actuating coil and an armature which is maintained in attracted position at all times when the coil is normally energized.

A further object of the invention is the provision of an undervoltage or equivalent device having an armature which is biased for movement towards attracted position whether or not the actuating winding is energized.

A further object of the invention is generally to improve the construction and operation of electro-magnetically operated devices.

Fig. 1 is a side elevation of an undervoltage device embodying the invention, and with the parts in normal position.

Fig. 2 is similar to Fig. 1 but with the parts in operated positions.

Fig. 3 is a plan view of the device.

Fig. 4 is a front elevation of the operating lever.

Fig. 5 is a diagrammatic representation of the device associated with an electric switch and its circuit.

Fig. 6 is a view similar to Fig. 1 but with the device in a relatively reversed position and with a spring supplanting the force of gravity to bias the armature for movement toward its attracted position.

As here shown, my invention is incorporated in an undervoltage device which includes a U-shaped electro-magnet having the parallel and upstanding legs 10 and 12 and the end connecting and separating leg 14. Said magnet structure is disposed within a frame 16 and is secured to the bottom wall 18 thereof. An armature 20 is disposed to overlie the pole

faces of the legs 10 and 12 of the magnet structure, and said armature is pivoted to the leg 10. For this purpose, side plates 22 are fixed to the armature and have upstanding end extensions 24. Side plates 26 are fixed to said leg 10 of the magnet structure and extend upwardly beyond the pole face of said leg and overlie said extensions 24. A pivot pin 28 is passed through said extensions 24 and is fixed in said extensions 26. Preferably said pin 28 passes loosely through a vertically elongated slot 30 in said armature extensions 24 so that said armature may seat firmly upon the pole faces of the legs 10 and 12 and thereby provide a substantially complete iron magnetic circuit.

An actuating winding or coil 32 is disposed upon said leg 12 and serves, when normally energized, to hold the said armature against the pole faces. The device ordinarily is arranged in upright position, as shown, so that the armature is biased by gravity to maintain its lowermost-position against the pole faces of the magnet structure, as shown in Fig. 1, so that the actuating coil 32 at all times is provided with a high value of reactance. If the device is arranged in other than vertical position as in Fig. 6 any equivalent means, as a spring 34, may be used to replace the force of gravity to bias the armature for movement toward attracted position.

The armature may be provided with outstanding projections 36 which are adapted to engage with suitable stop members, as the side plates 26 of the magnetic structure, whereby to limit the movement of the armature towards a released or operated position.

Said armature 20 is adapted to control the movements of an operating lever 38, which is pivoted to said frame 16 by the pivot pin 40 and is disposed at one side of and in line with said armature 20. Said armature is formed or provided with a latch-member 42 which is formed with a notch 44 therein; and said notch is adapted to engage a latch pin or roller 46 carried by said operating lever 38 intermediate the ends thereof. Said operating lever is biased for movement in an operating direction or for movement in the direction of the arrow A, Fig. 2, by means of a spring 48, but normally is restrained from such movement by the armature and latch. When the actuating coil 32 is normally energized the armature 20 is held in attracted position and thereby serves to hold the operating lever 38 in the normal or inoperated position shown in Fig. 1 against the action of its spring 48. In this position the magnetic circuit is relatively short and the actuating coil 32 has high reactive effect and thereby consumes but little current.

When the potential of the circuit associated with the actuating coil suffers a failure or reduction of potential to a predetermined value, the spring 48 of the operating lever is arranged to overpower the magnetic attraction on the armature, and also the force of gravity or the force of the spring 34, Fig. 6, on said armature whereby to break the connection between the armature and the operating lever and to move the operating lever toward its operated position and thereby effect the control of the circuit associated with the device. During the disconnecting movement of the operating lever 38, the armature is momentarily raised into the position shown in Fig. 2 before the operating lever 38 completely disengages with the armature and the armature immediately moves back into position against the pole faces, thereby restoring the short magnetic circuit.

With this arrangement, it is apparent that the actuating winding has a high reactive effect at all times when the winding is energized at normal potential so that there is small danger of the burning out of the coil. The operating lever is adapted to be reset manually and for this purpose may be provided with a handle 50.

The undervoltage device as above described may be associated with a switch 52, Fig. 5, which is adapted to control an alternating current circuit 54 supplying a motor 55. The actuating coil 32 is connected across said circuit and is energized at the potential thereof. When the potential fails or drops to a predetermined amount, the operating lever is adapted to move outwardly and toward the right and engage and operate a latch 56 to trip the switch. The operating lever 38 may be provided with a striker projection 58 for engagement with the switch latch.

The value of reduced potential at which the the device is arranged to operate is governed by the slope of the cam face 60 of the notch 44, which cam face is inclined to bias the latch connection for release of the operating lever. When said cam face is relatively abrupt the spring 48 of the operating lever 38 is less effective than when said cam surface is relatively more inclined. Consequently the holding effect of said armature 20 on the operating lever is governed by the inclination of said cam face and may be varied by varying the slope so that the device may be set to operate within a wide range of potential, from a value very slightly under normal potential with a cam face of but little inclination, to values much under normal potential with more abrupt inclinations of the cam face.

The construction may be otherwise modified without departing from the spirit of the invention.

I claim:

1. A device of the class described including an operating member movable from an inoperative to an operative position, an actuating winding, an armature having means

normally holding said operating member releasably in an inoperative position, and means to effect the movement of said armature into an attracted position after the release of said operating member and independently of current conditions in said coil.

2. In an undervoltage protective device for electric switches, the combination of switch operating means movable between an inoperating position and a switch-operating position, and controlling means for said switch operating means including an actuating winding arranged to be normally energized at normal potential and when insufficiently energized to effect the operation of said switch operating means and including means to maintain the inductance of said winding high whenever said winding is energized at normal potential regardless of the position of said switch operating means.

In testimony whereof, I have signed my name to this specification.

GEORGE W. O'KEEFFE.