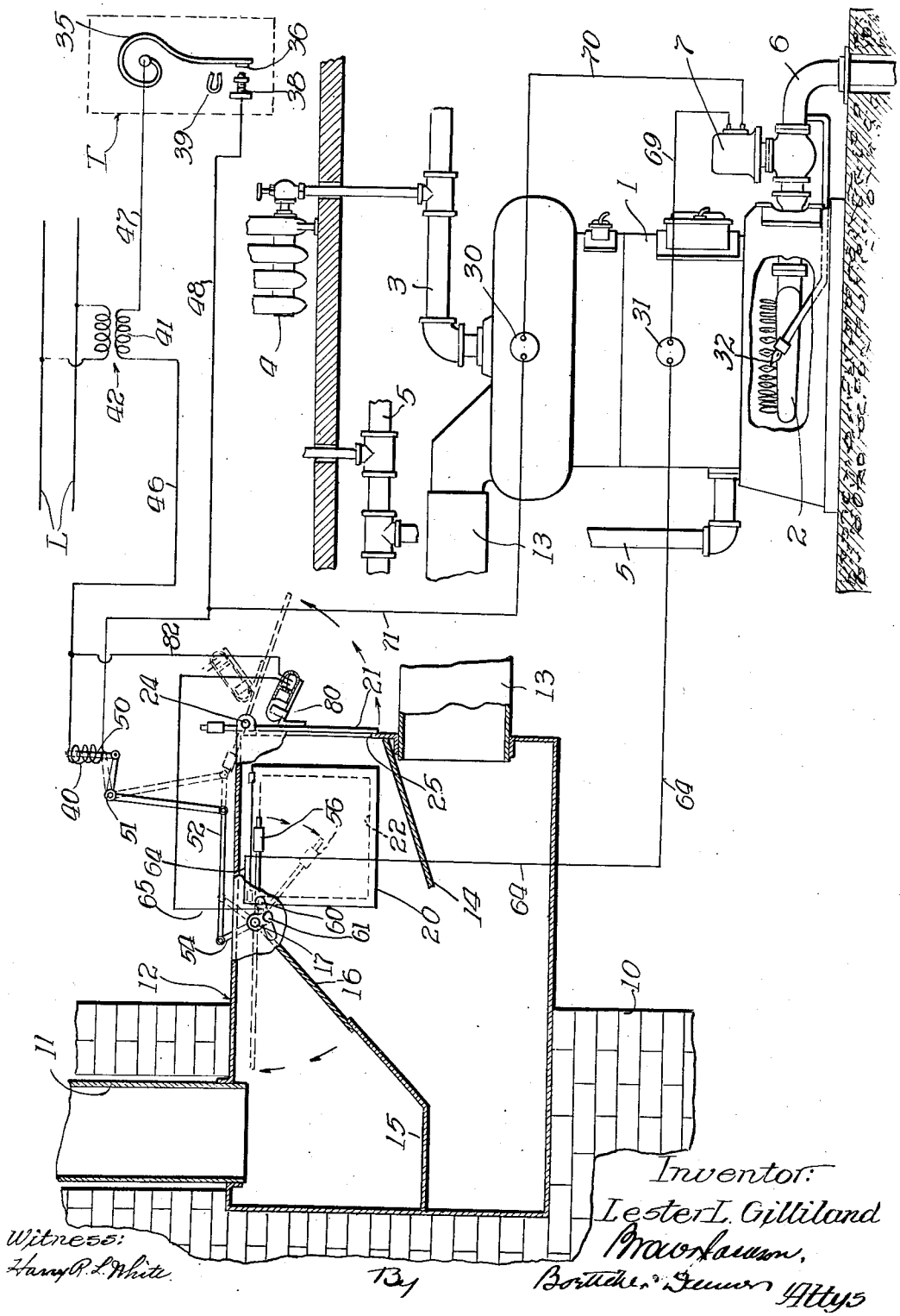
Sept. 20, 1938. L. L. GILLILAND 2,130,491

DRAFT CONTROL SYSTEM

Filed Oct. 21, 1935



Witness:
Harry P. L. White

Inventor:
Lester L. Gilliland
By Mason, Fenwick & Lawrence
Attys

Patented Sept. 20, 1938 2,130,491

UNITED STATES PATENT OFFICE

2,130,491

DRAFT CONTROL SYSTEM

Lester L. Gilliland, Blue Island, Ill.

Application October 21, 1935, Serial No. 45,911

10 Claims. (Cl. 158—1)

The present invention relates generally to control systems and is particularly concerned with the provision of control means adapted to govern the operation of a combustion appliance in accordance with draft conditions in the chimney or stack through which the products of combustion in the appliance are directed.

Most combustion appliances of any appreciable capacity have means arranged to vent the products of combustion through chimneys or stacks, the natural draft of which is depended upon to draw enough air through the appliance to supply the oxygen required in the proper operation of the appliance. Heretofore, means have been proposed to vent the products of combustion into the basement or space surrounding the appliance whenever there is no draft in the stack, which sometimes arises when the chimney becomes blocked. Also, such means serves to relieve any down draft, venting the excess pressure into the basement or space surrounding the appliance and diverting the same so that the proper combustion of the fuel in the appliance or the operation of the pilot flame is not affected, as might be the case if the down draft were permitted to enter the appliance.

The spillage of flue gases or products of combustion into the zone surrounding the appliance, if temporary, may not be harmful and, in general, serves the useful purpose of preventing momentary fluctuations in the stack action of the chimney from affecting the proper operation of the burner. However, it is recognized that the venting of the flue gases into the basement should not be continued for any length of time for not only is the presence of flue gases under these conditions objectionable but, in addition, their continued presence in the zone surrounding the appliance may dilute the oxygen content of the air if the available space in which the furnace is disposed is small, so that incomplete combustion may occur.

With the above factors in mind, one of the principal objects of the present invention is the provision of means responsive to a continued spillage of flue gases into the basement or zone surrounding the appliance for shutting off the latter so as to prevent any further operation thereof until the conditions giving rise to the spillage of flue gases are corrected. Another object of the present invention is the provision of means, preferably interlocked with said first responsive means, providing for shutting off communication between the stack or chimney and the draft or stack venting means so that when the appliance is temporarily shut down, the stack or chimney does not act to withdraw the heated air from the basement or zone surrounding the appliance nor from the appliance itself. Any passage of air through the appliance after the furnace or like appliance has been in operation for a time and has temporarily been shut down on account of no heat demand, is objectionable in that the flow of air tends to cool the appliance, and similarly the passage of air from the basement up the chimney removes heat and is therefore wasteful.

It is not desirable, however, to have the control means arranged to shut off the appliance every time a momentary down draft occurs. Hence, according to the principles of the present invention the means responsive to the occurrence of a down draft or to the occurrence of a spillage of the flue gases through the stack vent means is so constructed and arranged that there is a certain time lag in the actuation of the control device so as to accommodate momentary spillage of flue gases without shutting down the appliance. However, should the spillage condition remain constant for a length of time, as by a continued down draft or a continued spillage of flue gases due to a blocked chimney, the control mechanism will shut off the appliance.

Heretofore, means have been proposed for shutting off communication between the chimney and the appliance whenever the latter was shut down, but such means has not been generally adopted due to the danger that conditions may arise in which the appliance would be started up without having the damper means opened. If this condition should occur, then objectionable quantities of flue gases would be discharged into the basement or zone surrounding the appliance. As pointed out above, this is dangerous if continued for any appreciable length of time.

Therefore, another object of the present invention is the provision of means for controlling the shut-off damper so constructed and arranged that the appliance cannot be started up unless the damper is actually moved into its open or operating position.

These and other objects and advantages of the present invention will be apparent to those skilled in the art after a consideration of the following detailed description of the preferred form of the present invention, taken in conjunction with the accompanying drawing illustrating the same.

In the drawing, the figure illustrates a gas fired boiler in which the supply of fuel is con-

trolled by a shut-off damper, the movement of the latter being under the control of a room thermostat of conventional construction.

Although the present invention is not to be limited to any particular form of combustion device, in order to illustrate the principles of the present invention I have selected a construction embodying a hot water furnace 1 serving as a house heating plant and fired by a gas burner 2 and arranged to contain a heating medium, such as water, which is directed through a supply main 3 to radiators 4 in the room or space to be heated. The cool water from the radiating system, represented by the radiators 4, is directed back to the heater 1 through a return line 5. The gas burner 2 is supplied with gas from a supply conduit 6 and is controlled by a gas valve 7 of any desired construction. Generally, such gas valves are arranged to be controlled by an electric circuit, and one well known type of gas valve which has proven satisfactory in arrangements such as the one illustrated in the drawing includes an electric motor which is arranged to open the valve controlling the supply of gas when a circuit through the motor is completed, the valve automatically closing when the control circuit is opened. It is to be understood, of course, that any other type of controlling means for supplying fuel to the burner 2 is contemplated by the present invention, and it is also to be understood that the present invention is not necessarily limited to a hot water heater nor to a burner employing gas, for other forms of fuel and other types of burners may be employed. The gas valve 7 therefore represents any form of burner controlling means, and the heating plant 1 represents any type of combustion utilizing device.

In the combustion of any fuel, whether solid, liquid or gas, flue products are produced, and the disposal of these products of combustion must be taken care of in order to insure the proper and safe continuous operation of the appliance. Generally a chimney or flue is provided for all units except those of limited capacity, and such is the construction illustrated in the drawing. The reference numeral 10 indicates a chimney provided with an acid proof lining 11 the lower end of which is in communication with a chamber 12, and a stack pipe 13 connects the chamber 12 with the furnace 1 so that the products of combustion from the latter pass through the box 12 and out through the stack 10. A baffle 14 inside the box 12 overlies the discharge end of the stack pipe 13 and serves to protect the burner 2 against a down draft, as will be explained below. In the drawing, the chamber 12 and associated parts are shown at an enlarged scale relative to the furnace 1.

The chamber 12 is provided with a wall 15, and cooperating with the latter is a shut off damper 16 pivotally mounted in any suitable manner, as by a shaft or trunnion means 17. The damper 16 is adapted to be disposed in the position shown in full lines to shut off the communication between the chimney 10 and the furnace or appliance 1, but when the damper 16 is moved to the dotted line position the flow of hot gases from the furnace 1 out through the chimney is accommodated.

In venting the products of combustion from the appliance 1 through the stack pipe 13 and chamber 12 to the chimney 10, it is essential that the heating plant be arranged to secure a proper disposal of the products of combustion in the event that, for some reason, there is no draft up the chimney or if there should occur, either temporarily or otherwise, a down draft, or if the chimney should become blocked as by something falling onto or into the same. Furthermore, it is also essential to prevent a down draft from entering the heating plant directly, for should such occur the pilot flame might be extinguished if the heating plant at that moment is not in operation, or if in operation the proper combustion of the fuel might not be secured. In order to take care of these conditions, the chamber 12 is provided with two doors 20 and 21. The former is hingedly connected on the interior of the chamber 12 and over an opening 22 formed in one side wall of the latter, and the other door 21 opens outwardly, being hinged or otherwise pivotally supported, as at 24, to swing away from an opening 25 formed in an end wall of the chamber 12. Both the doors 20 and 21 are balanced so that they open under a relatively small pressure difference, such as tenths of inches of water pressure. For example, if a down draft should temporarily occur during the operation of the heating plant 1, the damper 16 being open as will be explained later, the baffle 14 serves to direct the downward flow of air against the door 21, thereby preventing the down draft from reaching the burner 2. The down draft opens the door 21 so that the downward movement of the air as well as the outwardly flowing products of combustion from the burner 2 will be temporarily vented through the opening 25, thereby eliminating any substantial variations in pressure at the outlet of the stack pipe 13 since the excess pressure due to the down draft is vented through the opening 25. Similarly, if there is an excessive up draft, greater than it is desired shall pass through the appliance 1, the door 20 will open inwardly and permit air from the basement or space surrounding the appliance 1 to enter the chamber 12 and secure the proper pressure equilibrium. Normally, the flue gases from the stack pipe 13 pass from under the baffle 14 around in the zone of the doors 20 and 21 through the damper opening to the chimney pipe 11.

According to the principles of the present invention, the shut-off damper 16 is arranged to be closed, in the full line position shown in the figure, whenever the burner is not in operation. By shutting off communication between the chimney and the furnace 1, there is no movement of air through the furnace 1 and out the chimney. Where no shut off damper is provided such movement of air does occur and serves to cool down the furnace unnecessarily. Also, in the absence of any shut-off damper, such as the one indicated at 16, there is a continual flow of air from the basement through the opening 22 into the chamber 12 to accommodate the stack action of the chimney 10, and this continuous flow of heated air from the basement out the chimney represents wasted energy and, in addition, cools the basement. However, it is essential whenever the furnace 1 is started up that the shut-off damper shall be opened immediately in order that the products of combustion may be properly vented into the chimney 10 and not spilled into the basement through the relief opening 25.

Heating appliances, such as the gas fired burner 1, are usually provided with a number of controls governing the supply of fuel directed to the burner 2. One of such controls includes a room

thermostat T usually disposed in the room or space to be heated, a limit switch or thermostat 30 and a pilot thermostat 31 normally responsive to the heat of a continually burning pilot flame 32, the two latter instruments being carried upon the furnace 1. The limit switch serves to shut off the supply of fuel whenever the temperature of the heating medium reaches an abnormal degree, and the pilot thermostat 31 serves to interrupt the control circuit whenever the pilot flame 32 becomes extinguished so that it is impossible to energize the gas valve 7 to open the supply valve when there is no pilot flame to ignite the gas from the burner 2. The room thermostat T is of conventional construction, employing a temperature responsive element 35 in the form of a bimetallic strip carrying a contact 36 at one end. The contact 36 is adapted to be moved by the element 35 into and out of engagement with an adjustable contact 38, and in order to provide a differential lag for the room thermostat T a magnet 39 is disposed adjacent the strip 35 so as to prevent the thermostat from fluttering from one position to another.

The room thermostat T is arranged in series with a solenoid 40 and a secondary 41 of a transformer 42, the primary of which is connected across the line L. Suitable conductors 46 and 47 connect the secondary 41 with the solenoid 40 and the room thermostat T, respectively, and a third conductor 48 serves to connect the adjustable contact 38 with the other end of the solenoid 40. Operating in conjunction with the solenoid 40 is a plunger 50 which is connected at its lower end with a bell crank 51. The lower arm of the bell crank 51 is connected by means of a link 52 with an arm 54 which is rigidly connected with the shut-off damper 16. The latter is substantially balanced, as by a weight 56, but is so arranged that whenever the flow of current through the solenoid 40 is interrupted the damper moves into its full line position to shut off the communication between the chimney and the stack pipe 13.

Whenever the temperature within the room descends, the bimetallic strip 35 moves the contact 36 into engagement with the adjustable contact 38, thereby completing a circuit through the solenoid 40, and this moves the plunger upwardly and acts through the bell crank 51 to swing the shut-off damper up to its dotted line position. It is to be noted that in this position the damper lies closely adjacent to the upper wall of the chamber 12 and does not interfere with the flow of hot gases from the stack pipe 13 through the chamber 12 and up through the chimney 11. Thus, by virtue of the construction just described, whenever the room thermostat T calls for heat, the shut-off damper is moved into its open position, and whenever the room thermostat contact 36 moves away from the contact 39, the current through the solenoid 40 is interrupted and the damper 16 automatically moves to its full line position and closes up the chimney.

In order to be sure that the burner is not started up unless the shut-off damper 16 has been moved into its full open position, even though the room thermostat should call for heat, I provide switch means of the mercury tube type and mount the same as a rigid part of the damper 16. In the figure the switch means is indicated by the reference numeral 60 and is of more or less conventional construction. Suitable mounting means 61 carries the mercury tube 60 on the shaft or trunnion 17 so that the switch mechanism moves at all times with the damper 16, and if the damper 16 is not moved the switch 60 is not actuated. Two leads 64 and 65 are provided with electrodes disposed in one end of the mercury tube 60 and are connected together by a globule of mercury whenever the damper 16 is moved into its dotted line position. The leads 64 and 65 are flexible to provide for the necessary movement of the switch mechanism. The lead 64 extends to the pilot thermostat 31 and a conductor 69 extends from the latter to one terminal of the gas valve 7. Another conductor 70 extends from the other terminal on the gas valve 7 to one side of the limit control thermostat 30, and a conductor 71 extends from the other side of the limit control switch 30 to a connection with the conductor 48.

The outwardly swinging door 21, responsive to the spillage of flue gases and to a down draft, carries a mercury tube switch mechanism 80, preferably of the hour glass type. The tube of the switch 80 carries two electrodes at one end with one of which the conductor 65 is connected and with the other a conductor 82 is connected and extends to the conductor 46. The switch mechanism 80, being of the usual hour glass type which is well known, does not respond instantly to a change in the position of the door 21 but a short time is required before the mercury completes its movement away from the end of the tube carrying the electrodes.

The door 21 with the mercury tube 80 is substantially balanced, as mentioned above, so that relatively small pressure differences serve to move it. Normally, the door is closed, but if the damper 16 is open a down draft will open the vent door 21, and also the latter will open if the burner 2 is operated when the chimney 10 is blocked. In the latter case it is immaterial whether the damper 16 is open or closed, for the box 12 is several feet higher than the burner 2 so that if the latter is in operation, the column of air heated thereby, being lighter than the equivalent outside column, will be forced out of the opening 25. In cases where, as illustrated, the heat source is a gas burner, the slight difference of pressure brought about by the fuel streaming into the burner, usually at a pressure of around five inches of water, aids the flue gas spillage to open the door, but this feature of my invention is not to be limited to gas burners, since the pressure difference due to the difference in weight of the cool and heated columns is in all cases, sufficient to open the door 21 and vent the flue gases, as aforesaid. Once the flue gases from the burner start spilling through the opening 25, the door 21 will be moved to its wide open position. This will interrupt the control circuit through the switch 80 and will shut down the burner.

This particular feature of my invention is of importance, especially in cases where the shut-off damper 16 is not used, for in such an event, a down draft, which might otherwise reach the combustion space and extinguish the pilot flame 32, is vented through the opening 25.

The operation of the control system described above is substantially as follows. Assuming that the gas valve 7 is closed and the furnace 1 not in operation, whenever the room thermostat T calls for heat the contacts 36 and 38 are brought into engagement, sending a current through the solenoid coil 40. This draws up the plunger 50 and swings the shut-off damper 16 from its closed position to its open or dotted line position. Since the mercury tube switch 60 is carried for move-

ment with the damper 16, the movement of the latter to its dotted line position causes the mercury globule to connect the electrodes associated with the leads 64 and 65. This will start up the burner by opening the gas valve 7, provided the pilot flame has not been extinguished, which would result in opening the contacts associated with the instrument 31, and provided further that the down draft door 21 has not been swung open or the contacts of the instrument 30 opened by an abnormal high temperature of the heating medium. If for any reason the damper 16 fails to open when the room thermostat T calls for heat, the burner cannot be started up because the switch 60 remains in open position. This eliminates the hazards connected with venting the products of combustion into the basement, which would occur if the burner were inadvertently started up with the shut-off damper closed.

The down draft responsive switch 80, being connected in series with the switch 60 and the instruments 37 and 31, serves to open the controlling circuit and shut off the burner 2 whenever a down draft continues for an appreciable length of time sufficient to swing open the door 21. Thus, whenever a down draft, sufficient to swing open the door 21, or a spillage of flue gases through the opening 25 should continue for any appreciable length of time, the switch mechanism 80 acts to interrupt the circuit through the gas valve 7 and thereby shuts off the supply of gas to the burner 2.

While I have shown and described above the preferred construction in which the principles of the present invention have been illustrated, embodying means by which the stack is closed off at all times unless the burner is in operation, but in which there is positive assurance that the stack damper will be open before the burner is started up, and means so interlocked therewith that continued down-draft or spillage of flue gases into the basement will shut off the burner, irrespective of the position of the stack damper, it is to be understood that, in fact, widely different means may be employed in the practice of the broader aspects of my invention.

What I claim, therefore, and desire to secure by Letters Patent is:

1. A control system for a combustion appliance venting into a chimney, comprising a chamber arranged at the outlet of said appliance and adapted to normally receive the products of combustion from the appliance and conduct them to said chimney, a vent in said chamber, movably mounted means normally biased to close said vent and adapted to open outwardly to spill the products of combustion therethrough when the draft up the chimney is interrupted, and means controlled by outward movement of said vent closing means upon spilling of the products of combustion for shutting down said appliance.

2. In a heating system having a burner venting into a chimney, control means comprising a damper adapted to shut off communication between the burner and the chimney when the burner is not in operation, vent means accommodating a spillage of flue gases in the absence of draft up the chimney, thermostatically controlled means for moving said damper into open position, means controlled by the movement of said damper into open position for starting up said burner, and means disposed in serial relation with said last named means and actuated by the occurrence of a spillage of flue gases through said vent means for shutting off said burner.

3. A control system for a burner venting into a chimney, comprising a chamber adapted to receive the products of combustion from the burner and to conduct them to said chimney and having an opening, a vent door biased to close said opening and arranged to be swingable outwardly of said opening, said vent door being substantially balanced about its axis of swinging movement so as to be responsive to pressure differences of the order of those due to a down draft in the chimney, and means movable with the vent door for shutting off the burner when a down draft occurs.

4. A draft control system for a burner venting into a chimney, comprising a chamber adapted to receive the products of combustion from said burner, a vent door swingable outwardly in response to a pressure increase in said chamber, damper means for closing off said chimney, means to open and close said damper, a first switch means movable with said damper to start up the burner when the damper is opened, and a second switch means arranged in serial relation with said switch actuated by said vent door swinging to open position to shut off said burner.

5. A control system for a combustion appliance having a stack pipe and venting into a chimney, comprising a chamber arranged at the outlet of said appliance and adapted normally to receive the products of combustion from the stack pipe and to conduct them to said chimney, a vent in said chamber, movably mounted means normally biased to close said vent and adapted to open outwardly in response to the pressure difference due to a down draft in the chimney, and a baffle disposed between said vent and the stack pipe so as to prevent the down draft from passing directly into said combustion appliance, and means controlled by the outward movement of said vent closing means for shutting down said appliance when a down draft occurs.

6. A draft control system for a burner venting into a chimney, comprising a chamber adapted to receive the products of combustion from said burner, a vent door swinging outwardly in response to a pressure increase in said chamber, damper means for closing off said chimney, means to open and close said damper, a first switch means movable with said damper to start up the burner when the damper is opened, and a second switch means actuated by said vent door swinging to open position to shut off said burner.

7. A draft control system for a burner venting into a chimney, comprising a chamber adapted to receive the products of combustion from said burner, a vent door swingable outwardly in response to a pressure increase in said chamber, damper means for closing off said chimney, means to open and close said damper, a first switch means movable with said damper to start up the burner when the damper is opened, a second switch means actuated by said vent door, and connections between said burner and said first and second switch means whereby outward movement of the vent door swinging to open position shuts off said burner independently of the damper switch means.

8. A draft control system for a burner venting into a chimney, comprising a chamber adapted to receive the products of combustion from said burner, a vent door swinging outwardly in response to a pressure increase in said chamber, damper means for closing off said chimney,

means to open and close said damper, a first circuit control means actuated by said damper to start up the burner when the damper is opened, and a second circuit control means actuated by said vent door swinging to open position to shut off said burner, said second circuit control means including time lag means requiring that said vent door remain in open position a substantial interval before said burner is shut off.

9. In a gas burning heating plant including a main burner adapted to be ignited by a pilot flame, the combination of a chamber interposed between said heating plant, and the chimney and through which chamber the products of combustion pass, a vent in said chamber, a closure member for said vent normally remaining in vent closing position during the operating and non-operating intervals of the burner, said vent and closure member being adapted to vent from said chamber a down draft through said chimney and thereby prevent the extinguishing of said pilot flame, and means actuated by opening movement of said vent closure member for shutting off said burner.

10. In a gas burning natural draft heating plant including a main burner adapted to be ignited by a pilot flame, the combination of a chamber interposed between said heating plant and the chimney and through which chamber the products of combustion are adapted to pass, a vent in said chamber, a closure member for said vent normally remaining in vent closing position during the operating and non-operating intervals of said burner, said vent and closure member being of relatively large capacity so to vent from said chamber a down draft through the chimney and thereby prevent extinguishing of said pilot flame, and means actuated by said vent closure member for controlling the flow of gas to said burner.

LESTER L. GILLILAND.