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MERCURY RELAY OF IMPULSE TYPE

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ATTORNEYS
MERCURY RELAY OF IMPULSE TYPE

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An impulse relay in that sense in which the term is being used in this specification may be defined as a relay which is to be actuated by electric current surges or impulses having a relatively short duration. The action of such a relay consists in alternating making and breaking a main circuit in response to such impulses which may originate e. g. from pressing a push button.

The patent literature comprises a number of specifications pertaining to impulse relays of the mercury type, as well as to mechanical ones. The best dependability as to insensitivity to wear and to occasional short circuits appears to be obtainable with mercury type relays, particularly when small size relays are being considered. When the magnet coil wattage is of the order of around 2 watts, as is usual with impulse relays, it is difficult to maintain large enough contact gaps if the relay is of a purely mechanical type.

In mercury relays on the other hand, one or both of the following shortcomings usually prevailed: (1) the relay function is not sufficiently positive, i.e. the device will once in a while fail to respond properly to a current impulse; (2) the switching action is—by the nature of the relay design—not immediately completed upon closing the current; i.e. the auxiliary current has to be interrupted as well to bring about the final phase of the switching action. The aim of the present invention is to overcome both of these objections.

The invention will presently be described in conjunction with the accompanying drawing in which Fig. 1 represents a sectional elevation of the new relay. Fig. 2 is an end view taken from the left of the embodiment shown in Fig. 1. Figs. 3, 4, and 5 are cross sections through the glass body of the relay in Figs. 1 and 2, showing the interior parts in various phases of operation. Fig. 6 illustrates in perspective the magnet core and pole shoe system employed; Figs. 7 and 8 are perspective views of the two movable parts inside the glass body: a soft steel armature member, and a contact carrying non-magnetic "swinging body," respectively. The same reference numbers are used throughout.

In Fig. 1 reference number 1 is a cylindrical glass bulb having (in its proper operational position) an essentially horizontal axis or shaft. It contains a mercury filling which is distributed between two pools, 2 and 3, by means of the glass ridge 4. A magnet coil 5 having a soft steel core is disposed upon top of the glass cylinder. The bent-in core legs are triangular in shape and are to serve as pole shoes (6 and 7); the complete core is more clearly illustrated in Fig. 6. At the bottom of the glass cylinder 1 a curved steel plate is provided for the purpose of absorbing stray magnetic fields. This will slightly reduce the coil wattage required for operating the relay.

The relay comprises in addition two main electrodes, 9 and 10, of which 9 is in contact with mercury pool 2, and 10 with mercury pool 3. The electrode 9 also serves as an axis for carrying the movable members inside the glass cylinder. Said members are a soft steel armature 11 and a non-magnetic swinging body 12 of which the latter is preferably made of steatite. In one of its ends the swinging body is equipped with a protruding lug 13 which cooperates with the armature 11. Fig. 7 is shown that the armature body in one of its ends is shaped like a triangular window 14 which gives a certain latitude of relative motion (back lash) between the armature 11 and the lug 13 (compare Fig. 8). In Figs. 1, 2, and 8 is shown that the swinging body also carries a double bent contact member 15, the purpose of which is to connect electrically the mercury pools 2 and 3.

The relay works as follows. Fig. 3 may be said to represent the initial position where both of the rotatable members, 11 and 12, are at rest against the top of the glass ridge 4. The contact member 15 in said position connects the two mercury pools, i. e. keeps the main current closed. Now when the magnet coil 5 is energized by means of an auxiliary current the armature 11 will rotate ¼ turn on its axis, owing to the magnetic attraction from the triangular pole shoes 6 and 7, and will come to a temporary rest in the position illustrated by Fig. 4. In the course of its motion the left radial frame member of the armature window 14 will have hit the lug 13 of the swinging body, thus transferring part of its momentum to the swinging body; this, as a consequence will be thrown past its upper dead center and thereafter comes to rest against the opposite radial frame member of the window 14 as shown in Fig. 4. In said position the contact member 15 is lifted away from the mercury pools 2 and 3, i.e. the main current is interrupted.

When the magnet coil is de-energized the swinging body, owing to its gravity, will carry the armature 11 over towards the right whereas the two members come to rest as shown in Fig. 5. The main current thus remains interrupted.

At the next current impulse through the magnet coil 5 the armature member 11 first rotates ¼ turn in an anti-clockwise direction; in the course of its motion it swings body over towards the left, and into the position given in Fig. 2. Already at this instance the contact member 15 has re-established the electrical connection between the mercury pools, i.e. the main current is being closed immediately as the impulse producing push button (not shown) is being pressed. When de-energizing the magnet coil both of the members 11 and 12 drop back into their original positions according to Fig. 3.

It should be apparent that the proper functioning of the relay depends on the feature that the center of gravity of the swinging body is sufficiently offset from a vertical plane through the axis of rotation to be able to carry over the armature from its top dead center position towards its own side. It also depends on properly choosing the angular opening of the armature window 14. This opening angle should be small enough to allow the swinging body to receive its impetus before the armature has reached its top dead center position, and at the same time sufficiently large to permit an angular motion of the swinging body beyond its top dead center position allowing contact between members 15 and the mercury pools at the phase of operation shown in Fig. 2. To make the entire device as effective as possible in regard to wattage of operation a certain optimum relation between the inertias of the two members 11 and 12 are obviously required. The elastic properties of the two members should here also be taken into account. The optimum dimensions are most easily determined experimentally. It is believed that the relative dimensions shown in the various figures will comparatively well coincide with said optimums.

Within the scope of the invention several modifications are possible. The armature may e. g. be provided with a lug protrusion, and the swinging body with the frame to cooperate with the lug. Both of the rotatable members may
be equipped with means to adjust the mutual impact resiliency and with additional means to protect the glass ridge from being exposed to undue stresses.

I claim:

1. An electromagnetically operated impulse relay comprising, in combination, a horizontally disposed cylindrical glass bulb, a partition dividing the lower wall section of said bulb into two portions, a pool of mercury in each of said portions, a pair of contact electrodes extending through said bulb walls, each of said electrodes making contact with one of said mercury pools, a shaft extending longitudinally through said bulb on the center line thereof, a generally U-shaped magnetic armature member pivoted by its arms on said shaft, a contact carrying member also pivoted on said shaft and a lost motion connection between said armature member and said contact carrying member whereby said armature member imparts motion to and receives motion from said contact carrying member to cause said contact carrying member to move past dead center position while said armature member is held in dead center position.

2. An impulse relay as claimed in claim 1, wherein an electromagnet having pole pieces extending against the upper wall of said cylindrical bulb causes the armature member to rotate approximately a quarter turn about its shaft when said magnet is energized, said armature member in the course of that motion imparting to the contact carrying member a motion in excess of a quarter turn but less than one-half turn.

3. An impulse relay as claimed in claim 1, in which means are provided for mechanically limiting the angular motion of the armature member and of the contact carrying member to approximately one-half turn.

4. An electromagnetically operated impulse relay comprising, in combination, a horizontally disposed cylindrical glass bulb, a transverse partition dividing the lower wall section of said bulb into two portions, a pool of mercury in each of said portions, a pair of contact electrodes extending through said bulb walls, each of said electrodes making contact with one of said mercury pools, a shaft extending longitudinally through said bulb on the center line thereof, a generally U-shaped magnetic armature pivoted by its arms on said shaft, at least one of said arms having an annular slot therein, a contact carrying member also pivoted on said shaft, said member having a lug extending therefrom into the slot of said armature member, said lug having a lesser angular extent than said slot, said armature and contact members normally at rest lying on said partition, magnetic pole pieces mounted outside said bulb substantially at the top thereof, said pole pieces being generally triangular with the points thereof facing each other, said points being substantially at the top of said cylindrical bulb, and electrical means comprising a winding on said pole pieces for magnetically energizing said pole pieces to thereby operate said U-shaped armature member to its uppermost position, said U-shaped member, by virtue of the lug and slot connection, picking up said contact carrying member and causing it to rotate until the lug strikes the opposite end of the slot, the contacts of said contact carrying member then breaking the contact with said mercury pool, said magnet winding, upon being deenergized, releasing said armature and permitting said armature and said contact carrying member to fall until they rest on the opposite side of said transverse partition wall, a subsequent energization of said magnet causing the contacts of said contact carrying member to be thrown by said armature member into engagement with said pool of mercury and to be dropped upon deenergization of said magnet winding into the original position of rest.

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