June 23, 1942. U. C. HEDIN ET AL 2,287,306

MERCURY SWITCH RELAY

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Fig. 1

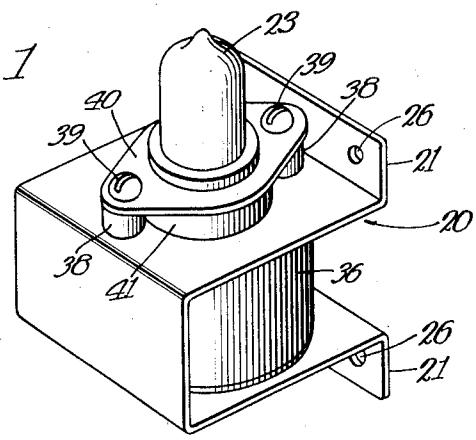

Fig. 2

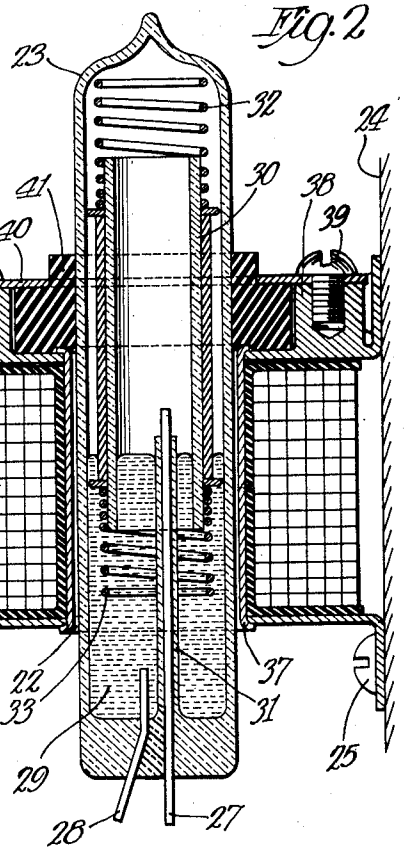

Fig. 3

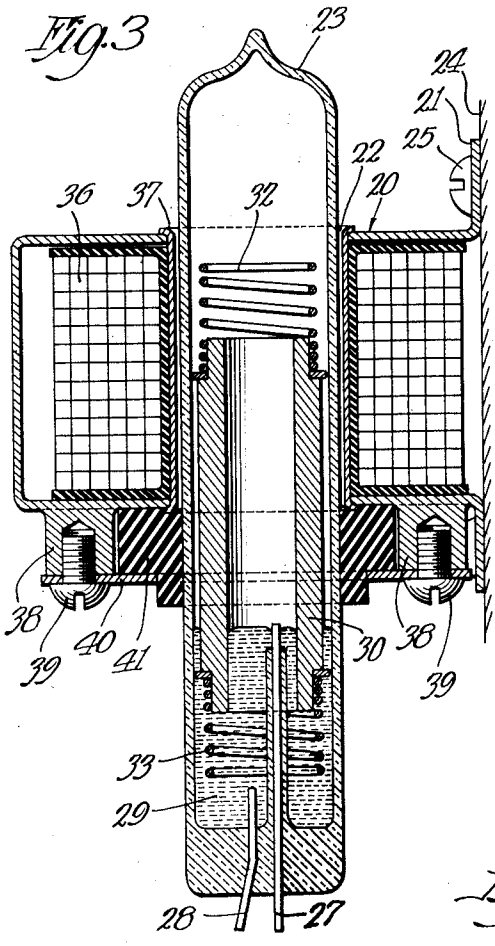

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Fig. 4

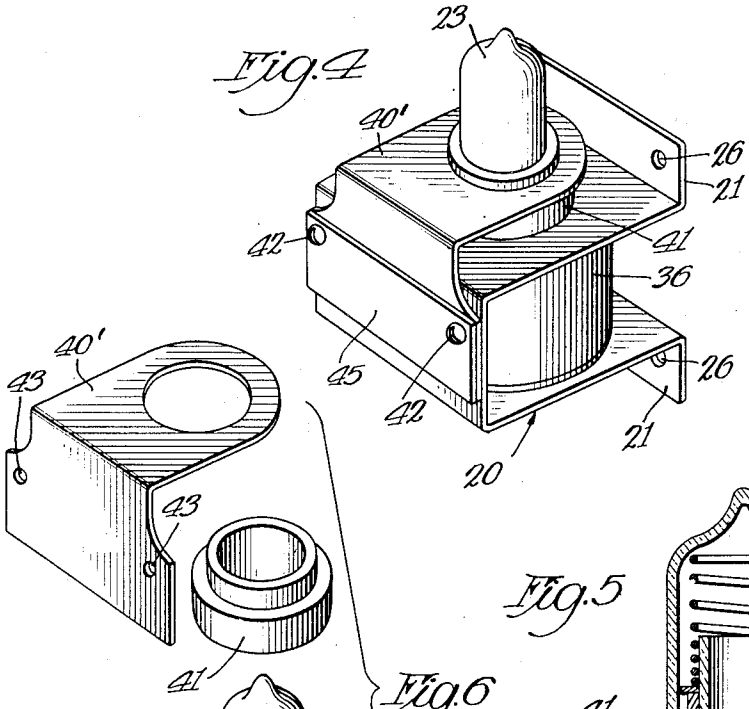

Fig. 5

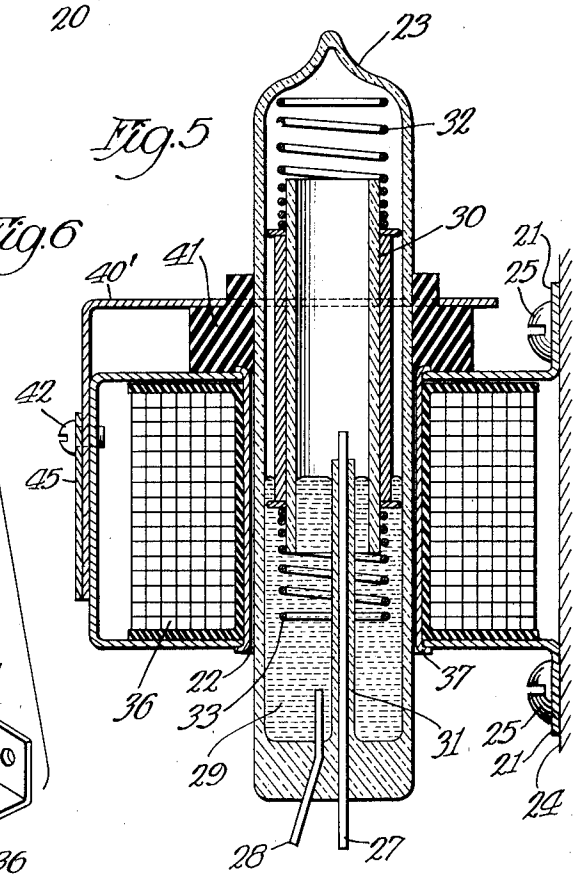

Fig. 6

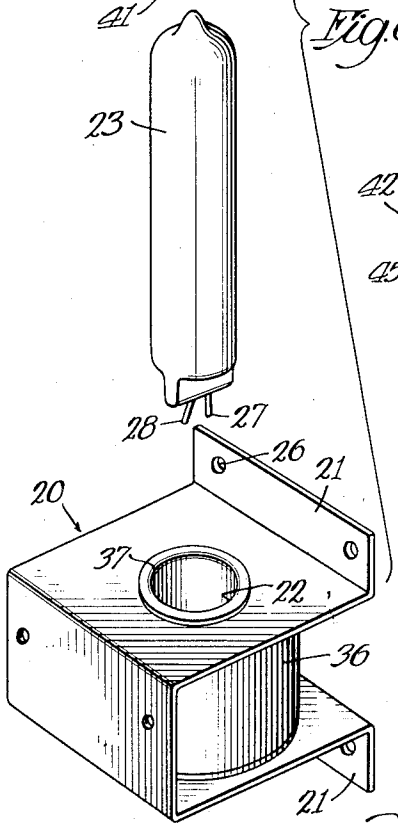

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Fig. 7

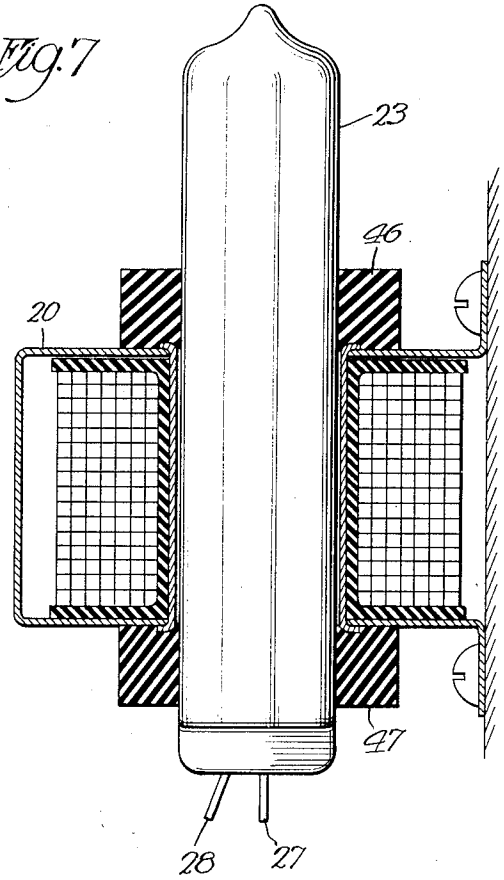
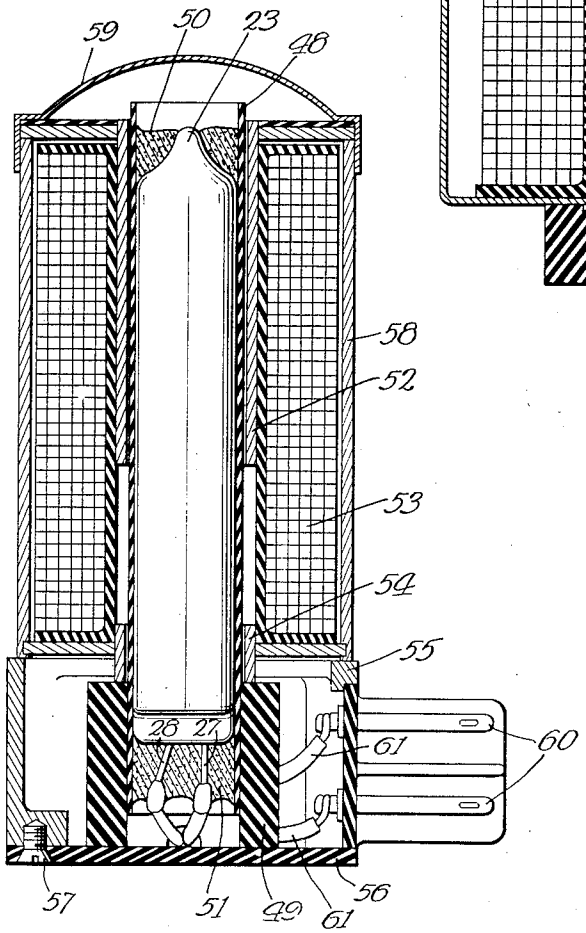


Fig. 8



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UNITED STATES PATENT OFFICE

2,287,306

MERCURY SWITCH RELAY

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Application June 12, 1939, Serial No. 278,710

21 Claims. (Cl. 200—112)

Among the principal objects of the present invention are the following: To provide a simple iron circuit and mounting suitable for use with front or back contact types of magnetically operated mercury switches; to securely hold the switch in any desired adjusted position by a simple elastic mounting; and to provide such a mounting using a minimum number of parts.

Other objects and advantages will become apparent as the disclosure proceeds and the description is read in conjunction with the accompanying drawings, in which

Fig. 1 is an isometric view of one form of the complete switch assembly;

Fig. 2 is a vertical sectional view taken through the switch assembly and showing the application of the present invention as it applies to a front contact switch;

Fig. 3 is a vertical sectional view through the assembly showing the application of the present invention to a back contact switch;

Fig. 4 is an isometric drawing showing another form of the invention;

Fig. 5 is a vertical sectional view taken through the switch assembly of the form shown in Fig. 4;

Fig. 6 is an exploded isometric view showing the method of assembling the elements shown in Fig. 4;

Fig. 7 is a vertical sectional view taken through the switch assembly (with the exception of the envelope, which is indicated only diagrammatically) showing two elastic sleeves employed for holding the switch envelope in place; and

Fig. 8 is a modified form of a mercury switch assembly employing a Bakelite tube around the switch envelope with the elastic sleeve surrounding the tube and showing the mercury switch with all of its elements completely enclosed.

In compliance with section 4888 of the Revised Statutes, specific embodiments of the present invention have been selected, but it is intended that the claims be construed as broadly as the prior art will permit.

Referring now to Figs. 1 to 3, inclusive, the entire assembly is supported on a U-shaped frame 20 having outwardly extending flanges 21. The frame 20 is mounted on a suitable support 24 (Fig. 2) by means of screws 25 passing through holes 26. Through the horizontal walls of the supporting frame is an opening 22 adapted to receive a mercury switch 23 of the mercury displacement type. As shown in Fig. 2, this switch may be what is known as a front contact switch, having a pair of electrodes 27 and 28 entering at the bottom, a quantity of mercury 29, and a plunger 30, adapted to be pulled down into the mercury in response to the action of a magnetic field. An insulating material, indicated at 31, surrounds the electrode 27, except for its extreme end, so that the circuit through the mercury is completed only when the plunger 30 causes the mercury to rise to complete the contact through the exposed end of electrode 27. The usual cushioning springs 32 and 33 are provided at the top and bottom ends, respectively, of the plunger.

Surrounding the opening 22 in the supporting frame and positioned between the top and bottom parallel surfaces of the frame is an electromagnet 36. A coil sleeve 37, preferably of brass, is passed through the open core of the coil 36, and is then spun over at both ends to hold the coil in place within the frame 20.

On the top surface of the supporting frame 20 are a pair of bosses 38, threaded to receive machine screws 39, which, in turn, fasten down a clamping plate 40. A sleeve 41, made of rubber or some other elastic material, surrounds the switch 23 and is supported on the top surface of the frame 20. The clamp 40 rests on the top surface of this sleeve and prevents upward movement of the sleeve. The sleeve preferably fits snugly around the envelope with sufficient friction therebetween to permit gripping of the envelope. The sleeve may be highly elastic, and pressure of the clamp 40 may be utilized to distort the rubber sleeve to obtain the gripping action. In this latter arrangement, in order to adjust the switch 23 in the assembly to change the operating characteristics of the relay, screws 39 are loosened, thereby releasing the pressure between the sleeve 41 and the envelope wall, so that the envelope may be moved up or down in the supporting frame; and, when the adjustment has been made, screws 39 are again tightened.

This assembly is suitable for either a front or back contact switch and may be used with the elastic sleeve 41 on top of the supporting frame, as shown in Fig. 2, or the entire frame may be inverted for use with the back contact switch, as shown in Fig. 3. In the inverted position, the switch envelope is more nearly centered in the assembly than it would be if a back contact switch were assembled with the supporting frame in the position shown in Fig. 2.

In the form shown in Fig. 3, the plunger 30 normally displaces the mercury, as shown, to complete the circuit through the mercury switch;

and the electromagnet 36 in this instance serves to raise the plunger 30 to break the contact through the mercury.

In the form of the invention shown in Figs. 4 and 5, an angle bracket 40' is used to clamp the sleeve 41 to the frame 20. It is secured to the vertical web of the frame by machine screws 42 inserted in holes 43. Plate 45 is a designation tag.

To assemble the relay shown in Fig. 4, the supporting frame 20 is held in the position shown in Fig. 6, and the electromagnet 36 is placed in its proper position between the parallel surfaces of the frame. The coil sleeve 37 is then put into place and spun over the horizontal webs of the frame. The switch 23 is inserted in the opening 22, and then elastic sleeve 41 is placed around the envelope on the top surface of supporting frame 20. The switch 23 is then adjusted so as to obtain the proper relative positions between the envelope and the electromagnet 36. Next, the clamp 40' is placed over the envelope, and screws 42 are inserted and drawn tight.

The back contact switch may be assembled in the same manner or, as previously suggested, the supporting frame may be inverted.

The frame 20 is made of sheet iron and serves not only as the support for the switch but also as the external iron circuit for the electromagnetic field. The relay, as thus constructed, is inexpensive to manufacture, and yet possesses the necessary flexibility for adjustment.

It may be desirable to employ two elastic sleeves around the switch envelope 23, one surrounding the upper portion of the envelope and resting on top of the frame 20, and one near the bottom of the envelope, as indicated in Fig. 7, and engaging the lower surface of the frame 20. In this arrangement, each of the sleeves identified at 46 and 47, respectively, fits snugly around the envelope 23 so as to grip the envelope; and, since they contact the top and bottom surfaces respectively of the supporting frame 20, they hold the switch envelope in place in the electromagnetic field.

As shown in Fig. 8, the glass envelope 23 may be housed within a Bakelite tube 48, in which case an elastic sleeve 49 may be tightly fitted over the bottom of the Bakelite tube. Some suitable sealing wax or sealing compound may be employed to seal the Bakelite tube 48 at the top of the switch envelope 23, as indicated at 50, and in the bottom of the tube as shown at 51. In this arrangement, the iron circuit is indicated at 52, and the electromagnet 53 is properly held in place within the circuit. A ring 54 is secured to the bottom of the iron circuit 52, and the elastic sleeve 49 engages this ring, thereby preventing upward movement of the sleeve with respect to the iron circuit 52. A housing 55 surounds the bottom portion of the Bakelite tube 48 and the sleeve 49, and a suitable cap 56 of Bakelite or other material is machine screwed to the housing 55, as shown at 57. The electromagnet and other switch elements are enclosed in the housing 58, and a suitable cap 59 fits over the top of this housing to complete the switch enclosure. As shown, housing 58 forms part of the iron circuit 52.

Electrical connections to the mercury switch are made through contact terminals 60 and suitable conductors 61 connecting these terminals to the corresponding electrodes 27 and 28. In this form, the elastic sleeve 49 is held between the ring 54 and the cap 56; and, if the relative position of the switch envelope 23 with respect to the magnet 53 is to be adjusted, the cap 56 is removed and the sleeve 49 is moved on the Bakelite tube 48.

Although, as shown, the tube 48 is made of Bakelite, any other suitable material may be employed.

As indicated at 50 and 51 in Fig. 8, the tube 48 is sealed at both ends so that the glass envelope 23 is entirely enclosed. In this way, any mercury which may spill out of the envelope due to breakage of the glass may be trapped within the tube 48 and prevented from spilling out.

In the appended claims the word "elastic" is to be understood as referring to a material having certain physical properties substantially similar to, or identical with relatively soft rubber, such as its coefficient of friction, flowability under pressure, modulus of elasticity and similar characteristics which contribute to the practical utility of my invention. Rigid resins and metals do not generally constitute a satisfactory substitute for rubber in my device and the word "elastic" is, therefore, not to be understood as including such materials even though they may possess a limited degree of resilience.

We claim:

1. A mercury switch assembly comprising a coil having an opening, a vertically positioned switch envelope extending through said coil, electrodes and a quantity of mercury within said envelope, means responsive to said coil for changing the condition of the circuit through the electrodes, and an elastic sleeve frictionally engaging the upper portion of said envelope to maintain said envelope in position relative to said coil.

2. A mercury switch assembly comprising a coil having an opening, a switch envelope within said opening, a sleeve of elastic material frictionally engaging one end of said envelope exteriorly of the coil and means of preventing movement of the envelope relative to the coil, said means including a rigid member fixed with respect to the coil and engaging the sleeve.

3. A mercury switch assembly comprising a switch envelope, spaced electrodes in said envelope, means responsive to magnetic flux to change the condition of the circuit through said electrodes, an iron circuit adjacent to said envelope, and an elastic sleeve frictionally engaging said envelope and iron circuit to support the switch envelope in fixed position with respect to the iron circuit.

4. A mercury switch assembly comprising a coil, a switch envelope, a rigid member, and means of supporting said envelope in said coil, said means comprising a sleeve of elastic material supported by said rigid member and adapted to frictionally engage the switch envelope.

5. In a mercury switch assembly, a coil, an iron circuit associated with said coil, the coil and iron circuit having openings adapted to receive a mercury switch envelope, a rigid member movably attached to the iron circuit, an elastic sleeve fitted around said envelope and at least partially interposed between the iron circuit and the rigid member, and means including the rigid member for squeezing the elastic sleeve into firm contact with said envelope, said contact constituting the sole means for retaining said switch envelope in fixed relation to the coil.

6. A mercury switch assembly comprising a coil having an opening, a switch envelope ex-

tending through said opening, a sleeve of elastic material frictionally engaging one end of said envelope exteriorly of the coil to prevent movement of the switch envelope in one direction and a sleeve on the other end of said envelope to prevent movement in the other direction.

7. A mercury switch assembly comprising a coil having an opening, a switch envelope extending through said opening, a sleeve of elastic material frictionally engaging one end of said envelope exteriorly of the coil to prevent movement of the switch envelope in one direction and a similar sleeve applied to the other end of said envelope to prevent movement in the other direction.

8. A mercury switch assembly comprising a coil having an opening, a switch structure including an envelope at least partially within said opening, a base housing on said coil, and a sleeve of elastic material frictionally engaging the walls of the switch structure, one end of said sleeve being supported by said housing to yieldably support the switch structure out of direct contact with the housing.

9. A mercury switch assembly comprising a switch envelope, spaced electrodes in said envelope, means responsive to magnetic flux to change the condition of the circuit through said electrodes, a protective tube telescoped over said envelope, the envelope being immovable within the tube, an iron circuit adjacent to the envelope, and an elastic sleeve sleeve frictionally engaging the protective tube and abutting the iron circuit to maintain said envelope in a fixed position relative to the iron circuit.

10. A mercury switch assembly comprising a switch envelope, a tube telescoped over the envelope, means for retaining the envelope within the tube, a coil, an iron circuit adjacent to said coil, a ring secured to said iron circuit, said coil, ring and iron circuit being adapted to receive the tube, a housing applied to the base of said coil and a substantial sleeve of elastic material positioned between said ring and housing frictionally engaging said tube to yieldably maintain said envelope out of direct contact with the housing.

11. A mercury switch assembly comprising a coil having an opening, a switch envelope, a jacket of rigid material telescoped over said switch envelope, means of retaining said envelope in said jacket, a housing applied to the base of said coil, an end plate attached to said housing, and a sleeve of elastic material positioned between said coil and housing base adapted to frictionally engage said jacket when positioned in said coil opening, whereby said switch envelope and jacket are yieldably maintained out of direct contact with said housing base.

12. A mercury switch relay assembly, including a coil having an opening, a switch structure within such opening, said switch structure including a hermetically sealed envelope, a sleeve of elastic material applied to one end of said switch structure exteriorly of the coil to prevent movement of the switch structure in one direction, and means to prevent movement of said sleeve and switch structure in the other direction.

13. A mercury switch relay assembly comprising a coil, an iron circuit energized by the coil, a switch structure extending through an opening in the coil and iron circuit, said switch structure including a hermetically sealed envelope, a sleeve of elastic material frictionally engaging said switch structure exteriorly of said coil to prevent movement in one direction, and means to prevent movement of said elastic sleeve and switch structure in the other direction.

14. A mercury switch assembly comprising a coil having an opening, a switch envelope extending through said opening, contacts and a quantity of mercury within said envelope, means responsive to said coil for changing the condition of the circuit through the contacts, an elastic sleeve frictionally engaging said envelope, and means for retaining said sleeve in fixed relation to said coil whereby said switch envelope is maintained in position relative to said coil.

15. A mercury switch assembly comprising a coil having an opening, a vertically positioned switch envelope extending through said opening, said switch envelope having a protective covering immovable with respect to said switch envelope, contacts and a quantity of mercury within the envelope, means responsive to the coil for changing the condition of the circuit through the contacts, an elastic sleeve frictionally engaging the protective covering and means for retaining said elastic sleeve in fixed relation to said coil, whereby said switch envelope is retained in position relative to the coil.

16. A mercury switch assembly comprising a coil having an opening, a substantially vertical switch envelope extending through said opening, contacts and a quantity of mercury within said envelope, means responsive to said coil for changing the condition of the circuit through the contacts, an elastic sleeve adapted to support said switch envelope in position within the coil solely by the exertion of substantially uniform radial pressure against said envelope, and means for preventing movement of said elastic sleeve relative to the coil.

17. A mercury switch assembly comprising a coil having an opening, a vertically positioned switch envelope extending through said coil, contacts and a quantity of mercury within said envelope, means responsive to said coil for changing the condition of the circuit through the contacts, and a sleeve of elastic material exerting a substantially uniform pressure against said envelope, said sleeve engaging a rigid member fixed with respect to said coil whereby the position of the switch within the coil is maintained.

18. In a mercury switch relay, the combination of a switch coil, a mercury switch mounted within the coil and including a switch envelope, means for supporting the switch within the coil comprising an elastic sleeve tightly telescoped over the envelope, the sleeve opening being of such size and the sleeve itself of such material that the switch envelope is firmly held in substantially immovable relationship to the sleeve under ordinary operating conditions and when subjected to ordinary shock, but being capable of manual adjustment relative to the sleeve, and means for preventing a movement of the sleeve relative to the switch coil.

19. In a mercury switch relay, the combination of a switch coil, a mercury switch mounted within the coil and including a switch envelope, means for supporting the switch within the coil comprising an elastic sleeve tightly telescoped over the envelope, the sleeve opening being of such size and the sleeve itself of such material that the switch envelope is firmly held in substantially immovable relationship to the sleeve under ordinary operating conditions and when subjected to ordinary shock, but being capable of manual ad-

justment relative to the sleeve, means for preventing movement of the sleeve relative to the switch coil, the switch being freely movable within the switch coil except as restrained by said elastic sleeve whereby the switch envelope is cushioned against longitudinal blows.

20. A mercury switch assembly including a switch envelope, electrodes and a quantity of mercury within the envelope, external magnetic means including a coil for changing the condition of the circuit through the electrodes, a substantial sleeve of elastic material telescoped over the envelope, and means secured to the external magnetic means and cooperating therewith for distorting the elastic sleeve into firm frictional engagement with the switch envelope whereby the envelope is maintained in substantially fixed relation to the external magnetic means.

21. A mercury switch relay including a switch structure comprising a hermetically sealed envelope, electrodes and a quantity of mercury within the envelope, external magnetic means adjacent the switch structure for changing the condition of the circuit through the electrodes, a sleeve of elastic material telescoped over the switch structure and having firm frictional engagement therewith, and means engaging the sleeve and secured to the external magnetic means for preventing substantial movement of the switch structure relative to the external magnetic means.

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