Dec. 24, 1940. K. CLARK 2,225,982

CONTROL DEVICE

Original Filed Jan. 3, 1938

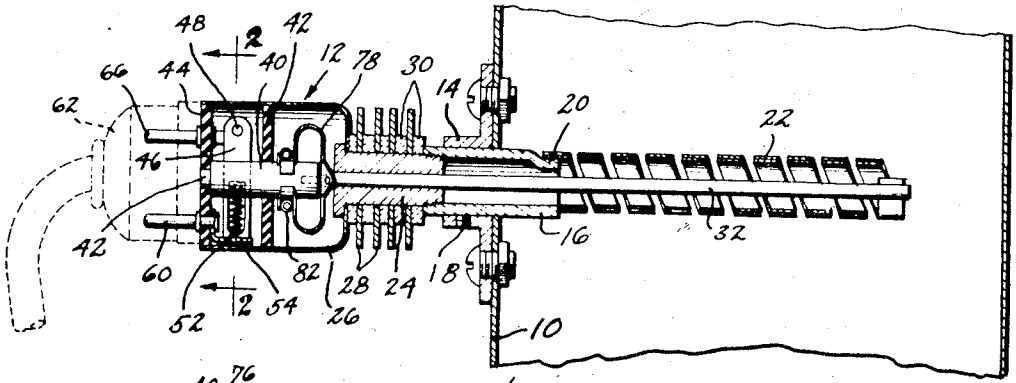


Fig. 1

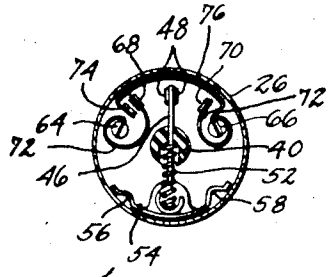


Fig. 2

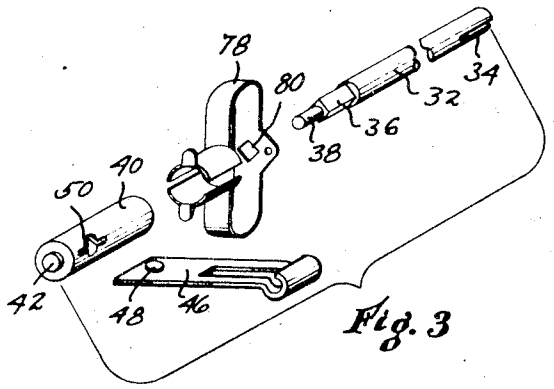


Fig. 3

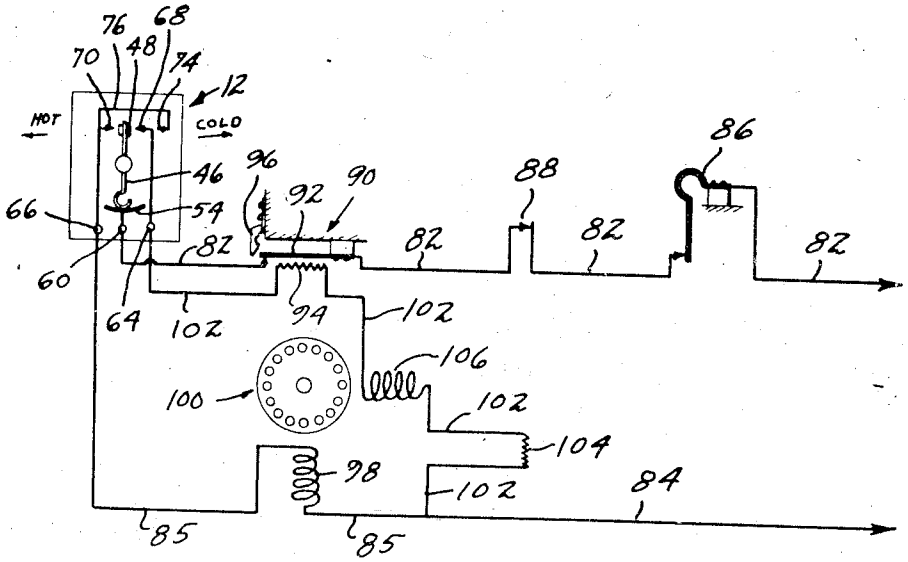


Fig. 4

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CONTROL DEVICE

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Original application January 3, 1938, Serial No. 183,148, now Patent No. 2,180,580, dated November 21, 1939. Divided and this application May 25, 1939, Serial No. 275,593

11 Claims. (Cl. 200—138)

This invention relates to control devices, for oil burners and the like, and especially to a thermostatically-controlled stack switch for turning on and off the motor and ignition means of the burner.

An object of the invention is to provide simple and effective means for first actuating both the motor and the ignition means and then turning off the ignition means after the burner ignites, without interfering with continued operation of the motor.

Another object is to provide a stack switch embodying a rapid snap action from the "cold" side to the "hot" side and a delayed action on returning to the cold side, whereby the burner is prevented from going on again until the furnace has cooled substantially.

Important features of novelty relate to the structure of the stack switch, as well as its arrangement in the control circuit. These features, and various other structural features and desirable arrangements, will be apparent from the following description of the illustrative embodiments shown in the accompanying drawing, in which:

Figure 1 is a longitudinal section of my novel stack switch;

Figure 2 is a transverse section on the line 2—2 of Figure 1;

Figure 3 is a partial exploded view showing in detail several elements of my novel switch; and

Figure 4 is a wiring diagram of a novel oil burner control circuit using resistance ignition and my novel switch and adapted to control a splitphase induction motor.

Referring to Figure 1 of the drawing there is shown a chimney or stack 10 through which the gases of combustion from an oil burner are adapted to pass. The oil burner may be of any type such as, for example, that shown in my copending application Serial No. 117,459, filed December 24, 1936, in which a motor is adapted to actuate a fan and fuel pump to supply a combustible mixture of oil and air to a furnace and in which the starting of the motor immediately, or at least within a very short time, starts the flow of combustible mixture.

My novel stack switch indicated generally by the numeral 12, is mounted on the stack by means such as a flanged fitting bolted thereto and having a circular opening coincident with an opening in the stack through which passes a tubular member 16 removably secured in the flange 14 by any desired means, such as a set screw 18, so that one end is inside the stack and the other outside.

A flattened portion 20 on the inside end of the tube 16 provides a seat to which is riveted or welded one end of a helical bi-metallic element 22 of less diameter than the tube 16 so that the switch may be removed bodily from the stack by loosening the set-screw 18 and withdrawing the switch from the flange 14.

Threaded into the outer end of the tube 16 is a combination bolt and bushing 24 having a head between which and the tube 16 are compressed: first, the bottom of a cup-shaped switch housing 26; and second, a series of heat radiating fins 28 preferably of copper, fitting tightly to the bushing and spaced by washers 30 of any suitable non-heat-conducting material.

In the bushing 24 is journalled a long shaft 32 having formed on its inside end (i. e. inside the stack) a slot 34 (Fig. 3) adapted to receive and have secured therein the bent-in, free end of the bimetal helix 22, and having at its other end, projecting into the switch housing 26, first a squared portion 36; and second, a cylindrical pin 38.

The squared portion 36 engages a clutch to be described below, and the pin 38 forms a bearing for one end of a shaft 40, the other end of which is provided with a portion 42 of decreased diameter journalled in a closure 44 for the open end of the cup. This closure is preferably made of electrical insulating material. The central part of the shaft 40 is supported by an insulating partition 43 separating the switching elements from the clutch elements previously mentioned. The shaft 40 is preferably made of Bakelite or other insulating material.

A switch arm 46 formed of a strip of brass or the like having contact points 48 secured on opposite faces adjacent one end and having its other end formed parti-cylindrically, passes through a slot 50 in the shaft 40. A spring 52 urges the arm radially so that the parti-cylindrical end maintains continuous contact with a main contact 54 secured to the closure 44. This contact is formed on an arc having its center at the center of the shaft, and it has humps 56 and 58 adjacent each end of the arc adapted to act as latches for the arm 46 in its respective contact engaging positions.

The contact 54 is secured to the closure 44 by means of a rivet 60 having a long prong on the outer end adapted to receive a plug-in socket or the like 62, and similar rivets 64 and 66, also adapted to coact with the socket, carry contacts

68 and 70 respectively which engage with the contacts 48 in opposite positions of the switch arm. The contacts 68 and 70 are resiliently mounted by means of spiral springs 72 secured in the inside projections of the rivets 64 and 66 respectively.

Another contact 74 is mounted on a support 76 secured in the rivet 66 which passes over the switch arm 46 so that the contact is positioned directly behind the contact 68 permitting the switch to close and open two circuits simultaneously.

An important minor feature of the invention is a novel slipping clutch connection between the shafts 32 and 40 comprising a C-shaped stamping 78 pierced at the back of the C with a square hole 80 fitting on the squared portion 36 of the shaft 32 and having the arms of the C closely formed around the shaft 40 and held in tight frictional engagement therewith by a garter spring 82. This clutch permits continued expansion or extraction of the bimetallic element 22 after the switch has been operated.

In operation, when no gases are passing through the stack 10 the bimetal element 22 is cold and urges the arm 46 in the counter-clockwise direction so that contacts 48, 68 and 74 are closed and the parti-cylindrical end of the arm 46 is to the right of the hump 58. The switch is now said to be on the "cold" side.

In this position the burner is brought into operation, and the gases of combustion passing the bimetal element 22 cause it to wind up more closely urging the arm 46 in the clockwise direction, but it is held in place by the hump 58 until the force exerted is sufficient to compress the spring 52, whereupon the arm snaps to the other side closing the contacts 48 and 70, the parti-cylindrical end of the arm 46 passing over the hump 56 which is lower than the hump 58. In this position the switch is said to be on the "hot" side.

Whenever gases cease to flow in the stack the bimetal element cools and unwinds and the arm snaps in the opposite direction. An important feature of the invention resides in making the hump 58 higher than the hump 56 whereby in returning to the "cold" side insufficient energy is stored in the bimetal element to move the arm over the hump 58, thus creating a delay period in which the bimetal element must cool further and store up sufficient energy to lift the arm over the hump 58 before the "cold" side contact is made.

While the foregoing refers to a specific embodiment it is clear that a great number of variations in arrangement of contacts and delay action might be worked out for particular circuit requirements.

Referring now to the control circuit diagram of Figure 4 there are shown the two wires 82 and 84 of a single-phase A. C. line. Connected in series in the line 82 is the usual room thermostat 86 of any desired type adapted to close the circuit when heat is called for, together with a limit switch 88 (adapted to open the circuit upon over-pressure in a steam heating system or upon excessive temperature in hot air and hot water systems), and a time delay switch 90. The wire 82 terminates at the main contact 54 of the stack switch 12.

In this case the time delay switch is illustrated as a bi-metal element 92 anchored at one end and closing the circuit by a contact at its other end, a heating coil 94 on a separate circuit and a latch 96, adapted to hold the bimetal element away from the contact when deformed by the heat in the coil 94, thereby requiring manual operation to reestablish the circuit.

The other line 84 terminates at the junction of two parallel circuits one of which 35 has connected therein, in series, the "running" or inductive winding 98 of a split phase induction motor 100 which operates the fuel pump and fan (not shown) of the oil burner. The wire 85 terminates at the prong 66 of the stack switch and is thus connected to both contacts 70 and 74 so that contact is made with it on both the "hot" and cold sides of the swtich.

The other parallel circuit 102, connected to the line wire 84, has connected in series in it a resistance ignition element 104 which may be of the type described below, the "starting" or split phase winding 106 of the motor 100 and the heating coil 94 of the time delay switch 90. The line 102 terminates at the contact 68 of the stack switch.

It will be noted that instead of employing the usual resistance winding in the splitphase coil, whereby energy is wasted, the ignition and delay switch resistances are substituted thereby causing the heretofore wasted energy to serve a useful purpose.

In operation, assuming the room thermostat to be open, the stack switch will be on the "cold" side with the contact 48 in engagement with contacts 68 and 74. As the space to be heated grows colder, the room thermostat 86 closes the circuit 82 and current flows through both circuits 85 and 102 energizing the starting and running windings 106 and 98 of the motor 100 and thereby starting the motor to supply the combustible mixture to the furnace.

At the same time the ignition element 104 is heated by the current in the circuit 102 and ignites the mixture. With combustion established, the hot gases in the stack 10 gradually heat up the bimetallic element 22 until the switch snaps to the "hot" side. This opens both circuits 85 and 102 but instantaneously reestablishes circuit 85 through the contact 70 and the motor 100 continues to run, energized solely by the "running" winding 98 in the manner of a simple single phase induction motor.

When the space being heated is warm enough the room thermostat 86 breaks circuit 82 stopping the motor. The gases in the stack gradually cool off permitting the switch 12 to return to the "cold side."

If the current should only be interrupted long enough for the motor to stop and then reestablished the motor could not start until the furnace has cooled and the stack switch snapped back to the "cold" position whereupon ignition is supplied and the burner restarts in the normal manner. The motor refuses to start until both the starting and running windings are energized.

If combustion fails to take place the continued flow of the heavy starting current through the circuit 102 heats up the bimetal element 94 of the time delay switch 90 opening the circuit 82 and throwing the whole system out of operation until the trouble is discovered and the switch 90 reset.

If combustion should fail while the burner is in operation, due, e. g., to clogging of the oil spray nozzle, or air inlet openings, or due to oil pump breakage or fan breakage, the cooling of the stack switch bimetal element 22 will stop the burner by separating contacts 70 and 48 and then return

the switch to the "cold" side to restart the burner. The previously described delay in returning permits the furnace to cool to the point where it is safe to restart without danger of explosion in event that the continued running of the motor, while the stack switch was cooling off enough to open the circuit 85, has resulted in discharging a lot of oil into the furnace. Upon restarting, if the condition which caused failure of combustion has not been remedied, the time delay switch 90 will lock out the system.

It will be noted that this system employing my novel stack switch provides intermittent ignition providing long life for the ignition element.

While only one embodiment of my invention has been described in detail, it is not my intention that the scope of the invention should be limited to that embodiment or otherwise than by the terms of the appended claims.

This application is a division of Patent No. 2,180,580 granted Nov. 21, 1939.

I claim:

1. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical contact, said cylindrical contact having humps at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

2. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical contact, said cylindrical contact having humps of different heights at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, the force to carry said member over the lower hump in the direction of the higher one being insufficient to carry it over the higher one until additional torque is built up on the shaft, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

3. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical contact, said cylindrical contact having humps at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof, together with a third contact electrically connected to one of the spaced contacts and closed by engagement with said contact member at the same time as the other of the spaced contacts.

4. A control device for an oil burner or the like comprising a thermostatically operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical contact, said cylindrical contact having humps of different heights at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, the force to carry said member over the lower hump in the direction of the higher one being insufficient to carry it over the higher one until additional torque is built up on the shaft, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof, together with a third contact electrically connected to one of the spaced contacts and closed by engagement with said contact member at the same time as the other of the spaced contacts.

5. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical surface against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical surface, said cylindrical surface having humps at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

6. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a contact member mounted on and movable radially with respect to said shaft, a cylindrical surface against which the end of said member bears, a spring yieldingly urging said member radially of the shaft against the cylindrical surface, said cylindrical surface having humps of different heights at opposite sides over which the shaft suddenly forces the contact member when the torque on the shaft builds up enough to overcome said spring, the force to carry said member over the lower hump in the direction of the higher one being insufficient to carry it over the higher one until additional torque is built up on the shaft, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

7. A switch comprising a shaft, resilient means

for urging the shaft in opposite directions at different times, a member carried by the shaft and radially movable thereon, a fixed cylindrical surface engaged by the member, a spring urging the member against the surface, spaced humps on the surface over which the shaft forces the member when the torque on the shaft is sufficient to overcome said spring, an electrical contact mounted on the shaft, and spaced contacts engageable by the first named contact and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

8. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a second shaft, slipping clutch means connecting the two shafts, a contact member mounted on and movable radially with respect to said second shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the second shaft against the cylindrical contact, said cylindrical contact having humps at opposite sides over which the second shaft suddenly forces the contact member when the torque on the second shaft builds up enough to overcome said spring, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

9. A control device for an oil burner or the like comprising a thermostatically-operated shaft, a second shaft, slipping clutch means connecting the two shafts, a contact member mounted on and movable radially with respect to said second shaft, a cylindrical contact against which the end of said member bears, a spring yieldingly urging said member radially of the second shaft against the cylindrical contact, said cylindrical contact having humps of different heights at opposite sides over which the second shaft suddenly forces the contact member when the torque on the second shaft builds up enough to overcome said spring, the force to carry said member over the lower hump in the direction of the higher one being insufficient to carry it over the higher one until additional torque is built up on the second shaft, and spaced contacts engageable by the contact member and one of which is engaged thereby when said member is forced over one of said humps to the outer side thereof and the other of which is engaged by said member when it is forced over the other of said humps to the outer side thereof.

10. A switch comprising an element movable between two positions, contacts engaged by said element at said two positions, a surface engaged by the element including two humps each adapted to hold said element at one of the extreme positions and one of said humps being higher than the other, resilient means urging the element against said surface, and resilient means adapted to urge said element from one position to the other and vice versa, said humps and said two resilient means being so constructed and arranged that when the element is urged over the higher one it will snap over the lower to the extreme position, but when the element is urged over the lower one in the reverse direction it will not pass over the higher one until additional force is exerted by the last named resilient means.

11. A switch comprising an element movable between two positions, contacts engaged by said element at said two positions, a surface engaged by the element, means constructed and arranged to hold said element at one of the extreme positions and having greater holding power at one extreme position than at the other to give a delayed action in one direction, resilient means urging the element against said surface, resilient thermostatic means adapted to urge said element from one position to the other and vice versa, and friction clutch means interposed between said element and the resilient thermostatic means.

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