Jan. 30, 1951 J. E. MOSSMAN ET AL 2,539,547

RELAY

Filed June 13, 1945 2 Sheets-Sheet 1

Fig. 1

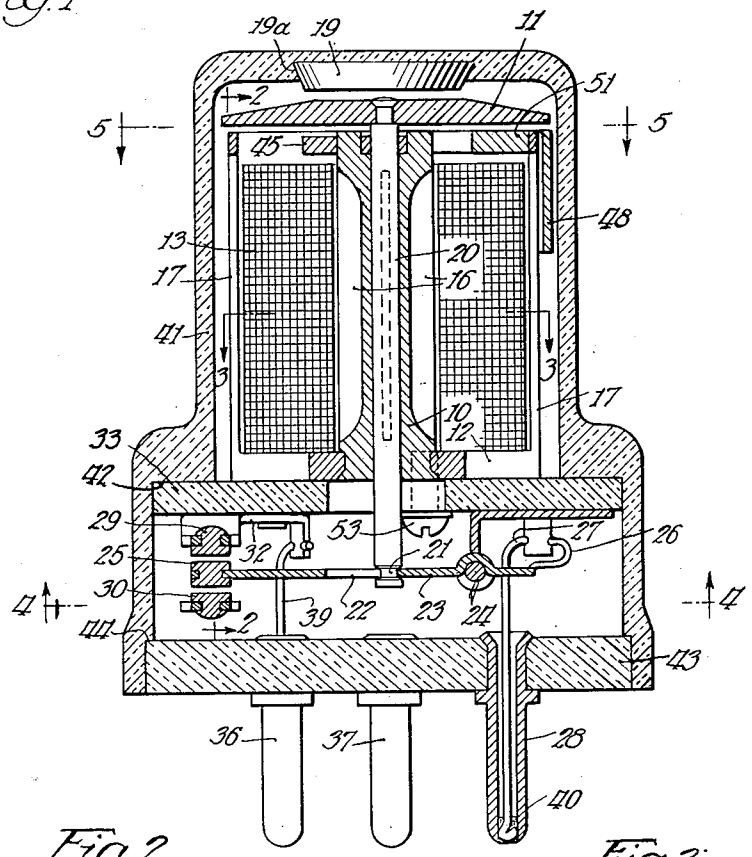


Fig. 2.

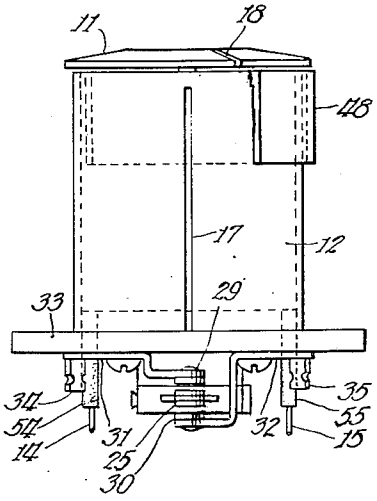
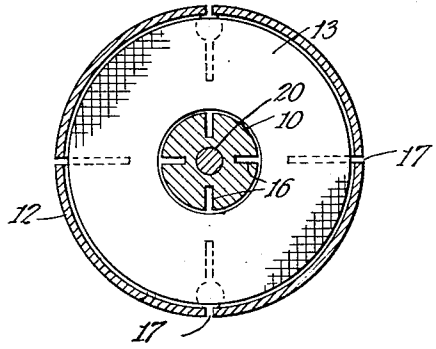


Fig. 3.



Inventors:
John E. Mossman.
James D. Elsom.
By: Greek Wells. Atty.

Jan. 30, 1951 J. E. MOSSMAN ET AL 2,539,547

RELAY

Filed June 13, 1945 2 Sheets-Sheet 2

Fig. 4

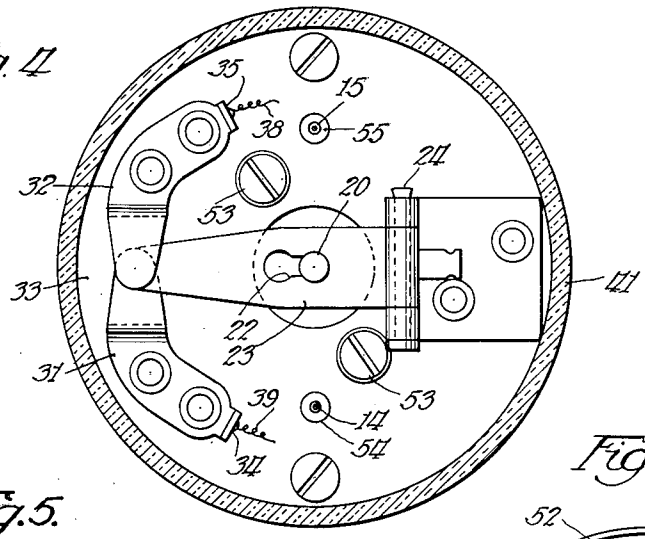


Fig. 5.

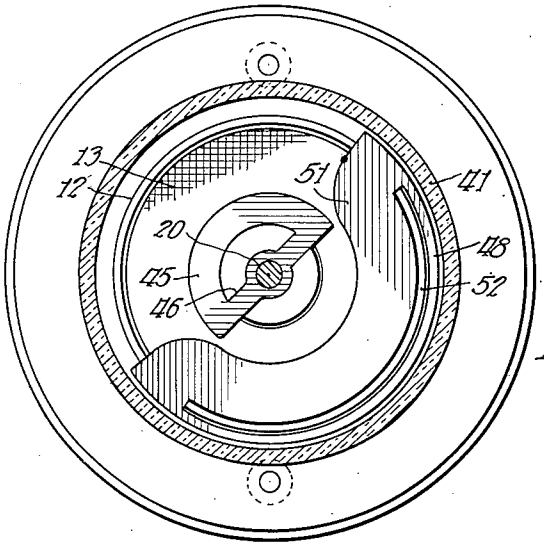


Fig. 6.

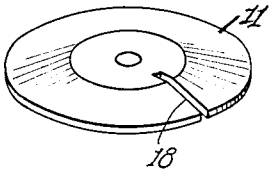


Fig. 8

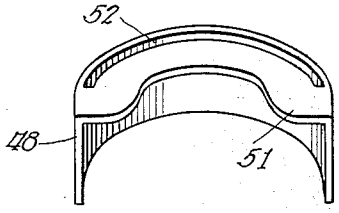
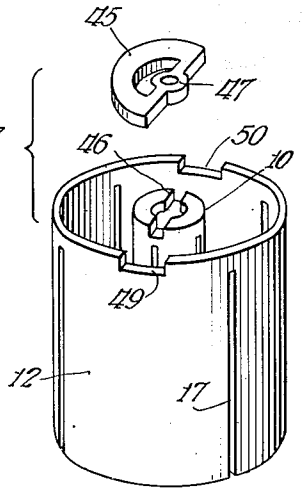


Fig. 7



Inventors:
John E. Mossman.
James D. Elsom.
By: Greek Wells Atty.

Patented Jan. 30, 1951 2,539,547

UNITED STATES PATENT OFFICE

2,539,547

RELAY

John E. Mossman and James D. Elsom, Chicago, Ill., assignors to C. P. Clare & Co., Chicago, Ill., a corporation of Illinois

Application June 13, 1945, Serial No. 599,132

1 Claim. (Cl. 200—98)

1

The present invention relates to relays, and has for its principal object the provision of a relay embodying a novel combination of parts whereby the necessity of springs to retract the armature is eliminated. It is customary in the manufacture of relays to depend upon springs or gravity to retract the armature when it is released by cutting off the current through the coil of the relay.

It is a further purpose of our invention to provide a relay construction that is particularly advantageous in giving higher rates of acceleration for breaking and making of contacts controlled by the armature. Although it is not limited thereto, our invention is particularly useful in alternating current relays for controlling sealed power units such as motors that are operated in sealed space over long periods of time without being opened for cleaning or inspection. In such environments it is essential that the relays be as free of sparking at the contacts as possible. In making or breaking a circuit for a motor or like power device, the sparking can be greatly minimized by speeding up the opening or closing of the contacts.

Our invention makes possible an increase in the speed of movement of the contacts at the critical point in their action. It is also essential in equipment of the character referred to above, that the opening and closing of the contacts be quite positive in character. It is well known that springs after repeated operations tend to crystallize or weaken, and this oftentimes results in failure of the equipment in a progressive way that is particularly damaging to the more expensive parts such as the motors.

Our invention contemplates the provision of a relay wherein both front and back contacts are closed with the same improvement in operation. However the invention is not limited in this manner since it may work equally well with only a front contact or a back contact. Likewise it may control a multiplicity of contacts with the same positive operation. The invention is embodied in an alternating current relay that utilizes the magnetic attraction of the armature by a permanent magnet for retracting the armature and holding it away from the core of the relay. The movable contacts are carried by a contact lever which is pivoted but which is not biased to any particular position by means of a spring. The lever may or may not be resilient depending upon the particular installation.

It is also a purpose of our invention to provide a novel relay construction embodying a coil and core for attracting the armature upon energization of the coil and a permanent magnet retracting the armature when the coil is de-energized, the entire assembly being sealed in a shell of non-conducting, non-magnetic material of such a nature that certain parts such as the permanent magnet are moulded in the material itself.

2

The nature and advantages of our invention will appear more fully from the following description and the accompanying drawings wherein a preferred form of the invention is disclosed. It should be understood, however, that the drawings and description are illustrative only, and are not to be taken as limiting the invention except insofar as it is limited by the claim.

In the drawings:

Figure 1 is a longitudinal sectional view through a relay embodying our invention.

Figure 2 is a view looking at the mechanical parts of the relay from the line 2—2 of Figure 1.

Figure 3 is a sectional view taken on the line 3—3 of Figure 1.

Figure 4 is a sectional view taken on the line 4—4 of Figure 1.

Figure 5 is a sectional view taken on the line 5—5 of Figure 1.

Figure 6 is a perspective view of the armature of the relay.

Figure 7 is an exploded perspective view showing the core construction of the relay, and

Figure 8 is a perspective view of an additional shading element that may be used under certain conditions.

Referring now to the drawings, the present invention is embodied in a relay wherein numeral 10 refers to the core, the armature is shown at 11, and a shell 12 is secured to the core at one end and extends upward to a point substantially flush with the end of the core adjacent the armature. A coil 13 is wound on the core and has its terminal leads 14 and 15 extending downwardly through the shell 12. The core, the armature and the shell preferably are constructed of silicon steel which is generally used in devices of this character, because of its low hysteresis and eddy current losses. In order to further improve the efficiency of the device, we provide slots 16 at intervals about the core, and similar slots 17 at intervals about the shell 12. The armature 11 may also be slotted as indicated at 18 for the same reason.

The relay includes, also, a suitable means for retracting the armature 11. This means comprises a permanent magnet 19 which is on the opposite side of the armature from the core 10 so that the attraction of the permanent magnet

is continually present, tending to move the armature away from the end face of the core and the shell. The armature is made to perform its function of opening and closing electrical contacts by means of a stem 20 of non-magnetic metal such as brass or stainless steel. The stem is riveted or otherwise firmly secured to the armature and extends through the core 10 to project a substantial distance below the lower end of the core. At its lower end the stem has a reduced neck portion 21 which fits in a slot 22 of a contact carrying lever 23. The lever 23 is pivoted on a pivot pin 24 and it carries a contact element 25 at its free end. The lever 23 is connected by suitable leads 26 and 27 to a plug 28 so that a source of current may be connected to the contact 25. The contact 25 cooperates with two opposed stationary contacts 29 and 30 so that when the lever arm 23 is moved downwardly by energization of the coil 13, and the resultant attraction of the armature 11 by the core 10 and the shell 12, a circuit is completed at the contacts 25 and 30. When the coil 13 is de-energized, the attraction of the permanent magnet 19 for the armature 11 moves the armature and its stem 20 upwardly to cause the lever 23 to swing the contact 25 away from the contact 30, and into engagement with the contact 29 to complete another circuit.

The contacts 29 and 30 are secured by terminal strips 31 and 32 upon a base plate 33 of insulating material. Wiring tips 34 and 35 are provided for these terminals so that they may be connected to plugs 36 which are similar to the plug 28. Two other plugs, 37, are utilized to connect the leads 14 and 15 from the coil 13 to a source of current. The lead wires, such as 27, 38 and 39 for connecting the coil and the contacts in the circuit, extend down inside the hollow plugs such as 28, 36 and 37, and are sealed in place by dipping the open ends of the plugs in solder so that the solder fills up the end of the plug as shown at 40 in Figure 1 of the drawings.

The mounting plate 33 is secured in a housing 41 by pressing it against a shoulder 42 in the housing, and cementing the plate 33 and the housing together. The plugs are carried by a mounting plate 43 which is seated in the open end of the housing 41 against a shoulder 44, and also cemented in place. The housing 41 is desirably circular in cross section with the lower portion housing the contacts being somewhat larger in diameter than the upper portion, so as to provide the shoulder 42. This housing is preferably constructed of a transparent insulating material. For example, a polystyrene resin or a similar material is satisfactory for our purpose. The plates 33 and 43 are constructed of the same material, and the cement used is such that it permanently bonds the plate to the shell.

In making up the shell 41 the permanent magnet 19 which is preferably of the material sold under the trade name Alnico is moulded in the shell itself. The magnet is formed with a tapering rim 19a, and is projected slightly beyond the inner surface of the shell, so as to give adequate clearance for engagement between the magnet and the armature. Magnets made of the material referred to above have the capacity to retain their magnetism for years with very little change in the strength of the magnet. These magnets are made and aged until the magnetic characteristics thereof are substantially uniform. They can withstand the necessary heat for moulding the polystyrene shell without adverse effects upon their magnetic qualities. Any effect of the repeated magnetization of the core upon the permanent magnet is substantially eliminated by the core and shell construction used which provides a substantially closed magnetic circuit about the coil.

As shown, this relay is constructed for use on alternating current. It is therefore provided with a shading coil 45 of copper. The coil is formed to fit in a slot 46 in the upper end of the core 10, and is pressed or staked in place. It will be noted that the shading coil has an aperture 47 through which the stem 20 passes. For some purposes it is desirable to have a greater shading effect, and in that case we prefer to employ a second shading coil 48, which cooperates with the shell 12. This shading coil comprises a copper stamping of substantially the shape shown in Figure 8 of the drawings. The shell 12 is notched as shown at 49 and 50 to receive the web portion 51 of the shading coil 48. This web portion is separated from the rim portion of the shading coil by a slot 52 that receives the edge of the shell 12 between the slots 49 and 50. The shading coil 48 is secured in place by staking it at the edges of the notches 49 and 50.

The shell 12 is fixed to the plate 33 by a pair of screws 53. The terminal strips 31 and 32 are riveted to the plate 33. The coil terminals 14 and 15 have sleeves 54 and 55 thereon, and these sleeves extend through the plate 33 and the shell 12 so as to insulate the coil terminals from the other parts of the relay.

The particular advantages of our improved relay lie in the improved acceleration of the movement of the armature 11 when it is attracted by the core 10, and when it is retracted by the magnet 19. In the case where the armature is in a retracted position the stem 20 has moved the lever 23 to bring the contact 25 against the contact 29. We prefer to make the lever 23 of a material having a slight resiliency, for example a nickel silver alloy so that the lever can yield sufficiently when the armature is retracted to bring the armature in close juxtaposition to the permanent magnet 19. Now when the coil 13 is energized sufficiently to initiate movement of the armature 11, the resultant action is a rapid deceleration of the attraction of the permanent magnet while the attraction of the core of the relay is increasing. This is because the attraction of a permanent magnet varies inversely as the square of the distance from the magnet to the armature. Thus when the armature has moved two thousandths of an inch from its resting position with respect to the permanent magnet, the attraction of the permanent magnet for the armature is one-quarter that when the armature was positioned one thousandth of an inch from the magnet. The result upon the movement of the armature 11 is a very rapid acceleration. This is translated to the contact 25 through the stem 20 and the lever 23 so as to break the contact away from the stationary contact 29, much more quickly than it would be broken if the armature were spring retracted or gravity retracted. When the armature is retracted by a spring, the spring must necessarily increasingly oppose the movement of the armature by the core, and that is the direct opposite of the effect of the permanent magnet. Much the same result is obtained upon the return stroke because when the armature is released by the core sufficiently for the permanent magnet to attract it, the movement of the arm-

ature is immediately accelerated at an increasing rate by its approach to the permanent magnet.

The construction of our relay, also, is particularly advantageous where it is necessary for the relay to be sealed in a space and left for long periods of time. There are no springs to crystallize, and with the type of shell provided, the inner parts of the relay are completely sealed from the atmosphere. Corrosion, therefore, is prevented from taking place and the only points of serious wear are at the junction of the stem 20 with the lever 23. Life tests on this relay have indicated that this wear even with the materials having no special hardening treatment, is adequate for many years of operation of the relay for its intended purpose.

It is believed that the nature and advantages of our invention are sufficiently explained in the foregoing description to enable those skilled in the art to practice the invention, and to appreciate the advantages thereof.

Having thus described our invention, we claim:

A relay of the character described comprising a cup shaped sealed housing having in one end thereof a permanent magnet with a flat face facing toward the other end thereof, a disc shaped armature adjacent said permanent magnet, a core of magnetic material fixed in the housing with its end face closely spaced with respect to said permanent magnet and on the opposite side of the armature from the magnet and holding the armature within the attraction range of the permanent magnet, whereby the permanent magnet will attract the armature when the core is de-energized, an energizing winding on the core, circuit control contacts in the housing, a guide stem for said armature extending through the core and operably connected to said contacts for actuating the same, and terminal leads for said circuit control contacts and said energizing winding extending through the end of the housing opposite the permanent magnet, said terminal leads being also sealed in the housing whereby all the operative parts of the device are completely sealed.

JOHN E. MOSSMAN.
JAMES D. ELSOM.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
428,650	Thomson	May 27, 1890
506,282	Timmins	Oct. 10, 1893
685,431	Pearson	Oct. 29, 1901
1,081,884	Bertagnolli	Dec. 16, 1913
1,086,985	Bliss	Feb. 10, 1914
1,215,422	Spangler	Feb. 13, 1917
1,987,144	Dinkel, Jr.	Jan. 8, 1935
2,369,331	Baker	Feb. 13, 1945
2,389,592	Bucklen, Jr. et al.	Nov. 27, 1945
2,450,924	Stilwell	Oct. 12, 1948

FOREIGN PATENTS

Number	Country	Date
407,052	Germany	Dec. 10, 1924
434,077	Great Britain	Aug. 26 1935