Jan. 5, 1937. O. T. McILVAINE 2,066,894

RELAY

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Fig. 1

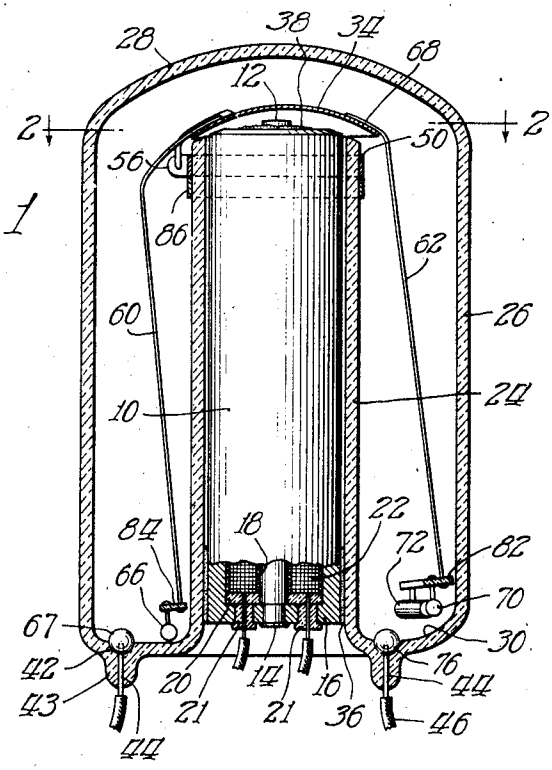
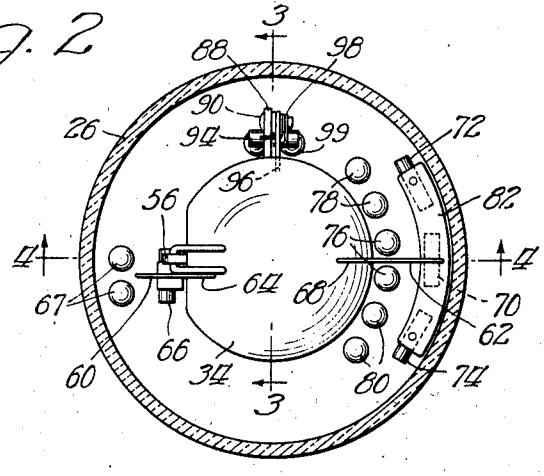


Fig. 2



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Fig. 3

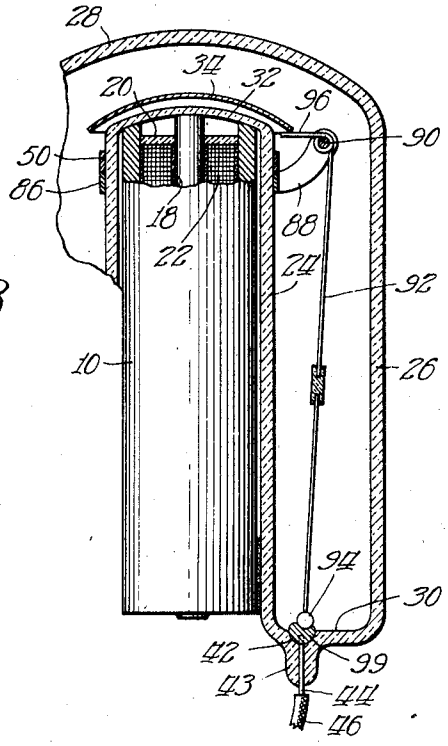


Fig. 5

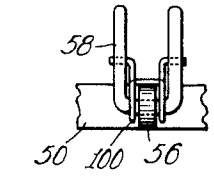
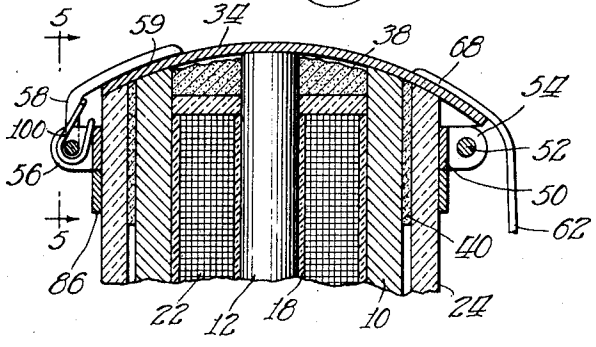


Fig. 4



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UNITED STATES PATENT OFFICE

2,066,894

RELAY

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Application May 28, 1934, Serial No. 727,872

11 Claims. (Cl. 200—87)

My invention relates to relays and includes among its objects and advantages quick action and compactness and an increased ratio between the controlled current and the actuating current.

In the accompanying drawings:

Figure 1 is an elevation of the magnetic unit and a central longitudinal section of the bulb;

Figure 2 is a section as on line 2—2 of Figure 1;

Figure 3 is a section as on line 3—3 of Figure 2, and also indicates a modified form of seal;

Figure 4 is an enlarged partial section as on line 4—4 of Figure 2; and

Figure 5 is a detail of the armature pivot.

In the embodiment of the invention selected for illustration the force unit is shown as electric and as magnetic. It comprises an outer tube 10 forming one arm of the magnet proper. The other arm is the central rod 12, riveted at 14 into the bottom wall 16 that completes the magnetic connection between the rod and the tube. In the annular space between the rod 12 and the tube 10 I insert the usual cartridge made up of the fibre tube 18 and the fibre end caps 20. The winding 22 is wound as on a spool, with the ends brought down to pass through the insulating bushings 24 in the bottom wall 16.

The entire magnetic unit is housed inside the inverted cup that constitutes the sealed bulb. This comprises the inner tube 24 and the outer tube 26. The outer tube has the usual domeshaped end at 28. The parts are assembled by flaring the lower end of the tube 24 and then welding the edge of the flared end to the lower edge of the tube 26. In doing this the joint is smoothed out to define a shallow trough at 30.

In the embodiment of Figure 3, the upper end of the tube 24 is closed by a dome 32, which is of relatively thin glass to decrease the magnetic gap between the magnetic unit and the armature 34.

In the embodiment of Figure 1 the seal is completed by suitable sealing wax at 36 around the base of the magnetic unit; and leakage through the magnetic unit may be prevented by extending the sealing 36 across the bottom of the unit, or by a similar sealing wax seal at 38, shown in elevation in Figure 1 and in section in Figure 4. In the embodiment of Figure 4 the sealing wax seal between the magnet tube 10 and the glass tube 24 is completed entirely at the top as at 40.

In the trough 30 I form a plurality of depressions 42 each having substantially the shape of a small hemisphere with the lower point of the rim of the hemisphere at substantially the lowest point of the trough 30. Below each such depression I weld on a sealing tit 43 in which is inserted the lead-in wire 44 insulated at 46 and passing through the glass up into the depression 42. In use, each depression receives a substantially spherical mercury globule. It is well known that the surface tension of mercury will hold such a globule of substantial size in subtantially spherical shape and that the capillary action between glass and mercury is such that mercury does not wet glass, so that the globule will be held quite definitely in position by the combined forces of gravity, surface tension, and capillary repulsion.

Near the top of the tube 24 I position a metal band 50 fastened in place by welding or by a bolt 52 passed through turned out ears 54. The band 50 also carries a lug 56 forming a pivotal support for the armature 34. I have illustrated a U-shaped metal arm 58 with its bight passing through the lug 56 and the ends of its legs welded to the upper surface of the armature at 59. I have illustrated the armature as a segment of a sphere concaved slightly downwards, for convenience in allowing a similar dome shape for the glass dome 32 of Figure 3 and at the same time reducing the magnetic gap in the embodiment of Figure 3 to a minimum. In the embodiments of Figure 1 and Figure 4, there is no such magnetic gap and the armature may be of any configuration and may be permitted to come as close to the tube 10 and rod 12 as may be desirable, taking into consideration the possibility of sticking of the armature by residual magnetism.

Depending from the armature 34 are a plurality of supporting rods of which I have illustrated two, 60 and 62. The parts are illustrated in Figure 1 with the armature remote from the magnet unit and with the switches at the bottom of the bulb in open position. The upper end of the rod 60 may be welded to the armature 34 at 64, and at the lower end is mounted a blade 66 in the form of a cylindrical metal rod of larger diameter than the supporting rod 60. It will be apparent from Figure 1 that attraction of the armature to closed position will move the blade 66 to the left and immerse its ends in the adjacent globules 67 to complete an electric circuit through the corresponding lead wires.

The supporting rod 62 is similarly welded to the opposite edge of the armature, as at 68, and carries at its lower end a similar blade 70. On either side of the blade 70 I have illustrated companion blades 72 and 74. The three blades 70, 72, and 74 move in unison to complete circuits through

pairs of globules at 76, 78, and 80. In this way all three branches of a three phase circuit can be simultaneously opened and closed. The companion blades 72 and 74 are separated from the central blade 70 by a bridge 82 of insulating material. It will also be obvious that in case the circuits to be controlled are such that no electrical contact should be established between the armature 34 and the blade 36, the rod 60 may be made up in part of a section of insulating material as indicated in Figure 1 at 84.

Below the band 58 I have illustrated a second band 86. Referring to Figure 3, the band 86 carries a bracket 88 affording a pivotal support by means of a pintle 90 for a supporting rod 92 carrying a blade 94. To permit the blade 94 to move radially with respect to the axis of the trough 30, the axis of the pintle 90 is positioned at right angles to the axis of rotation of the armature 34. I have illustrated the rod 92 wound once around the pintle 90 and then extending horizontally as at 96 to a position where the descent of the armature 34 will make contact with the end of the projection 96 and move the parts out of the position of Figure 3. I have illustrated a light biasing spring 98 that swings the rod 92 to the left into the position of Figure 3 to move the blade 94 over into the globules 98 when the armature is raised.

It will be noted that the rod 92 controls switching means that are open when the armature is actuated while the rods 60 and 62 control switching means that are closed when the armature is actuated. However, it will be obvious that this is a mere matter of choice, and that the operation of any one of these switches is easily reversed by interchanging the positions of the blade and the globules.

In case it is inconvenient to arrange the parts so that the armature will move to open position under the force of gravity, equal ease and speed of action can be obtained without such balancing of weights by the use of a small biasing spring indicated at 100 in Figure 4.

In assembling such a relay I place in the trough 30 the amount of mercury necessary to form as many globules as the relay is designed to have. By tipping the axis of the relay to about forty five degrees from the vertical, all this mercury can be assembled into a single mass and then by holding the axis practically vertical and giving the entire bulb a circular motion about a vertical axis offset from the axis of the bulb, the mercury can be washed around the circle, passing over each of the depressions in turn and leaving in each of them a globule of suitable size.

The relatively small angle through which the armature 34 must turn to open and close the relay contributes materially to both ease and speed of operation. All the parts except the blades can be mechanically much lighter than the blades themselves, and the blades themselves need only be long enough to bridge the gap between the globules. When a circuit of high voltage tends to establish an arc at the beginning of the opening movement, the current between the globules has to travel a U-shaped path in which the legs of the U are electric arcs and the bight of the U is the rigid blade. The magnetic field established by a current flowing in such a path will move the arcs out to the ends of the blade and continue to push them in the same direction beyond the end of the blade and thus blow them out.

The bulb may be filled with an inert gas or it may be evacuated, and in either instance the magnetic unit may be inside or outside the seal. In each such instance all the mechanically movable parts are inside the seal, and all the lead wires extend outside the seal.

Without further elaboration, the foregoing will so fully explain the gist of my invention that others may, by applying knowledge current at the time of application, readily adapt the same for use under various conditions of service.

I claim:

1. In a relay, in combination: a glass support having spaced depressions therein; mercury globules in said depressions and protruding above the rims thereof; lead wires in electrical contact with said globules; a conducting blade; an evacuated bulb enclosing said blade and globules; and means for moving said blade into and out of contact with said globules in a direction at a right angle to a line passing through both globules.

2. In a relay, in combination: a glass support having spaced depressions therein; mercury globules in said depressions and protruding above the rims thereof; lead wires in electrical contact with said globules; a conducting blade; an evacuated bulb enclosing said blade and globules; and means for moving said blade into and out of contact with said globules in a direction at an angle to a line passing through both globules.

3. In a relay, in combination: a glass support having spaced depressions therein; mercury globules in said depressions and protruding above the rims thereof; lead wires in electrical contact with said globules; a conducting blade; an evacuated bulb enclosing said blade and globules; and means for moving said blade into and out of contact with said globules in a direction such that the current, at the time of separating, flows in a U-shaped path of which the departing blade forms the bight.

4. In a relay, in combination: a magnetic unit; an inner sleeve housing said unit; an outer sleeve spaced from said inner sleeve to define an annular enclosure; the upper end of the outer sleeve being closed over; an annular trough having substantially the shape of the truncated lower third of a torus; the outer rim of said trough joining the edge of the lower end of said outer sleeve, the inner rim of said trough joining the adjacent lower end edge of said inner sleeve; said trough having localized depressions; mercury globules in said depressions; a pivoted armature adjacent the upper end of said inner sleeve; arms extending down from said armature between said sleeves; conducting switch blades mounted on said arms to move into and out of positions bridging said globules; and a vacuum seal completing the enclosure and positioned to include said armature and at least the adjacent metallic terminals of the magnetic unit, within the sealed space.

5. In a relay, in combination: a magnetic unit; an inner sleeve housing said unit; an outer sleeve spaced from said inner sleeve to define an annular enclosure; the upper end of the outer sleeve being closed over; an annular trough having substantially the shape of a truncated portion of a torus; the outer rim of said trough joining the edge of the lower end of said outer sleeve, the inner rim of said trough joining the adjacent lower end edge of said inner sleeve; said trough having localized depressions; mercury globules in said depressions, an armature adjacent the upper end of said inner sleeve; an arm extending down from said armature between said sleeves; a conducting switch blade mounted on said arm to move into

and out of a position bridging said globules; and a vacuum seal completing the enclosure and positioned to include said armature within the sealed space.

6. In a relay, in combination: a magnetic unit; an inner sleeve housing said unit; an outer sleeve spaced from said inner sleeve to define an annular enclosure; the upper end of the outer sleeve being closed over; an annular trough; the outer rim of said trough joining the edge of the lower end of said outer sleeve, the inner rim of said trough joining the adjacent lower end edge of said inner sleeve; said trough having localized depressions; mercury globules in said depressions; an armature adjacent the upper end of said inner sleeve; an arm extending down from said armature between said sleeves; a conducting switch blade mounted on said arm to move into and out of a position bridging said globules; and a vacuum seal completing the enclosure and positioned to include said armature and at least the adjacent metallic terminals of the magnetic unit, within the sealed space.

7. In a relay, in combination: a magnetic unit; an annular trough near the lower end of said unit; said trough having localized depressions; mercury globules in said depressions; an armature adjacent the upper end of said unit; an arm extending down from said armature; and a conducting switch blade mounted on said arm to move into and out of a position bridging said globules.

8. In a relay, in combination: a magnetic unit; an inner sleeve housing said unit; an outer sleeve spaced from said inner sleeve to define an annular enclosure; the upper ends of both sleeves being closed over; an annular trough, the outer rim of said trough joining the edge of the lower end of said outer sleeve, the inner rim of said trough joining the adjacent lower end edge of said inner sleeve; said trough having localized depressions; mercury globules in said depressions; an armature adjacent the upper end of said inner sleeve; an arm extending down from said armature between said sleeves; and a conducting switch blade mounted on said arm to move into and out of a position bridging said globules; the space between said sleeves being evacuated.

9. In a relay, in combination: a magnetic unit; an inner sleeve housing said unit; an outer sleeve spaced from said inner sleeve to define an annular enclosure; the upper end of the outer sleeve being closed over; an annular trough; the outer rim of said trough joining the edge of the lower end of said outer sleeve, the inner rim of said trough joining the adjacent lower end edge of said inner sleeve; said trough having localized depressions; mercury globules in said depressions; an armature adjacent the upper end of said inner sleeve; an arm extending down from said armature between said sleeves; a conducting switch blade mounted on said arm to move into and out of a position bridging said globules; and a vacuum seal completing the enclosure and positioned to include said armature and magnetic unit within the sealed space.

10. In a relay, in combination: a glass support having spaced depressions therein; globules in said depressions and protruding above the rims thereof; lead wires in electrical contact with said globules; a conducting blade; an evacuated bulb enclosing said blade and globules; and means for moving said blade into and out of contact with said globules in a direction at an angle to a line passing through both globules.

11. In a relay, in combination: an annular sealed evacuated bulb; stationary contacts mounted in said bulb; and movable contact means movable into and out of contact with said stationary contact means, said movable contact means making contact in the annular space defined by said bulb.

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