June 30, 1942. U. C. HEDIN 2,288,090

MERCURY RELAY

Filed Sept. 21, 1940

Fig. 1.

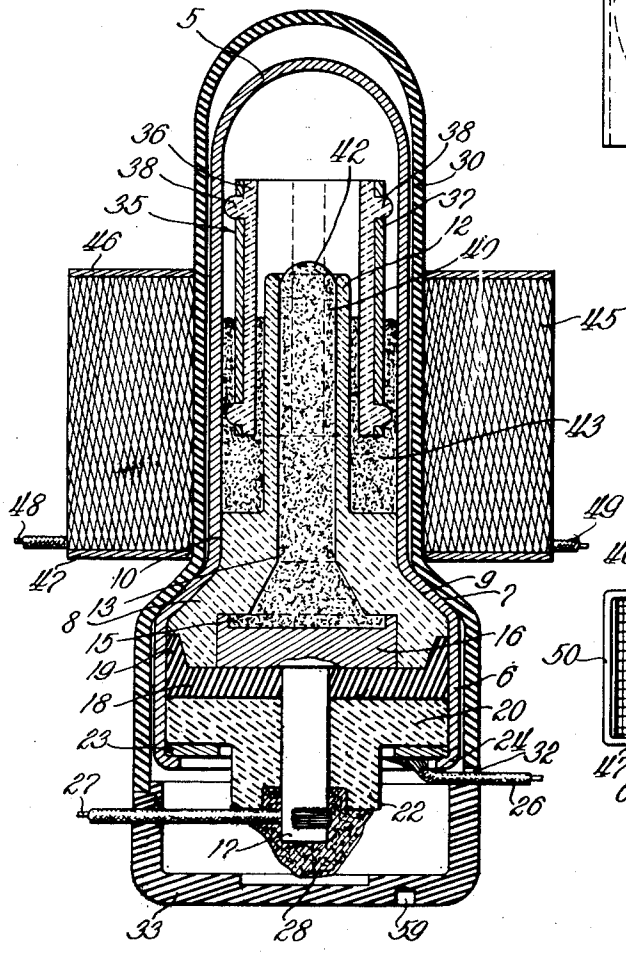


Fig. 3.

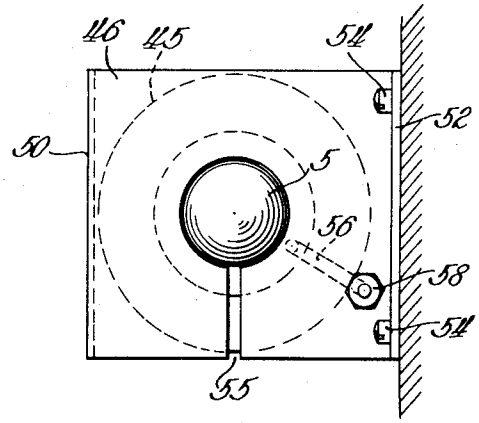
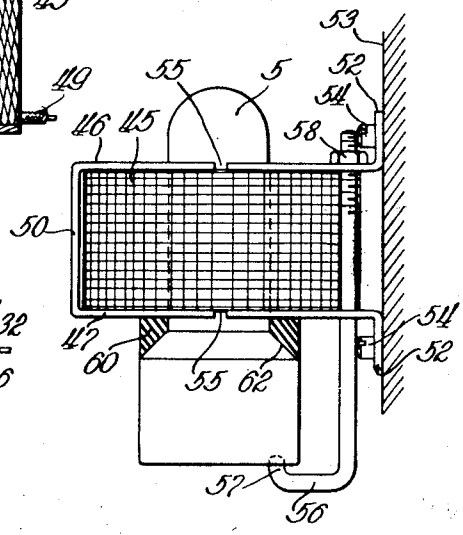


Fig. 2.



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MERCURY RELAY

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7 Claims. (Cl. 200—112)

This invention relates to mercury relays, and more particularly is directed to mercury relays of the displacer type comprising a metallic envelope having two electrodes spaced apart by means of a ceramic or refractory member with bodies of mercury retained in contact with one or both of the electrodes and adapted to provide bridging contact between the electrodes for completing a circuit upon displacement of a plunger or the like through magnetic action.

One of the primary objects of the present invention is to provide a metallic envelope mercury relay which will avoid the objections heretofore encountered in the use of glass relays in which the glass envelope was frequently cracked or broken during shipment or in use by reason of the action of the displacer, which must necessarily have a magnetic material associated therewith and which, when moved rapidly, might engage the glass envelope with sufficient force to break the same. In fact, in such previous constructions using glass envelopes it became necessary to employ cushioning means for the ends of the displacer to insure against too rapid movement thereof or shifting thereof during shipping, which means, however, was not wholly effective.

Another object of the present invention is to provide a construction in which the mercury relay can be readily mounted in a solenoid or the like, and is capable of assuming various axial positions therein by use of a novel type of spacing and clamping means so that relays of various capacities may be employed with the same solenoid mounting bracket.

Still another feature of the present invention is to provide an improved mounting for holding the switch in fixed axial non-rotative position within the solenoid core.

Other objects and advantages of the present invention will be more apparent from the following detailed description which, taken in conjunction with the accompanying drawing, will disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.

In the drawing:

Figure 1 is a sectional view through one form of mercury displacer embodying the present invention;

Figure 2 is an elevational view, partly in section, of a switch such as shown in Figure 1 in conjunction with the mounting bracket for the solenoid; and

Figure 3 is a plan view of the structure shown in Figure 2.

Referring now in detail to the drawing, in Figure 1 I have shown a metallic envelope 5 having the enlarged end portion 6 joined to the main tubular body portion by the frusto-conical shoulder 7. This envelope must be of the austenitic type, and may comprise stainless steel or a non-magnetic material that does not amalgamate with mercury. A stainless steel of the 18–8 group is preferable, having not less than 24% chromium and nickel combined, but not less than 8% of each element. The shell has an enlarged open end in which is inserted the ceramic or refractory member 8 having a frusto-conical shoulder portion 9 seating on the shoulder 7 and axially locating the refractory 8 in position. The shoulder 9, together with the inwardly extending cylindrical portion 10 of reduced diameter, form means for radially centering the insert within the envelope.

The insert 8 is provided with the tubular extending portion 12, which is bored as indicated at 13, to form an axial passage therethrough, opening out at its lower end through the flared portion 14 into the face 15 of an electrode head 16 secured in the counterbored lower end of the insert 8. The electrode head 16 is of an axial extent such as to fit fully within the end of the insert 8, and has the central projecting shank 17 projecting outwardly of the open end of the envelope 5. Seated against the rear face of the electrode head 16 and the lower end of the insert 8 is an elastic compressible sealing means 18, such as rubber or the like, forming a gasket having the projecting skirt or lip portion 19 extending about the frusto-conical shoulder formed on the insert 8. The gasket 18 is compressed in position by means of a refractory compression member 20 which extends into the open end of the envelope and has the reduced cylindrical portion 22 encircling the shank 17 of the electrode outwardly of the envelope end. The entire assembly is maintained under compression to force the gasket 18 into sealing engagement with the internal walls of the envelope by means of the metallic retaining ring 23 held in position by the spun-over edge 24 at the open end of the envelope. The retaining ring 23 is connected to one side of the circuit controlled by the relay through the conductor 26, electrically bonded thereto. The electrode shank 17 is connected to the opposite side of the circuit through the conductor 27 secured to the projecting end of the shank outwardly of the shouldered portion 22 of the compression member 20, and is preferably encased within a hard setting cementitious ma-

terial, such as indicated at 28, which forms a water-proof bond over the terminal and the end of the compression member 20.

The envelope assembly is preferably enclosed within an insulating molded case formed of two pieces comprising the main body portion 30 which extends about the closed end of the envelope and is shouldered to enclose the enlarged end of the envelope, being notched as indicated at 32 for leading out the conductor 26. The end of the case member 30 is closed by a cup-shaped cap member 33 which is rabbeted into the end thereof and suitably cemented thereto.

Disposed within the tubular body of the envelope 5 and radially spaced from the extension 12 of the insert 8 is a circular plunger 35 comprising an inner member of refractory insulating material 36 and an outer tubular shell 37 of magnetic material, such as soft iron or the like. Adjacent opposite ends the cylindrical sleeve 36 is provided with radially extending circumferentially spaced projections 38 which extend through suitable apertures formed in the iron sleeve 37 to locate the iron sleeve against axial movement relative thereto, and also to provide insulating bumpers for preventing contact between the iron sleeve 37 and the metallic shell 5. Disposed in the bore 13 of the extension 12 and lying in contact with the face 15 of the electrode is a body of mercury 40 which, at its upper end has the meniscus curve 42 lying within the circular edge of the sleeve 12. Disposed on the outside of the sleeve 12 and in the annular space between the external sleeve 12 of the tubular portion 5 is a second body of mercury 43 in which the lower end of the displacer 35 is immersed. Due to the relative difference in specific gravities of the displacer and the mercury, the displacer floats in the mercury, as shown in the normal inoperative position of the relay. At this time there is no contact between the two bodies of mercury 42 and 43, and consequently the circuit between the conductors 26 and 27 is open.

Surrounding the relay is a solenoid coil indicated diagrammatically at 45, and disposed between the metal plates 46 and 47, this coil having a bore through the center through which the tubular portion of the relay 5 extends. Upon energization of the coil 45 by closing a circuit through the conductors 48 and 49, the coil is energized and the magnetic action results in pulling the displacer 35 downwardly into the body of mercury 43. This displaces the mercury so that it rises in the annular space between the sleeve 12 and the shell until it breaks over the upper edge of the sleeve 12 and flows into contact with the body of mercury 40, completing a circuit between the conductors 26 and 27. So long as the coil is energized, the displacer remains in this position, but upon de-energization of the coil, the spacer moves upwardly due to its smaller specific gravity, consequently lowering the level of the mercury body 43 and breaking contact over the edge of the sleeve 12.

It will thus be seen that a mercury to mercury making and breaking of contact is effected over the refractory sleeve 12 and that any arc which might occur is located within the refractory sleeve 36, thereby preventing any possibility of arcing between the mercury and any adjacent metallic surface. As a result, the metallic surfaces are protected against possible pitting or burning caused by such arcs and a substantially uniform point of making and breaking contact is provided.

It will be noted that the body of mercury 40 has appreciable surface contact with the face of the electrode 15 so as to reduce the contact resistance between the electrode and this body of mercury. Similarly, the body of mercury 43 has considerable surface contact with the tubular shell 5 to insure low contact resistance therebetween, thereby reducing the resistance to flow of current through the switch when the coil 45 is energized.

Considering now the form of the invention shown in Figures 2 and 3, the switch 5 shown in these figures is similar to the switch disclosed in detail in Figure 1. The coil 45 in this embodiment of the invention is mounted in a substantially U-shaped bracket member 50 which has normally extending flanges 52 at the ends thereof which are adapted to be secured to a supporting surface 53 by means of the screws 54. The clamp 50 is normally made with the two parallel clamping surfaces 46 and 47 extending at a slight angle away from each other so that when placed in position they tend to clamp the coil 45 therebetween. The two legs 46 and 47 of the clamp are split, as indicated at 55, to prevent eddy currents therethrough and to reduce the magnetic reluctance of the circuit.

The plates 46 and 45 are apertured to receive the small diameter portion of the switch 5 which extends therethrough and through the bore of the coil 45. The switch is held in position by means of a J-bolt 56, preferably formed of spring material, having the vertically extending end 57 engaged in the recess 59 in the cap member 33 and having the shank portion extending through suitable openings in the legs 46 and 47 and secured by means of the nut 58 over the upper plate 46 in tensioned relation to hold the switch firmly in position.

To adapt the construction for use with various lengths of relays, a spacer member 60 is provided which may be formed of wood, porcelain, or any similar insulating material and which has a frusto-conical recess 63 therein seating about the frusto-conical surface formed by the enlarged portion of the relay. This member seats against the under surface of the plate 47 and when the bolt 56 is tightened in position, the switch is securely held against movement axially with respect to the coil 45 or the clamp 50. Preferably, the recess 59 in the cap is arranged with respect to the bolt 56 so that the bolt extends radially with respect to the axis of the relay. Thus the bolt serves not only to hold the relay 5 against downward displacement relative to the coil 45, but also prevents rotation of the relay 5 within the clamp.

This provides a very simple mounting arrangement in which the switch can be accurately held in position both axially and rotatably, and insures a quick means of assembling the switch in position relative to the coil.

It is therefore believed apparent that I have provided a novel type of mercury relay construction which can be readily manufactured at low cost and which includes the provision of a metal enclosing envelope providing added strength and insuring against breakage of the relay, such as is common in connection with glass envelope types. Further, the construction is so designed as to facilitate the use of standard mercury switch parts. In addition, a novel type of clamping means for holding the relay in position relative to its energizing coil is provided and which is capable of adjustment to take care of various

sizes of relays. It is to be understood that the switch shown in Figure 1 can also be provided with a tubulation for filling, evacuating and refilling with hydrogen under pressure when such procedure is desired.

I am aware that various changes may be made in certain details of the construction herein shown and described, and therefore do not intend to be limited except as defined by the scope and spirit of the appended claims.

I claim:

1. In combination, a mercury relay switch including a tubular body portion and an enlarged end portion, a coil adapted to receive said body portion, and a clamp for securing said coil and switch to a supporting surface comprising a U-shaped portion receiving said coil between the legs thereof and having apertures through which said tubular body extends, and a bolt passing through said leg portions and having means at one end engaging the enlarged end of said switch to hold it against axial and rotational movement relative to said clamp.

2. In combination, a metal envelope mercury relay switch including a tubular body portion and an enlarged end portion, a molded insulating case enclosing said switch, a cylindrical magnetic coil adapted to receive said body portion axially therein, a U-shaped metal strap having alined apertures in the legs thereof receiving the switch with the coil disposed between the legs, a J-bolt extending through said legs and engaging in the lower end face of said switch case for supporting the switch against axial movement relative to the clamp and coil, and radial slots in said legs of said clamp preventing eddy currents therein.

3. A clamp for a tubular metal envelope mercury relay switch of the displacer type having an encircling magnetic coil, comprising a channel-shaped metal strap adapted to receive the coil therein, means defining alined apertures in the walls of the channel receiving the projecting portions of the switch, said switch having a radial enlargement at its lower end limiting axial movement thereof relative to said clamp in one direction, and a bolt carried by the clamp and having a reversely bent offset end engaging in the lower end face of the switch for preventing axial movement thereof in the opposite direction.

4. A clamp for a two-diameter metal envelope mercury relay switch having a molded insulating case comprising a channel-shaped metal strap having out-turned end flanges for attachment to a supporting surface, means forming apertures in the walls of the channel for receiving the small diameter portion of the switch, said walls being spaced apart to receive a magnetic coil encircling that portion of the switch between the walls, and a tension member extending through the walls in laterally offset relation to said apertures and having an end portion engaging in the lower end face of the switch case for holding the shoulder of the switch up against the lower wall of the channel.

5. The clamp of claim 4 further characterized in the provision of a ring around said case between said lower channel wall and said shoulder for spacing said shoulder below said wall.

6. The clamp of claim 4 further characterized in that said tension member comprises a J-bolt having radially offset interlocking engagement with said lower end face of the switch case to hold said switch against rotation relative to said clamp.

7. The clamp of claim 4 wherein said channel strap is normally formed with said walls diverging slightly away from the web thereof whereby upon securing said flanges to a supporting surface said walls move toward parallel relation to clamp said coil therebetween.

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