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DAMPER AND HEATER CONTROL SYSTEM

2,633,299

Filed June 23, 1949

3 Sheets-Sheet 1

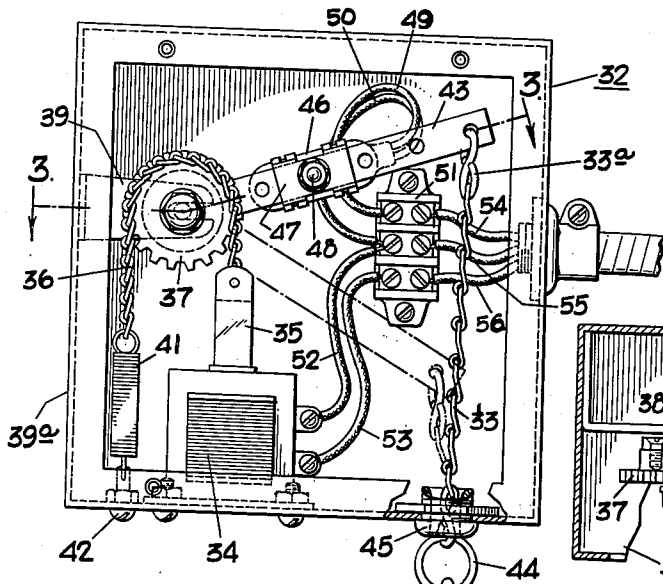


Fig. 1.

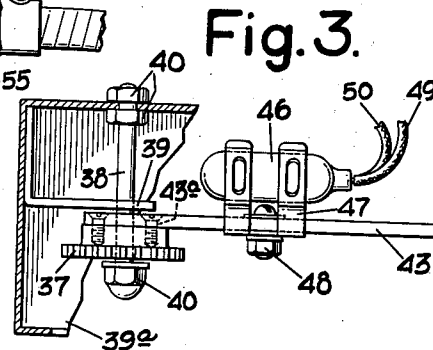


Fig. 3.

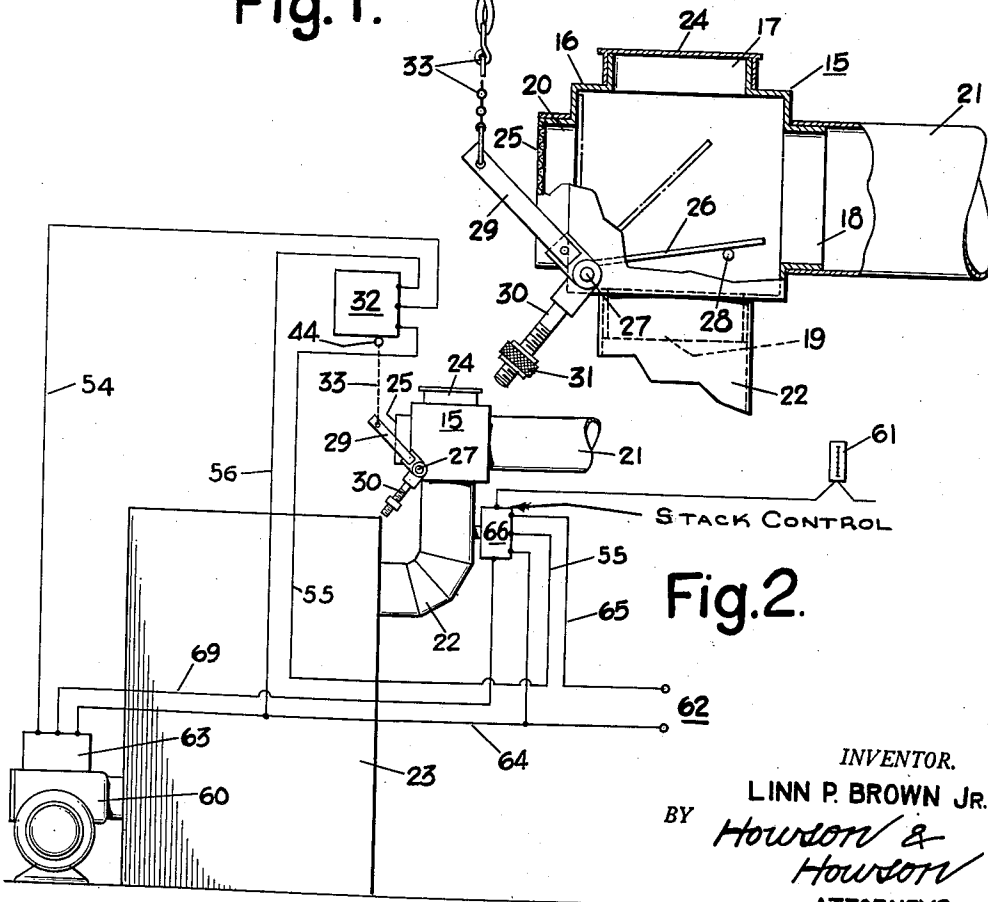


Fig. 2.

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Fig. 4

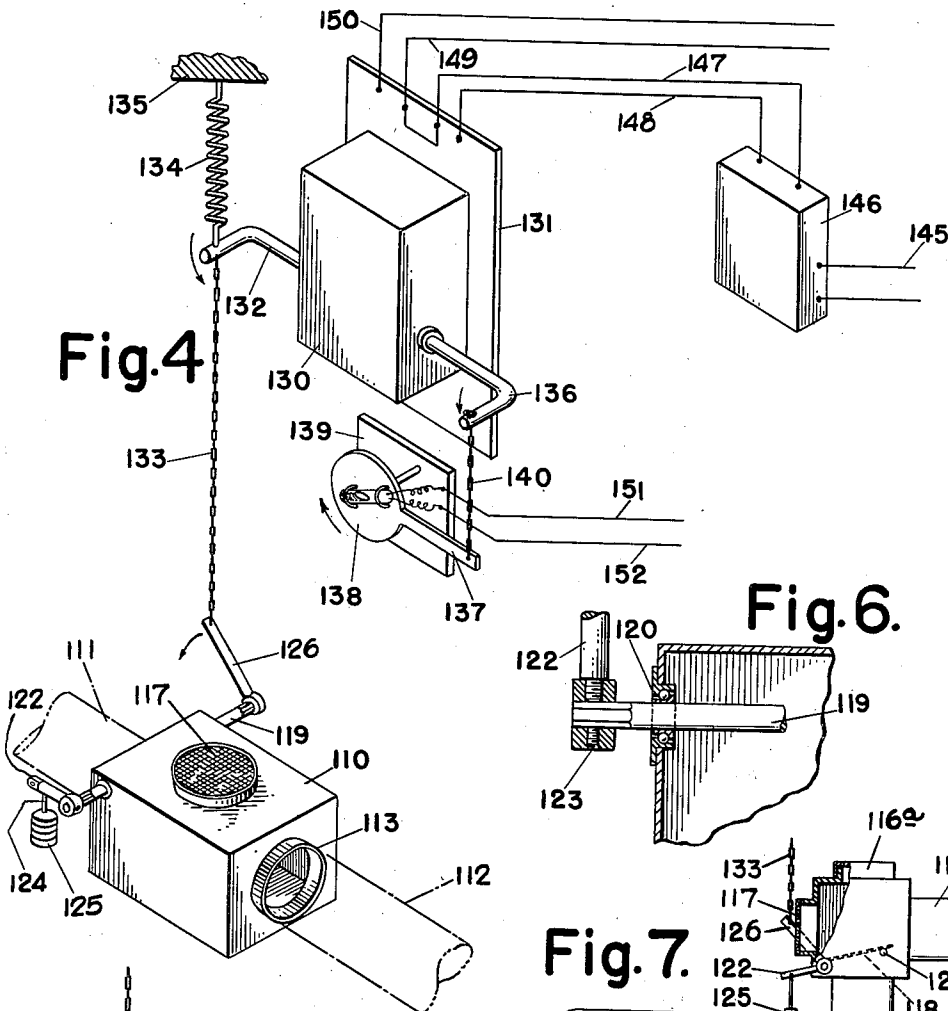


Fig. 6.

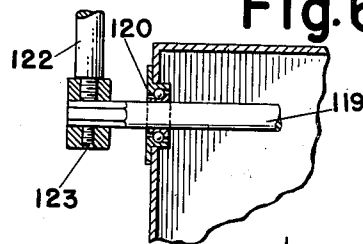


Fig. 7.

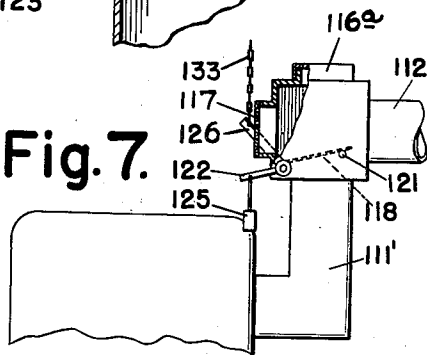
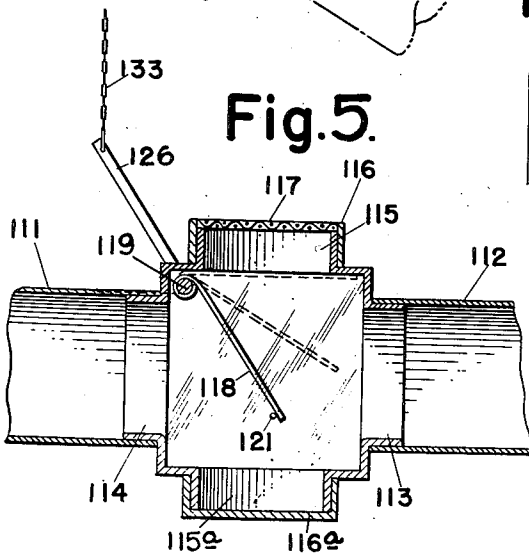


Fig. 5.



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DAMPER AND HEATER CONTROL SYSTEM

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5 Claims. (Cl. 236-1)

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This invention relates to control systems for heating plants and is more particularly adapted to oil burner heating plants of the variety used in homes.

I have found that it is highly desirable to provide a damper assembly in the flue of a heating system which permits the chimney to draw relatively cold cellar air at times when the burner is off. The purpose of this expedient is to prevent excessive cooling of the heating boiler and its associated structure by drawing off all the heat therefrom. Obviously, such a damper should be automatically controlled so that the stack is substantially closed when the burner is off, and the construction of the control system must be adequate to take care of the first puff of exhaust gases which takes place when the burner starts, so that the damper may completely open momentarily. In the normal operating position however, the damper is permitted to fluctuate by means of an adjustable balance so that the amount of air drawn from the cellar is controlled in accordance with the draft.

A primary object therefore of the invention, is to provide an automatic control system for a damper, whereby the damper shutter is retained in a partially closed position when the burner motor is off but which will be opened by suitable controls when the thermostat calls for heat and before the burner circuit is closed.

A further object of the invention is to provide an automatic damper for heating systems in which the damper shutter selectively admits outside air and products of combustion to the stack.

A still further object of the invention is to provide an automatic damper assembly for heating systems in which the damper shutter substantially closes the flue pipe to the heater when the heater is off, and in which the damper shutter is permitted to fluctuate relatively free of control and subject to draft conditions in the chimney when the heater is on, to permit selective opening and closing of the flue pipe to the heater and an air passage to the exterior of the flue pipe.

Further objects will be apparent from the specification and drawings in which:

Fig. 1 is a side elevation partly sectioned of a preferred form of my damper and automatic control mechanism;

Fig. 2 is a schematic diagram showing the damper installed in a heater and also showing the electrical wiring connections;

Fig. 3 is an enlarged sectional detail of the control arm and mercury switch of Fig. 1;

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Fig. 4 is a perspective of a modified form of damper control mechanism;

Fig. 5 is an enlarged sectional detail of the damper of Fig. 4;

Fig. 6 is an enlarged sectional detail of the damper of Fig. 1;

Fig. 7 is a detail showing the damper of Figs. 4 and 5 employed in an elbow rather than a straight through installation; and

Figs. 8-11 are diagrammatic illustrations of successive positions of a damper control system constructed in accordance with the invention.

The invention comprises essentially the provision of an improved damper assembly for the flue pipe or stack of a heating system. The damper assembly is characterized by a shutter which is pivotally mounted in the damper so that in one extreme position the shutter completely or substantially closes the flue pipe between the damper and the burner. In this position, an aperture through which cold air from outside the flue pipe may enter the stack is completely open. In the other extreme position of the shutter, the cold air aperture is closed and the flue pipe to the heater is open to permit free passage of the products of combustion to the chimney. The damper is automatically controlled by means of either a solenoid or an electric motor in cooperation with a heat-responsive thermostat so that when the burner or stoker (as the case may be) is shut off, the shutter will be pivoted to one position and when the burner is on, the shutter will be permitted to fluctuate between two extreme positions in accordance with the draft present in the chimney. Throughout the description, the term "burner" will be employed in referring to the fuel feeding device for the heater. It will be understood however, that the invention is adaptable to either liquid or solid fuel feeding means which are electrically controlled.

Referring now more particularly to Figs. 1-3, the damper assembly 15 comprises a boxlike housing 16 having four apertures 17, 18, 19 and 20 which are preferably of a size adapted to connect with conventional stovepipe sizes. In the showing of Fig. 1, aperture 18 is connected to pipe 21 which leads to the chimney or stack (not shown). Aperture 19 is connected to pipe 22 which leads to the heater 23. In the form of Fig. 1, aperture 17 is provided with a removable cap 24 whereas aperture 20 is provided with a screen 25. A shutter 26 is pivoted in housing 16 on shaft 27 in such a way that in one extreme position shutter 26 is adapted to close aperture 20 as shown in broken lines in Fig. 1, whereas

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in the opposite extreme position shutter 26 abuts a limit stop 28 to substantially close pipe 22. The position of limit stop 28 may be located in accordance with individual requirements and may permit the shutter 26 to completely close pipe 22 or any desired proportion thereof. Shaft 27 is mounted in housing 16 by means of suitable bearings and extends on one side of the housing to accommodate an actuating lever 29 and arm 30 having an adjustable threaded counterweight 31 in the form of a collar. Arm 29 is connected to the shutter actuating device indicated generally at 32 by means of a flexible connection such as chain 33.

In the preferred form, the shutter actuating mechanism comprises a solenoid 34 having an armature 35 adapted for axial movement within the solenoid. Armature 35 is connected with a chain 36 which extends around a sprocket 37 rotatably mounted on shaft 38 supported in housing 39a of the actuating device by bracket 39 and nuts 40, 40. One end of chain 36 is anchored to housing 39a through a helical extension spring 41 and adjustable eye 42.

The sprocket 37 is rigidly attached to an arm 43 by means of screws 43a, 43a, and the arm 43 is connected to the upper end of chain 33 by a link 33a, as seen in Fig. 1. Upward pivotal movement of arm 43 is limited by means of an enlarged ring 44 in chain 33 which seats against the grommet 45, the bore of which is smaller in diameter than ring 44. Arm 43 also carries a mercury switch 46 attached to the arm by means of bracket 47 and bolt 48. Electrical leads 49 and 50 connect the mercury switch 46 to a junction block 51 within the housing 39a. Likewise, solenoid 34 is connected to junction block 51 by means of leads 52 and 53. Current to switch 46 as well as for solenoid 34 is carried to block 51 through leads 54, 55 and 56 as shown clearly in Fig. 1.

To describe the operation of my control, let it be assumed that burner 60 is off. Under this condition, shutter 26 is in the relatively closed position against the limit stop 28 and lever arm 29 is consequently raised by the tension of spring 41 acting through chain 36, sprocket 37 and arm 43. Solenoid 34 is of course, deenergized in this case and mercury switch 46 is open. When thermostat 61 calls for heat, the electrical circuits function in accordance with conventional practice except that the power connection to burner 60 is fed through mercury switch 46 by means of leads 49 and 50.

Fig. 2 illustrates the wiring diagram for operating the damper control unit 32. A source of power 62 is connected to burner motor 63 through lead 64. The other lead 65 from power source 62 is connected to the conventional stack control 66 in the customary manner. The solenoid 34 is connected in series with the output lines 54 and 55 from the stack control 66 so that when the stack control 66 is closed, the burner motor 63 will not start until the circuit through leads 54 and 55 is completed by clockwise pivoting of arm 43, as will be described hereinafter. Lead 69 connecting the burner motor and the stack 66 is for ignition. As solenoid 34 becomes energized through proper action of the thermostat 61 and stack control 66, armature 35 is retracted within solenoid 34 which in turn drops arm 43 to the broken line position shown in Fig. 1. As the arm drops, mercury switch 46 closes the circuit through leads 54 and 55, thus starting burner motor 63. However, the timing of the

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system is such that switch 46 does not start motor 63 until the arm 43 is in a nearly completely lowered position. This permits the shutter 26 to pivot upwardly and thereby close aperture 20 during the first rush of exhaust gases from the heater 23 which customarily takes place when the burner ignites.

With arm 43 in the fully lowered position, there is sufficient slack in chain 33 to permit the shutter 26 to return to an intermediate position, such as that shown in broken lines in Fig. 1. So long as the solenoid 34 is energized, there is no control of the position of shutter 26 through chain 33. Therefore, with the burner 60 operating, the shutter is free to fluctuate in the damper housing 61 in accordance with the draft conditions present in the stack. The adjustment of nut 31 regulates the intermediate position of the shutter so that any desired ratio between outside air and stack gases may be provided. Likewise, the position of nut 31 controls the amount of slack in chain 33 in accordance with the angular relationship between shutter 26 and lever 29.

Referring now to Figs. 4-6, a straight-through damper assembly 110 is shown connected to flue pipe 111 leading to the heater and to pipe 112, leading to the chimney or stack in the same manner described in conjunction with Figs. 1-3. Likewise, damper assembly 110 is provided with aperture 113 communicating with pipe 112, and aperture 114 communicating with pipe 111. Aperture 115 has a cap 116 which supports a screen 117 through which outside air is permitted to enter the stack, and aperture 115a has a cap 116a which may be removed for clean-out purposes. Shutter 118 is mounted on shaft 119 which is in turn journaled in ball bearings 120 in the damper housing. A stop 121 is positioned in the damper assembly and functions in the same manner as does stop 28 in Fig. 1. Shaft 119 extends through the damper housing and has an actuating lever 122 secured to a splined end of shaft 119 by means of set screw 123. Arm 122 carries a rod 124 on which a plurality of counterweights 125 may be selectively positioned in order to provide suitable adjustment for shutter 118. The opposite end of shaft 119 is provided with a lever arm 126 which is similar to the arm 29 of Fig. 1.

The shutter actuating mechanism comprises an actuating motor 130 mounted on a panel 131 so that one arm 132 of the motor is substantially above the end of lever 126 on damper 110. Arm 132 of the motor is connected to lever 126 by means of a chain 133 or other flexible connection.

Arm 132 is also spring-loaded upwardly by means of helical extension spring 134 attached to the ceiling or other fixed member 135. The opposite motor arm 136 is operatively associated with an arm 137 of a mercury switch assembly 138 which is rotatably mounted on a panel 139. A chain 140 serves to connect arms 136 and 137. It will be understood that motor 130 may, if desired, be of any variety well known in the art, an example of which is the type M-87A motor supplied by the Minneapolis-Honeywell Regulator Company. Motor 130 is connected to the usual house current source 145 through transformer 146 and electrical lines 147 and 148. Lines 149 and 150 connect the motor to the thermostat (not shown). Lines 151 and 152 connect to the oil burner motor (not shown) through a suitable relay (not shown) for the purpose of stopping and starting the burner, substantially as described previously.

The operation and timing of both systems will

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be more clearly understood from the following description which is intended to relate either to the motor controlled device of Fig. 4, or the solenoid actuated device of Fig. 1. Let it be assumed that the burner motor has been previously shut off by the thermostat. The relative positions of the control system elements is then illustrated by Fig. 4 in which arm 126 is raised to its upward limit as are likewise arms 132 and 136 of the motor 130. In the schematic illustration of Figs. 8-11, arm 136' operates in the reverse vertical direction from arm 132 whereas in the showing of Fig. 4, arms 132 and 136 work simultaneously in the same direction, the only difference being that the arm 137 for mercury switch 138 will be located on the opposite side of the switch in order to provide the desired functioning for switch 138.

When the thermostat circuit in leads 149 and 150 is closed, motor 130 starts and arms 132 and 137 are gradually lowered (shown by the arrow in Fig. 4). In this cycle, arm 137 will be raised in the showing of Figs. 8-11. When arm 122 and shutter 118 are pivoted to the position shown in Fig. 9, the counterweight 125 balances the shutter 118 so that with the burner still off, the shutter and its associated arms 122 and 126 will remain in the position of Fig. 9 which corresponds to the intermediate broken line position of Fig. 5. Motor 130 however, continues to lower arms 132 and 136 until the mercury switch is in the approximate position shown in Fig. 10. At this point, there is substantial slack in chain 133 and the position of switch 138 in Fig. 10 shows the mercury an instant before closing the circuit in lines 151 and 152 to the burner motor. It will be apparent that adjustment of the balanced position of the shutter which in turn controls the amount of slack in the chain at the time the burner starts, may be adjusted by means of counterweights 125 and the splined connection between shaft 119 and levers 122 and 126.

When the burner motor circuit is closed, there is a momentary rush of gases in the stack which occurs upon starting of the burner. When this happens, shutter 118 is forced upwardly as shown in Fig. 11, but the amount of slack in chain 133 is sufficient to permit the shutter to completely close opening 115 in the damper assembly 110. It is important therefore, that the burner circuit remain open until there is sufficient slack in the damper control means to permit the shutter to swing to the position of Fig. 11. After a few seconds, the gas pressure in the stack decreases, thus permitting shutter 118 to partially open the cold air intake 115. Such position corresponds approximately to the intermediate broken line position of Fig. 5 in which the shutter is automatically regulated by the draft in the stack.

As long as the thermostat calls for heat, motor 130 will be energized or otherwise locked so that chain 133 is slack and spring 134 extended. When the thermostat is satisfied however, the locking means for motor 130 is released to enable spring 134 to return the damper and mercury switch to the original position of Fig. 4. In this return cycle, it is important that the burner motor be stopped before the chain 133 becomes taut. Therefore, the adjustment of arm 122 and the amount of slack in chain 133 are carefully proportioned so that the circuit between leads 151 and 152 is broken for an appreciable length of time before the shutter 118 is fully lowered. Fig. 9 also illustrates this condition and clearly shows that the burner circuit is opened by mercury switch 138 at about the time chain 133 becomes

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taut and substantially before the shutter 118 pivots to the "off" position.

It will therefore be apparent that a damper control system in accordance with the present invention is relatively inexpensive to manufacture, is completely automatic in all respects, and is so constructed that all safety requirements are met by proper timing of the burner motor with the action of the damper.

Having thus described my invention, I claim:

1. In a control system for an automatically fired furnace having a stack connecting the combustion chamber of the furnace to a chimney, a damper housing located in said stack between the furnace and the chimney, walls defining an external opening in said housing for admission of outside air thereto, a shutter pivotally mounted in said housing to swing from a first position substantially closing the stack from the housing to the furnace and uncovering said external opening to a second position providing unrestricted passage for the stack gases through the stack to the chimney and covering said external opening, actuating means for pivoting the shutter from said second position to said first position, electric motor operated heating means for the furnace, an electrical control circuit for the motor of said heating means including a thermally-responsive switch for starting and stopping said motor operated heating means in accordance with temperature demands, a second switch in said control circuit in series with said thermally-responsive switch, means operatively connected with the shutter actuating means for opening and closing said second switch upon predetermined movement of the actuating means, a chain-like element connected between the actuating means and the shutter, means for normally pivoting the shutter to a partially opened and balanced position in the housing intermediate said first and second positions, and means for permitting free over travel of the shutter to said second position when said thermally-responsive switch and said second switch are closed to start the motor of said heating means.

2. A control system in accordance with claim 1 in which the actuating means includes a motor having a pair of arms, the first of said arms being connected to the chain-like element, and the second of said arms being connected to said second switch, and spring means for returning said arms to an initial position with the shutter in said first position and said second switch open when said thermally-responsive switch opens to stop the motor of said heating means.

3. A control system in accordance with claim 1 in which the actuating means includes a solenoid, a pivotally mounted arm operatively associated with the armature of said solenoid and mounting said second switch whereby energization of said solenoid serves to pivot said arm in one direction to move said second switch to circuit-closing position, and spring means operatively associated with said arm for returning said arm to an initial position with the shutter in said first position and said second switch open when said solenoid is deenergized.

4. A control system in accordance with claim 1 in which the shutter is mounted on a shaft extending through the damper housing, with an arm having one end connected to said shaft and its other end connected to said chain-like element, and means on said arm and shaft for regulating the effective length of the said chain-like element.

5. A control system in accordance with claim 1 in which the shutter is mounted on a shaft pivoted in the damper housing, with a first arm adjustably connected to one end of said shaft, a counterweight on said first arm, and a second arm adjustably connected to the other end of said shaft and connected to said chain-like element.

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