

Dec. 15, 1936.

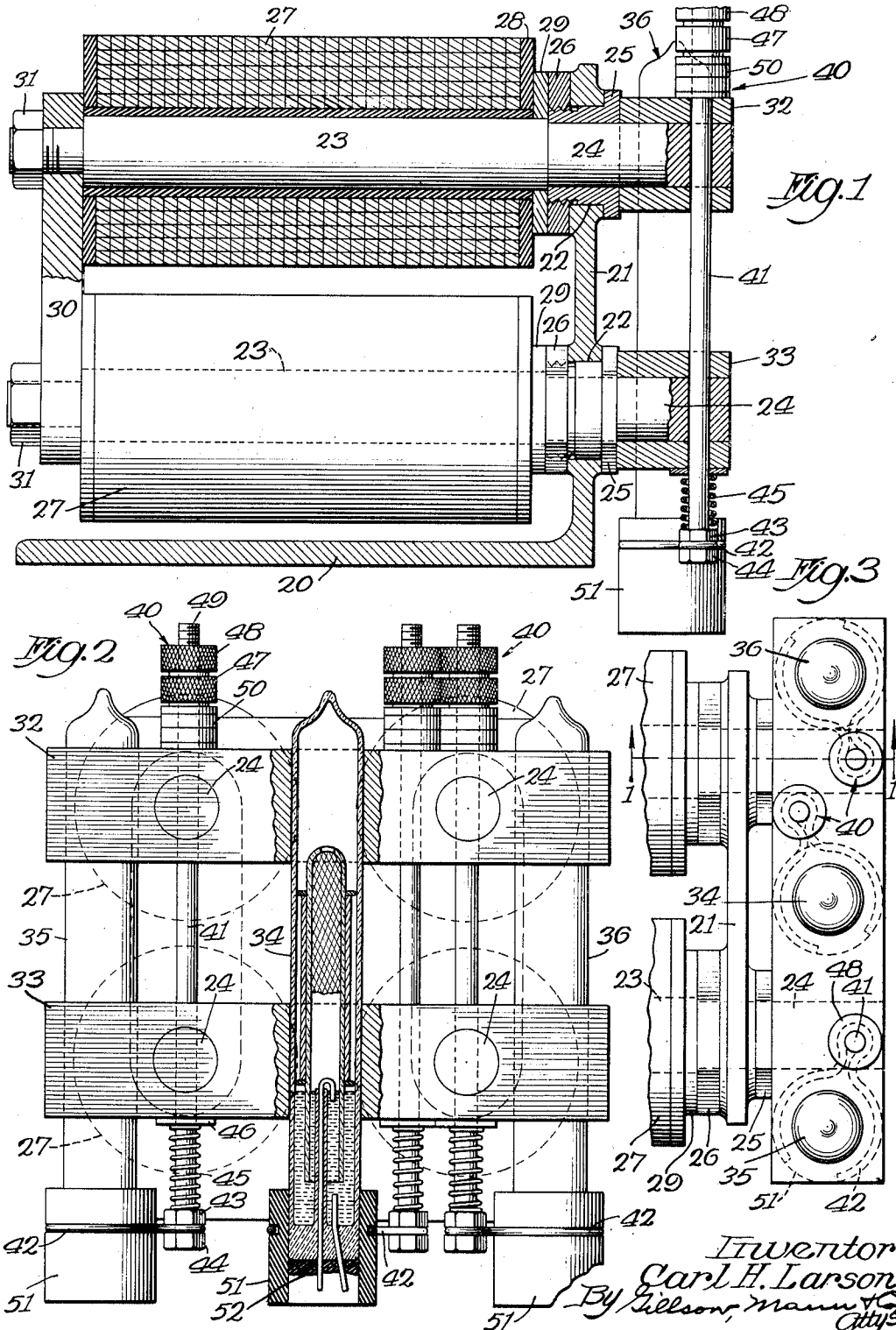
C. H. LARSON

2,064,478

MERCURY SWITCH RELAY

Filed Aug. 24, 1935

3 Sheets-Sheet 1



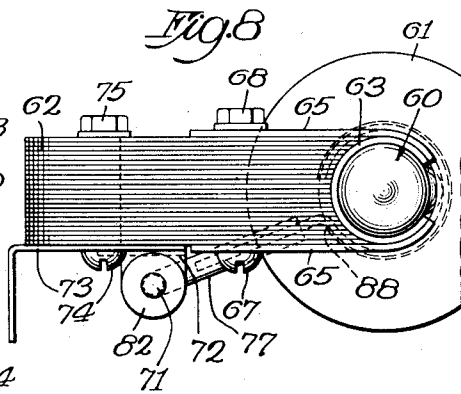
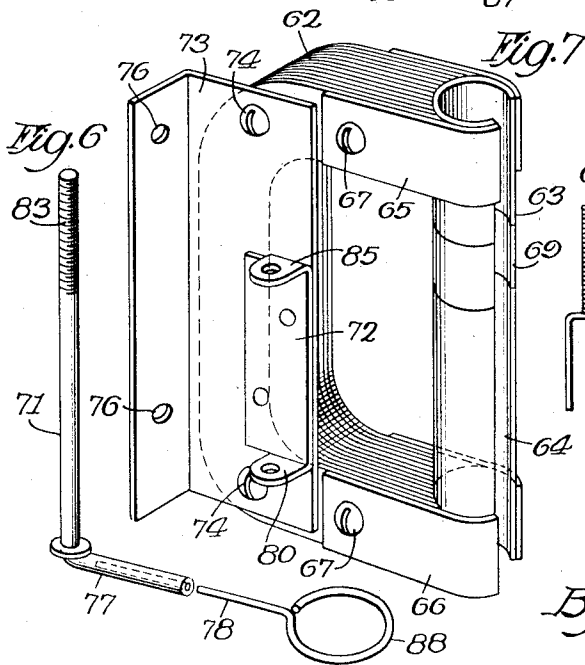
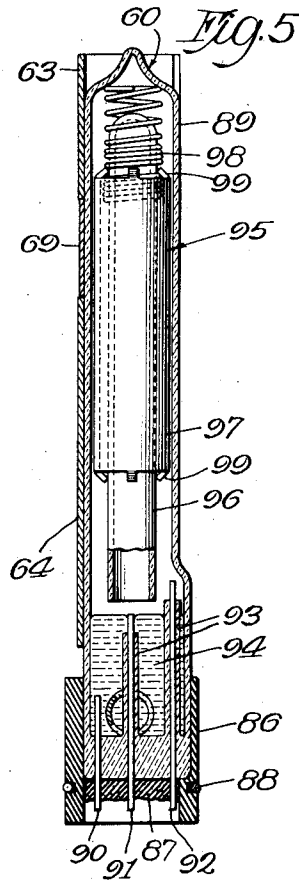
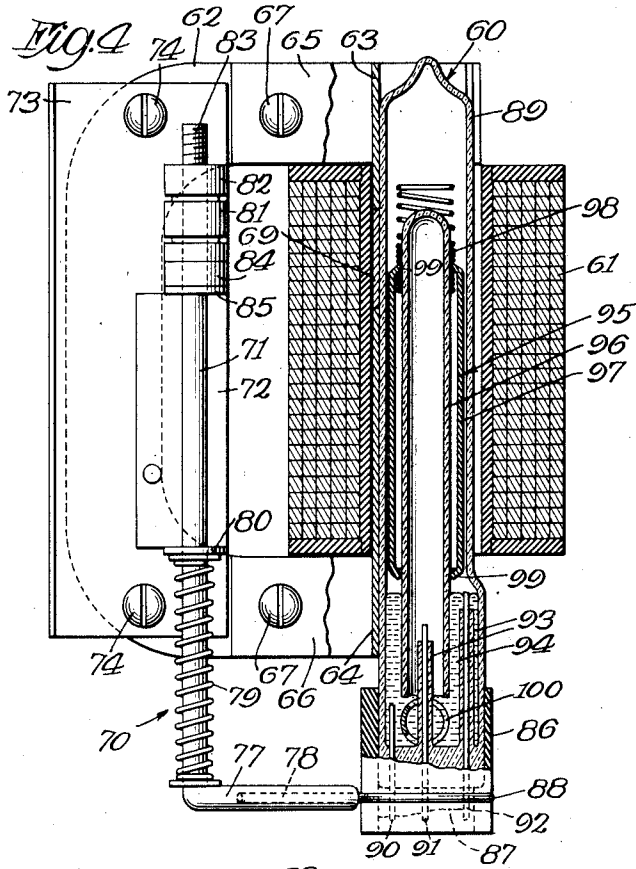
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MERCURY SWITCH RELAY

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3 Sheets-Sheet 2



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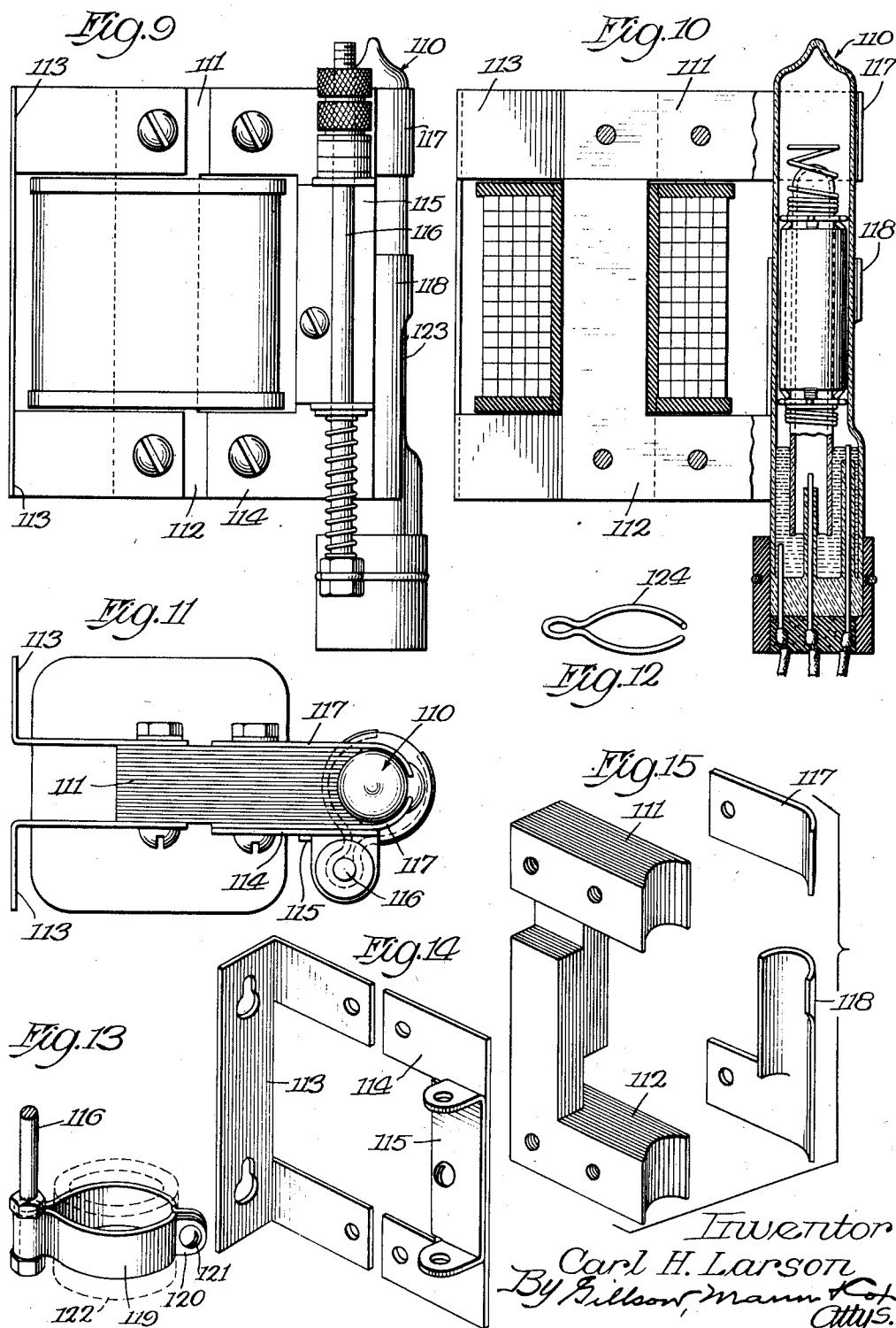
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2,064,478

MERCURY SWITCH RELAY

Filed Aug. 24, 1935

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,064,478

MERCURY SWITCH RELAY

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Application August 24, 1935, Serial No. 37,724

9 Claims. (Cl. 200—112)

In my Patent No. 1,967,946 I disclose a mercury tube relay of the plunger type equipped with an adjusting device for selectively positioning the mercury tube with respect to the magnetic circuit in order to obtain certain time relay characteristics. The adjusting means disclosed therein consists of a cap surmounting the tube and having a threaded stem projecting upwardly through an opening in a fixed support to receive a nut for effecting a slow motion adjustment of the switch tube. A spring is interposed between the support and the cap for steadying the switch within the coil.

The present invention is an improvement on the construction shown in the above identified patent, and some of the objects and advantages of the improved relay are as follows: The adjusting device is a part of the relay unit and may be set at the factory; the adjusting nut is placed in a position where it is readily accessible for making adjustments; the tube is supported by the adjusting device in a manner that permits accurate adjustments to be made and retained even though the relay unit is jarred in service; the lower portion of the tube is provided with a base which not only protects the tube from damage and minimizes the possibility of short-circuiting, but also furnishes a convenient place for gripping the switch and holding it in its proper position within the magnetic circuit; and, finally, the relay parts may be made and assembled with minimum cost and labor.

The adjusting device of this invention is applicable, not only to time delay relays, but also to quick acting relays, the adjustments being made for the purpose of obtaining given operating characteristics such as selected pick-up and drop away values.

Further and 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 a vertical, sectional view through a mercury switch relay embodying the principles of this invention, the section being taken on the line 1—1 of Fig. 3;

Fig. 2 is a front elevational view of the relay shown in Fig. 1;

Fig. 3 is a plan view of the same;

Fig. 4 is a view showing a modified form of the invention, the switch tube in this case being mounted within the relay coil;

Fig. 5 shows the energized position of the switch tube shown in Fig. 4;

Fig. 6 is a detached perspective view of the adjusting rod and switch holder;

Fig. 7 is a perspective view of the magnetic circuit associated with the switch tube, and the bracket which supports the adjusting rod;

Fig. 8 is a plan view of the assembled relay shown in Fig. 4;

Fig. 9 shows another modified form of the invention in which the switch tube is mounted exteriorly of the coil;

Fig. 10 is a vertical sectional view through the relay shown in Fig. 9;

Fig. 11 is a plan view of the same;

Fig. 12 is a perspective view of the clip which supports the switch tube from the adjusting arm;

Fig. 13 shows a modified form of clip;

Fig. 14 is a perspective view showing the brackets which support the relay and hold the adjusting rod; and

Fig. 15 is a perspective view of the laminated core showing the pole clips slightly spaced from the core for clarity of illustration.

But this specific illustration and the corresponding specific description are for the purpose of disclosure only and are not to be construed as imposing limitations on the claims except as may be required by the prior art.

In the form of the invention shown in Figs. 1-3 inclusive, the relay comprises a cast aluminum base 20 having an upstanding wall 21 which is provided with reinforced apertures 22 for receiving horizontal cores 23 of metal having low reluctance, such as Svea-electrical iron or Permalloy. The cores 23 have reduced diameters where they pass through the apertures, as indicated at 24, and they are supported in place by threaded bushings 25 and lock nuts 26.

Relay coils 27 are mounted on the cores (there are four cores and four relay coils in this embodiment of the invention) and their bakelite spools 28 are spaced from the lock nuts 26 by cork or felt washers 29.

The rear ends of the cores 23 are reduced in diameter and threaded to receive links 30 of magnetic material which are held in place by nuts 31. Each pair of cores with the link that connects the component cores forms a magnetic circuit that is closed except for the air gap between the forward ends of the cores.

The reduced ends 24 of the cores are carefully machined to proper diameter and are then driven into suitable apertures in pole pieces 32 and 33, each consisting of a bar of low reluctance material (Svea-electrical iron, Permalloy, or similar material) and having three sets of vertically 55

aligned apertures for receiving mercury switches 34, 35 and 36. These switches are of the type fully disclosed in my copending application, Ser. No. 759,634, filed December 29, 1934, and reference 5 is made to that application for a full disclosure of the details of the switches and the electrical circuit associated therewith.

It is important that the mercury tubes 34, 35 and 36 be properly positioned with respect to the 10 magnetic air gaps which operate them if the relay is to function as intended.

In the present invention, this is accomplished by supporting the tubes within the pole pieces 32 and 33 by adjusting devices, generally designated 15 40, one being associated with each mercury tube. After the pole pieces 32 and 33 have been mounted on the cores 23, vertical holes are drilled through the pole pieces and cores to receive adjusting rods 41, the lower ends of which are equipped with 20 spring clips 42 of music wire bent into the form best shown in Fig. 3 and secured to the adjusting rods by nuts 43 and 44. A spring 45 interposed between a wear washer 46 and the nut 43 tends to force the rod downwardly and this is resisted 25 by nuts 47 and 48 which are screwed on the threaded end 49 of the adjusting rod. Cork washers 50 are provided between the lower nut 47 and the pole piece 32.

The laterally projecting portion of the clip 42 30 engages a base 51 of insulating material which comprises a sleeve of Bakelite slipped over the lower end of the mercury tube and held in place by a sealing compound generally indicated at 52. The base not only serves to protect the lower end 35 of the mercury tube from breakage due to accidental blows, but also lessens the chance of having the tube short circuited by blows which force the bared ends of the electrodes together.

Since the relay disclosed in Figs. 1-3 employs 40 three mercury tubes, it is impractical to obtain a symmetrical arrangement of the three adjusting devices. Accordingly the adjusting devices for the tubes 34 and 36 are placed adjacent one another, the former being to the rear of the pole 45 pieces and the latter being nearer the front of the pole pieces.

Supporting the tube at the bottom not only gives a more stable support for the switch but also saves considerable space. The adjusting device being a part of the relay unit, the tubes may 50 be accurately positioned at the factory and the manufacturer has assurance that when the relay is set up for service, it will operate as intended. However, if any adjustment is necessary when 55 the relay is installed, it may be conveniently accomplished.

In the form of the invention shown in Figs. 4-8 inclusive, the mercury tube, generally designated 60, is mounted within a relay coil 61 and has an external iron circuit which consists of a laminated U-shaped yoke 62 of high grade transformer iron, pole pieces 63 and 64, and pole clips 65 and 66, the pole clips being secured to the yoke 62 by screws 67 and nuts 68. A brass ring 69 spaces the pole sleeves 63 and 64 a predetermined distance.

The mercury tube fits loosely within the pole sleeves 63 and 64 and brass ring 69 and is adapted to be adjustably positioned with respect to the 70 air gap between the pole pieces by an adjusting device, generally designated 70, which consists of an adjusting rod 71, mounted in a guide 72 riveted to a bracket 73 attached to the yoke 62 by screws 74 and nuts 75 and having openings 76 75 in its rear face for attachment to some fixed

support. The rod 71 has at its lower end a laterally extending arm 77 which is drilled to receive a tube holder 78 consisting of music wire bent to the form best shown in Fig. 6. A spring 79 is interposed between the lower lug 80 of the 5 guide 72 and the arm 77 for yieldably urging the rod downwardly, and nuts 81 and 82 are screwed on the threaded end 83 of the adjusting rod for resisting the downward thrust. Cork or felt washers 84 are telescoped over the adjusting rod 71 10 between the lower nut 81 and the top lug 85 of the guide 72.

The tube 60 is provided with a base 86 consisting of a bakelite sleeve held in place by a sealing compound, as indicated at 87, and the ring portion 15 88 of the tube holder 78 engages a groove in the tube base for supporting the tube within the magnetic circuit. It is obvious that by suitably manipulating the nuts 81 and 82, the tube 60 may be raised and lowered within the coil 61, thus 20 changing the characteristics of the relay, particularly as to the pickup and drop away values.

In my Patent No. 1,967,946, I was particularly interested in using the adjusting device for changing the time characteristics of a time delay 25 mercury switch; in the present case, the adjusting device is used primarily for controlling the amount of power required for operating the relay.

The mercury tube switch 60 comprises, briefly, a switch envelope 89 through the base of which 30 electrodes 90, 91 and 92 are sealed, the two latter electrodes being enclosed within insulating sleeves 93 for a portion of their lengths. A quantity of mercury 94 is in the switch envelope and its position within the envelope is adapted to be changed by a displacer, generally designated 35 95 consisting of a glass tube 96 closed at its top and an iron sleeve 97 telescoped over the tube 96 and held in place by a spring 98 which is tightly fitted over the top of the tube 96 and has its lower coils close together for engaging inwardly turned lugs 99 of the sleeve 97. 40

When the displacer is in its lowermost position, as shown in Fig. 4, the bottom of the tube 96 rests upon a spring 100 anchored on the 45 central electrode 96 and in this position of the displacer, mercury bridges the electrodes 90 and 92 but the entrapped gas within the tube 96 holds the mercury away from the electrode 91.

When the coil 61 is energized, the displacer 50 rises to the position shown in Fig. 5 and before the mercury level reaches the bared end of the electrode 91, the outside mercury level has dropped sufficiently to uncover the bared end of the electrode 92, thus preventing more than one 55 of the insulated electrodes 91 and 92 from being in electrical circuit with the electrode 90 at any given time.

The adjusting device for the relay disclosed in Figs. 9-15 inclusive is used where the mercury 60 tube here designated 110 is mounted exteriorly of the relay coil. In this case, the core is made up of two separable parts 111 and 112, as described in patent to Hedin 1,967,948, issued July 24, 1934. The two halves of the core are held together by a mounting bracket 113 and by a second bracket 114 which carries a guide member 115 for the adjusting rod 116. As before, the pole clips 117 and 118 receive the tube rather loosely so that the adjusting device may position the 70 tube within the magnetic circuit.

In place of using a wire clip, such as shown in Fig. 12, it is possible to use a band clip 119 as shown in Fig. 13, the ends of the band having lugs 120 which may be forced together 75

by a screw 121. The switch base 122 is suitably grooved to receive the band.

The mercury tube 110 differs from the tube 60 only in details which are unimportant here, and for that reason further description is deemed unnecessary.

It will be noted that the lower pole piece 118 is cut away, as indicated at 123 so that the condition of the electrodes and mercury level may be watched while the switch adjustment is being effected.

The bracket 113 holds the two halves 111 and 112 of the core firmly together and thereby minimizes the reluctance of the iron circuit.

It will be noted that new switches may be substituted for old ones, in any of the relays disclosed, with minimum effort and loss of time.

What I claim is:—

1. In combination, a vertical switch envelope, spaced electrodes in the envelope, a mercury fill, a magnetically responsive displacer for shifting the mercury level to change the condition of the circuit through the electrodes, a magnetic circuit associated with the displacer including a metal yoke of low reluctance substantially closed except for an air gap adjacent to the displacer, and means carried by the magnetic circuit for adjustably supporting the switch envelope in selected relation with the magnetic circuit, said means including a rod and a slow motion device.

2. In combination, a vertical switch envelope, spaced electrodes in the envelope, a mercury fill, a magnetically responsive displacer for shifting the mercury level to change the condition of the circuit through the electrodes, a magnetic circuit associated with the displacer including a metal yoke of low reluctance substantially closed except for an air gap adjacent to the displacer, a sleeve of insulating material rigidly mounted on the bottom portion of the switch envelope, and means carried by the magnetic circuit for engaging the sleeve to hold the switch envelope in its desired relation with the magnetic circuit.

3. In combination, a vertical switch envelope, spaced electrodes in the envelope, a mercury fill, a magnetically responsive displacer for shifting the mercury level to change the condition of the circuit through the electrodes, a magnetic circuit associated with the displacer including a metal yoke of low reluctance substantially closed except for an air gap adjacent to the displacer, and slow motion means carried by the yoke for adjustably supporting the switch envelope in its proper relation to the yoke, said means including a threaded rod substantially parallel to the switch envelope.

4. In combination, a vertical switch envelope, spaced electrodes in the envelope, a mercury fill, a magnetically responsive displacer for shifting the mercury level to change the condition of the circuit through the electrodes, a magnetic circuit associated with the displacer including a metal yoke of low reluctance substantially closed except for an air gap adjacent to the displacer, slow motion means carried by the yoke for adjustably supporting the switch envelope in its proper relation to the yoke, said means including a threaded rod substantially parallel to the switch

envelope, and an arm on the lower end of the rod for engaging the switch envelope.

5. In combination, a fixed support, a magnetic circuit attached to said support and including a metal yoke of low reluctance substantially closed except for a single air gap, a mercury switch of the type including a magnetic armature mounted in operative relation with the magnetic circuit, and means for adjustably supporting the switch in selected relation to the magnetic circuit, said means including a sleeve of insulating material rigidly mounted on the bottom portion of the switch envelope and a slow motion device engaging the sleeve.

6. In combination, a fixed support, a magnetic circuit attached to said support and including a metal yoke of low reluctance substantially closed except for a single air gap, a mercury switch of the type including a magnetic armature mounted in operative relation with the magnetic circuit, and means carried by the magnetic circuit for adjustably supporting the switch in selected relation to the magnetic circuit, said means including a slow motion device rigidly attached to the lower portion of the switch.

7. In combination, a fixed support, a magnetic circuit attached to said support and including a metal yoke of low reluctance substantially closed except for a single air gap, a mercury switch of the type including a magnetic armature mounted in operative relation with the magnetic circuit, and means for adjustably supporting the switch in selected relation to the magnetic circuit, said means including a sleeve secured to the lower portion of the switch, and a vertically adjustable arm engaging the sleeve.

8. In a mercury switch relay of the class described, a relay coil, an iron circuit substantially closed except for a single air gap, a mercury switch associated with the iron circuit and comprising a mercury switch envelope, a quantity of mercury in the envelope, electrodes sealed through the base of the envelope and having portions projecting outside thereof, a displacer responsive to the coil for shifting the mercury level to change the condition of the electrical circuit through the electrodes, a sleeve of insulating material telescoped over the lower end of the envelope and projecting beyond the base thereof, and a sealing compound in the projecting end of the sleeve.

9. In a mercury switch relay of the class described, a relay coil, an iron circuit substantially closed except for a single air gap, a mercury switch associated with the iron circuit and comprising a mercury switch envelope, a quantity of mercury in the envelope, electrodes sealed through the base of the envelope and having portions projecting outside thereof, a displacer responsive to the coil for shifting the mercury level to change the condition of the electrical circuit through the electrodes, a sleeve of insulating material telescoped over the lower end of the envelope and projecting beyond the base thereof, and a sealing compound in the projecting end of the sleeve, and means for supporting the switch in selected relation to the iron circuit, said means including a vertically adjustable arm engaging the sleeve.

CARL H. LARSON.