Sept. 30, 1969 L. T. BROCKBANK 3,469,569

AUTOMATIC SAFETY SYSTEM AND THERMAL SENSOR FOR HEATING SYSTEMS

Filed Nov. 20, 1967

Fig. 1.

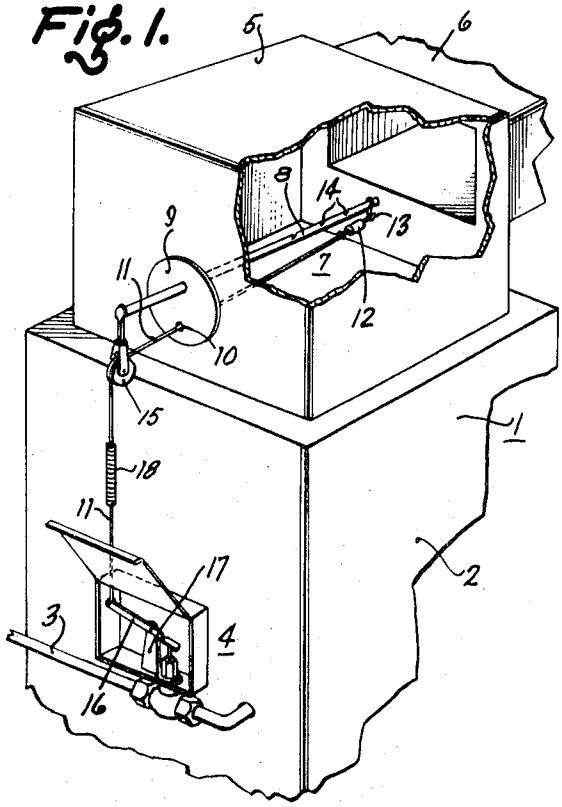


Fig. 2.

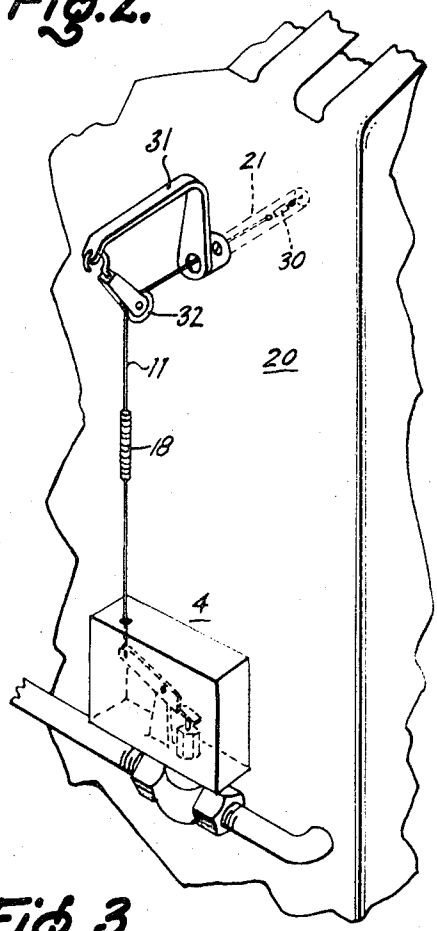


Fig. 3.

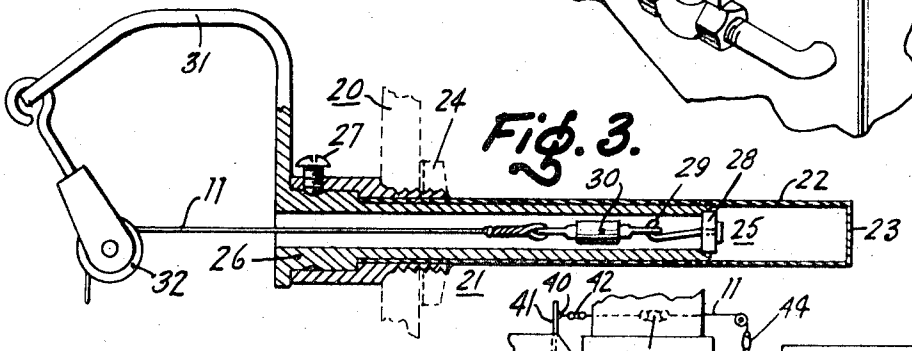


Fig. 4.

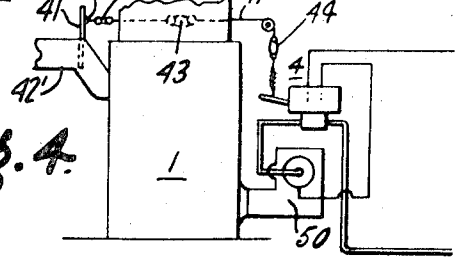
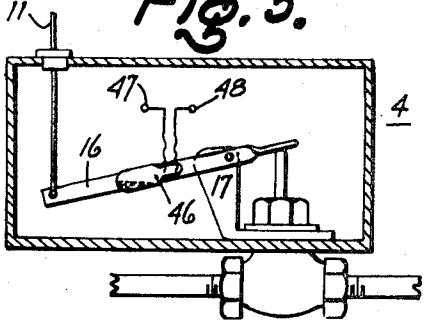


Fig. 5.



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AUTOMATIC SAFETY SYSTEM AND THERMAL SENSOR FOR HEATING SYSTEMS

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ABSTRACT OF THE DISCLOSURE

An automatic safety system for heating systems, includes a biased shut-off valve in a fuel supply line to a heater, a fusible thermal sensor which is positioned in a plenum connected to the heater to receive the working fluid at its point of maximum temperature, the sensor having one end attached to a rod which extends into the plenum, and its other end connected through a flexible cable to the shut-off valve.

My invention relates to automatic safety arrangements for heating systems and in particular to an improved thermal sensor for such systems.

In my United States Patent 2,870,827, granted Jan. 27, 1959, there is disclosed an automatic valve and switch for fuel burners in which the automatically operable safety device is connected in the fuel line between the burner and the fuel supply tank. A shut-off valve which is normally held open when the burner is in operation, is triggered by the fusing of a fusible element located in the vicinity of the furnace or burner where fire hazards are most likely to occur, and operative to instantaneously close the valve and open the switch to the burner upon fusion of the element.

In addition to the system disclosed in my above-mentioned patent, there have been numerous other systems proposed and installed for detecting fires in connection with burners and rendering the burners and the fuel supplies inoperative upon the occurrence of a fire. While the preventing of a heating device from overheating to the point where it damages or destroys itself and its surrounding environments is naturally important, of greater importance is the prevention of fire which can take a toll of loss of life and property. Heating systems of the type that have cutoff switches and fusible link systems for shutting off fuel supply lines are actuated only when extensive overheating or a fire has started and serious damage has already been done. Of greater value to mankind is a system in which hazardous conditions are sensed and fire is prevented before it starts to minimize or completely prevent any loss due to overheating of the system. Such conditions may be created, for example, by the sticking of a fuel valve, the fusing of a contact, or similar mechanical or electrical failures.

It is a primary object of my invention to provide a new and improved automatic safety system and thermal sensors for heating systems in which overheating is anticipated and prevented.

It is another object of my invention to provide a new and improved heating system in which the temperature of the heating fluid is measured and the system rendered inoperative or shut down upon the heating of the working fluid beyond a predetermined temperature.

In its broadest aspects, my invention consists in a heating system in which a thermal sensor is placed in a working fluid receiving or plenum chamber connected to a heater to receive the heated working fluid at its point of maximum temperature, the sensor being under tension and attached to a shut-off valve which is closed when the sensor is ruptured by overheating. An important feature of the invention is the sensor which includes a fusible link connected to a rod-like member positioned at the point of maximum temperature of the heated fluid in the plenum chamber, the fusible link having one of its ends connected to the rod-like member and its other end connected through a tension cable to a shut-off valve which disconnects the supply of fuel to the burner of the heating system.

The features of my invention which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, both as to its organization and method of operation, togther with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings wherein

FIGURE 1 is a vertical perspective view, partly cut away, of a portion of a warm air furnace embodying my invention,

FIGURE 2 is a vertical perspective view of a portion of a hot water or steam heating system embodying my invention,

FIGURE 3 is a side view, partly in section, of a sensor employed in the heating system of FIGURE 2,

FIGURE 4 is a schematic illustration of a modification of the heating system of FIGURE 1, and

FIGURE 5 illustrates a valve connection in the system of FIGURE 4.

In the system of FIGURE 1, there is shown a furnace 1 of the warm air type having a vertically positioned housing 2 in which is located a burner of the conventional type (not shown) and to which is supplied fuel over a supply line 3 through a conventional, spring-biased shut-off valve 4. Positioned on top of housing 2 is a plenum chamber 5 which receives the air heated in furnace 1 and supplies it to a heating duct 6.

In accordance with my invention there is positioned within plenum chamber 5 at the point approximately where the working fluid of the heating system reaches its maximum temperature, a sensor 7 which, in the modification illustrated in FIGURE 1, comprises a rod-like member 8 which extends substantially entirely across the plenum chamber. The rod 8 is supported by a plate member 9 which is fastened across an opening in one wall of the plenum chamber. An opening 10 in plate 9 permits free, unrestricted passage of a cable 11 which is connected to one end of a fusible link 12 having its other end connected through a hook 13 to a point on rod 8. Rod 8 contains a plurality of notches or similar points of attachment 14 so that the hook 13 may be attached to rod 8 at a point that the fusible link 12 is positioned in the plenum chamber substantially at the point at which the heated working fluid is at a maximum temperature. Cable 11, after passing through aperture 10 in plate 9, passes over a pulley 15 which may conveniently depend from the external end of rod 8 and then is connected to the end of a lever 16. Lever 16 in turn is fulcrumed on a bracket 17 and has its other end connected to a conventional shut-off valve 4 of the spring-biased type. The spring in such a valve maintains tension in cable 11 and, when fusible link 12 ruptures, operates to close the valve and stop the flow of fuel to the heater in furnace 1. Fusible link 12 is formed of a suitable solder or equivalent material whose melting or fusion temperature is of a value equal to the maximum temperature desired at its location in the heating system. Thus the melting point of link 12 is preferably approximately 250° F.

In operation, the heating system of FIGURE 1 anticipates any overheating and prevents the occurrence of dangerous temperatures in the system by melting or rupture of the fusible link 12 when an undesirably high tem-

perature is reached in the working fluid in plenum chamber 5. Upon fusing of link element 12 valve 4 operates in a conventional manner through a spring (not shown) in that valve to shut off flow of fuel to the heater in warm air furnace 1.

As a safety precaution, to prevent increasing hazards of a fire or overheated condition which might occur through causes external to the heating system, I include in cable 11 a second fusible link 18 which is exposed to the air outside the furnace. If fire, external to but in the vicinity of the furnace, or other conditions cause undesirably high temperature outside the furnace itself, while the temperature of the working fluid in the furnace remains below temperature which would cause the fusing of link element 12, then fusible element 18 ruptures to shut off supply of fuel to the burner and thus prevent any increase in the fire hazard already existing outside the furnace. Element 18 may have, for example, a rupture or melting temperature of 165° F.

FIGURE 2 illustrates my invention as applied to a heating system employing hot water or steam as a working fluid, and FIGURE 3 is an enlarged sectional view of the sensor employed in the system of FIGURE 2. In this system the plenum chamber 20 comprises a boiler which contains the hot water or steam which comprises the working fluid of the system. Sensor 21 is located near the upper working fluid of the system. Sensor 21 is located near the upper portion of the boiler and is connected through cable 11 with shut-off valve 4. Included in the cable connection between sensor 21 and shut-off valve 4 is a fusible element 18 whose function is similar to that of element 18 of the system of FIGURE 1. Sensor 21 comprises a tube 22, having a closed end 23 positioned within the boiler 20. Its other end is open and in screw-threaded relation with an opening in the side wall of boiler 20 as illustrated in FIGURE 3. A water-tight seal at the point of entry into the boiler is obtained by means of a gasket and nut combination 24. Positioned within tube 22 is a replaceable element 25 which comprises an open-ended tube 26 held in position within tube 22 by means of a set screw 27. A plug 28 which closes the open end of tube 26 within the boiler supports a hook 29 which engages one end of a fusible element 30, the other end of fusible element 30 being connected to cable 11. A curved arm 31 which may be formed integral with or welded to tube 26, provides means for supporting a pulley 32 over which tension cable 11 passes. In this system, by suitably selecting the length of hook 29 and the lengths of tubes 22, 26, fusible element 30 may be positioned within boiler 20 at a point where the maximum temperature of the working fluid occurs.

FIGURE 4 schematically illustrates a modification of my heating system which includes certain additional safety features and FIGURE 5 illustrates the valve and circuit breaker arrangement employed in the system of FIGURE 4. In this system, which is illustrated as comprising a warm air furnace, cable 11 has one end connected at point 40 to a smoke breaching element 41 in flue 42'. Its other end is connected to shut-off valve 4. Connected in series with cable 11 between valve 4 and point 40 are three fusible links 42, 43, 44. Links 42, 44 may comprise elements fusible at a temperature of 165° F. for example, while link 43, which is located in the plenum of the heating system, is fusible at a higher temperature, for example, 250° F. Carried on arm 16 of the operating lever of valve 4 is an electrical switch 46 which suitably may be of the mercury type and which normally closes contacts 47, 48 in the circuit of burner 50. FIGURE 5 illustrates valve 4 in its closed position at which the fuel supply to burner 50 is cut off, for example, after one of the links 42–44 has ruptured to open the circuit to the burner and shut off the supply of the fuel to burner 50. Switch 46 is also operative in its open position to disconnect the supply of electrical energy to burner 50. In the system of FIGURES 4 and 5, the additional fusible links 42, 44 are located to protect against over-firing and overheated conditions, or a disconnected smoke pipe or flue.

In all the systems embodying my invention, the underlying principle of operation is the anticipation of hazardous conditions and preventing any overheating or fire before it actually occurs. This is accomplished by placing a sensor in the flow path of the working fluid of the system at the point at which the temperature of that working fluid is a maximum. When the maximum temperature desired at this point is exceeded, a fusible element positioned at the point ruptures to release the tension in an attached cable and operate a shut-off valve to interrupt the flow of fuel to the burner of the system.

An important advantage of my improved safety system is that it prevents dangerous conditions from arising by sensing temperatures of a working fluid which exceed a preset value and shutting down the heating system before any hazardous condition occurs or damage is done.

Another important advantage of my invention is that it provides a safety arrangement which is simple in construction and in which even through the fusible elements are positioned at the critical temperature points of the system they may be easily and readily inspected and replaced.

Although the present invention has been described in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention. As those skilled in the art will readily understand, such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a warm air heating system having a housing containing a fuel burner for heating air, a plenum chamber comprising a plurality of wall members connected to said housing for receiving the heated air, the temperature of the heated air varying at different points in said plenum chamber, said chamber having an opening in one wall member, an outlet duct connected to another wall member of said chamber for receiving the heated air, a fuel supply line, a biased shut-off valve in said supply line, and means including a lever for maintaining said valve in an open position, the combination comprising a plate having a pair of holes therein connected across the opening in said one wall member, a thermal sensor inserted in said plenum, said sensor comprising a rod-like member extending into said plenum through one of said holes, a first fusible link in direct contact with the heated air and having one end connected to said member, means whereby the position of said link may be adjusted to the point of maximum temperature in said plenum chamber, and a tension cable extending through the other of said holes and connected between the other end of said link and said lever whereby when said link ruptures said cable releases said lever and said valve moves to shut-off condition.

2. A thermal sensor for a heating system comprising a rod-like member positioned in the flow path of the working fluid of a system, a fusible link in direct contact with the working fluid and having one end connected to an adjustable point on said member whereby said link may be positioned at the point of maximum temperature of said working fluid, and a tension cable connected to the other end of said link and extending parallel to said member, whereby when the working fluid exceeds a predetermined maximum temperature said fusible link ruptures, and means controlled by said cable for interrupting the operation of the heating system upon such rupture.

3. The sensor of claim 2 which includes a plate member, said plate member having a pair of openings, said rod-

like member being sealed to one of said openings, and said tension member passing freely through the other opening.

4. The combination of claim 1 which includes at least one additional fusible link positioned adjacent the external surface of said housing and connected in series with said first link and said cable.

5. The combination of claim 1 in which said rod-like member contains a plurality of points for attaching said one end of the fusible link to facilitate positioning said link at the point of maximum temperature of the heated air.

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U.S. Cl. X.R.

431—21; 126—287.5; 122—504.1