July 11, 1939. C. G. KRONMILLER ET AL 2,165,555

CONTROL DEVICE

Filed Aug. 6, 1936

Fig. 1

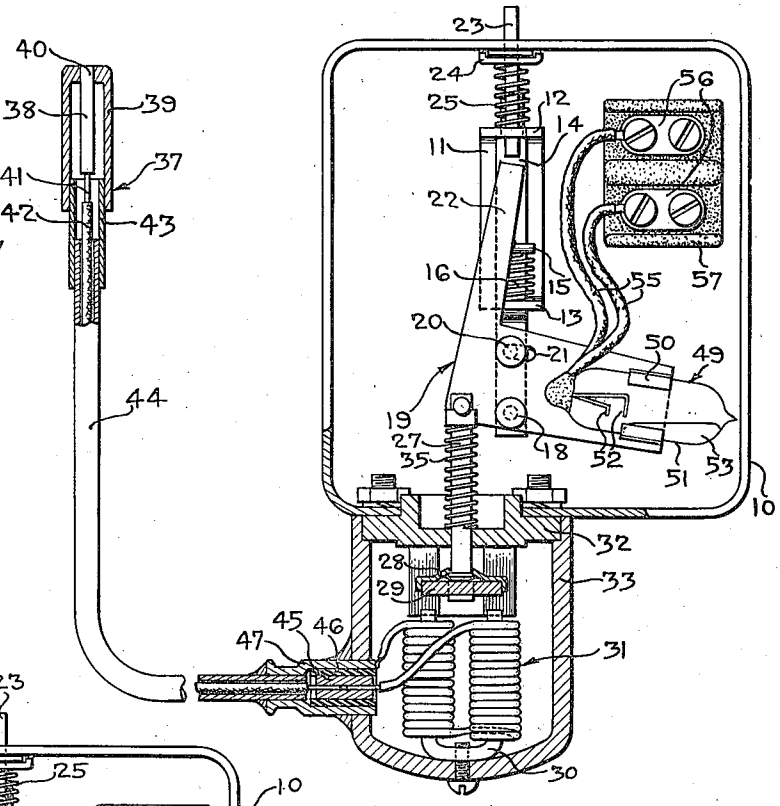


Fig. 2

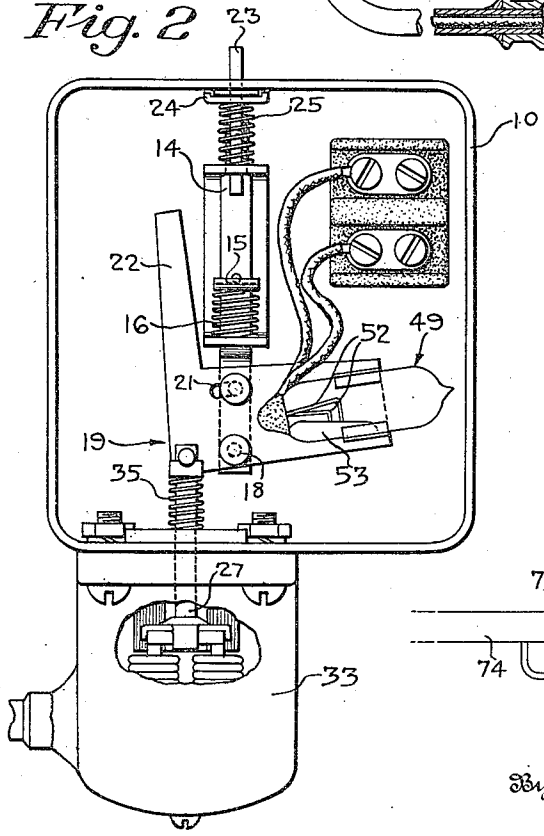
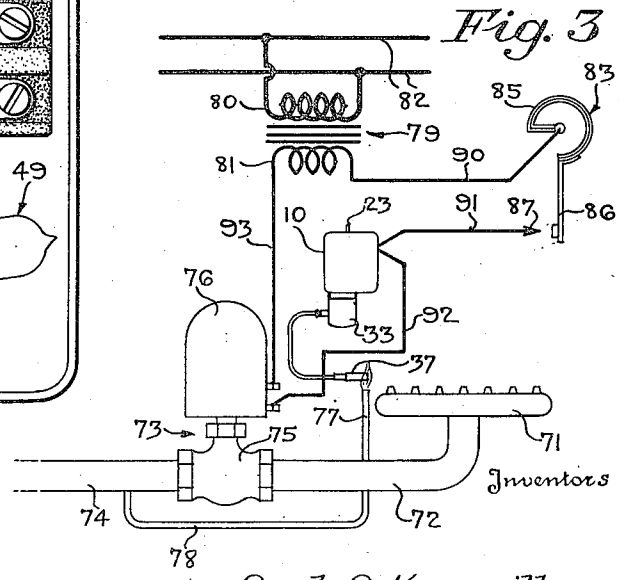


Fig. 3



Inventors

Carl G. Kronmiller
Frederick D. Joesting

By George H Fisher
Attorney

Patented July 11, 1939

2,165,555

UNITED STATES PATENT OFFICE

2,165,555

CONTROL DEVICE

Carl G. Kronmiller and Frederick D. Joesting, Minneapolis, Minn., assignors to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application August 6, 1936, Serial No. 94,530

14 Claims. (Cl. 200—112)

Our invention relates to a control device, and more particularly to a switch controlled by a condition responsive means.

It is common to employ for various control purposes a switch which will remain in closed position only when some controlling condition has a desired value. A particularly common use for such a switch is in a "safety pilot" in a fluid fuel burner control system wherein the switch will remain closed only when the pilot is burning. In certain of such switches, a manual operating means is provided which is effective to close the switch only when the controlling condition has the desired value. With this type of structure, it has further been proposed to provide means whereby the manual operating means is ineffective to open the switch while the controlling condition has the desired value.

In these prior structures, the switch employed has been an open contact switch which is actuated between open and closed position by a more or less rectilinear movement of one or more switch elements. The present invention is particularly concerned with such a device wherein a mercury switch, or some other switch which is actuated between open and closed positions by tilting thereof, is employed. Our invention further provides an additional safety factor in that after the switch has been moved to closed position, the actuating means is not only ineffective to open said switch but is ineffective to apply any force to any of the members directly associated with the switch.

An object of the present invention is accordingly to provide a switch or other control device having an actuating means which upon the switch or other control device being moved to a desired controlling position is ineffective to alter the position of the device or to even apply a force tending to alter the position thereof.

A further object of the present invention is to provide a switch of the type set forth in the previous object wherein the switch is held in the desired controlling condition only during the duration of a certain condition and upon the termination of said condition, the switch is moved to a different controlling position regardless of the position of the actuating means.

Our invention further resides in the particular structural features by which we obtain a device of the type discussed which is adapted for use with a tiltable switch. While we have shown our device as employed in connection with a mercury switch, it is to be understood that the structure employed is of broad general utility for the operation of any control device which is moved from one controlling position to a second controlling position by changing the angular position thereof.

Other objects of our invention will be apparent from the accompanying specification, claims and drawing, of which

Figure 1 is a view of our controlling device as applied to a mercury switch with the switch in one circuit controlling position,

Figure 2 is a view of the same device with a switch shown in a different circuit controlling position, and

Figure 3 is a schematic view of our device applied to a gas burner control system.

Referring to Figure 1 of the drawing, a switch is shown as located within a housing 10. Secured to the rear wall of this housing is a U-shaped bracket 11 having forwardly extending legs 12 and 13. Slidably mounted in the forwardly extending legs 12 and 13 of bracket 11 is a bar member 14. Secured to the bar 14 is a collar 15, and interposed between said collar and the lower forwardly extending leg 13 is a spring 16 which serves to yieldably urge bar 14 upwardly. Attached to bar 14 through a pivot 18 is a lever 19. The pivotal movement of lever 19 about pivot 18 is limited by a pin 20 also secured to member 14 and extending into an arcuate slot 21 in lever 19.

Lever 19 is provided with an upwardly extending extension 22 which in the position shown in Figure 1 lies in the path of movement of an actuator member 23. Actuator member 23 is slidably mounted in the leg 12 of member 11 and in the upper wall of housing 10. Secured to the member 23 is a collar 24 and interposed between said collar and leg 12 is a spring 25 which serves to bias member 23 upwardly. It will be readily seen that upon member 23 being pushed downwardly, the lower end thereof engages the extension 22 of lever 19 moving the entire lever along with strip 14 downwardly. Since the actuator member 23 is in line with pivot 18 and pin 20 or slightly to the right thereof, such downward movement of actuator 23 will not cause member 19 to be tilted.

Pivotally secured to member 19 is a rod 27. This rod has secured thereon at its lower end through a clip 28 an armature member 29 of suitable magnetic material. This armature 29 is designed to cooperate with the core 30 of an electromagnet 31. Rod 27 extends through the upper wall 32 of a housing 33 for electromagnet 31. A spring 35 is interposed between the upper end of rod 27 and the upper wall 32 of housing

33. This spring serves to bias rod 27 upwardly causing lever 19 to assume the angular position shown.

A thermo-couple is generally indicated by the numeral 37. This thermo-couple comprises the usual elements 38 and 39 of different thermo-electric characteristics which are joined at 40 to provide the "hot junction" of a thermo-couple. While the metals employed for elements 38 and 39 may be any metals having suitable dissimilar thermo-electric characteristics, I have found it desirable to employ an inner member of "Constantan", an alloy comprising approximately fifty per cent nickel and fifty per cent copper, and an outer member 39 of stainless steel. The stainless steel employed may be any suitable stainless steel capable of adequately resisting the heat of the pilot burner flame where the device is intended to be employed in connection with a pilot burner.

The inner member 38 is connected to a conductor 41 which is suitably insulated as at 42. The outer member 39 is connected to a copper reducing sleeve 43, which in turn is connected to a copper tube 44. The conductor 41 is electrically joined through a metal coupling sleeve 45 with one terminal of the winding of electromagnet 31. Surrounding the metal sleeve 45 is an insulating bushing 46 and surrounding this bushing is a copper sleeve 47 which is rolled down to engage the copper tube 44. Electrically connected to sleeve 47 is the other terminal of the winding of electromagnet 31. In order for the rather small electromotive force generated by the thermo-couple to produce a sufficient holding action of electromagnet 31, the conductor 41, copper tube 44 and the winding of the electromagnet are all of relatively large size to provide an extremely low resistivity. By reason of this fact, sufficient force is generated in the electromagnet 31 so that when the armature 29 is moved into engagement with the pole pieces of core 30, the electromagnet is able to hold the same in said position against the action of spring 35.

As pointed out previously, our device is particularly applicable for use with a switch which is moved from one circuit controlling position to a second controlling position by tilting thereof, such as a tiltable mercury switch. We have accordingly shown a mercury switch 49 mounted on the lever 19. This mercury switch is secured to lever 19 in any suitable manner, such as by a clip 50. A switch 49 comprises in the usual manner a container 51 in which is housed a plurality of electrodes 52 and a mercury globule 53. In the usual manner, when the switch is tilted, the mercury is caused to shift its position so as to bridge the electrodes 52. Connected to electrodes 52 are conductors 55 which are connected to suitable terminals 56 of a terminal block 57. Although we have shown one pair of electrodes in switch 49, it is understood any desired number of electrodes may be employed and if desired one pair may be employed at each end of the container so that one pair of electrodes are bridged when the switch is in one position and a second pair bridged when the switch is in the other position.

As previously pointed out, when actuator member 23 is moved downwardly with the members in the position shown in Figure 1, the end of the actuator engages the extension 22 of lever 19 and moves the entire lever 19 downwardly along with bar 14 upon which it is pivotally mounted. As previously explained, this downward movement of actuator member 23 does not cause any tilting of lever 19 to occur. Accordingly, this movement has no effect upon the circuit controlling position of switch 49. This downward movement of lever 19 causes armature 29 to be moved into engagement with the poles of core 30 of electromagnet 31. Unless the thermocouple is energized so as to energize electromagnet 31, springs 35 and 16 will be effective to return lever 19 to its original position without tilting thereof. If, however, the electromagnet is energized, armature 29 will be held downwardly against the action of spring 35. At the same time, spring 16 will be effective to move bar member 14 upwardly, carrying upwardly the right-hand end of lever 19 so that the parts now assume the position shown in Figure 2.

It will be noted that in the new position of elements, switch 49 is changed in angular position from that occupied in Figure 1 so that the mercury 53 is now bridging electrodes 52 causing a circuit to be established therebetween. It will further be noted that the tilting of lever 19 has caused the upwardly extending extension 22 to be moved out of the path of movement of member 23 so that further movement of actuator 23 has no effect whatsoever upon either member 14 or lever 19. In this manner, we insure that movement of actuator 23 after the switch has been closed is not only ineffective to open such switch but is ineffective to apply any force to any of the members directly associated therewith, tending to open said switch.

If actuator 23 is moved downwardly and held in that position in an attempt to prevent opening of the mercury switch, the switch will, nevertheless, open upon the deenergization of the thermo-couple. This is due to the fact that while actuator 23, in its lowermost position prevents a complete return movement of lever 19, due to the fact that it lies in the path of arm 22 of the lever, sufficient return movement of lever 19 is permitted to open the switch. Thus it is impossible for an operator to prevent operation of the switch by securing actuator 23 in its innermost position.

As previously stated, the particular structure employed is of broad general utility for use with various control devices. It is particularly applicable for use as a safety pilot in a fuel burner control system. In Figure 3, we have shown it so used. Referring to said figure, a conventional gas burner is indicated by the reference numeral 71. This gas burner 71 is connected through a pipe 72 with a valve 73 which controls the flow of gas to said burner from a gas main 74. Valve 73 may be of any suitable power actuated type and is shown as comprising a valve body 75 and a suitable power operated valve actuating means 76.

A pilot burner 77 is connected through a pipe 78 with the gas supply pipe 74. Located adjacent to said pilot burner 77 is the thermo-couple 37 of our improved control device.

A step-down transformer 79 supplies power for the operation of the system. This transformer comprises a line voltage primary 80 and a low voltage secondary 81. The primary 80 is connected to line wires 82 leading to any suitable source of power (not shown).

A thermostat 83 of conventional form is shown as controlling the operation of the gas valve 73. This thermostat comprises a bimetallic element 85 to which is attached a contact arm 86. The contact arm 86 is moved by the bimetallic element 85 into engagement with a contact 87 upon the temperature dropping below a predetermined value.

After the pilot 77 is ignited so that thermo-couple 37 is heated, the moving of actuating mem-

ber 23 inwardly and releasing the same causes the switch within housing 10 to be closed, in the manner previously described. When the temperature drops below the value desired to be maintained, the contact arm 86 will be caused to move into engagement with contact 87. In other words, the thermostat "calls for heat". Upon this taking place, the following circuit is established: from the right-hand terminal of secondary 81 through conductor 90, bimetallic element 85, contact arm 86, contact 87, conductor 91, switch 10, conductor 92, motor 76 and conductor 93 to the left-hand terminal of secondary 81. This causes the valve 73 to be opened with the result that gas is supplied to the burner 71, the gas being ignited by the pilot 77. In a normal operation, this continues until the temperature in a room or a space to be heated has risen above the desired value so that contact arm 86 separates from contact 87, or in other words, until the thermostat is "satisfied". Upon this taking place, a circuit through valve motor 76 is broken and the valve is closed. If at any time the pilot burner 77 is extinguished, the thermocouple 37 will very rapidly cool off, allowing the switch of the safety pilot to open, thus interrupting the portion of the circuit between contact 87 and the motor 76. With the switch open, it is impossible for the valve to be opened or to remain open.

It will be seen that we have provided a control device of particular applicability as a safety pilot wherein it is impossible to close a switch or other controlling device so long as the controlling condition, such as a temperature adjacent a pilot burner, has a desired value, and wherein, after the switch is closed, it is impossible to even apply an opening force to the same by operation of the actuating means. Furthermore, it is impossible to prevent opening of the switch upon extinguishment of the pilot burner. It will further be seen that our construction is relatively simple and is of general utility wherever it is desired to change the angular position of a member and to prevent such change being effective unless a predetermined condition exists.

While we have shown a specific embodiment of our device, it is to be understood that this is for purposes of illustration only and that our invention is to be limited only by the scope of the appended claims.

We claim as our invention:

1. In combination, a switch, a switch actuating member movable between first and second positions, and operative upon movement to said second position to move said switch between first and second positions without changing the circuit controlling position of said switch, selectively operable holding means, and means operative upon said holding means being effective and upon said actuating member being returned to said first position to move said switch from said second to a third and different circuit controlling position, said third position being such that said actuating member is free to move between said first and second positions but is inoperative to cause movement of said switch.

2. In combination, a controlling member comprising elements movable from one controlling position to a second controlling position upon change in angular position of said member, supporting means for said member comprising a pivot, actuating means for moving said pivot from a first to a second position to move said controlling member without changing the angular position thereof, and means for pivotally holding said member at a point spaced from said pivot when said member is in the position assumed during the second position of said pivot so that upon movement of said pivot back to said first position, said member is changed in angular position to cause the elements thereof to move to said second controlling position.

3. In combination, a controlling member comprising elements movable from one controlling position to a second controlling position upon change in angular position of said member, supporting means for said member comprising a pivot, actuating means for moving said pivot from a first to a second position to move said member without changing the angular position thereof, and means, including an electromagnet, for pivotally holding said member at a point spaced from said pivot when said member is in the position assumed during the second position of said pivot so that upon movement of said pivot back to said first position, said member is changed in angular position to cause the elements thereof to move to said second controlling position.

4. In combination, a switch having spaced electrodes and a movable conductive liquid element adapted to be moved into and out of bridging engagement with said electrodes upon change in angular position thereof, actuating means for moving said switch between predetermined positions without changing the angular position thereof sufficiently to cause the liquid element to bridge the electrodes, and further selectively operable means effective when operable to vary said movement of said switch by said actuating means to cause a sufficient change in the angular position of said switch to cause such bridging of the electrodes.

5. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, a pivotally mounted support for said switch, actuating means for moving said support and said switch between predetermined positions without changing the angular position thereof and means selectively operable to pivotally hold said support at a point spaced from the pivot point of said support to vary the movement thereof by said actuating means to cause a change in the angular position of said switch.

6. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, a pivotally mounted support for said switch, actuating means for moving said support and said switch between predetermined positions without changing the angular position thereof and means, including an electromagnet, selectively operable to pivotally hold said support at a point spaced from the pivot point of said support to vary the movement thereof by said actuating means to cause a change in the angular position of said switch.

7. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, a pivotally mounted support for said switch, actuating means for moving said support and said switch between predetermined positions without changing the angular position thereof, and means selectively operable to pivotally hold said support at a point spaced from the pivot point of said support to vary the movement thereof by said actuating means to cause a change in the angular position of said switch, said actuating means being inef-

fective to cause movement of said support after said change in angular position thereof.

8. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, actuating means for moving said switch between predetermined positions without changing the angular position thereof, and further selectively operable means effective when operable to vary said movement of said switch by said actuating means to cause a change in the angular position of said switch, said actuating means being ineffective to cause movement of said switch after said change in angular position.

9. In combination, a support, a member slidably mounted on said support, a lever pivotally secured to said member, a switch mounted on said lever, said switch being movable between different circuit controlling positions upon change in angular position thereof, a switch actuator slidably mounted on said support, said lever having a portion lying in the path of movement of said actuator when said lever is in one angular position, said actuator being effective upon movement thereof to engage said portion to slide said lever and the switch mounted thereon without changing the angular position thereof, and selective operable holding means effective when operable to pivotally hold said lever at a point spaced from the point at which it is secured to said slidable member to cause said lever to be tilted upon motion thereof being caused by said actuator.

10. In combination, a support a member slidably mounted on said support, a lever pivotally secured to said member, a switch mounted on said lever, said switch being movable between different circuit controlling positions upon change in angular position thereof, a switch actuator slidably mounted on said support, said lever having a portion lying in the path of movement of said actuator when said lever is in one angular position, means for biasing said slidable member and the lever secured thereto in the direction of said actuator, said actuator being effective upon movement thereof to engage said portion to slide said lever and the switch mounted thereon against the action of biasing means without changing the angular position thereof, and selectively operable holding means effective when operable to pivotally hold said lever at a point spaced from the point at which it is secured to said slidable member to cause said lever to be tilted upon motion thereof being caused by said biasing means.

11. In combination, a support, a member slidably mounted on said support, a lever pivotally secured to said member, a switch mounted on said lever, said switch being movable between different circuit controlling positions upon change in angular position thereof, a switch actuator slidably mounted on said support, said lever having a portion lying in the path of movement of said actuator when said lever is in one angular position, said actuator being effective upon movement thereof to engage said portion to move said lever and the switch mounted thereon without changing the angular position thereof, and selectively operable holding means effective when operable to pivotally hold said lever at a point spaced from the point at which it is secured to said slidable member to cause said lever to be tilted upon motion thereof being caused by said actuator, said tilting of said lever being effective to move said portion lying in the path of movement of said actuator out of said path of movement so that further movement of said actuator is ineffective to cause movement of said lever.

12. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, selectively operable holding means for an element associated with said switch, reciprocable means effective when moved in one direction to move said element into cooperative relationship with said holding means without changing the angular position of said switch, and means operative upon movement of said reciprocable means in the direction of its original position and upon said holding means being effective to change the angular position of said switch.

13. In combination, a switch movable between different circuit controlling positions upon change in angular position thereof, selectively operable holding means for an element associated with said switch, reciprocable means effective when moved in one direction to move said element into cooperative relationship with said holding means without changing the angular position of said switch, and means operative upon movement of said reciprocable means in the direction of its original position and upon said holding means being effective to change the angular position of said switch, said reciprocable means being ineffective in the new position of said switch to affect the position thereof.

14. In combination, a switch having spaced electrodes and a movable conductive liquid element adapted to be moved into and out of bridging engagement with said electrodes upon change in angular position thereof, selectively operable holding means for an element associated with said switch, reciprocable means effective when moved in one direction to move said element into cooperative relationship with said holding means without changing the angular position of said switch, and means operative upon movement of said reciprocable means in the direction of its original position and upon said holding means being effective to change the angular position of said switch.

CARL G. KRONMILLER.
FREDERICK D. JOESTING.