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ABNORMAL FUEL PRESSURE CUT OFF AND PURGE SYSTEM

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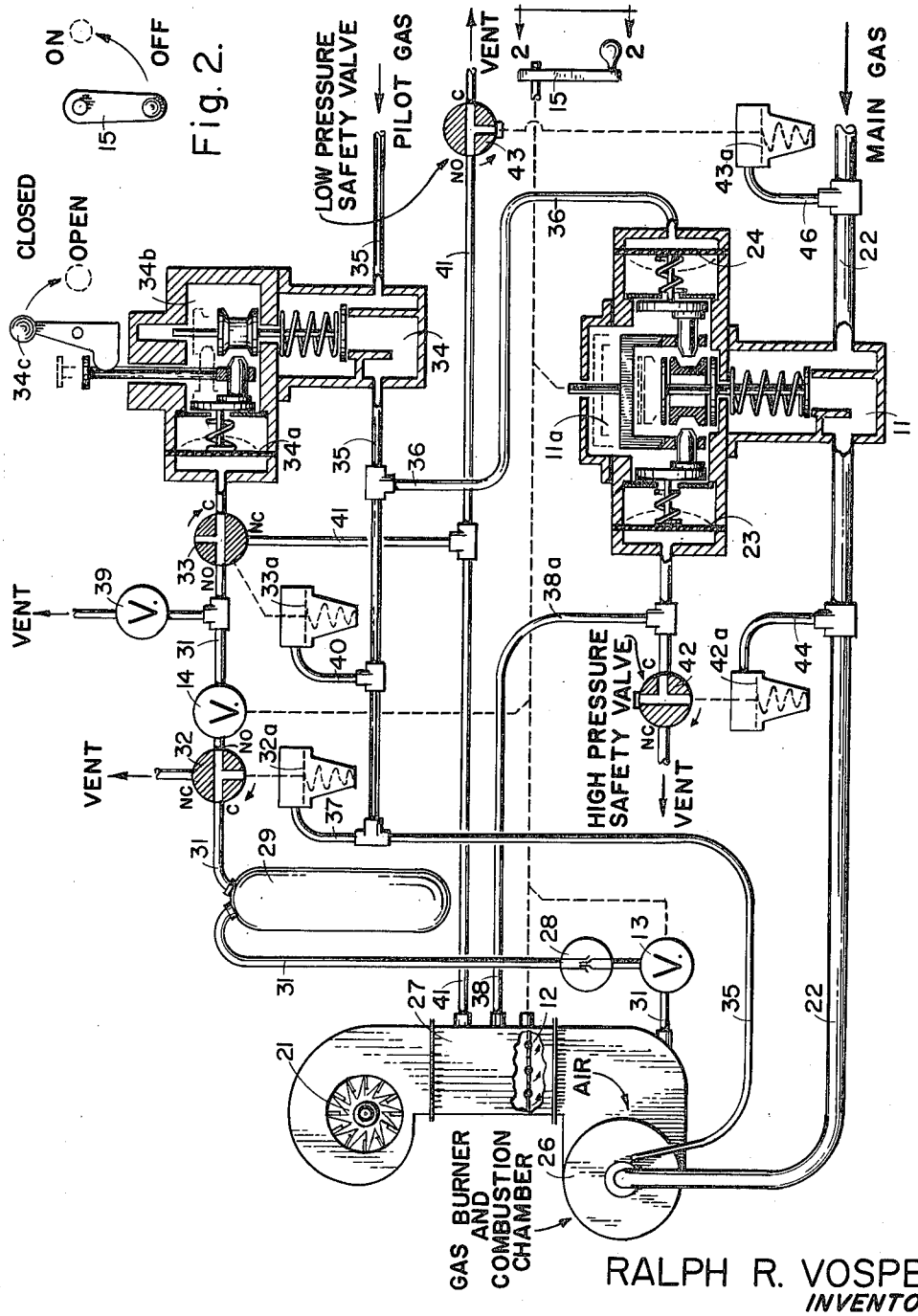


Fig. 1.

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ABNORMAL FUEL PRESSURE CUT OFF AND PURGE SYSTEM

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This invention relates to a safety system for use in connection with forced air draft gas burners as may be employed as a source of heat energy for steam boiler installations, refractory furnaces, or the like.

It is currently normal practice to provide various types of flame failure safety devices in gas burners to detect and implement corrective action in reference to unsafe conditions that may develop with the burner or in the furnace or boiler room. For example, there are various devices that are operable to detect extinguishment of the pilot flame or to detect abnormal high or low pressure fluctuations in the primary gas supply line. Generally speaking, most such safety devices operate to shut off the supply of gas to the burner and to sound a visual or audio warning signal to the operator so that corrective action can be taken. Although certain components of conventional safety systems are directly responsive to, and are actuated by pressure changes in the main gas supply line and/or in the gas pilot line, all modern safety system of which I am aware depend, at least in part, upon the supply of electric current to actuate electric relays or other electrically actuated component parts included within the system as a whole.

Although the dependence upon uninterrupted or continuous supply of a source of electrical energy to maintain a safety system in operation has been found to be quite satisfactory in many types of boiler or furnace operations, it will be realized that in such types of systems should the source of electric current be stopped or interrupted due to power failure, the system will operate in its intended manner to shut off the boiler and extinguish the flame heat source for the boiler. In other words, in such types of safety systems, the entire boiler or furnace operation can be shut down due to circumstances (i.e., failure of electric power supply) that are completely unrelated to the proper functioning of the burner and boiler room operations per se.

It would appear evident that any optimum safety system should not shut down the boiler except for causes directly related to some malfunction of the burner or boiler operation per se. Even in commercial processes where the shut down of a boiler will result only in temporary work interruption and consequent curtailment of productive output, it follows that any such interruption or curtailment will reflect an economic loss due to the shutdown. In certain commercial processes, particularly in reference to certain oil refining and/or chemical processes where temperatures must be maintained within critical ranges for prolonged periods of time to properly carry out the process or reaction, even a temporary shutdown of a burner sufficient to cause loss of boiler pressure or heat below the necessary minimum can be of critical importance. For example, we are aware of instances in certain oil refinery processes where even a temporary loss of boiler heat necessary to maintain the reaction continuously to completion has resulted in the necessity of throwing away and disposing as waste the raw materials being processed at the time of the shutdown.

A principal object of the present invention is to provide a safety system which is not dependent in any way on the supply of electric current or other activating energy sources outside the forced draft air-gas burner system itself. Stated otherwise, a primary object of the invention is to provide a safety system which is responsive

solely to the maintenance in the system of a predetermined forced draft combustion air pressure source in conjunction with the maintenance of a predetermined range of minimum low to maximum high pressure in the main gas supply line and in the pilot gas supply line. As will be explained in more detail hereinafter, a system embodying the present invention is directly actuatably responsive to abnormally low and abnormally high pressures in the main gas supply line whereby if the pressure in the main gas supply line should elevate above or drop below the predetermined safety pressure limits, the said system will operate to shut down the burner. The system is also directly responsive to the continued maintenance of forced draft combustion air to the burner and also to the maintenance of a minimum safety pressure limit being maintained in the pilot line whereby if there should be a failure in the forced air draft system, and/or an abnormal drop of pressure in the pilot gas line, the system will likewise operate to shut off the gas supply to the burner and thereby shut down the system. However, and as above indicated, none of the safety components incorporated within the present system depend upon electric energy being supplied to relays or other electric devices as are normally included in more conventional types of safety systems in current use today. Consequently, the operation of the present system is not dependent upon, nor will it be affected by, any electric power failure that may occur in the operating plant facility.

Other objects are to provide a system of the character briefly mentioned above which is dependable in operation, relatively simple and economic of construction, and which can be fabricated largely, if not entirely, from commercially available components such as conventional piping, valves and the like.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a diagrammatic view of a safety system embodying the present invention; and

FIG. 2 is a fragmentary diagrammatic view of the master control lever viewed along line 2—2 in FIGURE 1.

Referring more specifically to the drawings, it is believed that the present system can best be understood by explaining the function of the system and its various components during various phases of operation. In this connection, the operation of the system will be first described in reference to a normal startup phase commencing with the purging of the combustion chamber with air followed by the lighting of the pilot light and the eventual turning on of the main fuel gas valve. This explanation will be followed by a further explanation on how the system operates when dangerous high and/or low gas pressure conditions subsequently occur during operation.

Referring to FIGURE 1, main gas control valve **11**, the adjustable damper control **12**, the purge valve **13**, and the low fire valve **14**, mechanically are all linked or connected to a common master control lever **15** which is operable to actuate simultaneously all four of the components **11–14** in predetermined relation to one another. In general, when the master control is moved from its full "off" to "on" positions, both the damper and the main fuel valve will move from fully closed to fully open positions. The air purge valve **13** and the low fire valve **14** operate in substantially reverse sequence to one another, in that the low fire valve is only open during the first 20% movement of the master control lever, whereafter further opening movement of the master control will shut off the low fire valve completely; whereas, the purge valve **14** is

opened only during the last 20% opening movement of the master control lever.

With this interrelation between the main fuel valve, damper, purge valve, and low fire valve in mind, the system as a whole will now be described. For purposes of such explanation, it may be assumed that the system is used in connection with a gas burner which is installed to introduce into a combustion chamber and boiler furnace proper a forced draft air-gas mixture for ignition and flame propagation therein.

Assuming the system is completely shut down and that it is desired to start it up, the following sequential steps or acts would be taken:

In order to air-purge the furnace of any raw gas, the fan **21** is started and the master control lever **15** moved to full "on" position, which latter movement will cause the damper **12** and purge valve **13** to fully open, and to cause the low fire valve **14** to close. Although the master control lever is mechanically linked to the main fuel valve, the latter at this stage of operation will not open to admit gas into the burner fuel supply line **22**. More specifically, until certain other conditions exist in the system, particularly such as to actuate fuel valve control diaphragms **23** and **24**, respectively, the manual reset component **11***a* of main fuel valve **11** cannot be operated so as to open said valve and admit gas into burner supply line **22**. This is so because valve **11** is of the type known in the art as a gas shut off safety valve of which a typical commercial example is given in the table in col. 7, line 70. In valves of this type the valve stem is caused to physically connect to its operator within a reset component such as that shown at **11***a* only when fluid pressure is applied and maintained on diaphragms **23** and **24**. The source and occurrence of such fluid pressure in my invention is explained in greater detail hereinafter. Mechanical movement of the handle and operator before fluid pressure is applied to diaphragms **23** and **24** is physically possible in valves of this type but will produce no movement such as that of valve **11**; this is the condition that prevails during initial air purge of the system described herein, prior to firing of the system, at which time physical movement of the operator occurs because of linkage to handle **15** but no gas passes through valve **11**.

With the fan on and the damper open, air will be supplied to the burner plenum or wind box **26** via air supply conduit **27**, and thence flow into the combustion chamber and boiler furnace to purge any raw gas through the furnace exhaust. Means are provided in the present system for establishing a predetermined time period during which the purge cycle must continue before the pilot light can be lit. More specifically, such means includes the purge time needle-valve **28** and volume chamber **29**, both of which are located in the pilot air control line **31** which taps air from the wind box **26**. In this connection, valve **28** may comprise a conventional needle valve which can be adjusted to bleed air at a predetermined rate through line **31** into the volume chamber **29**. Thus, for example, if it is desired to establish a minimum air purge time of three minutes (before the pilot valve can be turned on) the needle-valve **28** can be adjusted and pre-set to bleed air into chamber **29** at a rate that will take three minutes before pressure equilibrium between chamber **29** and the wind box is established. (The length of time that it takes for pressure equilibrium to be reached is primarily a function of the cross-sectional opening of the needle valve and the volume of the chamber **29**.) When pressure equilibrium between chamber **29** and the wind box **26** has been established, air from the volume chamber will flow through pilot opening valve **32** which, as indicated, is a three-way valve and has a common port, a normally open port, and a normally closed port designated respectively by the letter reference characters "C" (common port), "NO" (normally open port), and "NC" (normally closed port). As further indicated, the common port and normally open port of valve **32** establish normal straight-through communication in line **31**, whereas, when the valve is actuated by pressure diaphragm responsive means **32***a* (to be referred to more specifically hereinafter), the normally closed port is opened so as to vent pressure in line **31** to atmosphere.

Valve **32**, as well as valves **33**, **42** and **43**, referred to hereinafter, is of the type known in the art as a pressure controller valve of which a typical commercial example found to be satisfactory for my invention is listed in the table in col. 7, lines 65 thru 69. When diaphragm **32***a* (or **33***a*, **42***a*, or **43***a* of the other valves referred to) has an external fluid pressure applied to it, the three way porting of valve **32** itself is shifted by the action of the diaphragm moving a valve plunger which causes the port changes indicated on the accompanying drawing and referred to hereinafter. When the external fluid pressure is removed from the diaphragm, the valve returns to its former porting position.

At this stage of operation, after the full minimum purge time has elapsed, it may be assumed that the operator will move the master control **15** to low starting fire position, which said movement will: (1) cause the damper **12** to substantially close, (2) cause the purge valve **13** to close, (3) cause the main fuel valve **11** to correspondingly move toward closed position, and (4) cause low fire valve **14** to open. Opening of low fire valve **14** will establish air flow communication from volume chamber **29** through the air line **31** and through the normally open and common ports of pilot-sustaining valve **33** into the pressure-responsive valve actuator **34***a* of the manual reset gas pilot control valve **34**. Previously mentioned pilot sustaining valve **33** is a pressure responsive three-way valve substantially identical to pilot opening valve **32**. Valve **33** includes a pressure responsive actuator **33***a* which will be referred to more specifically hereinafter.

The assembly comprising valve **34**, reset component **34***b* and actuator or diaphragm **34***a* are known expedients in the valve art of which a typical commercial example is listed in the table in col. 7, line 60. Such a valve may be physically shifted by handle **34***c* to permit passage of a fluid through its body only after fluid pressure is applied to diaphragm **34***a*, which fluid pressure causes movement of said diaphragm and operative engagement of the valve operator with the valve stem. After such fluid pressure is removed, valve **34** returns to its original or closed position. The referred to fluid pressure is obtained and applied as explained in detail below.

When air pressure is established between volume chamber **29** and the pressure actuator **34***a*, the manual reset component **34***b* of pilot valve **34** is placed in an operable condition whereby the pilot valve turn-on handle **34***c* can be manually opened to turn on the pilot gas leading to the pilot light in the burner via pilot gas supply line **35**. On the downstream side of pilot valve **34** are three gas pressure control take-off lines indicated at **36**, **37**, and **40**, respectively, which are connected respectively to the pressure responsive valve actuator means previously designated at **24**, **32***a* and **33***a*.

More specifically, gas pressure in line **36** will actuate pressure responsive diaphragm **24** of the main fuel valve **11**. This alone will not render valve **11** in a condition to open and permit flow of gas through supply line **22**, because it is also necessary that for valve **11** to be rendered operative to open pressure, responsive diaphragm **23** must also be actuated under influence of air pressure in the primary air conduit **27** leading from the fan **21** to the damper **12** and through branches **38** and **38***a* to the chamber in communication with said responsive diaphragm **23**. It is seen that lines **38** and **38***a* are normally open to establish constant air pressure to diaphragm actuator **23** during all stages and conditions of operation, except in the single instance where there is developed dangerously high gas pressure in line **22**. The operation of the system where this latter condition develops will be explained hereinafter.

Pressure control line 37 actuates the pressure responsive diaphragm 32*a* which will cause actuation of pilot opening valve 32, whereby the normally open port will be closed and the normally closed port will be vented to atmosphere. The valve will be held in this latter position as long as normal pilot gas pressure continues to flow through pilot gas supply line 35. When valve 32 is actuated as above described, it is seen that air flow from the volume chamber side of line 31 is shut off, and any residual air on the downstream side of valve 32 is bled to atmosphere from the line by low fire control bleed valve 39.

Moreover, bleed valve 39 is pre-set to a slightly open condition so that volume chamber 29 is relieved of its pressure after a given safe time interval. This causes relief of pressure on actuator 34*a* and prevents pilot valve 34 from being actuated after a predetermined period subsequent to purging. This insures that pilot gas pressure must be initiated promptly after a given purge procedure has been carried out; otherwise the operation of start up must be reinitiated. This gives the added safety feature of not permitting valve 34 from being actuable for an indefinitely long period of time after purging. The amount that valve 39 is left open, however, is small in relation to the normal air flow between chamber 29 and actuator 34*a* so that the constant bleeding that is inherent does not interfere with nor prevent normal operation after purging if done within a reasonable time. Valve 39 is a globe type valve of any manufacturer and a well-known expedient in the valve art. Pressure within the pressure responsive valve actuator 34*a* sufficient to maintain gas pilot valve 34 open is continued to be maintained by air pressure from the fan 21 as supplied via conduit 41 and pilot sustaining valve 33. More specifically, simultaneously with the actuation of valve 32 to shut off volume chamber pressure to valve 34 as aforesaid, valve 33 will also be actuated by virtue of pilot gas line pressure acting on pressure responsive valve means 33*a* via pressure control line 40. More specifically, the pressure responsive diaphragm 33*a* will cause valve 33 to actuate whereby the normally open port will close and the normally closed port will open, whereby air communication between line 31 and the pressure responsive component of pilot valve 34 is closed and whereby simultaneously direct air pressure communication between the fan 21 and the said pilot valve 34 is open via line 41. During normal operation of the burner, air pressure from the fan via conduit 41 and through valve 33 will maintain actuating and holding pressure sufficient to keep the pilot valve open, and whereby gas continues to flow to the pilot light in the burner.

Briefly recapitulating certain portions of the foregoing explanation it is seen that as long as the burner continues to operate within normal ranges and conditions of maximum and minimum gas pressures, air and fuel gas will be supplied and controlled by regulation of the master control lever 15 which, as above explained, simultaneously controls the air damper and the opening and closing movements of the main fuel valve. Obviously, the amount of fuel and air supplied would be related to and dependent upon the particular load requirements and capacity of the burner required during its operating cycle. In other words, as long as the main gas pressure in the supply line 22 is maintained within normal predetermined high and low pressure operating limits (conditional also upon continued supply of air pressure in the system from fan or blower 21), the components of the system hereinabove described will continue to maintain both the pilot valve 34 and the main fuel valve open.

In the event that the gas pressure in line 22 should elevate above a predetermined safety pressure level, high gas pressure safety control valve 42 will actuate to close the main fuel valve 11; whereas, should pressure in line 22 drop below a predetermined minimum safety level, low gas pressure safety control valve 43 will be caused to actuate and shut off both the main fuel valve as well as the pilot gas valve.

More specifically, if and when gas pressure in line 22 should exceed a predetermined safety limit, such pressure will be sensed by the pressure responsive actuator 42*a* of the high pressure safety control valve 42. In this connection, pressure responsive actuator 42*a* is directly connected to the downstream side of the fuel line 22 via gas pressure tap line 44. High pressure actuation of valve 42 will cause the normally plugged port to vent to atmosphere whereby air pressure in lines 38 and 38*a* will be bled and which in turn will result in the loss of pressure against pressure responsive diaphragm 23 associated with the fuel valve 11. As previously explained, in order for the fuel valve to be opened, or to remain open, it is necessary that both the pressure responsive diaphrams 23 and 24 be actuated by their respectively associated pressure sources. When either of the diaphrams 23 or 24 becomes de-actuated, the main fuel valve will automatically close and prevent further supply of fuel gas to the burner until the condition causing the shut down of the system is remedied. Generally speaking, high pressure gas will develop in the line due to pressure fluctuations at the primary source of fuel supply and/or due to failure of pressure regulators normally provided in the supply line.

As previously indicated, should pressure in main gas line 22 drop below the predetermined minimum safety level, low gas pressure safety control valve 43 will operate to cause both the main fuel valve 11 and the pilot valve 34 to shut off. More specifically, in normal operations where the pressure in line 22 is maintained above its predetermined safety limit, gas pressure, tapped from line 22 via conduit 46, will act upon the pressure responsive component 43*a* of the said valve 43 to maintain the valve parts in their position of operation shown in FIG. 1 of the drawings. More specifically, it will be observed that valve 43 is shown with a common port "C" connected to air tap line 41 and is also shown with normally open and normally closed ports designated by the reference characters "NO" and "NC" respectively. The port indicated at NC is plugged to atmosphere, and the normally open port is vented to atmosphere. During normal burner operations, pressure tapped from line 22 via line 46 will act upon pressure responsive valve component 43*a* to cause the valve element of valve 43 to rotate in the direction of the arrow shown whereby the normally open port will be plugged to prevent venting of pressure in air tap line 41 to atmosphere, whereby air pressure in said tap line 41 will continue to be transmitted via pilot sustaining valve 33 to the pressure responsive component 34*a* of pilot valve 34 to maintain the latter valve open as heretofore explained. When, however, pressure in main gas line 22 drops below the predetermined minimum safety level, such pressure drop will be sensed by the pressure responsive component 43*a* of valve 43 which, in turn, will cause actuation of the valve element to its position shown in the drawings, and whereby air from tap line 41 will be vented to atmosphere through the normally open port. This will cause an immediate corresponding pressure loss in tap line 41 which, in turn, will be sensed by the pressure responsive component 34*a* of pilot valve 34 to cause the latter valve to shut off. Closing of the pilot valve, in turn, will result in a substantially immediate loss of pressure in pilot gas supply line 35 and in the three pressure take-off lines 36, 37 and 40, respectively. Loss of pressure in take-off line 36 will deactuate pressure responsive diaphragm 24 and cause the main fuel valve 11 to shut off. Loss of pressure in line 37 will deactuate the pressure responsive component 32*a* of pilot opening valve 32 and return the valve parts to their position shown in the drawings as they exist at the moment of start-up of an operating cycle as earlier explained. Simlarly, loss of pressure in take-off line 40 will deactuate pressure responsive component 33*a* of pilot sustaining valve 33 and likewise cause the valve parts to

return to their start-up position as shown in the drawings and as also earlier described.

From the foregoing it may be noted that the closing of the fuel valve 11 due to high pressure gas conditions as above described will not effect the pilot gas valve and pilot gas will continue to be supplied to the burner even during the shutdown of the main fuel valve because of high pressure gas conditions. It therefore follows that if and when the main fuel valve should be automatically shut off due to high pressure gas conditions, it is unnecessary to go through the steps of either shutting off the pilot or of purging the furnace with air before the main fuel valve can again be turned on in order to continue normal operations after alleviation of the high pressure gas conditions in the line. On the other hand, a different situation is true when both the main fuel valve and pilot valve are shut off due to the development of a low pressure gas condition in the system, the happening of which will necessitate that an operator go through the necessary air purging steps previously described before he can turn on either the pilot or the main fuel valve. This is an intentional safety measure which is built into the present system to prevent any possibility of prematurely lighting the burner with raw gas present after low gas pressure failure has caused it to shut down.

Air purging is unnecessary after failure of the main gas alone due to a high pressure condition since the pilot having remained unextinguished will ignite any gas introduced at the burner at a later time by the main gas supply line. Thus no unignited gas mixture may collect within the combustion chamber to cause a dangerous explosive condition. This of course is not the case where there has been failure of the pilot alone due to low pressure or loss of pressure in the pilot line. This is so because under the latter circumstances, after the pilot has been extinguished, large quantities of gas may be introduced in the system by faulty admission of gas conveyed by low level pilot pressure and/or faulty introduction of gas to the combustion chamber from the main gas line. In such event, permitting firing of the pilot line with normal operating pressures before an air purge could result in a damaged explosion.

The present system, and the various components thereof have been illustrated schematically in the drawings. It is pointed out that a system embodying the present invention can be fabricated from parts and equipment that are per se known in the art and that can be purchased from existing market sources. It is believed apparent that the air lines and gas lines comprising the system involve conventional plumbing. Likewise, the various types of pressure responsive valves that are used in the system can be of known types. In this connection and in order to provide more complete practical information as to how the present invention may be practiced, the following manufacturing sources from whence certain designated component parts may be purchased are hereinbelow listed:

Name of component	Part No.	Name of manufacturer
Pilot valve	34	Manual reset valve type, Model 22-0-M-G, manufactured by North American Manufacturing Co., Cleveland, Ohio.
Pilot opening valve	32	Pressure controller valve Type 164A, manufactured by Fisher Governor Co., Marshalltown, Iowa.
Pilot sustaining valve	33	Do.
High pressure gas supply valve	42	Do.
Low pressure gas supply valve	43	Do.
Main fuel valve	11	Manual reset "Locktite" valve, manufactured by Eclipse Fuel Engineering Co., Rockford, Illinois.

The foregoing manufacturing sources are given only to indicate that the various types of pressure sensitive valves used in the system may be purchased commercially from existing manufacturing sources. It is understood, that the present invention does not depend upon the use however, of any particular brand of manufactured item and that the components can be purchased from other manufacturers than those above listed, or can be fabricated especially for their intended purpose within the present system.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention as limited only by the scope of the appended claims.

I claim:

1. In forced draft air-gas burners utilizing a main gas supply line including a pressure responsive manual reset main gas valve, a primary air source, and a pilot gas supply line including a manual reset pressure response pilot valve, a safety system comprising: means connecting said pressure response pilot valve to be responsive to air pressure of said primary air source to permit said pilot valve to be manually opened and permit gas flow therethrough into said pilot gas supply line; means connecting said pressure responsive main gas valve to be responsive to pressure in said pilot gas supply line and also responsive to air pressure from said primary air source to permit opening of said main gas valve and establish gas flow in said main gas suplpy line, a high gas pressure sensing valve, means connecting said high gas pressure sensing valve to be responsive to unsafe high pressure in said main gas supply line to shut-off air pressure from said primary air source to said main gas valve; said main gas valve through its connecting means arranged to be responsive to shut-off of air pressure from said primary air source to close said main gas valve and shut-off supply of gas through said main gas supply line; a low gas pressure sensing valve means operably responsive to unsafe low pressure in said main gas supply line to shut off air pressure from said primary air source to said pilot valve to cause the latter to close and shut off supply of pilot gas line pressures to said main gas valve and thereby cause said latter valve to close and shut off supply of gas to said main gas supply line.

2. The combination of claim 1 and including air purge timing means operable to require the primary air source to operate for a predetermined minimum time limit and to supply forced draft air to the system before said pilot gas valve can be opened.

3. The combination of claim 2 and wherein said air purge timing means includes an air purge control line; a bleeder valve in said air purge control line; an air reservoir chamber immediately downstream from said bleeder valve and in fluid comunication with said primary air source through said bleeder valve and said air purge control line; said bleeder operable to admit air from said source to said chamber at a predetermined rate whereby a predetermined time delay is required for air pressure to develop within the said chamber sufficient to cause said pressure responsive pilot valve to be opened after said primary source develops said air pressure and is shut off from said chamber.

4. The combination of claim 3 and wherein said air purge control line further includes a pressure responsive pilot opening valve and a three-way pressure responsive pilot sustaining valve both located on the downstream side of said reservoir chamber; said pilot opening valve normally open to admit air through said control line and through the normally open sustaining valve to said pilot valve to permit the latter to be manually opened as aforesaid; the pressure responsive component of said pilot opening valve connected to said pilot gas supply line and responsive to pressure in said pilot gas supply line to close off further air flow through said control line to said pressure responsive pilot valve; the normally closed port of

said pilot sustaining valve connected to said primary air source and the pressure responsive component of said sustaining valve connected to said pilot gas supply line and operable under influence of such pressure to open said normally closed port to admit air flow therethrough from said air source to said pressure responsive pilot valve to maintain the latter open when the pilot opening valve closes as aforesaid.

5. In forced draft air-gas burners utilizing a main gas supply line, a primary air source, and a pilot gas supply line, a safety system responsive to predetermined limits of unsafe low and high gas pressure in said gas supply line comprising: a pressure responsive gas turn-on-valve arranged to open and close gas communication through said main gas supply line; first pressure responsive safety means associated with said gas turn-on valve and operable to sense and unsafe high pressure condition in said gas supply line and cause said turn-on valve to close; second pressure responsive safety means associated with said gas turn-on valve operable to sense an unsafe low pressure condition in said pilot gas supply line and cause said turn-on valve to close.

6. The combination of claim 5 and wherein a pilot in said pilot gas supply line and said gas turn-on valve includes a first pressure responsive component sensitive to pressure from said primary air source and also includes a second pressure responsive component sensitive to pressure in said pilot gas supply line; said gas turn-on valve constructed so as to close upon loss of pressure acting on either of its first and second pressure components; said first safety pressure responsive means including a valve operable upon a condition of unsafe high gas pressure in said main gas line to close off air communication from said air source to said first component of said gas turn-on valve and thereby cause the latter to close; said second safety pressure responsive means including means operable upon a low gas pressure condition occurring in said main gas line to close said pilot valve and thereby shut off pilot gas line pressure to said second component of said gas turn-on valve and thereby cause said turn-on valve to close.

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