No. 829,828. PATENTED AUG. 28, 1906.

L. ANDREWS.

REVERSE CURRENT CUT-OUT.

APPLICATION FILED JUNE 19, 1905.

Fig. 1.

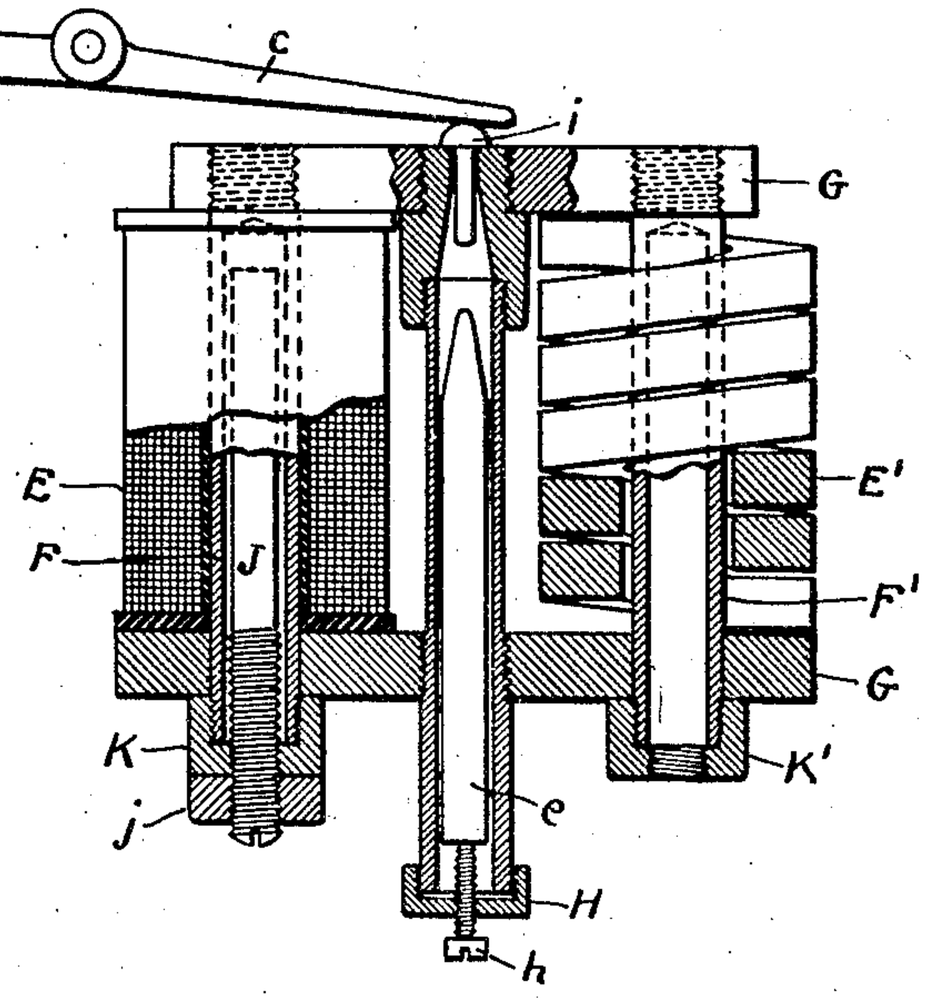
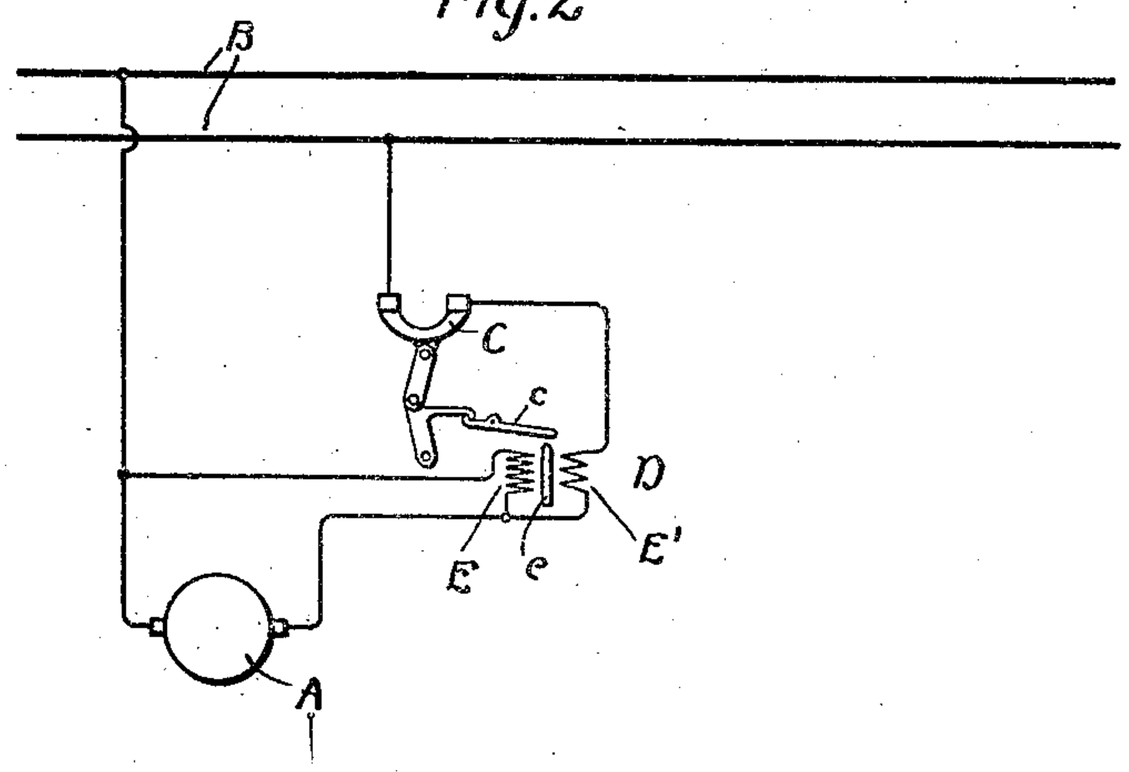


Fig. 2.



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UNITED STATES PATENT OFFICE.

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REVERSE-CURRENT CUT-OUT.

No. 829,828. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed June 19, 1905. Serial No. 265,899.

To all whom it may concern:

Be it known that I, LEONARD ANDREWS, a subject of the King of Great Britain, residing at Manchester, England, have invented certain new and useful Improvements in Reverse-Current Cut-Outs, of which the following is a specification.

My invention relates to protective devices for electric circuits; and it consists in an improvement in the reverse-current cut-out disclosed in United States Letters Patent No. 751,442, issued to me February 9, 1904. In that patent I disclosed a cut-out comprising a magnetic core having two coils wound on different portions of its length and connected one in series with and the other in shunt to the electric current to be protected, and a movable member shunting each of the portions of the magnetic core on which the coils are wound and adapted by its movement to open a switch in the circuit to be protected. In some cases it is desirable that a cut-out of this character should operate only on reverse current and should remain inoperative on an overload-current, no matter how heavy. In other cases it is desirable that a device should operate both as a reverse-current cut-out and also as an overload cut-out.

My present invention comprises a modification of the arrangement disclosed in my former patent, whereby the device may be adjusted in a simple and efficient manner to act on an overload of any desired magnitude or to operate only on a reverse current. I accomplish this result by providing means for varying the relative reluctances or effective cross-sections of the two portions of the magnetic core on which the shunt and series windings are placed. If the cross-section of the portion of the core on which the shunt-winding is placed is made greater than the cross-section of that part of the core carrying the series winding, a heavy overload-current will saturate the portion of the core carrying the current-coil, but cannot saturate that portion of the core carrying the shunt-coil. The portion of the core carrying the shunt-coil consequently remains at all times an effective magnetic short-circuit for the movable member, and the device will not operate on an overload-current of any amount. On the other hand, if the cross-section of the portion of the core carrying the current-coil is increased relatively to that portion carrying the potential coil, the latter portion may become saturated by a heavy overload-current, and consequently the movable member forming a magnetic shunt thereto will be actuated. By adjusting the relative cross-section of the two portions of the core carrying the two coils, the device may be adjusted to act on any desired overload.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows an elevation, partly in cross-section, of an improved reverse-current cut-out arranged in accordance with my invention; and Fig. 2 is a diagram of connections.

Referring first to Fig. 2, A represents a direct-current generator connected to the bus-bars B. It is assumed that it is desired to prevent a flow of current from the bus-bars to the generator in case the voltage of the generator fails for any reason, such as a short-circuit, a breaking of the field, failure of the prime mover, or other cause.

Although I have illustrated my device as applied to the protection of a generator, it will be understood that it is not limited to this particular application, but may be used to protect any electric circuit against a reversal of current flow therein.

In Fig. 2, C represents a switch or circuit-breaker inserted in the circuit of generator A and provided with a latch *c*, adapted to hold the switch in closed position. D represents the protective device, which comprises two coils E and E′, the first of which is connected in shunt to the generator A and the second in series therewith. *e* represents a plunger controlled by the coils E and E′ in the manner which will be hereinafter explained and adapted to engage the latch *c*, so as to trip the switch C and to open the circuit of generator A.

The construction of the device D is shown in Fig. 1. In this figure the coils E and E′ are shown mounted, respectively, on two hollow cores F and F′, which are connected by yokes G G of magnetic material. These yokes, together with the hollow cores, form a closed magnetic circuit. The plunger *e* is adjust-

ably supported in any suitable manner, as by the cap H and set-screw *h*, and forms a normally open magnetic shunt for each of the hollow cores on which the shunt and series coils are wound. When the plunger *e* is drawn up, it strikes a hammer-blow upon the pin *i*, upon which the latch *c* rests, so that the latch is moved on its pivot to release the switch and open the circuit in the manner that has heretofore been explained. The coils E and E′ are so connected that while the current in the main circuit is in its normal direction their magnetomotive forces are in the same direction in the closed magnetic circuit formed by the hollow cores F and F′ and the yokes G G. Consequently there is little or no tendency for any flux to pass through the open magnetic shunt formed by the plunger *e*. If, however, the current in the main circuit is reversed, the direction of the magnetomotive force of the series coil E′ will be reversed in direction, so that the coils E and E′ will oppose their magnetomotive forces in the closed magnetic circuit, tending to divert the flux of both coils through the shunt formed by the plunger *e*. The plunger will consequently be drawn up, tripping the switch, as has been heretofore explained. Now if the action of the device upon an overload-current in the normal direction is considered it is obvious that its operation will depend upon what portion of the closed magnetic circuit first becomes saturated. Thus if the core on which the coil E′ is mounted becomes saturated first the remaining portion of the magnetic circuit will remain unsaturated and continue to act as a magnetic short circuit for the movable plunger *e*. Consequently under these conditions the device will not operate on any overload-current in the normal direction however heavy. If, on the other hand, the portion of the closed magnetic circuit on which the potential coil E is wound becomes saturated first, the increasing flux due to the current-coil will be diverted through the movable plunger *e*, and when the diverted or leakage flux reaches a predetermined amount, the plunger will be drawn up, so as to trip the switch. Under these conditions the device will operate not only as a reverse-current cut-out, but also as an overload cut-out.

Sometimes one mode of operation and sometimes the other is desirable, and in order that the device may be conveniently adjusted for either operation, I provide a core J, which may be adjustably inserted within either of the hollow cores F or F′. For the purpose of adjustment the cores F and F′ are provided with internally-screw-threaded caps K and K′, respectively, and the core J is externally screw-threaded, as shown. By this means the position of the core J within either of the hollow cores may be conveniently and accurately adjusted. The core J carries a locknut *j*, by means of which it may be locked firmly in position after it has been properly set.

Many modifications may be made in the structure and arrangement of parts, and accordingly I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination with an electric circuit, a reverse-current protective device comprising a magnetic core, two windings carried on two different portions of said core and connected in shunt and in series respectively with said circuit, a movable member forming a magnetic shunt for each of said two portions of said core, means actuated by the movement of said member for opening said electric circuit, and means for adjusting the relative reluctances of said two portions.

2. In combination with an electric circuit, a reverse-current protective device comprising a magnetic core, two windings carried on two different portions of said core and connected in shunt and in series respectively with said circuit, a movable member forming a magnetic shunt for each of said two portions of said core, means actuated by the movement of said member for opening said electric circuit, and means for adjusting the relative effect cross-sections of said two portions.

3. In combination with an electric circuit, a reverse-current protective device comprising a closed magnetic circuit, two windings carried on two portions of said magnetic circuit, and connected in shunt and in series respectively with said electric circuit, a movable plunger forming a normally open magnetic shunt for each of said two portions, means actuated by the movement of said plunger for opening said electric circuit, and means for adjusting the relative reluctances of said portions.

4. In combination with an electric circuit, a reverse-current protective device comprising a magnetic circuit including two hollow cores, two windings carried respectively on said cores and connected respectively in shunt and in series with said electric circuit, a movable member forming a magnetic shunt to each of said cores, means actuated by the movement of said member for opening said electric circuit, and a core adapted to be adjustably inserted in either of said hollow cores.

5. In combination with an electric circuit, a reverse-current protective device comprising a magnetic circuit including two hollow cores each provided with an internal screw-thread, two windings carried respectively on said cores and connected respectively in shunt and in series with said electric circuit, a

movable member forming a magnetic shunt for each of said cores, means actuated by the movement of said member for opening said electric circuit, and an externally-screw-threaded core adapted to be adjustably inserted in either of said hollow cores.

6. In combination with an electric circuit, a reverse-current protective device comprising a magnetic circuit including two hollow cores, two windings carried respectively on said cores and connected respectively in shunt and in series with said electric circuit, a movable member forming a magnetic shunt to each of said cores, means actuated by the movement of said member for opening said electric circuit, a core adapted to be adjustably inserted in either of said hollow cores, and means for locking said core in position.

7. In combination with an electric circuit, a reverse-current protective device comprising a magnetic circuit including two hollow cores each provided with an internal screw-thread, two windings carried respectively on said cores and connected respectively in shunt and in series with said electric circuit, a movable member forming a magnetic shunt for each of said cores, means actuated by the movement of said member for opening said electric circuit, an externally-screw-threaded core adapted to be adjustably inserted in either of said hollow cores, and a lock-nut carried by said externally-screw-threaded core.

8. In combination with an electric circuit, a switch in said circuit, a latch for holding said switch closed, a tripping device comprising a magnetic core, two windings carried on two different portions of said core and connected in shunt and in series respectively with said circuit, a movable plunger forming a magnetic shunt for each of said portions and adapted when moved to engage said latch, and means for adjusting the relative reluctances of said two portions.

In witness whereof I have hereunto set my hand this 16th day of June, 1905.

LEONARD ANDREWS.

Witnesses:
EDGAR CAFFALL,
L. C. FOSS.