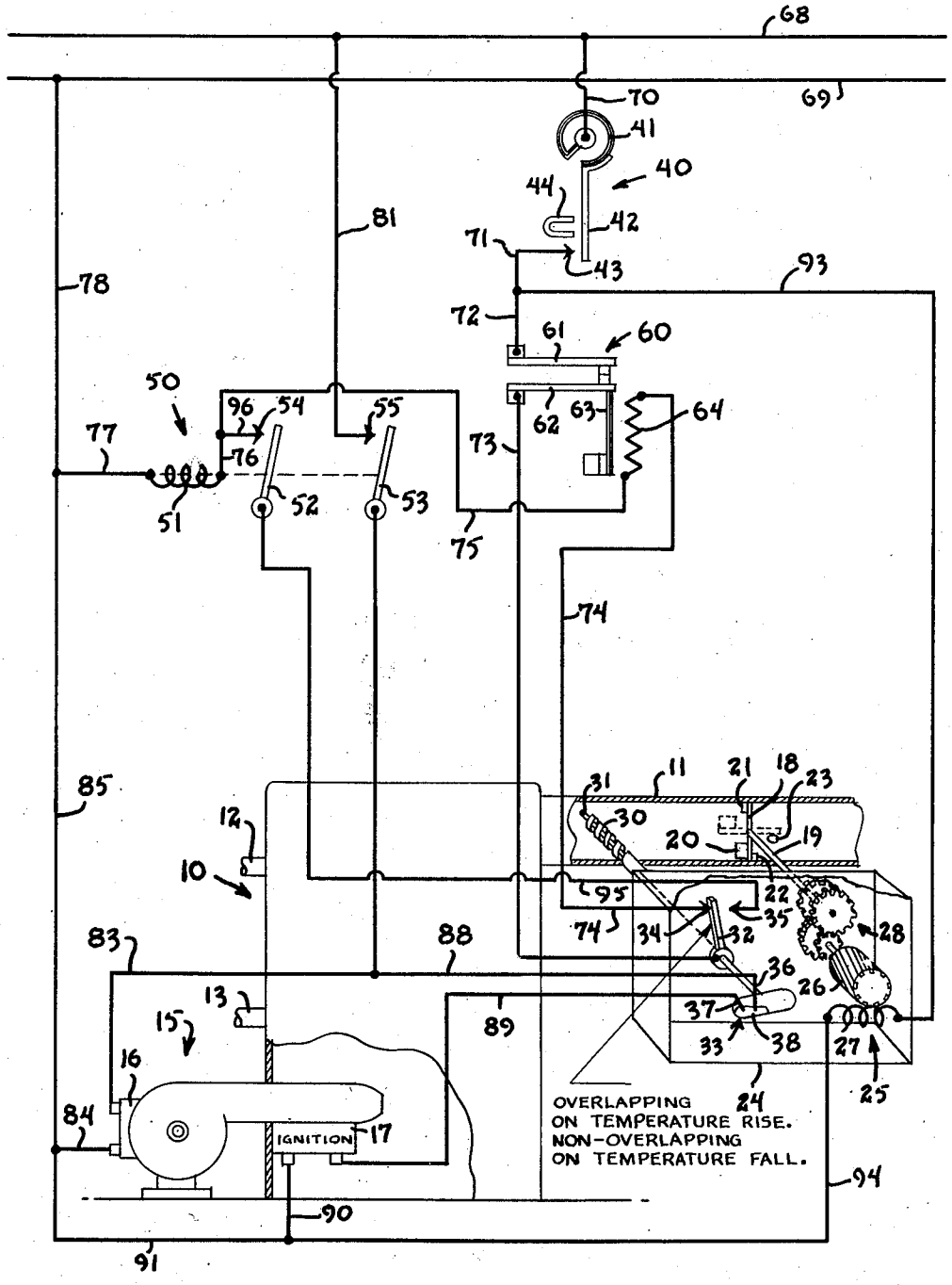
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FURNACE CONTROL SYSTEM

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FURNACE CONTROL SYSTEM

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This invention relates to a furnace control system and more particularly to a system controlling a furnace of the type having a damper for controlling the draft therethrough.

An object of the present invention is to provide a draft controlling damper for a furnace which is normally moved to closed position whenever burner operation is terminated but which is maintained in open position if such termination arises solely by reason of accidental failure of combustion.

A further object of the present invention is to provide a draft controlling damper for an oil burning furnace which is normally moved to closed position whenever burner operation is terminated but which is maintained in open position when the burner operation is terminated by a safety switch opening as the result of failure of combustion.

A further object is to provide a control system of the type referred to in the previous objects in which the draft controlling damper is a stack damper.

Further objects of the present invention will be apparent from a consideration of the accompanying specification, claims and drawing.

In the single figure of the drawing the invention is illustrated in schematic form. A furnace is generally designated by the reference numeral 10. This furnace is provided with a stack 11. The furnace is shown for illustrative purposes as being of the hot water type with pipes 12 and 13 leading to and from radiators (not shown) in the space to be heated.

An oil burner generally indicated by the reference numeral 15 extends into the furnace. This burner is of the conventional type and comprises a burner motor, the terminal plate of which is indicated by the reference numeral 16. Associated with the burner is an ignition means 17.

Located within the stack 11 which is shown in the drawing with a portion thereof broken away is a stack damper 18. This stack damper is secured adjacent its mid portion to a shaft 19 which is pivotally mounted in the stack. The damper 18 is provided adjacent its lowermost portion with a weight 20 which acts to bias the damper to closed position and is of sufficient mass to move the damper and its actuating means to a closed position upon deenergization of the actuating means. Stops 21 and 22 are provided for the purpose of stopping the damper in its closed position. A stop 23 is provided for limiting the opening movement of the damper. The open position of the damper is indicated in the drawing by dotted lines. The shaft 19 extends into a housing 24 and located within this housing is a motor 25 of any suitable type. This motor is shown as being of the induction type and as comprising a squirrel cage rotor 26 and a field winding 27. The rotor 26 is connected through a reduction gearing 28 to the shaft 19. Upon energization of the field winding 27, the motor is operative to rotate shaft 19 in clockwise direction against the action of the biasing means 20. This motor is limited by the stop 23 when the damper reaches open position and thereafter the damper is maintained in such open position as long as the motor is energized. Upon deenergization thereof, the biasing means 20 is effective to rotate the damper in a counter-clockwise position along with the gear train 28 and the rotor 26 to the closed position of the damper shown in the drawing in full lines.

Also located within the stack 11 is a helical bimetallic element 30. This element is secured at one end to a rod 31 and at its other end to the housing 24. The rod 31 extends into the housing 24 and is connected through a slip friction connection with a switch blade 32 and a mercury switch 33. The switch blade 32 is designed to move between contacts 34 and 35. It is so designed as to be overlapping on temperature rise and non-overlapping on temperature fall. In other words, on temperature rise, the switch blade 32 engages contact 35 before it leaves contact 34. On temperature fall, it disengages contact 35 before it engages contact 34. The mercury switch 33 is of conventional construction and is provided with electrodes 36 and 37 which are adapted to be biased by a mercury element 38. The mercury switch 33 is shown in the drawing in its closed position. Upon a temperature rise in stack 11, the bimetallic element 30 is effective to rotate rod 31 in a clockwise direction. This action is operative to almost immediately move switch blade 32 into engagement with contact 35 and to immediately thereafter move switch 33 to its open position. If such movement has occurred, the continued rise in the stack temperature merely causes rod 31 to slip with respect to switches 32 and 33. Thus upon a drop in temperature, bimetallic element is almost immediately effective to rotate the switches in the reverse direction. The assembly consisting of the bimetallic element 30, the rod 31 and the switch including switch blade 32 and contacts 34 and 35 may be of the type shown in the patent to F. S. Denison et al., 1,941,540 of

January 2, 1934. It is to be understood that the housing 24 may be supported in any suitable manner independently of the stack 11.

A room thermostat is generally indicated by the reference numeral 40. This thermostat consists of a bimetallic element 41 to which is secured a contact blade 42. The contact blade 42 is adapted to be engaged with a fixed contact 43. A magnet 44 is associated with the contact blade 42. The purpose of the magnet is to impart a differential to the thermostat and to insure a quick making and breaking of the blade 42 with respect to the contact 43. It will be readily apparent that as the blade 42 approaches the contact 43, the magnet 44 will be effective to accelerate such movement of blade 42 and cause the blade 42 to make the contact 43 at a temperature slightly different from that at which it would otherwise make contact 43. In the case of thermostat 40, the blade 42 is moved into engagement with contact 43 upon a temperature fall. Consequently, the effect of magnet 44 is to cause blade 42 to engage contact 43 at a higher temperature than it would otherwise effect such engagement. Similarly, upon a temperature rise the magnet retards the movement of blade 42 away from contact 43 so that such movement does not take place until a still higher temperature is reached. This differential eliminates any danger of frequent energization and deenergization of the oil burner or of chattering of the relay due to the thermostat fluttering around the contact.

A relay is employed for the purpose of controlling the operation of the oil burner. This relay is designed by the reference numeral 50. The relay 50 comprises a relay coil 51 which cooperates with a plurality of switch blades 52 and 53. The switch blades 52 and 53 are adapted to be moved into engagement with contacts 54 and 55, respectively. By reason of the energization of relay coil 51, the switch blades 52 and 53 are normally biased away from contacts 54 and 55 by any suitable biasing means (not shown).

A safety switch is designated by the reference numeral 60. This safety switch may be of any suitable form. One preferred form is that shown in the patent to Frederick S. Denison, No. 1,958,081 of May 8, 1934. The safety switch is shown in the drawing schematically as comprising two switch blades 61 and 62, the lower of which is pivotally mounted and held in contact making engagement with blade 61 through a bimetallic element 63. The bimetallic element 63 in its cold position extends under the end of blade 62. A heater 64 is associated with the blade 63 and is operable when energized to heat element 63 and cause the same to deflect towards the right. If such heating continues for a sufficiently long time, the upper end of bimetallic element 63 is moved out from under the end of blade 62 to permit switch blade 62 to drop away from blade 61.

Power is supplied to the system through line wires 68 and 69 leading to any suitable source of power (not shown).

Operation

The various elements are shown in the drawing in the position which they assume when the temperature in the space is above the value which is desired. Upon the temperature dropping below the desired value, thermostatic switch 42 is moved into engagement with contact 43. When this occurs, the following circuit is established to the relay coil 51 of relay 50: from line wire 68 through conductor 70, bimetallic element 41, switch blade 42, contact 43, conductors 71 and 72, switch blades 61 and 62, conductor 73, switch blade 32, contact 34, conductor 74, heating element 64, conductors 75 and 76, relay coil 51, and conductors 77 and 78 to the other line wire 69. The energization of relay coil 51 causes switch blades 52 and 53 to be moved into engagement with contacts 54 and 55.

The movement of switch blade 53 into engagement with contact 55 results in the following circuit being established to the oil burner 60: from line wire 68, through conductor 81, contact 55, switch blade 53, conductors 82 and 83, oil burner motor 16, and conductors 84, 85 and 78 to the other line wire 69. At the same time the following circuit is established to the ignition means 17: from line wire 68 through conductor 81, contact 55, switch blade 53, conductors 82 and 88, mercury switch 33, conductor 89, ignition means 17, and conductors 90, 91, 85 and 78 to the other line wire 69.

The engagement of thermostatic switch blade 42 with contact 43 results in addition to the energization of relay coil 51 the energization of field winding 27 of damper motor 25 through the following circuit: from line wire 68 through conductor 70, bimetallic element 41, contact blade 42, contact 43, conductors 71 and 93, field winding 27, and conductors 94, 91, 85 and 78 to the other line wire 69. The establishment of this circuit causes the motor 25 to move the damper 18 to the open position shown in dotted lines, as previously explained. The damper is now in open position in preparation for the establishment of combustion.

The establishment of the circuits to the oil burner motor 16 and the ignition means 17 in a manner previously traced results in the establishment of the conditions necessary for combustion. Under normal circumstances, combustion will take place almost immediately. The effect of this very quickly produces a rise in the stack temperature by reason of the hot gases of combustion passing therethrough. The effect of this rise in stack temperature is to cause bimetallic element 30 to move contact arm 32 out of engagement with contact 34 and into engagement with contact 35. At the same time or immediately thereafter, mercury switch 33 is moved to open position.

The switch blade 32, as previously explained, moves into engagement with contact 35 before it moves out of engagement with contact 34. The movement of switch blade 33 into engagement with contact 35 results in the establishment of the following circuit to relay coil 51: from line wire 68 through conductor 70, bimetallic element 41, contact blade 42, contact 43, conductors 71 and 72, switch blades 61 and 62, conductor 73, switch blade 32, contact 35, conductor 95, switch blade 52, contact 54, conductors 96 and 76, relay coil 51, and conductors 77 and 78 to the other line wire 69. It will be noted that this new energizing circuit to relay coil 51 is independent of heater 64. The separation of switch blade 32 from contact 34 results in the previously traced circuit through this heating element being interrupted. The result of this is that heater 64 is no longer energized so that bimetallic element 63 continues to retain switch blades 61 and 62 in engagement.

The movement of mercury switch 33 to open position results in the ignition means 17 being deenergized. This is desirable since in the ordi-

nary burner control system it is unnecessary to have the ignition means continuously operated.

Under normal conditions, the burner will continue to operate and the damper 18 will continue to remain in open position until such time as the temperature of the space being heated rises sufficiently to cause disengagement of thermostatic switch blade 42 from contact 43. When this takes place, the energizing circuit to both the damper motor 25 and the relay 50 controlling the energization of oil burner 15 is interrupted. Thus almost simultaneously the stack damper is closed and the oil burner operation is terminated. The stack damper continues to remain closed the entire time the oil burner is off and by reason of the fact that it effectively closes off the stack 11 prevents any of the accumulated heat in the furnace 10 from passing up the stack 11. This results in a very substantial saving in fuel inasmuch as the heat accumulated in the furnace 10 after any appreciable operation of the oil burner 15 is very considerable. If some means is not provided for closing off the draft through the furnace, this heat or the larger amount of it will pass up the stack before the next burner operation.

In the previously traced operation, it was assumed that the establishment of the conditions normally necessary for combustion resulted in combustion taking place. It occasionally happens that due to the condition of the equipment, combustion does not take place as it should. Under these circumstances the rise in stack temperature previously mentioned does not occur so that the sole energizing circuit for relay 51 continues to be through the heating element 64. Under these circumstances, the bimetallic element 63 is within a predetermined period of time deflected to the right sufficiently to permit separation of switch blades 61 and 62. Such separation of switch blades 61 and 62 causes deenergization of relay coil 51 and the consequent deenergization of oil burner 15. Such opening of the safety switch 60 does not, however, result in the deenergization of the damper motor 25. It will be noted that the circuit to this damper motor is independent of the safety switch 60. The result is that the damper motor continues to remain energized maintaining the stack damper 18 in open position even though the oil burner is deenergized. This is highly desirable inasmuch as an opportunity is given for the gases resulting from the operation of the oil burner 15 without combustion taking place to pass up the stack. If these gases are not removed, there is a danger that upon a subsequent attempt to operate the oil burner, the turning on of the ignition will cause the ignition of these accumulated gases with explosive violence. Moreover, the closing of damper 18 would be of no utility whatsoever inasmuch as the oil burner has not been placed into operation so that there is no heat in the furnace which must be conserved. Thus with the particular control system of the present invention, the damper is only closed after combustion has taken place and when the termination of operation of the burner is by reason of the thermostat being satisfied.

Provision is also made for safe operation of the control system in the event of combustion being extinguished after a period of operation of the burner and before the thermostat is satisfied. Under these conditions, the stack will immediately begin to cool again causing switch blade 32 to first separate from contact 35, mercury switch 33 to again be closed, and finally causing switch blade 32 to again remake contact 34. The movement of switch blade 32 out of engagement with contact 35 deenergizes the circuit to relay coil 51 which is independent of heater coil 64. This stops operation of the burner motor, thus permitting the unignited oil to pass up the stack. After a brief interval sufficient to permit this "scavenging" of the furnace, the engagement of switch blade 32 with contact 34 occurs, again establishing the first traced circuit to relay coil 51, which circuit includes heating element 64. In the meantime, reclosure of the mercury switch 33 has resulted in the ignition means 17 again being reenergized. The conditions necessary for igniting the burner 15 are again established so that if for any reason the condition causing the combustion interruption was a temporary one, the burner will again be reignited. This interruption of combustion and the reestablishment thereof in no way affects the damper 18, however. This is extremely important inasmuch as it is desirable that the damper 18 remain open during the scavenging period and during the attempt to restart the burner 15. If the attempt to restart the burner 15 is unsuccessful, the safety switch 60 will be opened in the manner previously described so that operation of the oil burner 15 is discontinued. At the same time, the operation of the damper motor will not be affected. The result is that the damper 18 remains in its open position to permit the accumulated gases in the furnace from passing out through the stack 11.

It will be seen that I have provided a system wherein a damper is provided for the purpose of controlling the draft, which damper is normally closed, as soon as the burner operation is terminated, for conserving the heat within the furnace. However, whenever the operation of the burner is terminated by reason of the failure of combustion, the damper 18 continues to remain in open position to permit the gases accumulated in the furnace to pass up the stack.

While a specific embodiment of the invention has been shown for purposes of illustration, it is understood that my invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a temperature control system in combination fuel burning means comprising a combustion chamber, means for controlling said fuel burning means including a first electrical switching means, fuel igniting means controlled by said first electrical switching means, draft control means controlled by said first electrical switching means for normally permitting draft through said combustion chamber only when fuel is being supplied to said fuel burning means, and safety means including a device indicative of the presence or absence of combustion in said combustion chamber, said safety means being operable to terminate the supply of fuel and deenergize the fuel igniting means in the absence of combustion in the combustion chamber while fuel is being supplied, said draft control means being independent of the said safety means whereby if said last mentioned means terminates the supply of fuel and deenergizes the fuel igniting means, draft through the combustion chamber is continued for scavenging it of combustible gases and said safety means comprising a switch operable to open only in the event

of absence of combustion in the combustion chamber for a predetermined time while fuel is being supplied thereto.

2. In a temperature control system, in combination, fuel burning means comprising a combustion chamber, means for controlling said fuel burning means including a first electrical switching means, fuel igniting means controlled by said first electrical switching means, draft control means controlled by said first electrical switching means for normally permitting draft through said combustion chamber only when fuel is being supplied to said fuel burning means, and safety means including a device indicative of the presence or absence of combustion in said combustion chamber, said safety means being operable to deenergize said igniting means in response to combustion in the combustion chamber and to reenergize said igniting means after a predetermined period of absence of combustion in the combustion chamber, said safety means comprising a switch operable to open only in the event of absence of combustion in the combustion chamber for a predetermined period while said igniting means is energized, opening of said switch terminating the fuel supply and deenergizing the igniting means, said draft control means being independent of said safety means whereby draft continues in the event of combustion failure and in the event of opening of said switch.

3. In a temperature control system, in combination, fuel burning means comprising a combustion chamber, means for controlling said fuel burning means including a first electrical switching means, fuel igniting means controlled by said first electrical switching means, draft control means controlled by said first electrical switching means for normally permitting draft through said combustion chamber only when fuel is being supplied to said fuel burning means, means comprising a temperature responsive switch device responsive to the temperature of exhaust gases from said combustion chamber, said switch device being operable to deenergize said igniting means after starting of said fuel burning means in response to combustion temperature and to reenergize said igniting means in the event of failure of combustion, and safety means comprising a switch cooperating with said switch device whereby said igniting means is deenergized and the fuel supply is discontinued in the event of absence of combustion in the combustion chamber for a predetermined period while fuel is being supplied thereto, said draft control means being independent of the said safety means whereby if said last mentioned means terminates the fuel supply and deenergizes the fuel igniting means, draft through the combustion chamber is continued for scavenging it of combustible gases.

4. In a combustion control system, in combination, a combustion chamber having an oil burner associated therewith, ignition means for igniting fuel supplied by said oil burner, and means comprising a motorized stack damper, control means comprising a space thermostat, combustion responsive switch means and means comprising a safety switch, said thermostat being operable to energize the oil burner and ignition means through said safety switch and said damper means through a separate circuit, said combustion responsive switch means controlling said safety switch means whereby said safety switch means opens in the event of absence of combustion in the combustion chamber for a predetermined period while said thermostat is calling for heat to deenergize the oil burner and ignition means, said damper means remaining energized as long as the thermostat is demanding burner operation.

5. In combination, a furnace, means controlling the draft through said furnace, said draft controlling means being movable between a draft retarding and a draft producing position, a burner in said furnace, means controlling the delivery of fuel to the burner comprising electrical switch means normally operable to cause said fuel controlling means and said draft controlling means to effect delivery of fuel to said burner and to move to draft producing position respectively at substantially the same time, means including a device responsive to a condition indicative of the presence or absence of combustion in the combustion chamber for causing said fuel controlling means to interrupt the delivery of fuel without causing said draft controlling means to move to draft retarding position, and safety switch means operable to prevent further delivery of fuel to said burner in the event the fuel supply has been interrupted for a predetermined time by said combustion responsive means, said first electrical switch means controlling said draft controlling means independently of said safety switch means.

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