Aug. 8, 1944. F. E. LANGE 2,355,222

ELECTRIC SWITCH

Filed July 11, 1941

Fig. 1

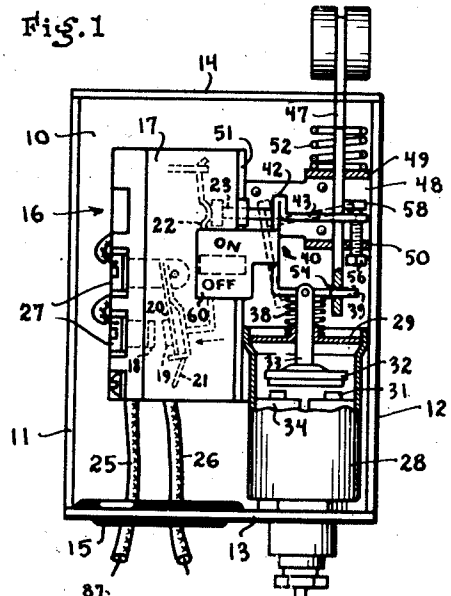
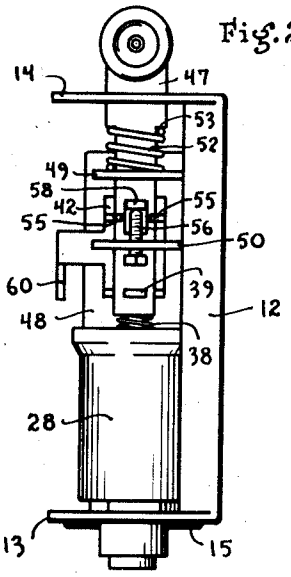


Fig. 2



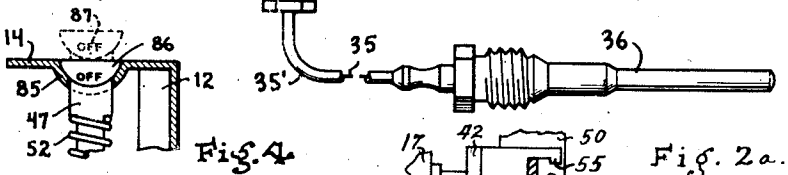


Fig. 4

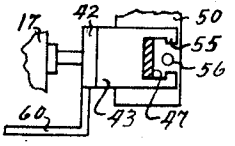


Fig. 2a.

Fig. 3

Inventor
Frederick E. Lange
By George H. Fisher
Attorney

Patented Aug. 8, 1944

2,355,222

UNITED STATES PATENT OFFICE

2,355,222

ELECTRIC SWITCH

Frederick E. Lange, Lincoln, Nebr., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application July 11, 1941, Serial No. 401,949

10 Claims. (Cl. 200—87)

The present invention relates to a safety device for a burner control system and more particularly to one designed to interrupt the flow of fuel to a main burner upon pilot flame extinguishment.

It is quite customary in connection with the gas burning art to employ a control switch or a control valve to prevent flow of fuel to the main burner in the event that the pilot burner is extinguished. In recent years, it has become quite common to hold the control device in its active position by means of an electromagnet which is energized by a thermocouple exposed to the pilot burner flame. Such an arrangement offers a number of advantages including the one that it may be operated independently of any external source of power and at the same time provide the extreme flexibility in installation provided with an electrically operated device. When the pilot burner becomes extinguished in connection with such a mechanism the armature and electromagnet are separated to cause movement of the control device to a safe position. In certain types of mechanisms of this character, before the mechanism can be again placed in operation, it is necessary to reset it. This is desirable in certain types of burner control systems where the pilot flame failure condition may be due to a difficulty which requires personal attention before the burner system is again placed in operation. This resetting operation usually involves moving the armature into engagement with the electromagnet so that the electromagnet is capable of retaining the armature. The movement of the armature into engagement with the electromagnet necessitates the provision of some means to prevent the control device from being moved to its active position by this resetting operation. This often involves the use of a complicated linkage or an auxiliary control device. The present invention is particularly concerned with an arrangement of this type wherein the armature is moved only into proximity to the electromagnet, the electromagnet being effective to move the armature the rest of the way, this further movement operating the control device from its safe to its active position wherein a flow of fuel to the burner is again permitted.

A further object of the present invention is to provide such an arrangement wherein the control device is in the form of a switch in which the armature is moved into proximity to the electromagnet and wherein upon the electromagnet being energized, a further movement of the armature into engagement changes the circuit controlling position of the switch.

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

Figure 1 is a front elevational view of the improved safety mechanism of the present invention with the cover thereof removed,

Figure 2 is a side elevational view of the safety mechanism also with the cover removed,

Figure 2*a* is a plan view of a portion of the mechanism,

Figure 3 is a view of the complete improved burner control system, and

Figure 4 is a fragmentary view of a modification of the safety mechanism.

Secured to a base plate 10 of a case is a snap switch 16 which constitutes the control device of the safety apparatus. This snap switch may take any desired form wherein a snap switch is actuated by means of a longitudinally reciprocable member. Such a switch is shown in the copending application of Albert E. Baak, Serial No. 307,991, filed December 7, 1939, for "Snap action switch", which became Patent No. 2,318,734 on May 11, 1943. In general, such a switch comprises a housing 17, a stationary contact 18, and a movable contact 19 carried by a lever 20. Bearing against the end of lever 20 is a spring pressed toggle 21 which biases the lever 20 to a position wherein contacts 18 and 19 are out of engagement. Also bearing upon lever 20 is a lever 22 which is designed to be engaged by a reciprocable button 23 extending through the wall of housing 17. Upon movement of button 23 inwardly, the lever 22 is pushed against lever 20 so as to move the same against the action of toggle 21 to the contact making position. The toggle 21, however, does not go "over-center" so that the switch is continuously biased toward open position. Extending through a grommet 15 are leads 25 and 26 which are connected to contact screws 27.

Secured to the lower flange 13 of the case is an electromagnet housing 28. This housing is cup-shape in form and is closed off at its upper end by a closure plate 29. Located within the housing 28 is an electromagnet 31 which is adapted to be engaged by an armature 32. Secured to the armature 32 is an armature stem 33 which extends through an aperture in the center of closure plate 29. The electromagnet 31 is provided with windings 34 which are connected in series with a thermocouple 36 by a wire 35 and a conducting surrounding tube 35'. The particular details of this thermocouple form no part of the present invention although this thermocouple

may well be of the concentric form shown in the patent to Carl G. Kronmiller 2,165,801 issued July 11, 1939.

A spring 38 biases the stem 33 upwardly thereby opposing the effort of the electromagnet to move the armature into engagement therewith. The lower leg 39 of a U-shaped lever 40 is pivotally secured to the upper end of armature stem 33. A vertical portion of the U-shaped lever 40 is adapted to bear against the push button 23. At the point of engagement, the lever 40 is doubled back to form a portion 42 of double thickness. The upper horizontal leg 43 of the U-shaped member 40 is designed to cooperate with a reciprocable reset bar 47. This bar is carried by a bracket plate 48 having forwardly turned flanges 49, 50 and 51. The switch 16 is supported by the flange 51. Flanges 49 and 50 are slotted, the slots therein being aligned with a slot in the flange 14 of the case. The slidable reset bar 47 extends through the three aligned slots in flanges 49, 50 and 14. A spring 52, interposed between flange 49 and a shoulder 53 of bar 47, tends to move the reset bar upwardly.

The lower horizontal leg 39 of the lever 40 extends through a slot 54 in the bar 47. The edges of this slot are rounded to permit rocking of lever 40 in the slot. The upper horizontal leg 43 of the lever 40 is provided with a slot of limited extent which straddles the bar 47. As best indicated in Figures 2 and 2a, this slot 54 is reduced at its outer end to provide a pair of shoulder portions 55. The extent of this slot between the inner end thereof and the shoulder portions 55 is indicated in Fig. 1 by dotted lines.

A screw 56 extends through the flange 50 of bracket 48 and is adapted to engage a tongue 58 struck out from the slidable bar 47. The screw 56 acts as an adjustable stop to limit the downward movement of bar 58.

Turning now to Fig. 3, the device shown in detail in Figs. 1 and 2, is adapted to be used in connection with a fuel system herein shown as comprising a main gas burner 66, which is supplied with gas through a suitable conduit 67, the flow of gas in turn being controlled by an electrically operated valve 68. The main burner 66 is adapted to be ignited by a pilot burner 69 which is connected to the main gas line on the upstream side of the main valve 68 so that it is constantly supplied with gas. The thermocouple 36, of the device shown in Figs. 1 and 2, is inserted into the flame issuing from the pilot burner 69 so as to be heated thereby. The control system further includes any suitable manual or automatic switching means, herein shown as comprising a thermostat 70, which may be placed, for example, in the room or space being heated by the main gas burner 66. This room thermostat is shown as comprising a coiled bimetallic element 71, one end of which is relatively fixed and the other end of which carries a contact arm 72. The contact arm 72, upon fall in temperature, is adapted to engage a stationary contact 73. In order to provide a good firm contact and to provide a snap action of the contact, a magnet 74 may be associated with the switch arm 72 in a manner now well known in the art. Power for the system may be supplied in any suitable manner and in Fig. 3 there is illustrated a transformer 75 having a primary winding 76 connected to the usual line wires. The secondary low voltage winding 77 supplies power to the electrical gas valve 68. When the room thermostat 70 closes its contacts as a result of temperature fall, a circuit is completed through the gas valve 68 as follows: from the upper end of secondary 77, wire 78, contact 73, switch arm 72, bimetallic element 71, wire 79, the switch 16 contained within the device of this invention, wire 80, electrical gas valve 68, and wire 81 back to the lower side of secondary 77. The gas valve 68 will thereby be moved to open position to supply gas to the burner 66 which gas will be ignited by the pilot burner 69. When the room thermostat becomes satisfied or moves its contact to open position as shown in Fig. 3, the above described circuit will be broken and the gas valve 68 will close to shut off the supply of gas to the burner 66.

This is of course the normal operation of the system. If the pilot burner 69 should become extinguished however, then the thermocouple 36 will cool whereupon power will no longer be furnished to the windings 34 of the magnet 31 and the mechanism of Figs. 1 and 2 will move to switch opening position so that switch 16 will open. In such case the gas valve 68 will close even though the room thermostat is demanding heat.

In Figs. 1 and 2, the parts are shown in the position they assume after the switch 16 has been open by reason of pilot failure and after the reset bar 47 has been manually moved inwardly to the fullest extent permitted by the stop screw 56. Such inward movement of the reset bar 47 does not close the switch 16 for reasons which will become clearly apparent hereinafter. Such movement however does bring the armature 32 within close proximity to the magnet 31. If, at this time, the pilot burner is relighted or has already been relighted so that the thermocouple 36 is generating current, the attractive force of magnet 31 will be sufficiently great to attract the armature 32, now that the armature has been manually moved in close proximity to the magnet 31. When this occurs, the stem 33 moves downwardly against the action of the relatively light spring 38. Since the right-hand end of the lower horizontal portion 39 of the U-shaped lever 40 is pivoted in the lower end of the reset bar 47, such downward movement of stem 33 results in counter-clockwise rotation of the U-shaped member 40 to the dotted line position shown in Fig. 1. This causes the upper end of the vertical portion 42 of this U-shaped member to swing to the left whereupon the operating button 23 of the switch 16 is pushed to the left so as to move the switch 16 to its closed circuit position. The device is now reset and is ready for operation. The reset bar 47 may now be released and the attractive force of the magnet 31, with the armature 32 actually in contact with it, will be sufficient to overcome both the light spring 38 and the heavier spring 52. Both of these springs now tend to pull the armature 32 away from the magnet 31. Also, since the lever now is pivoted about its pivotal connection with stem 33, the heavier spring 52 urges the button to the left so that the switch 16 is held in closed position quite firmly.

If the pilot flame should now become extinguished again, the thermocouple 36 will cool so that it generates little or no power. When the power supply to the magnet winding 34 has become small enough by reason of the cooling of the thermocouple 36, the action of springs 52 and 38 will pull the armature 32 away from the magnet 31 whereupon reset bar 47 will move upwardly to its fullest extent. The action of the relatively light spring 38 together with the nor-

mal tendency of the button 23 to move to the right will move the U-shaped member 40 in a clockwise direction so that the portion 42 is again in its vertical position as shown in full lines of Fig. 1, except that the complete U-shaped member and reset bar 47 as well as the associated parts will have been moved upwardly farther than as shown in Fig. 1. The device is now in its off position and the opening of the switch 16 will of course cause closure of the gas valve 68 if it were open at the time the pilot failure took place.

To reset the switch 16, the reset bar 47 is moved downwardly to the position of Fig. 1. It cannot be moved downwardly any further than this by reason of the tongue 58 engaging the stop screw 56. During such downward motion of the reset bar 47, the U-shaped member 40 remains in the general position shown in that the arms 39 and 43 thereof remain in the horizontal position and the connecting portion 42 remains in a strictly vertical position. This is true because the light spring 38 operating on the lower surface of the arm 39 tends to rotate the U-shaped member 40 in a clockwise direction about the pivot 54 at the lower end of the reset bar 47. As a result, this downward shifting of the reset bar 47 and the consequent downward movement of the U-shaped member 40 in no way is effective to move the button 23 to the left. The part 42 merely moves downwardly in a vertical direction so that the button 23 remains in the same relative position. However, after the reset bar has been moved to the position shown in Fig. 1, and if the pilot is relighted or has been relighted so that thermocouple 36 is hot, the armature 32 will again be brought into close enough proximity to the magnet 31 to enable the same to pull the armature 32 down into engagement with the magnet 31 whereupon the U-shaped member will again tilt or rotate slightly in the counterclockwise direction as shown by the dotted lines in Fig. 1 wherein the switch 16 is reclosed.

The U-shaped member 40 may be provided with a member 60 having the words "on" and "off" thereon which may in turn cooperate with a window 64 of the cover 65 for the device to give a visual indication of the condition of the switch 16. The position of window 64 with respect to the indicia on member 60 is indicated in dotted lines in Figure 1. It will be noted that the words "on" and "off" are so spaced apart that when the reset bar has been moved downwardly to the position shown in Figure 1, neither the word "on" nor the word "off" appears behind window 64; this indicates that the device is in the process of being reset.

From the above it will be seen that manual effort initially contracts the heavy spring 52 until the tongue 58 on the reset bar 47 engages the stop screw 56. Then, the electromagnet need attract the armature only through a short distance as shown and against the relatively light action of the spring 38. It is this last movement, that is the final movement of the armature 32 by reason of the attractive force of magnet 31, which results in the closing of the switch 16. Manual movement of the reset bar 47 does not in itself reclose the switch 16, unless the magnet 31 is actually exerting sufficient attractive force to pull the armature 32 into engagement therewith. Then, when the reset bar 47 is released, the magnet 31 holds the armature 32 in engagement with itself even against the force of spring 52. The holding or attractive force of the magnet 31 is of course much stronger after the armature 32 has actually been moved into engagement with it than it is when the armature is slightly spaced from it as shown in Fig. 1.

Fig. 4 shows a modification wherein the reset lever 47 is provided with a reset button 86 that cooperates with a recess 85 in the casing for the apparatus. In this arrangement, when the resetting operation has been completed, the button 86 is located within recess 85 as shown by solid lines. This prevents manual reopening of the switch after it has been reclosed. When the switch again opens as a result of deenergization of the coils 34, the reset button 86 moves to the position shown by dotted lines in Fig. 4. The button 86 may be provided with the legend "off" as shown at 87, this legend becoming visible when the switch has opened as a result of deenergization of coils 34.

The switch 16 can of course be replaced by a valve placed in the main gas line 67 as is well known in the art. Also, the source of power for the electrical valve 68 may be derived in any desired manner and, may even be derived from the thermocouple 36 as is also well known.

It will be obvious that many modifications and rearrangements may be made without departing from the spirit of the present invention, particularly a simple reversal of the magnet and armature, and therefore I intend to be limited only by the scope of the claims appended hereto.

I claim as my invention:

1. In an electromagnetically operated safety mechanism, a stationary electromagnet, an armature, switch means movable between first and second positions, means biasing said armature to a position wherein said switch means is in said first position and said armature is out of the attractive range of said electromagnet, actuating means for moving said armature to an intermediate position within the attractive range of said electromagnet without moving said switch means out of said first position, and means operatively connected to said armature and to at least a portion of said switch means for moving said switch means to said second position independently of said actuating means upon said armature being attracted by said electromagnet.

2. In combination, a control means having first and second positions, mechanism including an electromagnet device and an armature device normally held closely together by their magnetic interaction, one of said devices being stationary, two biasing means tending to separate said devices, means for overcoming one of said biasing means and for moving one of said devices toward the other to an intermediate position wherein their magnetic interaction is sufficient to overcome the action of the other of said biasing means, and operative connections between said mechanism and said control means for holding said control means in its first position when said devices are apart and during movement thereof to said intermediate position, and for moving said control means to its second position upon movement of said devices together from said intermediate position.

3. In combination, a control means having first and second positions, mechanism including an electromagnet device and an armature device normally held in engagement by their magnetic interaction, one of said devices being stationary, two springs tending to separate said devices, manual means for overcoming one of said springs and for moving one of said devices toward the other to an intermediate position wherein their mag-

netic interaction is sufficient to overcome the action of the other of said spring, and operative connections between said mechanism and said control means for holding said control means in its first position when said devices are apart and during movement thereof to said intermediate position, and for moving said control means to its second position upon movement of said devices together from said intermediate position.

4. In a magnetically operated safety mechanism, a magnet device, an armature device, a control means movable between first and second positions, means biasing said armature device and magnet device apart to a position wherein said control means is in said first position and said armature device is out of the attractive range of said magnet device, manually operated actuating means for moving one of said devices towards the other to an intermediate position wherein the armature device is attracted by the magnet device without moving said control means to said second position, stop means for limiting the motion of said actuating means to prevent said actuating means from moving the device moved by it beyond said intermediate position, and means operatively connected to one of said devices and to at least a portion of said control means for moving said control means to said second position independently of said actuating means as one of said devices remains stationary and the other is moved toward it from said intermediate position as a result of their mutual attractive force.

5. In a magnetically operated safety switch, a magnet device, an armature device, switch means movable between circuit open and circuit closing positions, a stationary support for said switch means, one of said devices being mounted in a stationary manner on said stationary support and the other being movable relative thereto, means for biasing the movable device away from the stationary one to a position wherein said switch means is in said circuit open position and said armature device is out of the attractive range of said magnet device, manually operated actuating means for moving the movable one of said devices towards the other to an intermediate position within their attractive range of each other without moving said switch means to said circuit closing position, and means operatively connected to the movable one of said devices and to at least a portion of said switch means for moving said switch means to circuit closing position independently of said actuating means as the stationary one of said devices remains stationary and the movable one is moved towards it from said intermediate position.

6. In an electromagnetically operated safety mechanism, an electromagnet device, an armature device, a control means movable between first and second positions, a stationary support for said control means, one of said devices being mounted in a stationary manner on said stationary support and the other being movable relative thereto, means for biasing the movable device away from the stationary one to a position wherein said control means is in said first position and said armature device is out of the attractive range of said electromagnet device, manually operated actuating means for moving the movable one of said devices towards the other to an intermediate position wherein said armature device is attracted by the electromagnet device without moving said control means to said second position, and means operatively connected to the movable one of said devices and to at least a portion of said control means for moving said control means to said second position independently of said actuating means as the stationary one of said devices remains stationary and the movable one is moved toward it from said intermediate position as a result of their mutual attractive force.

7. In a manually resettable mechanism of the class described, a control device movable to a first controlling position upon the occurrence of an undesirable condition to which it automatically responds, a casing for the control device, said casing having a recess, and a manually operable reset device effective when pushed inwardly of said casing to move said control device to a second controlling condition, said reset device having a member terminating at its outer extremity in an element which closely conforms with the shape of said recess and which so enters said recess when said resetting operation has been completed as to preclude said member being manually grasped, said member being the only manually movable member projecting from said casing so that upon said element being moved into said recess, the position of said control device can not be manually changed.

8. In a magnetically operated safety mechanism, a magnet device, an armature device, a control means movable between first and second positions, means biasing said armature device and magnet device apart to a position wherein said control means is in said first position and said armature device is out of the attractive range of said magnet device, manual actuating means operative upon being moved in resetting direction to the end of its range of movement to move one of said devices towards the other to an intermediate position wherein the armature device is attracted by the magnet device without moving said control means to said second position, and means operatively connecting one of said devices to at least a portion of said control means for moving said control to said second position without further movement of said actuating means as said armature device and magnet device move toward each other from said intermediate position as a result of their mutual attractive force, whereby the position of said control means when in its second position can not be affected by movement of said actuating means in resetting direction.

9. In a magnetically operated safety mechanism, a magnet device, an armature device, a control means movable between first and second positions, means biasing said armature and magnet device apart to a position wherein said control means is in said first position and said armature device is out of the attractive range of said magnet device, manual actuating means for moving one of said devices towards the other to an intermediate position wherein the armature device is attracted by the magnet device without moving said control means to said second position, means operatively connecting one of said devices to at least a portion of said control means for moving said control means to said second position as said armature device and magnet device move toward each other from said intermediate position as a result of their mutual attractive force, and a casing surrounding said mechanism and having an opening through which an element of said manual actuating mechanism projects when said armature device is out of the attractive range of said magnet device, said manual actuating mechanism being inaccessible for manipulation

from outside said casing when said control means is moved to said second position.

10. In a manually resettable safety mechanism having an electromagnet device and an armature device, a control means movable from a second controlling position to a first controlling position upon the deenergization of said electromagnet, a casing for the control means, said electromagnet device and said armature device, said casing having a recess, and a manually operable reset means for moving one of said devices towards the other without causing said control means to move to said second position until said electromagnet device is energized, said manually operable reset means including a member which moves completely into said recess when said resetting operation has been completed in such a manner that said member can not be manually grasped, said member being the only manually movable member projecting from said casing so that upon said member being moved into said recess, the position of said control means can not be manually changed.

FREDERICK E. LANGE.

CERTIFICATE OF CORRECTION.

Patent No. 2,355,222. August 8, 1944.

FREDERICK E. LANGE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 36, for "the contact" read --a contact--; same line, after "position" and before the period insert "in which contacts 18 and 19 are in engagement--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of November, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 2,355,222. August 8, 1944.

FREDERICK E. LANGE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 36, for "the contact" read --a contact--; same line, after "position" and before the period insert "in which contacts 18 and 19 are in engagement--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of November, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.