

Nov. 21, 1933.

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1,935,906

ELECTRIC SWITCH

Filed May 26, 1930

2 Sheets-Sheet 1

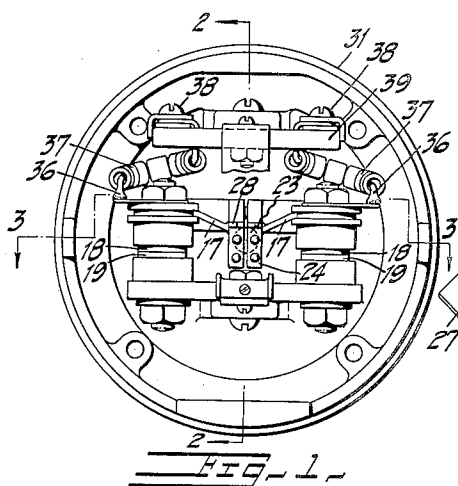
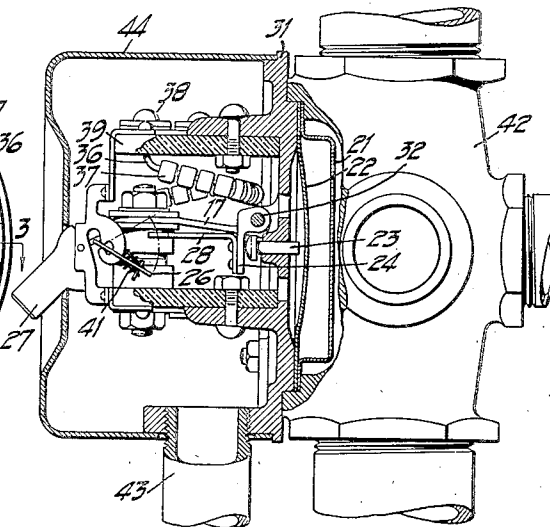
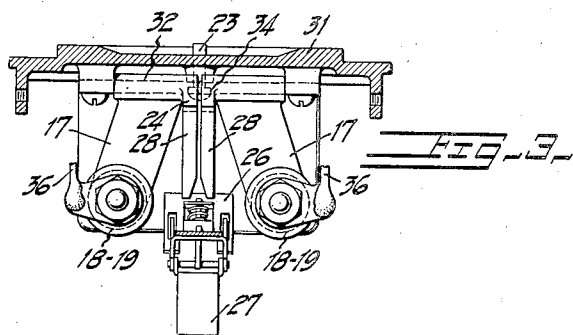
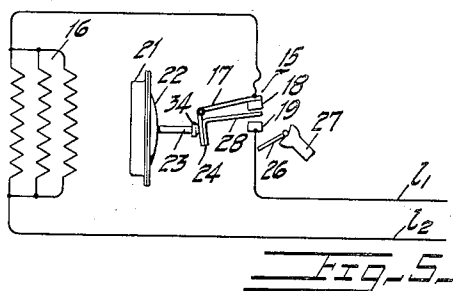
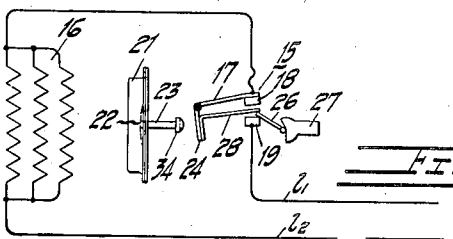
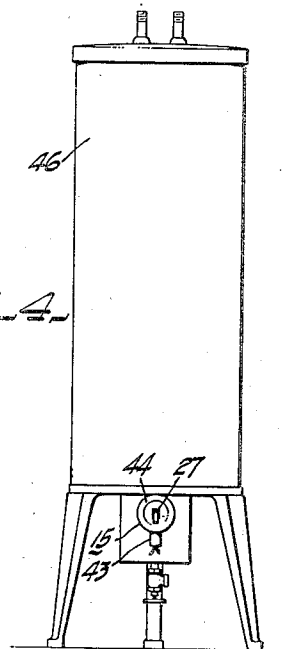


FIG. 4



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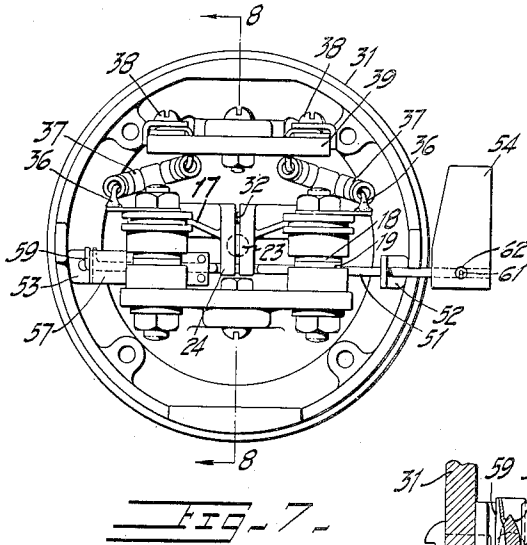
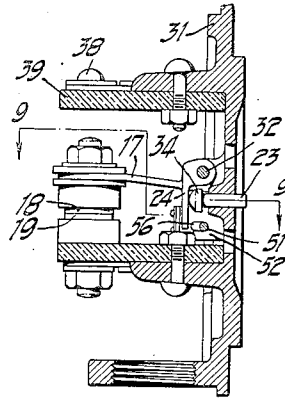
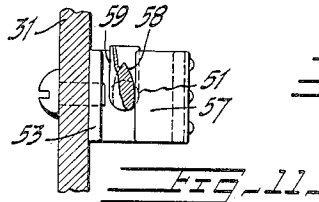
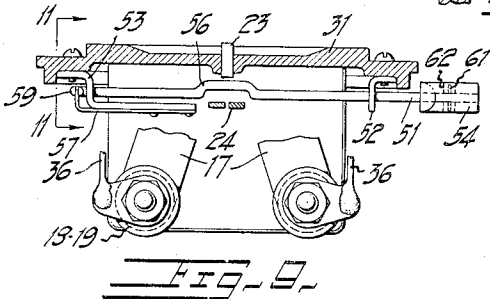
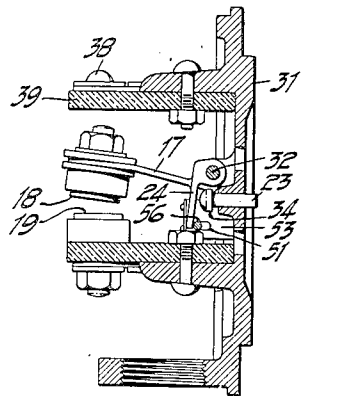
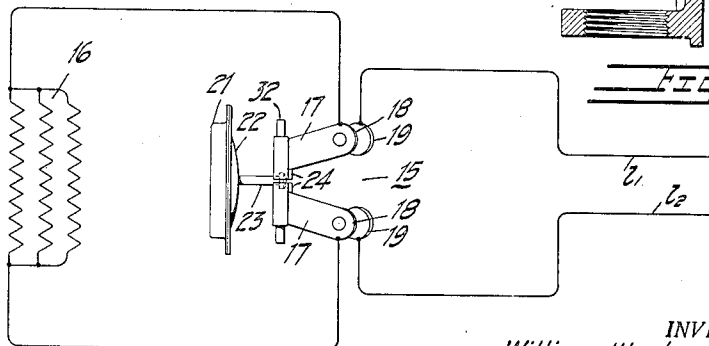
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2 Sheets-Sheet 2



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ELECTRIC SWITCH

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2 Claims. (Cl. 200—140)

This invention relates generally to automatically controlled electric switches and is particularly applicable to switches of this type in which manual control is also desired.

5 In electrical systems employing automatic switches which are responsive to temperature, pressure, volume or any other characteristic of a medium being acted upon by the current, it is frequently desirable to control the periods during
10 which the automatic switches are operable by auxiliary means, as for example, by means of a manually operated switch or by a time controlled switch. Heretofore, such auxiliary switches have necessitated the use of additional
15 contacts in the circuit. Such additional contacts increase the cost of installation, tend to complicate the system and introduce a point of weakness in the circuit.

It is one object of this invention to simplify
20 installations of this general character.

Another object is to provide means for disabling an automatically controlled switch without resorting to additional contacts in the circuit controlled by the automatic switch.

25 Still another object is to provide auxiliary means for controlling a circuit under the control of an automatic switch.

A further object is to provide novel means for controlling the period of operation of an automatically controlled switch.

30 A still further object is to provide control apparatus for an electric circuit which includes an automatic switch and manually operated means which are concurrently operable for effecting control over the circuit.

A still further object is to provide a combined automatic switch and manual switch utilizing contacts which are common to both switches.

Other objects and advantages will become apparent to those skilled in the art as the detailed description of certain preferred embodiments of this invention proceeds.

45 In order that the principles of this invention may be more fully understood, attention is directed to the accompanying drawings in which:

Fig. 1 is an elevational view illustrating one embodiment of the invention as applied to a thermoresponsive switch.

Fig. 2 is a cross sectional view taken on the
50 line 2—2 of Fig. 1 and showing the manner in which the device can be applied to a water heating system.

Fig. 3 is a cross section taken on line 3—3 of Fig. 1.

55 Fig. 4 shows the relative position of the device as applied to one type of water heater.

Figs. 5 and 6 are circuit diagrams which illustrate the operation of the device, a single pole switch being shown for convenience.

60 Fig. 7 is an elevational view of a modification.

Fig. 8 is a cross section taken on line 8—8 of Fig. 7.

Fig. 9 is a cross section taken on line 9—9 of Fig. 8.

Fig. 10 is a view similar to Fig. 8 showing the
65 switch in open position.

Fig. 11 is an enlarged sectional detail view taken on the line 11—11 of Fig. 9.

Fig. 12 is a circuit diagram.

In the embodiment shown in Figs. 1 to 6 a
70 thermoresponsive switch of a type particularly adapted to control the circuit of an electric water heater is shown in combination with a manually operated toggle mechanism for controlling the period of operation of the thermoresponsive
75 switch.

It is to be understood that the invention is not limited to thermoresponsive switches nor to automatic switches on water heaters and that it is applicable to a wide variety of other types of
80 switches which may be employed for various purposes.

Referring first to Figs. 5 and 6 an electric heater 16 is shown connected in a circuit 11, 12 controlled by a switch 15 having relatively movable contacts 18 and 19. A thermoresponsive device 21 having a buckling diaphragm 22 is adapted to control the opening and closing of switch 15 in accordance with the temperature of some medium being heated by heater 16. Thermoresponsive device 21 may be of any suitable type, but the particular type illustrated comprises a movable diaphragm covering a gas-tight chamber filled with any suitable gas, such as, for example, ordinary air. The thermoresponsive device 21 is placed in thermal contact with the medium being acted upon by heater 16 and when the temperature rises to a certain predetermined value the pressure exerted by the gas inside of the thermoresponsive device exerts sufficient pressure to bulge diaphragm 22 outwardly as shown in Fig. 5. When the temperature falls below a certain other predetermined value the pressure exerted by the gas is reduced to a value sufficient to bulge diaphragm 22 inwardly as shown in Fig. 6.

As representative of suitable means for utilizing the buckling movement of diaphragm 22 to control switch 15, a pin 23 is shown contacting lightly against diaphragm 22 and abutting against a lever 24 extending from arms 17 on which switch contacts 18 are mounted. When the diaphragm 22 bulges outwardly as shown in Fig. 5, pin 23 effects separation of the switch contacts to break the circuit to heater 16. The circuit then remains broken until the temperature of the medium falls below a predetermined value whereupon diaphragm 22 bulges inwardly as shown in Fig. 6. Preferably contacts 18 are made relatively heavy and are pivoted about a horizontal axis and in this manner the contacts are gravitationally
120

biased toward closed position. When diaphragm 22 bulges inwardly in response to a drop in the temperature, contacts 18 are gravitationally moved to close the circuit. Thus the circuit is recurrently opened and closed in accordance with the rise and fall of the temperature of the medium being acted upon, the heating element 16 being made operative when the temperature reaches its lower limit and being made inoperative when the temperature reaches its upper limit and in this manner the medium is kept at a temperature between predetermined limits.

A toggle mechanism comprising links 26 and 27 is provided for controlling the period of operation of the thermoresponsive switch. This toggle mechanism may be operated by any suitable means, such as a clock mechanism, or it can be operated manually. The toggle mechanism, as illustrated, is suitable for manual operation and for this reason link 27 is shown in the form of a convenient finger hold lever of a type frequently employed in toggle switches of the domestic type. When the toggle mechanism is in the position shown in Fig. 5, switch 15 is under the exclusive control of thermoresponsive device 21 and the switch will be opened and closed in accordance with the movement of diaphragm 22. When, however, the toggle mechanism is moved to the position shown in Fig. 6, link 26 engages a projection 28 extending from the lever on which contact 18 is mounted thereby holding this lever in a position which prevents closing of the contact 18. When the toggle mechanism is in this position the switch contacts are under the exclusive control of the manually operated means and the switch contacts will be held open irrespective of the movement of diaphragm 22. In Fig. 6, for example, the thermoresponsive device is in a condition which would allow contact 18 to engage contact 19, but the toggle mechanism prevents this movement.

Figs. 1, 2 and 3 illustrate the structural details of one embodiment of the device. The switch is mounted on a plate 31 which is preferably vertically disposed when the device is in operative position. The switch shown is of the double pole type having two movable contacts 18 and two relatively stationary contacts 19. Each contact 18 is mounted on an arm 17 which is insulated from its associated contact and which is pivoted about a shaft 32. Extending from each of the arms 17 is a downwardly extending lever 24. Pin 23 is provided with an enlarged head portion 34 which is adapted to abut against both levers 24 and in this manner pin 23 controls the operation of both contacts 18, which are otherwise independently movable in order that each will make a clean and firm contact. Flexible wires 36 having beaded insulation 37 connect contacts 18 with binding posts 38. Binding posts 38 are mounted on an insulating support 39.

Extending from and rigidly secured to lever 24 are projections 28 which are so positioned that they are forcibly struck by member 26 of the toggle mechanism when the toggle mechanism is operated to the position which effects opening of the contacts. When projections 28 are struck by members 26 of the toggle mechanism, contacts 18 are rapidly snapped out of engagement with contacts 19, thereby insuring a quick break and one which is free from sparking. To further increase the snapping action of the toggle mechanism formed by links 26 and 27, a biasing spring 41 interconnects these mem-

bers in a manner which is already well known in the art.

Thermoresponsive element 21 is adapted to be mounted adjacent plate 31 with diaphragm 22 disposed in operative relationship with pin 23 as shown in Fig. 2. When the switch is employed in a water heating system thermoresponsive device 21 can be mounted in any convenient manner relative to a coupling member 42 through which the water of the system passes. Preferably, thermoresponsive device 21 is mounted to be in direct contact with the water, as shown in Fig. 2, although in some systems it may be desirable to arrange the elements differently.

A conduit 43 can be provided for housing the conductors leading to and from the switch and this conduit can be coupled in any suitable manner to the support for the switch. To protect the switch against injury a sheet metal casing 44 is provided which covers all of the exposed parts of the switch. Finger hold lever 27 of the toggle mechanism, however, extends through a suitable opening in casing 44 in a manner which is common in switch construction and this opening is large enough to allow lever 27 to move freely to either one of its two positions.

Briefly summarizing the operation of the device as applied to a water heating system, it will be assumed that the system has remained idle for an appreciable period and that the toggle mechanism is in the position shown in Fig. 6. To initiate heating of the water the toggle mechanism is moved to the position shown in Fig. 5. The water in the system being cold, diaphragm 22 has been bulged inwardly and contacts 18 are free to engage contacts 19, this movement being caused preferably by the weight of contacts 18, although a light spring can be employed to bias contacts 18 toward contacts 19. When the circuit is closed, current flows through heater 16 and presently the water in the system becomes heated to a predetermined temperature which is sufficient to bulge diaphragm 22 outwardly, thereby moving pin 23 to a position which causes separation of contacts 18 and 19 to break the circuit, as shown in Fig. 5. As long as the water remains at this temperature or at any temperature which is sufficient to keep diaphragm 22 bulged outwardly the circuit will remain open. When, however, the temperature falls below a predetermined value diaphragm 22 will again bulge inwardly allowing contacts 18 and 19 to close the circuit and the water is again heated by heater 16 to the temperature which causes breaking of the circuit. The circuit to the heater 16 is in this manner made and broken recurrently as long as the toggle mechanism is in the position shown in Fig. 5. When it is desired to restore the system to idleness the toggle mechanism is moved to the position shown in Fig. 6, and the contacts in the circuit then remain open regardless of the temperature of the water in the system.

Fig. 4 illustrates a convenient position for the circuit controlling device of this invention when it is associated with a water heating system of the type which employs a tank 46 for storing the heated water.

A modified manual control mechanism is shown in Figs. 7 to 11 inclusive. In this modification the toggle mechanism is replaced by a crank or a cam which is adapted to engage the downwardly extending levers 24 associated with contacts 18 to keep these contacts disengaged from contacts 19. The other parts of the cir-

cuit controlling mechanism remain unchanged.

In this modification the manually operated control member comprises a rod or shaft 51 journaled in brackets 52 and 53 secured to plate 31.

5 Shaft 51 is capable of rotational movement through approximately 180° and to effect this movement a finger hold lever 54 is mounted on one end of shaft 51. Shaft 51 is provided with a bent or offset portion 56 which serves as a cam surface to engage lever 24 in one position of the shaft to separate contacts 18 and 19. In the other position of the shaft, which is 180° removed from the first position, the cam surface 56 is rotated to a noninterfering position with respect to levers 24.

When shaft 51 is moved to open the circuit it is desirable that the movement be relatively rapid so that the contacts will be separated quickly and thereby prevent sparking. For this purpose a spring 57 is provided which engages a cam surface 58 on the end of the shaft 51. One convenient manner of forming cam surface 58 is to provide shaft 51 with a bent end portion 59 which extends at an angle of about 90° with shaft 51. A groove wide enough to receive the end of spring 57 is provided in the bent end portion 59 and preferably the cam surface is formed at the bottom of this groove. The approximate contour of a cam surface which operates satisfactorily is shown in detail in Fig. 11. From an inspection of Fig. 11 it will be seen that when cam 58 is rotated through approximately 90°, spring 57 is tensioned by the cam and at the dead center position of the elements the tension on spring 57 becomes greatest. A slight additional movement past dead center brings a receding surface of the cam in contact with spring 57 and the energy stored up in spring 57 is directed against this cam surface to move the bent end portion 59 and shaft 51 to a position 180° removed from its original position, thus moving the offset portion 56 of shaft 51 from the position shown in Fig. 8, for example, to the position shown in Fig. 10. Since cam 58 is substantially symmetrical its action is practically the same when the lever 54 is moved in the other direction, that is, to turn shaft 51 from the position shown in Fig. 10 back to the position shown in Fig. 8.

In order that spring 57 may move shaft 51 from one position to another with a quick action, a lost motion connection is provided between shaft 51 and lever 54. For this purpose lever 54 has a loose fit on shaft 51 and a pin 61 extending through shaft 51 is employed to form the connection between shaft 51 and lever 54. In order to provide the lost motion effect, pin 61 extends through relatively large apertures 62 in lever member 54. By this construction lever 54 is capable of a limited movement relative to shaft 51 and likewise shaft 51 is capable of a limited

rotational movement without effecting lever 44. Thus, when lever 54 is turned to move cam surface 58 to its dead center position pin 61 engages one side of aperture 62 and upon a slight additional movement of lever 54, spring 57 acting against cam surface 58 rapidly moves shaft 51 to the position in which pin 61 engages the opposite side of aperture 62. During this rapid movement of shaft 51 the offset portion 56 engages levers 24 and quickly separates contacts 18 and 19.

In the modification shown in Figs. 7 to 11, pin 23 operates in the manner already described to open and close the contacts in accordance with the movement of the diaphragm of the thermoresponsive device 21. When shaft 51 is turned to the position shown in Fig. 10, however, contacts 18 and 19 remain separated irrespective of the movement of pin 23.

Fig. 12 is a circuit diagram illustrating the manner in which a double pole switch would be connected in a circuit analogous to the circuit shown in Figs. 5 and 6. It will be understood that this invention is equally applicable to either single pole or double pole switches. It will also be obvious to those skilled in the art that pin 23 may be actuated by automatic means other than thermoresponsive means as, for example, pressure responsive means, volume responsive means or by suitable timing mechanism.

While certain preferred embodiments of this invention have been shown and described, many other embodiments will be apparent to those skilled in the art without departing from the invention as defined in the appended claims.

I claim:

1. In a circuit controlling device, an automatic switch, thermoresponsive means for effecting operation of said switch to either open or closed position, a member adapted to be moved from an inactive position to a position in which it imposes a mechanical restraint against closure of the contacts of said switch, and means for effecting rapid movement of said member from said inactive position to said restraining position, said means including a spring-biased toggle mechanism.

2. In a circuit controlling device, an automatic switch, thermoresponsive means for effecting operation of said switch to either open or closed position, a member adapted to be moved from an inactive position to a position in which it imposes a mechanical restraint against closure of the contacts of said switch, means for effecting rapid movement of said member from said inactive position to said restraining position, said means including a spring-biased toggle mechanism, and a manually operable lever for actuating said means.

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