

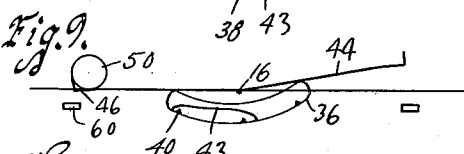
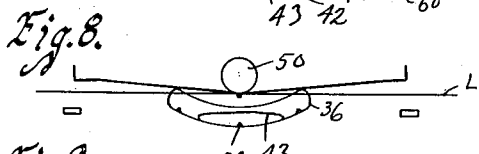
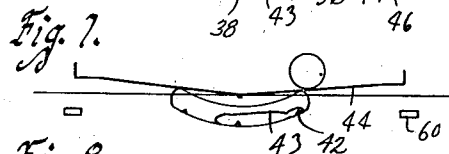
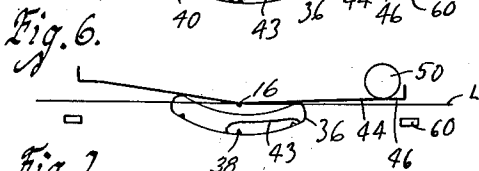
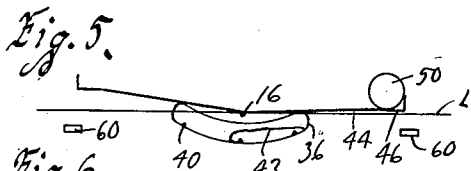
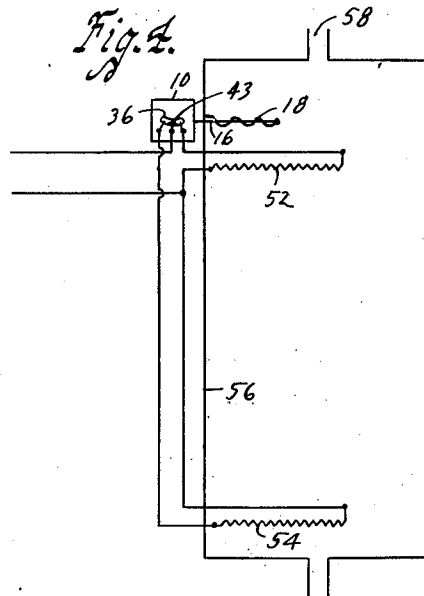
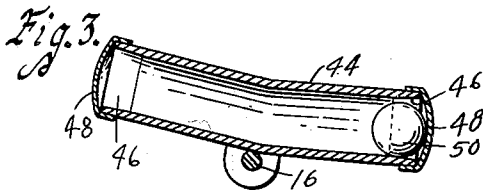
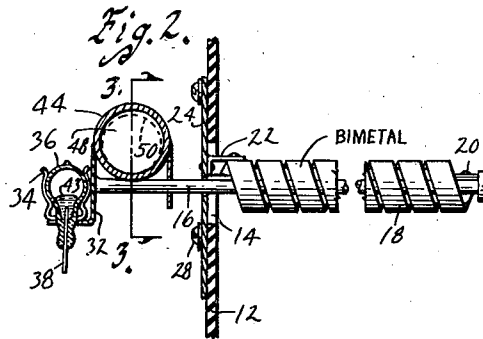
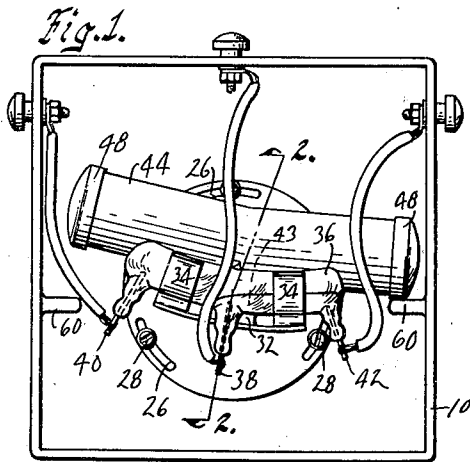
May 18, 1937.

P. GRAY

2,080,707

MERCURY SWITCH STRUCTURE

Filed March 31, 1936



Witness
H. Mungenmaier

Inventor
~ Percy Gray ~
by Bair, Freeman & Sinclair
Attorneys

UNITED STATES PATENT OFFICE

2,080,707

MERCURY SWITCH STRUCTURE

Percy Gray, Jefferson, Iowa

Application March 31, 1936, Serial No. 71,940

19 Claims. (Cl. 200—152)

The object of my invention is to provide a mercury switch structure which is simple, durable and comparatively inexpensive to manufacture.

A further object is to provide, in combination with a single pole, double throw type of mercury switch of that type in which the glass tube is so curved that the central or common electrode is in connection with only one of the other electrodes at one time, a means for insuring that the switch will pass its central position comprising preferably an enclosed tube having a rolling weight, such as a ball, therein, the ends of the tube being inclined upwardly and the degree of inclination being so co-ordinated with the degree of inclination necessary to change the switch from one position to another that upon the ball starting to roll along the tube, it will continue its rolling movement and the weight thereof will insure changing of the switch from one position to the other without any possibility of "hanging" in a central position, which is undesired.

A further object is to provide a means particularly operable in connection with a two position switch which insures movement of the switch from one position to the other after such movement is started by a condition responsive means, the condition responsive means being arranged to build up energy to assist in the change-over movement of the switch from one position to the other.

A further object is to provide a switch which is adaptable to control two independent circuits in such manner that both circuits are not energized at the same time, yet a mechanical means is provided for insuring that as soon as one circuit is broken the other one will be made without any possibility of the second one not being made.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawing, in which:

Figure 1 is a front elevation of a switch structure embodying my invention.

Figure 2 is a sectional view on the line 2—2 of Figure 1, except eliminating the casing for the switch with the exception of a portion of the back or supporting wall.

Figure 3 is a sectional view on the line 3—3 of Figure 2 showing the internal construction of the tube and ball arrangement for insuring change in the position of the switch.

Figure 4 is an electro-diagrammatic view showing an installation in which my type of switch is desirable.

Figure 5 is a diagrammatic view showing the action of the switch at the beginning of the change-over position; and

Figures 6, 7, 8 and 9 are similar diagrammatic views showing further movements of the switch and the parts thereof in moving from one position to the other.

On the accompanying drawing, I have used the reference numeral 10 to indicate generally a switch housing, the cover plate therefor being omitted. The casing 10 has a back wall 12 provided with an enlarged perforation 14 through which an operating rod 16 and a bimetal coil 18 are projected. The bimetal coil 18 has one end secured as at 20 to one end of the rod 16 and its other end secured by a bracket 22 to an adjusting plate 24. The plate 24 is adjustably secured as by slots 26 and screws 28 to the back wall 12.

Within the casing 10 a bracket 32 is secured to the other end of the rod 16 and is provided with a pair of clips 34 to support a mercury switch comprising a tube 36, a common electrode 38 and second and third electrodes 40 and 42. Within the glass tube 36 is a pellet of mercury 43 which is movable.

Secured by brazing or the like to the rod 16 and located within the casing 10 is a tube 44 having its ends inclined upwardly. At the terminal ends of the tube it is tapered or flared interiorly as indicated at 46 and caps 48 enclose the ends of the tube. Within the tube a heavy ball 50 of steel or the like is loosely mounted.

The end caps 48 are preferably soldered or otherwise sealed in position and then the tube and end caps galvanized or otherwise provided with a protective coating, to protect the tube against corrosion.

The type of switch illustrated, as will be obvious from an inspection of Figures 5 to 9 inclusive, is of the type in which all three electrodes are never connected together at the same time. In the various positions of the switch, the central electrode 38 is connected with either the electrode 42, as in Figure 7, with neither the electrode 40 nor the electrode 42 and only with the electrode 38, as in Figure 8, or with electrodes 38 and 40 as in Figure 9. Such a type of switch is desirable in various installations.

By way of illustration, in Figure 4, I show two heating elements 52 and 54 independently controlled, the heating element 52 by the electrodes 38 and 42 and the heating element 54 by the elec-

trodes 38 and 40. These are mounted in a water heating tank 56 for heating the water therein. The heating elements are comparatively heavy and it is undesirable to have them both in circuit at the same time as this calls for too much of a load on the current wires. Therefore, in the intermediate position of Figure 8, it is desirable that the electrodes 40 and 42 are not in the circuit at the same time, which result is secured by curving the ends of the tube 44 upwardly. In the particular installation shown, however, the heating element 52, when the water in the tank is cold, is first energized for heating the water in the top of the tank adjacent the outlet 58. When the water above the heating element is heated sufficiently, it will affect the bimetal coil 18 for changing the position of the switch for thereafter energizing the heating element 54 to heat the rest of the water. A separate thermostat (not shown because it forms no part of my present invention) is provided for de-energizing the heating element 54 when the water in the tank is sufficiently heated thereby.

Without the tube 44, or if the tube were straight, the position of Figure 8 would be assumed and the switch would remain in this position until cold water again affected the bimetal coil 18, which would cause an intermittent energization of the heater 52 without the heater 54 ever being energized.

If the tube 44 were straight, the position of Figure 8 would have to be passed before the ball 50 could start to roll and hence, the heating element 52 would be de-energized before the ball started rolling which would result in the switch remaining in the position of Figure 8. For that reason, the ends of the tube must incline upwardly.

When the position of Figure 8 is assumed, however, it is desirable to carry the switch on to the position of Figure 9 and the tube 44 and its rolling weight 50 accomplish this result as will now be described.

I have shown in Figure 5 the inclination of the right hand end of the tube 44 as being slightly above a level position, indicated as "L". The incline 46, however, is not yet level, thus holding the ball 50 until the position of Figure 6, in which the incline 46 has just passed level position. The right hand incline of the tube 44 will thereupon insure (being inclined relative to level) that the ball will roll over toward the left hand end of the tube. The position of Figure 7 will be assumed wherein the mercury is just breaking away from the pole 42 and thereafter the central position of Figure 8 will be assumed. However, the ball 50 has gained momentum which will carry it to the position of Figure 9 in which the circuit is made across the electrodes 38 and 40.

Just before the position of Figure 5 is assumed, the bimetal 18 has stored up energy in lifting the ball 50 which energy is expended as the ball rolls from the position of Figure 6 to the position of Figure 9. This accumulated or stored up energy thus aids in swinging the switch from one of its positions to the other.

Although I have described operation in only one direction, it is obvious that in the opposite direction the operation is the same.

The switch casing 10 is provided with a pair of stops 60 for limiting the movement of the switch. These are necessary to avoid over-movement of the switch although they do not enter into the operation of the switch structure.

The means for insuring against past center movement of the switch need not necessarily be a

tube and ball, although it is preferably such in order that it may be sealed. However, any guide and a weight movable relative thereto would accomplish the result sought.

By way of illustration, assuming that it takes one or two degrees before the central position of Figure 8 is assumed, for the mercury to break away from the electrode 42 and several degrees thereafter before it contacts with electrode 40, then I incline the ends of the tube 44 so that about three or four degrees more movement is had before the position of Figure 8 is assumed and the ball starts rolling as in Figure 6. This gives from one to two degrees leeway in which to insure that the ball will start rolling before the position of Figure 8 is assumed, thus making sure that the switch will carry over from one position to the other and not rest in a central position.

In calculating the inclination of the ends of the tube, it is, of course, necessary to take into consideration the particular type of condition responsive means actuating the switch, such as the bimetal coil 18 illustrated. Some means for this purpose would store up more energy than other means in lifting the weight of the ball 50 and would accordingly necessitate a different inclination for proper operation without allowing excess leeway.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common contact which contact is in contact with the second or the third contact only, one at a time, in combination with means for causing movement of said switch from position with the first contact in connection with the second contact to position with the first contact in connection with the third contact or vice versa, said means comprising an enclosed tube carried by said mercury switch and inclined upwardly at its ends and a ball within said tube.

2. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common contact which contact is in connection with the second or the third contact only, one at a time, in combination with means for causing movement of said switch from position with the first contact in connection with the second contact to position with the first contact in connection with the third contact or vice versa, said means comprising an enclosed tube carried by said mercury switch and inclined upwardly at its ends and a ball within said tube, the degree of inclination being in excess of that required to change the position of the mercury within the mercury switch from one position to the other.

3. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common contact, which contact is in contact with the second or the third contact only, one at a time, in combination with means for causing movement of said switch from position with the first contact in connection with the second contact to position with the first contact in connection with the third contact or vice versa, said means comprising an enclosed tube carried by said mercury switch

and inclined upwardly at its ends and a ball within said tube and condition responsive means for moving said mercury switch and tube, which means upon moving in response to a change in condition stores up energy to assist the movement of the mercury switch and tube in response to shifting of the weight of the ball.

4. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common contact, which contact is in contact with the second or the third contact only, one at a time, in combination with means for causing movement of said switch from position with the first contact in connection with the second contact to position with the first contact in connection with the third contact or vice versa, said means comprising an enclosed tube carried by said mercury switch and inclined upwardly at its ends and a ball within said tube, at least one end of said tube being internally flared to hold said ball against movement along the tube until the angle of the end of the tube in which the ball is positioned exceeds level position.

5. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends.

6. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends, the degree of inclination being in excess of that required to change the position of the mercury within the mercury switch from one position to the other.

7. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends and condition responsive means for moving said mercury switch and guide, which means upon movement in response to a change in condition stores up energy to assist the movement of the mercury switch and guide in response to shifting of said weight along the guide.

8. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which

is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends, at least one end of said guide being inclined reversely to hold the weight against movement along the guide until the angle of the end of the guide adjacent the weight is in a position exceeding a level position.

9. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends, the degree of inclination being in excess of that required to change the position of the mercury within the mercury switch from one position to the other and condition responsive means for moving said mercury switch and guide, which means upon movement in response to a change in condition stores up energy to assist the movement of the mercury switch and guide in response to shifting of said weight along the guide.

10. In a switch structure, a single pole, double throw mercury switch of the type wherein one electrode constitutes a common electrode which is in connection with the second or third electrode, one at a time only, in combination with means for causing movement of said switch from position with the first electrode in connection with the second one to position with the first electrode in connection with the third one or vice versa, said means comprising a guide and a weight movable therealong, said guide being carried by said mercury switch and inclined upwardly at its ends and condition responsive means for moving said mercury switch and guide, which means upon movement in response to a change in condition stores up energy to assist the movement of the mercury switch and guide in response to shifting of said weight along the guide, at least one end of said guide being inclined reversely to hold the weight against movement along the guide until the angle of the end of the guide adjacent the weight is in a position exceeding a level position.

11. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising an enclosed tube carried by said switch and inclined upwardly at its ends and a ball within said tube.

12. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position comprising an enclosed tube carried by said

switch and inclined upwardly at its ends and a ball within said tube, the degree of inclination being in excess of that required to change the position of the switch from one of its positions to the other position thereof.

13. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position comprising an enclosed tube carried by said switch and inclined upwardly at its ends, a ball within said tube and condition responsive means for moving said switch and tube, which means upon movement in response to a condition change stores up energy to assist movement of the switch and tube in response to shifting of the ball relative to the tube.

14. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising an enclosed tube carried by said switch and inclined upwardly at its ends and a ball within said tube, at least one end of said tube being internally flared to hold said ball against movement along said tube until the angle of the end of the tube in which the ball is positioned exceeds level position.

15. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position comprising an enclosed tube carried by said switch and inclined upwardly at its ends and a ball within said tube, the degree of inclination being in excess of that required to change the position of the switch from one of its positions to the other position thereof and condition responsive means for moving said switch and tube, which means upon movement in response to a condition change stores up energy to assist movement of the switch and tube in response to shifting of the ball relative to the tube.

16. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position

from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising a guide and a weight movable therealong, the ends of said guide being inclined upwardly, the degree of inclination being in excess of that required to change the position of the switch from one of its positions to the other position thereof.

17. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising a guide and a weight movable therealong, the ends of said guide being inclined upwardly.

18. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising a guide and a weight movable therealong, the ends of said guide being inclined upwardly, the degree of inclination being in excess of that required to change the position of the switch from one of its positions to the other position thereof and condition responsive means for moving said switch and guide, which means upon movement in response to a change in condition stores up energy to assist the movement of the switch and guide in response to shifting of said weight along the guide.

19. In a device of the class described, the combination with a two position switch requiring a predetermined movement to pass central position from one position of the switch to the other position thereof and means for insuring movement of the switch past said central position, comprising a guide and a weight movable therealong, the ends of said guide being inclined upwardly, the degree of inclination being in excess of that required to change the position of the switch from one of its positions to the other position thereof, at least one end of said guide being inclined reversely to hold the weight against movement along the guide until the angle of the end of the guide adjacent the weight is in a position exceeding a level position.

PERCY GRAY.