Jan. 3, 1950 R. VRADENBURGH 2,493,371

RELAY

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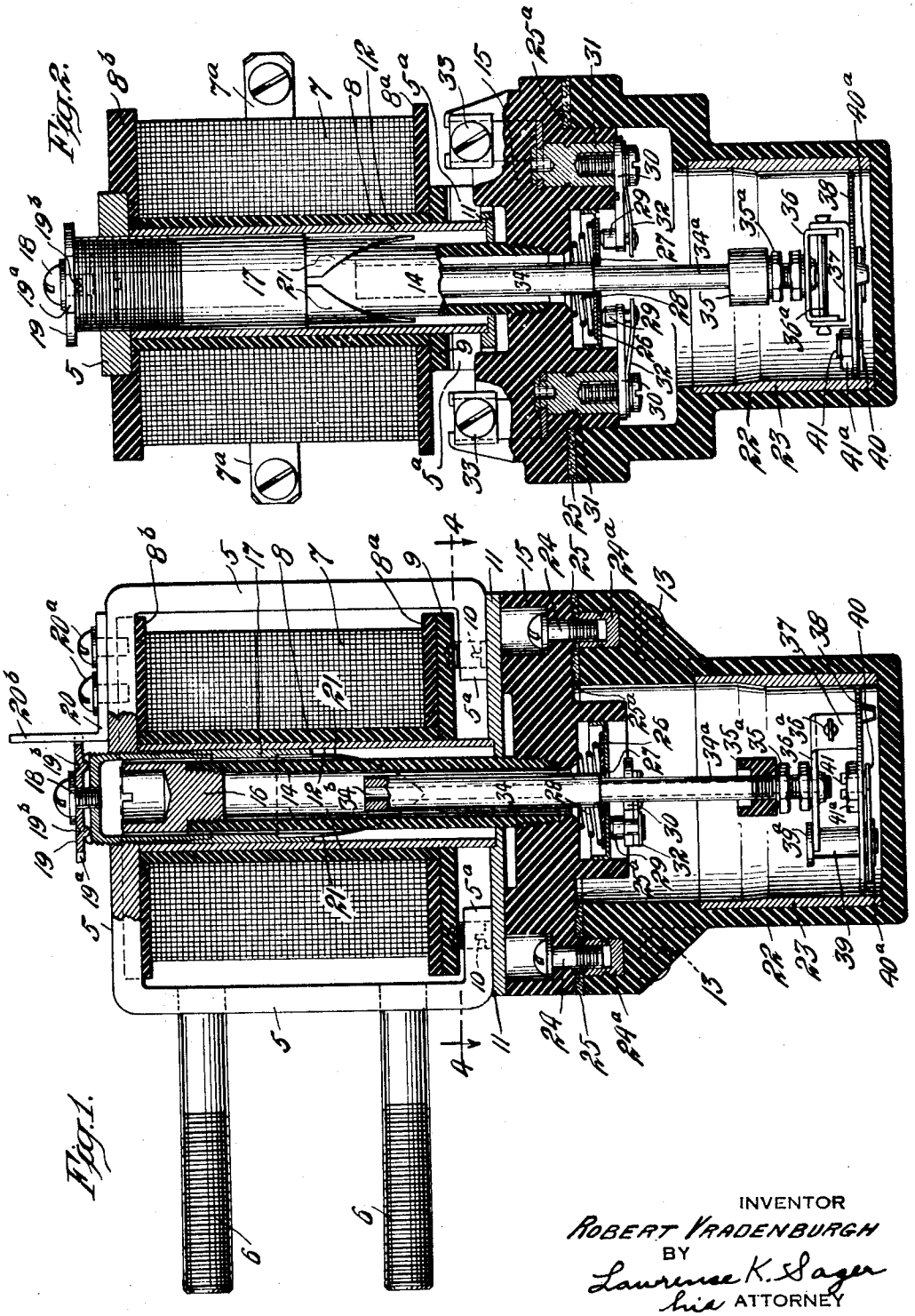


Fig. 1.

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Fig. 3.

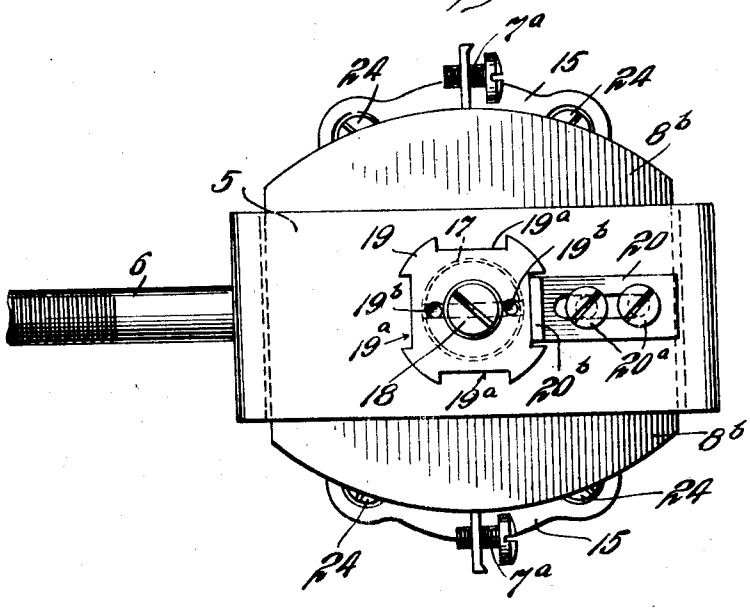
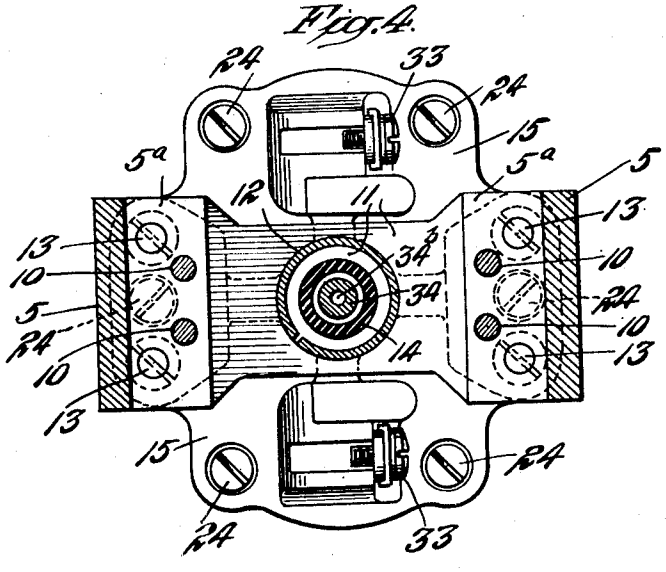


Fig. 4.



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RELAY

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9 Claims. (Cl. 200—97)

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This invention relates to relays of the overload type which may be used to open the circuit of a contactor through which current is supplied to various translating devices such as a motor and may be variously applied to the control of other circuits or of an auxiliary relay interposed between it and the line contactor and utilized in various ways according to the particular requirements and the selected form of control.

One important object of the invention is to provide an improved form of relay which will automatically reset after it has performed its function in opening a control circuit. In this manner, the relay is conditioned to perform its control function again a short interval after the relay contacts have been opened without the necessity of otherwise resetting. In the usual type of overload relay a latch is tripped upon the occurrence of the overload but this has the objection that in order to restart a motor for example, it is not only necessary to reclose the starting switch but also necessary to manually reset the latch of the relay. This procedure is undesirable because the operator is obliged to go to the location where the relay is mounted to manually reset the relay and then go to the switch or other means for closing the circuit for restarting. This causes delay and inconvenience. This objection may be overcome by providing a magnetic reset and mounting the reset control adjacent to the starting switch, but this requires an additional device which increases the cost and space occupied and is not as satisfactory because it requires some form of latch or clutch actuated by the overload control, introducing friction and some degree of variations in response and some uncertainty. This improved self-reset relay is particularly advantageous in the control of a motor because it permits its restarting within a few seconds after an overload trip merely by closing the starting switch or start button of the motor. The relay may be used for purposes other than overload control and may sometimes be used with normally open contacts, or with response to changes in voltages, and for general purposes as a time delay relay.

Another object is to enclose the controlling contacts of the relay within a sealed container which protects them from dirt and other foreign matter and permits the use of oil, or other suitable liquid, in the container which serves as a cooling medium for the arc upon separation of the relay contacts and also secures the advantage of a reduction in the contact break distances. The oil also serves to provide a time delay in the action of the relay and the structure also has the advantage of overcoming the effects of mechanical shocks and jars. Another object is to provide means whereby the range of adjustment is greatly increased which avoids the necessity of changing the coils or heaters for securing wide range of control. Another object is to provide convenient means for adjustment of the relay at the outside thereof without having to dissemble it or portions of it. Another object is to provide a form of relay capable of utilizing high current coils which avoids the use of an auxiliary transformer for extending the operating range, as the rating adjuster of the improved relay provides substantially straight line pull characteristics with the use of conventional coils and also with coils having few turns for high currents. Other objects and advantages will be understood from the following description and accompanying drawings which illustrate a preferred embodiment of the invention.

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Fig. 1 is a central vertical cross-section; Fig. 2 is a central vertical cross-section taken at right-angles to that of Fig. 1; Fig. 3 is a top plan view; and Fig. 4 is a section on the line 4—4 of Fig. 1.

Referring to Fig. 1 the magnetic frame 5 is of a U shape, the downwardly extending sides having inturned lower ends 5a. The relay is adapted to be supported on a panel board by threaded rods 6 whch are fixed to the rear leg of the frame. The controlling coil or winding 7 of the relay is provided with terminals 7a at opposite sides for convenient connection thereto of the controlling circuit. The coil 7 is mounted upon a tube 8 of insulating material and between a lower disk 8a of insulating material and an upper disk 8b of insulating material which is channeled on its upper face from front to back for the purpose of fitting under the upper portion of the frame 5 as shown in Fig. 2. This insures the coil and its supporting parts being locked in proper position when assembled in place and preventing it from turning. Below the coil disk 8a is another strip 9 of insulating material which extends from front to back and serves as a spacer between the bottom of the coil spool and the top of the ends 5a of the magnet frame. A pair of headless set screws 10 have a threaded engagement with each end 5a of the magnet frame and extend upwardly to engage the disk 8a for forcing the coil assembly firmly against the top portion of the magnet frame for preventing any displacement of the coil assembly or any vibration thereof under shocks or jars. A keeper 11 of magnetic material extends from front to back under the ends 5a of the magnet frame, as particularly shown in Fig. 4. This keeper has a central opening for the passage of

parts to be described later and has a counter-sunk central upper portion in which fits the lower end of a longitudinally slotted tube 12 of non-magnetic material, such as brass, which serves as a sleeve for lining the central opening of the coil assembly. This sleeve 12 engages the under face of the upper portion of the magnet frame and is held in fixed position by the keeper 11 which in turn is fastened to the lower face of the ends 5a of the magnet frame by a pair of screws 13 at each end of the keeper which extend upwardly through parts to be described later and have threaded engagement with the ends 5a of the magnet frame.

A tube 14 of insulating material extends within the coil and passes through an opening in the keeper 11 and has a threaded engagement with the cap or cover 15 of the dashpot, forming a sealed joint therewith and being supported thereby. The upper end of the tube 14 is internally threaded to receive and support the plug 16 of magnetic material, the connection forming a sealed joint between the parts. The general magnetic circuit of the relay is through the frame 5 to and through the keeper 11 and then through the plunger of the relay to be described later to the plug 16 and to the magnet frame. The tube 14 and plug 16 is removable from within the coil as a unit with the cover 15.

The magnet circuit is controlled and subject to modification by an adjustable hollow rating adjuster 17. This is formed of a central cylindrical portion and an upper cylindrical portion. The upper portion extends within the coil 7 and around the plug 16 and is externally threaded to have a threaded engagement with an opening in the upper central portion of the magnet frame 5. The top of the rating adjuster is closed and receives at its center a screw 18 which passes freely through an indicator lock 19 of generally square form having four slots 19a, as shown in Fig. 3, at each of its four sides. The indicator lock is depressed at two opposite portions 19b to form two projections on its lower face which enter a crosswise slot in the top of the rating adjuster 17. Thus when the screw 18 is tightened, it firmly locks the indicator lock to the rating adjuster. On top of the magnet frame at the front portion thereof is a rectangular strip of metal 20 bent at right-angles and having a longitudinal slot in the portion extending along the top of the magnet frame. A pair of screws 20a pass downwardly through this slot and have a threaded engagement with the magnet frame. The upwardly extending portion 20b of the strip 20 forms an indicator post which has a marked scale on its front face for indicating the adjusted rating for which the rating adjustor is set. The indicating post 20b is adapted to engage any one of the slots or cut-away portions 19a of the locking plate 19 and the position of the locking plate with reference to the scale of the post 20b shows the rating for which the relay is set. A mid-position of this plate with reference to the scale post is the setting for the normal current to which the relay will respond or trip being a one hundred per cent setting of the rating adjuster. An upward adjustment decreases the rating and a downward adjustment increases the rating over a wide range of control. In order to permit adjustment the screws 20a must first be loosened to permit the scale post to be moved outwardly from the locking plate, after which the rating adjuster may be turned to an upper or lower position. After the adjustment is obtained, the scale post is moved into one of the slots 19a and the screws 20a are then tightened which thereby locks the rating adjuster in its new position.

The lower portion of the rating adjuster 17 is formed preferably of two oppositely positioned triangular-shaped parts 21 having semi-circular upper portions and tapered downwardly extending portions as shown in Figs. 1 and 2, although the adjuster may be otherwise formed. The middle tubular portion of the rating adjuster 17 is of brass or other non-magnetic material whereas the triangular pieces 21 and the threaded head or upper portion of the adjuster are of magnetic material. The upper portion being of magnetic material reduces the reluctance of the magnetic path from the frame 5 to the magnetic plug 16 and to the plunger. The upper and lower portions are secured to the middle tubular portion by silver soldering or otherwise. The triangular-shaped pieces 21 form an auxiliary flux path which shunts flux to a greater or less degree from the magnetic plunger of the relay as determined by the upward or downward adjustment of the rating adjuster. The downward adjustment shunts an increased amount of magnetic flux from the lower portion of the magnet to the upper portion away from the magnetic plunger thereby increasing the rating at which the relay will respond. The upward adjustment decreases the amount of flux shunted away from the magnetic plunger and thereby decreases the rating at which the relay will respond. It is apparent that by this improvement the rating of the relay may be adjusted externally in a simple and convenient manner merely by the use of a screw driver for loosening the screws 20a and by turning the locking plate 19 and without the necessity of taking any portion of the relay apart and the locking means insures permanency of any adjustment for which the relay is set. The over-all range of adjustment obtainable by means of the rating adjuster of this improvement is approximately 40% for any coil winding and permits the use of coils having a wide range in the number of turns and current rating.

The dashpot 22 and its cover 15 are of molded Bakelite. The dashpot in its lower portion has a metal liner 23 molded in place which after molding is machined and polished to definite dimensions and tapered at the top portion. The dashpot and cover are fastened together by means of six screws 24 which extend downwardly through the cover and have a threaded engagement with metal inserts 24a molded in place in the upper outer portions of the dashpot. The joint between these two parts is sealed by a gasket 25 between the parts in conjunction with an oil seal rib 25a which is molded on and projects downwardly from the cover as shown in Figs. 1 and 2. This seal between the dashpot and its cover together with the sealed joint between the tube 14 and the cover and the sealed joint between the plug 16 and the upper end of the tube 14 insures complete sealing of the dashpot assembly. This assembly is securely held in place against the lower face of the keeper 11 by the four screws 13, previously described, which pass upwardly through flanged portions of the dashpot and cover and through the keeper 11 to their threaded engagement with the inwardly extending portions 5a of the magnet frame.

The circuit controlled by the relay comprises a single pole, double break, normally closed contact means which is located within the hermeti-

cally sealed dashpot assembly. This comprises a contact disk 26, preferably of silver which is provided with an upwardly turned outer rim which slidably fits within the wall of a cavity or cylindrical recess formed in the lower portion of the cover 15. A washer 27 of Bakelite on the top of the contact disk serves to guide the plunger and between this washer and the top of the cavity in the cover is located a spiral spring 28 which normally forces the contact disk to its lowest position. The contact disk normally bridges the contacts 29 which are carried at the inner ends of contact brackets 30. These brackets are secured at their outer ends to terminal connections 31 molded in place in the cover. The screws which fasten the contact brackets to the connections 31 also secure the outer ends of leaf springs 32 in place, the inner ends of which have riveted thereto the lower ends of the contacts 29 which ends or necks are of reduced size and pass freely through the inner ends of the brackets. The upward movement of the contacts 29 is limited by the springs 32 engaging the bottom of the brackets 30; and the downward movement of the contacts is limited by the main portion of the contacts engaging the top of the brackets. The springs 32 tend to move the contacts upwardly a limited amount as the contact disk moves upwardly, giving a self-cleaning wiping action between the contacts and the disk not only when the contact disk moves upwardly but also when it moves downwardly to engage the contacts. This wiping or sliding action between contacts is determined by the length of the arc through which the riveted end of the contact moves in its limited movement and is controlled by the length of the neck portion of the contact. Connection to the outside circuit controlled by the relay is made to the terminals 33 well shown in Fig. 2 and form part of a terminal assembly which is molded in place in the cover 15 of the dashpot. Each terminal 33 comprises a strip of metal which extends downwardly within the cover and then sidewise toward and to the top of the insert 31 to which it is fixed at the upper end of the insert. The portions of each terminal by being molded in place in the cover of the dashpot forms a seal against any leakage of oil from the dashpot.

The plunger assembly comprises a main plunger portion 34 of magnetic material from the lower end of which extends a portion 34*a* of reduced diameter. The plunger and its lower extension has a central longitudinal opening 34*b* which is opened at its upper and lower ends which may permit passage of some oil therethrough as the plunger moves upwardly or downwardly. Near the lower end of the extension of the plunger is fixed a Bakelite nut 35 fixed in position by a locknut 35*a*. At the lower end of the extension of the plunger is fixed between two locking nuts a metal plate 36 which extends crosswise and at one end is provided with a pair of downwardly extending ears which are pivotally connected by a pin 36*a* with upwardly extending ears of a cross-piece 37 which in turn is fixed to the metal circular disk 38 which serves as the piston of the dashpot. The other end of the metal strip 33 is forked to embrace a post 39 which is fixed to the piston and is provided with an enlarged upper head 39*a*. When the plunger moves upwardly, the forked end of the cross-piece 36 engages the head 39*a* and thereby insures that the piston 38 will always be at right-angles to the axis of the relay in its upward movement for retarding the upward movement of the plunger. But in the downward

movement the piston turns on the pin 36*a* to occupy a position oblique to the axis of the relay for permitting a comparatively rapid downward movement of the plunger. In the normal unattracted position of the plunger, the shoulder of the main portion 34 rests on the washer 27 and some clearance is then provided between the lower part of the plunger assembly and the bottom of the dashpot.

Compensation for changes in timing due to ambient temperature changes is accomplished by means of a bi-metallic strip 40 which is positioned under the piston 38 and extends along one side thereof. One end of this strip is riveted in fixed position by a reduced portion of the post 39 which extends through the end of the strip and through a washer or extension which spaces the strip a small distance from the piston and through a washer 40*a* under the strip. The other end of the bi-metallic strip 40 is opposite and spaced from an opening in the piston. A hollow stud 41 has a threaded engagement with this opening in the piston and is adjustable toward and from the end of the compensating or bi-metallic strip, being held in any adjusted position by a locknut 41*a*. The dashpot is filled with oil to a level to just cover the top of the plunger when in its lowest position which allows a cushion of air above the oil and a reasonable allowance for absorption of oil by the Bakelite or other plastic materials of which the dashpot assembly is composed. The oil or other liquid used should preferably be one having low change of viscosity under change of temperature.

In operation, when an overload current passes through the coil 7, the plunger is attracted upwardly from the position shown in Figs. 1 and 2 but the movement is retarded by the dashpot action. If the overload controlling current continues long enough, the plunger will continue to rise slowly but when the beveled upper portion of the liner is reached by the piston the rate of the upward movement increases and the nut 35 passes up between the fixed contacts 29, the brackets supporting these contacts extending to one side of the center. The nut 35 then engages the underside of the contact disk 26 and moves it upwardly against the pressure of the spring 28, thereby opening the controlled circuit. At this time the top of the plunger is close to or in engagement with the lower end of the magnetic plug 16. In the upward movement there is some clearance between the piston and the liner of the dashpot permitting oil to pass around the piston and some oil passes through the central opening of the stud 41. When the current in the controlling coil 7 is interrupted, the plunger will move down with a comparatively rapid movement because the piston then turns on its pivot to assume an oblique position and thereby permits the oil to pass quite freely around it, giving a quick automatic resetting of the relay in readiness for further controlling action.

The current rating of the relay, as already explained, is controlled by adjustment of the rating adjuster for securing any desired control over a wide range.

It is apparent that the make and break contacts of the relay are fully protected by being within the hermetically sealed dashpot and by reason of the contacts being immersed in oil any arcing is effectively quenched and cooled by the oil and by the agitation of the oil by the movement of the parts, giving a smothering of the arc within a small movement of the contact

disk. This protects and preserves the contacts from deterioration and they are kept clean by the wiping action of the contacts during the separation and closing of the contacts.

The relay is adapted to withstand shocks and jars without affecting its operation in any position of the parts. The oil serves to cushion and retard any movement of the plunger and piston which may be due to severe shocks and it likewise avoids any material movement of the contact disk 26 under severe shocks. In the unattracted position of the plunger, any shock in a downward direction, or downward component of a shock, will not effect the separation of the contacts for several reasons. One is that the plunger then rests directly on the contact disk 26 through the washer 27 with a firm unyieldable engagement and any upward movement of the disk is opposed by the dashpot action on the plunger. Also the contact disk itself is opposed in any upward movement by its dashpot action and by its spring in the cavity in which it is slidably movable. Furthermore the limited follow through upward movement of the yieldably mounted contacts 29 upon any upward movement of the disk maintains the contact engagement throughout the effects of the shock or shocks. When a shock occurs in an upward direction, the contacts 29 by reason of resting directly on the brackets 30 do not yield in a downward direction and maintain a firm engagement with the contact disk. When the plunger is in its uppermost position, any shock in an upward direction, or upward component of a shock tending to close the contacts is opposed by the dashpot action of the plunger by its direct firm unyielding engagement with the contact disk and also by the dashpot action of the contact disk. Thus the relay is well protected against the effect of shocks which might otherwise cause an improper action of the relay. Also the controlling coil 7 is firmly secured and clamped in position by the parts already described which prevents any possible movement thereof relatively to the frame and other parts under shocks.

The structure is sturdy and durable under long continued use without the necessity of any attention. By reason of the effective sealing of the engaging parts and the molding in place of the contact terminals, the oil is prevented from seeping outside which avoids any necessity of replenishing.

Instead of having the relay contacts normally biased closed and automatically reset to their closed position, they could be normally biased open and closed by movement of the plunger and automatically reset to their open position.

Athough a particular embodiment of the invention has been shown and described, various modifications may be made for adaptation to particular requirements without departing from the scope of the invention.

I claim:

1. A relay comprising a magnet frame, a controlling coil within the frame, a plunger within the coil, and a rating adjuster having a magnetic portion located between the coil and the plunger, said adjuster having means extending outside the magnet frame for adjusting the position of said magnetic portion, and a scale post mounted on the magnet frame opposite said means for indicating the position of said magnetic portion, said scale post being movable toward and from said means for locking said means in any adjusted position and for releasing said means for permitting adjustment of said means.

2. A relay comprising a magnet frame, a controlling coil within the frame, a plunger within the coil, and a rating adjuster having a magnetic portion located between the coil and the plunger, said adjuster having means extending outside the magnet frame for adjusting the position of said magnetic portion, and a scale post mounted on the magnet frame opposite said means for indicating the position of said magnetic portion, said means having slotted portions and said scale post being movable within any one of said slotted portions for locking the rating adjuster in any adjusted position and said scale post being movable away from said means for permitting adjustment of the rating adjuster.

3. A relay comprising a magnet frame, a controlling coil within the frame, a dashpot, a cover for said dashpot, means for connecting said cover and dashpot together, means extending through outside portions of said dashpot and through said cover and into said magnet frame for securing said parts together, a plunger movable within said coil, and a piston in the dashpot connected with the plunger for retarding the movement of the plunger.

4. A relay comprising a magnet frame, a controlling coil within the frame, a dashpot, a cover for said dashpot, means for connecting said cover and dashpot together, a magnetic keeper extending between portions of the magnet frame and positioned between said cover and the magnet frame, means extending through outside portions of said dashpot and through said cover and through said magnetic keeper into the magnet frame for holding said parts firmly together, a plunger movable within said coil, and a piston in the dashpot connected to the plunger for retarding the movement of the plunger.

5. A relay comprising a magnet frame, a controlling coil within said frame, a dashpot, a cover for the dashpot, a tube of insulating material fixed to and removable with said cover and extending upwardly within said coil, a magnetic plug secured to the top of said tube and removable with said tube, a plunger within said tube movable within said coil, and a piston in the dashpot connected with said plunger.

6. A relay comprising a magnet frame, a controlling coil within said frame, a dashpot, a cover for the dashpot, a tube of insulating material united with said cover and extending upwardly within said coil, a magnetic plug secured to the top of said tube, a plunger within said tube movable within said coil, and a piston in the dashpot connected with said plunger, said dashpot and cover having a sealed joint between them, said tube having a sealed joint with the cover and said plug having a sealed joint with the tube.

7. A relay comprising a magnet frame, a controlling coil within the magnet frame, a plunger movable within the coil, a dashpot, a cover for the dashpot, a pair of contacts supported by said cover, said cover having a cylindrical recess on its underside, a movable contact disk adapted to bridge said pair of contacts and fitted within said recess to be slidably movable within said recess and actuated by movement of said plunger, a spring between said movable contact disk and a portion of the cover for pressing said movable contact in engagement with said

pair of contacts, and a piston within the dashpot connected with said plunger.

8. A relay comprising a magnet frame, a controlling coil within the frame, a plunger within the coil, and a rating adjuster having a magnetic portion located between the coil and the path of the plunger and having an intermediate non-magnetic portion, and having a third magnetic portion supported by the magnet frame and extending within the coil and adjustable with reference to the frame.

9. A relay comprising a magnet frame, a controlling coil within the frame, a plunger within the coil, and a rating adjuster having a tapered magnetic portion located between the coil and the path of the plunger and having an intermediate non-magnetic portion, and having a third magnetic portion supported by the magnet frame and extending within the coil and adjustable with reference to the frame.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
888,340	Macloskie	May 19, 1908
969,866	Henderson	Sept. 13, 1910
1,430,612	Arnold	Oct. 3, 1922
1,590,001	Van Valkenburg	June 22, 1926
1,655,453	Brown	Jan. 10, 1928
2,303,442	Draper	Dec. 1, 1942
2,331,162	Becker	Oct. 5, 1943