Aug. 10, 1954 C. E. BASTON 2,686,278

ELECTROMAGNETIC DEVICE

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Fig.1.

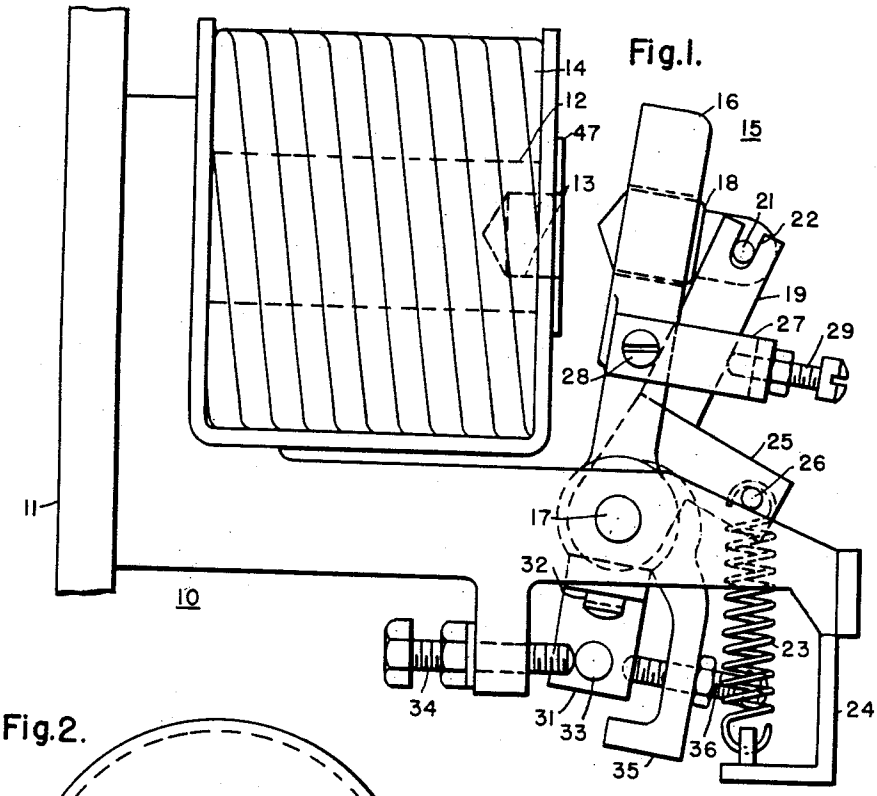


Fig.2.

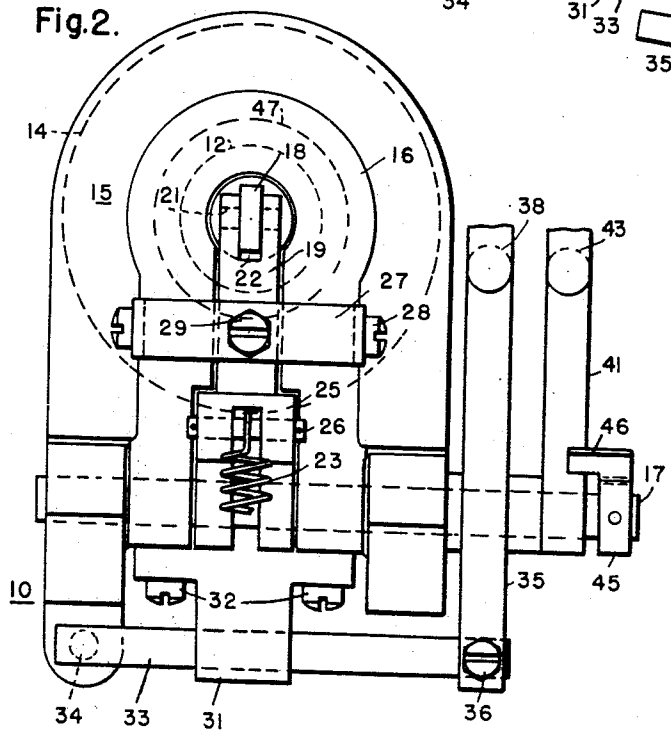
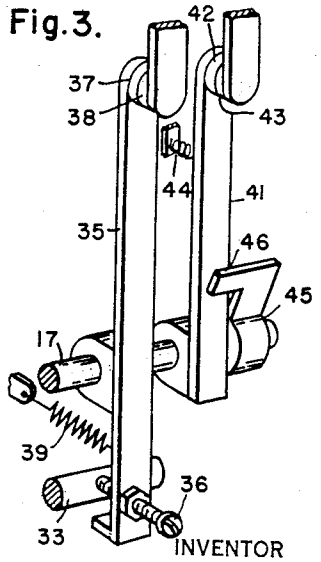


Fig.3.



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ELECTROMAGNETIC DEVICE

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My invention relates, generally, to electromagnetic devices and, particularly, to relays of the overcurrent type which are designed to protect electrical apparatus against overloads.

When designing control systems for a steam turbine-electric locomotive, it is desirable to take special steps to prevent overspeeding of the turbine-generator set in addition to the usual overspeed devices which operate infrequently and, therefore, may be caked with scale deposit and not in condition to function properly when the occasion arises.

One special step is to avoid opening the electric power circuit from the generator even at the risk of damage to the electrical system. This may be accomplished by so connecting the overcurrent relays in the control system that they close the steam valve to shut off power to the turbine. Such a scheme is satisfactory under normal conditions where overcurrent arises from too rapid movement of the master controller handle. Although some damage to the electrical equipment may result from such overcurrent, the necessity of removing such overcurrent is not urgent and the few seconds required to correct the condition are not vital. The foregoing scheme has recently been utilized on steam turbine-electric locomotives which are now in service.

Experience in service has demonstrated that while the foregoing protection suffices for ordinary overloads, there occasionally occur insulation breakdowns, flashovers, etc., which are not properly met by the above-described scheme. If an arc once becomes established great damage will result within a few seconds after the steam supply is cut off from the turbine since the kinetic energy stored in the rapidly revolving masses of the turbine and the generator rotors is fed into the fault, thereby causing extensive destruction.

In order to prevent such destruction, it is necessary to provide protective means which will operate only on the much heavier currents resulting from insulation failures, flashes, short circuits, etc. This could be done by adding another relay which is adjusted to operate only on high currents. However, the provision of another relay is not always feasible because of the additional space required for the relay and the extra expense involved.

An object of my invention is to provide an overload relay which may be utilized to perform the usual function of cutting off steam from the turbine of a turbine-generator set in case of a normal overload and another function of opening an electrical circuit breaker in case of an excessive overload.

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Another object of my invention is to provide a relay having independently operable contact members which are actuated sequentially by increasing amounts of current.

A more general object of my invention is to provide an overload relay which shall be simple and efficient in operation and which may be economically manufactured and installed.

Other objects of my invention will be explained fully hereinafter or will be apparent to those skilled in the art.

According to one embodiment of my invention, a relay is provided with an armature having two members, one of which is actuated by a predetermined amount of current flowing through the relay coil and the other of which is actuated only by a higher amount of current. The contact members actuated by the armature members may be so connected in the control system for a steam turbine-electric locomotive that the operation of one contact member shuts off the steam from the turbine in case of a normal overload and the operation of the other contact member opens the circuit breaker in the generator circuit in case of an excessive overload.

For a better understanding of the nature and objects of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a view, in side elevation, of a relay embodying the principal features of the invention;

Fig. 2 is a view in front elevation of the relay, and

Fig. 3 is a view, in perspective, of a portion of the relay structure.

Referring to the drawing, the relay structure shown therein comprises a supporting structure including a magnet-frame 10 which may be mounted on a panel 11 in the usual manner. The magnet-frame 10 includes a core 12, one end of which is attached to the rest of the frame 10 and the other end of which has a hole 13 provided therein. The relay structure includes a suitable electric current exciting-means, such as a coil 14 which produces a magnetic flux in the core 12 in the usual manner, and also a two-part armature 15.

The two-part armature 15 comprises both a clapper 16 which is rotatably mounted on a shaft 17, which, in turn, is rotatably mounted in the supporting structure 10, and a plunger 18 which is slidably disposed in the clapper 16 and which is connected to a plunger arm 19 by means of a pin 21 which is disposed in a slot 22 in the upper

end of the arm 19. The arm 19 is mounted upon and secured to the shaft 17. One end of a spring 23 is attached to a bracket 24 which, in turn, is attached to the supporting structure 10 and the other end of the spring 23 is attached to an angularly disposed extension 25 on the arm 19 by means of a pin 26. A stirrup 27 is attached to the clapper 16 by screws 28 and an adjustable stop screw 29 is provided in the stirrup 27 for engaging the arm 19.

A tail piece 31 is attached to the bottom of the clapper 16 by screws 32 and carries a pin 33. An adjustable screw 34 is provided in the supporting structure 10 for engaging the pin 33 to limit the opening movement of the clapper 16.

As shown, a movable contact arm 35 is rotatably mounted on the shaft 17 and is provided with an adjustable screw 36 which is engaged by the pin 33 when the clapper 16 is actuated toward the core 12. The contact arm 35 carries a contact member 37 which engages a fixed contact member 38 when the clapper 16 is in the open position as shown in Fig. 3. A spring 39 biases the contact arm 35 to maintain the contact members 37 and 38 closed.

As shown most clearly in Figs. 2 and 3, a second movable contact arm 41 is rotatably mounted on the shaft 17. The arm 41 carries a contact member 42 which engages a fixed contact member 43. A compression spring 44 biases the arm 41 to maintain the contact members 42 and 43 closed. An arm 45 is secured to the shaft 17 and is provided with a lateral extension 46 which engages the contact arm 41 when the shaft 17 is rotated a predetermined amount.

When a predetermined current flows through the coil 14, the core 12 is sufficiently magnetized to attract the clapper 16 toward the core. Since the screw 29 in the stirrup 27 engages the arm 19, the clapper and the arm are moved simultaneously toward the core and are restrained by the spring 23 which, as previously explained, is attached to the arm 19.

The movement of the clapper 16 toward the core actuates the contact arm 35 by means of the pin 33 and the screw 36, thereby opening the contact members 37 and 38. As explained hereinbefore, these contact members may be so connected in the control system that their opening causes the steam to be shut off from the turbine which drives the generator. The movement of the arm 19 along with the clapper 16 rotates the shaft 17 since the arm 19 is secured to the shaft 17. However, the rotation of the shaft 17 is not sufficient at this time to cause the extension 46 of the arm 45 to engage the contact arm 41. Thus, the arm 45 functions as a lost-motion connection between the shaft 17 and the contact arm 41.

As shown most clearly in Fig. 1, a non-magnetic spacing member 47 is disposed on the end of the core 12, thereby preventing the clapper 16 from directly engaging the core 12. When the clapper 16 engages the spacer 47, the plunger 18 is in alignment with the hole 13 in the core 12. Because of the fact that the clapper 16 does not come into direct contact with the core 12, there is a resultant pull on the plunger 18, which, if the current flowing through the coil 14 increases to an amount which indicates a damaging fault in the electrical apparatus, pulls the plunger 18 into the hole 13. The clapper 16 cannot follow the movement of the plunger 18. Therefore, the arm 19 is disengaged from the screw 29 in the stirrup 27, but the magnetic pull on the plunger 18 must still overcome the tension of the spring 23.

The additional movement of the arm 19 rotates the shaft 17 sufficiently to cause the extension 46 on the arm 45 to engage the contact arm 41, thereby opening the contact members 42 and 43. As explained hereinbefore, these contact members may be so connected in the control system that their opening causes the opening of the circuit breaker in the main power circuit, thereby protecting the electrical apparatus against serious injury.

From the foregoing description it is apparent that I have provided a single relay which performs the functions normally performed by two separate relays. The present relay may be constructed at a slight increase in the cost of one of the two relays normally required to perform the functions herein described, and at no increase in the mounting dimensions of one of the previous relays. Thus, a saving may be made in both the cost of the apparatus and the space required to mount the apparatus in a locomotive or other railway vehicle.

The present relay may be so constructed and adjusted that the differential between the normal overload current and an excessive overload current may be made anything desired within reasonable limits. While the present relay is particularly suitable for utilization in the control system for a steam turbine-electric locomotive, it is not necessarily limited in its application to such a system.

Since numerous changes may be made in the above-described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. An electromagnetic device comprising: a supporting structure including a magnet-frame, said magnet-frame including a core having a hole in the end thereof; an electric-current exciting-means for producing a magnetic flux in the core; a first armature-means, comprising an open-biased clapper pivotally mounted on the supporting structure, said clapper being mounted and biased in such position as to be magnetically attracted toward the end of the core in response to a predetermined amount of current flowing through the exciting-means, said clapper having a hole therein in alinement with the hole in the core; a second armature-means comprising an open-biased movably mounted plunger disposed within said hole in the clapper; a means for limiting the opening-movement of the plunger with respect to the clapper whereby the plunger moves jointly with the clapper when the clapper moves toward the core; and marginal biasing-means for biasing said plunger so as to permit the same to be further magnetically attracted, and movable down into the hole in the core, moving independently of the clapper, in response to a larger predetermined amount of current flowing through the exciting-means.

2. The invention as defined in claim 1, characterized by the principal bias-producing means, for both said clapper and said plunger, being a single biasing-means for biasing said plunger away from said core.

3. The invention as defined in claim 1, characterized by the second armature-means also including a plunger-arm, pivotally mounted on the

supporting structure, for supporting said plunger; and the principal bias-producing means, for both said clapper and said plunger, being a single biasing-means for biasing said plunger-arm away from said core.

4. The invention as defined in claim 3, in combination with: a first motion-transmitting means, for responding to the attractive-movement of said clapper; and a second motion-transmitting means, for selectively responding to only the independent attractive-movement of the plunger.

5. The invention as defined in claim 3, characterized by the pivotal mounting-means, for both said clapper and said plunger-arm, including a shaft rotatably mounted in the supporting structure; the clapper being rotatably mounted on said shaft; and the plunger-arm being secured to said shaft.

6. The invention as defined in claim 5, in combination with: a first motion-transmitting means, for responding to the movement of said clapper;

and a second motion-transmitting means, including a lost-motion connection, for responding only to the final independent attractive-movement of said plunger-arm and shaft.

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