



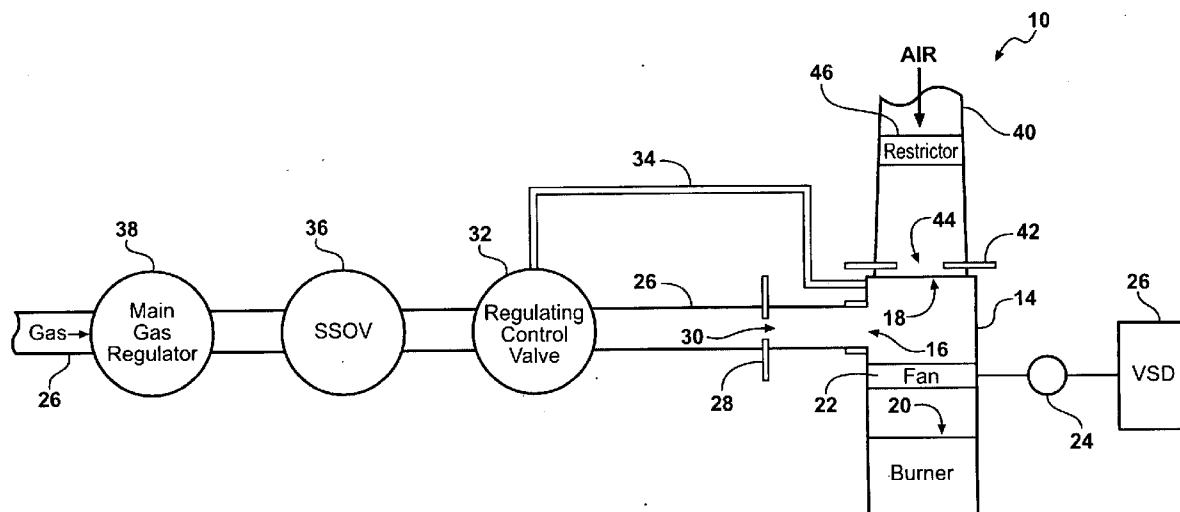
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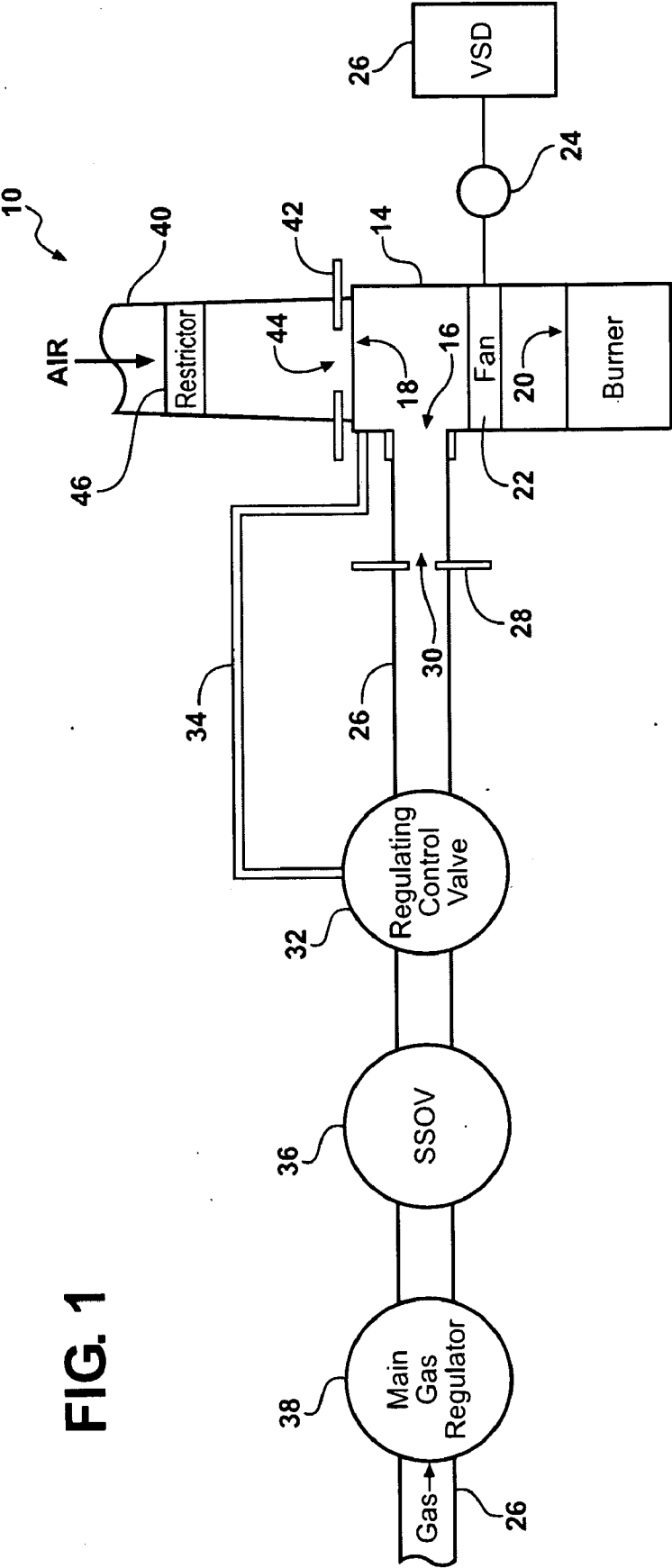
(19) **United States**(12) **Patent Application Publication**  
**Masen**(10) **Pub. No.: US 2009/0197212 A1**(43) **Pub. Date: Aug. 6, 2009**(54) **PREMIX BURNER CONTROL SYSTEM AND METHOD**(75) Inventor: **Mark Masen**, Leonard, MI (US)Correspondence Address:  
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Royal Oak, MI 48067 (US)(73) Assignee: **Maxitrol Company**, Southfield, MI (US)(21) Appl. No.: **12/365,511**(22) Filed: **Feb. 4, 2009****Related U.S. Application Data**

(60) Provisional application No. 61/026,041, filed on Feb. 4, 2008.

**Publication Classification**(51) **Int. Cl.**  
**F23N 1/02** (2006.01)(52) **U.S. Cl.** ..... **431/12; 431/18**(57) **ABSTRACT**

A fan modulated premix burner control system includes a regulating control valve for regulating the pressure of gas fed to a premix chamber. The pressure of the gas is based on the pressure of air also fed into the chamber to produce a constant air/fuel ratio. The system also includes an air restrictor for reducing the pressure of the air to permit operation of the burner at low fan speeds.





## PREMIX BURNER CONTROL SYSTEM AND METHOD

### CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of provisional patent application No. 61/026,041, filed Feb. 4, 2008, which is hereby incorporated by reference.

### BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates generally to gas burners. More specifically, the present invention relates to a control system for premix gas burners and a method for maintaining flow of an air/fuel mixture to the premix gas burner.

[0004] 2. Description of the Related Art

[0005] Premix gas burners operate by mixing gaseous fuel and air prior to produce an air/fuel mixture. The air/fuel mixture then enters the burner and is ignited and burned. A fan is often used to induce mixing of the air and fuel.

[0006] However, typical methods of controlling the air/fuel mixture limit minimum firing rates of the burner due to their inability to maintain the desired air/fuel mixtures at very low fan pressures. That is, the controls are not sensitive enough to react to minute changes in pressure that occur at reduced flow rates. Eventually, the firing rate, i.e., the rate at which the air/fuel mixture is burned, is limited with these typical control systems. For example, the fan motor may actually stall or the air pressure changes may be so minute that the control valve is no longer able to adequately sense the changes and react accordingly.

[0007] Accordingly, there exists a need for new and improved systems and methods for regulating air and/or fuel flow in fan modulated premix gas burners that overcome at least one of the aforementioned problems.

### SUMMARY OF THE INVENTION AND ADVANTAGES

[0008] The present invention discloses a method of maintaining flow of an air/fuel mixture to a burner. The burner is fed from a premix chamber enclosing a variable speed fan. The premix chamber also defines an air inlet, a fuel inlet, and an outlet in fluidic communication with the burner. The method includes the step of regulating a flow of gaseous fuel through the fuel inlet with a regulating control valve to maintain a specified pressure. The gaseous fuel and air are drawn into the premix chamber by operation of the fan. Mixture of the gaseous fuel and the air in the premix chamber are affected by operation of the fan to produce an air/fuel mixture. The air/fuel mixture is forced to the outlet by operation of the fan. The method continues with the step of lowering an inlet air pressure of air drawn through the air inlet by reducing the area of an air duct ahead of the air inlet to decrease the flow rate of the air/fuel mixture.

[0009] The present invention also discloses a premix burner control system. The system includes a housing defining a gas inlet for receiving a gaseous fuel, an air inlet for receiving air, and at least one outlet for connection to a burner. A fan is disposed in the housing for drawing the gaseous fuel and the air into the housing, affecting mixture of the gaseous fuel and the air to produce an air/fuel mixture, and forcing the air/fuel mixture to the outlet. A motor is operatively connected to the fan for turning the fan. A variable speed drive is operatively

connected to the motor for turning the fan at a plurality of speeds to control a flow rate of the air/fuel mixture into the outlet. A regulating control valve in fluid communication with the gas inlet regulates the flow and pressure of the gaseous fuel. A restrictor device is in fluid communication with the air inlet for controlling an air inlet pressure of air drawing through the air inlet and into the housing. The restrictor device is operable to lower the air inlet pressure of the air drawn through said air inlet by reducing the area of an air duct ahead of said air inlet to decrease the flow rate of the air/fuel mixture.

[0010] By lowering the inlet air pressure ahead of the air inlet with the restrictor device, a constant air/fuel ratio can be obtained even at very low fan speeds. As such, the control system and method of the present invention permits operation of the burner at a wider range of fan speeds, thus improving efficiency and economy of the burner.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0012] FIG. 1 is a schematic diagram of an embodiment of a system of the present invention.

### DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring to the Figures, wherein like numerals indicate like parts throughout the several views, a premix burner control system 10 and method of maintaining flow of an air/fuel mixture to a burner 12 is described herein.

[0014] Referring to FIG. 1, the premix burner control system 10 (hereafter referred to simply as the system 10) includes a housing 14 for mixing a gaseous fuel and air to produce an air/fuel mixture. Accordingly, the housing 14 defines a gas inlet 16 for receiving the gaseous fuel and an air inlet 18 for receiving air. The gaseous fuel may be natural gas; however, other suitable gaseous fuels may alternatively be utilized. The housing 14 may also be referred to as a pre-mix chamber by those skilled in the art.

[0015] The housing 14 also defines at least one outlet 20 for connection to the burner 12. The burner 12 preferably defines a plurality of burner ports (not shown) as is well known those skilled in the art. The air/fuel mixture is ignited and burned via these burner ports. Other than the inlets 16, 18 and the outlet 20, the housing 14 is generally sealed from the environment.

[0016] A fan 22 is disposed in the housing 14 for drawing the gaseous fuel and the air into the housing 14. More specifically, the fan 22 generates a negative pressure within the housing 14 which precipitates the flow of the gaseous fuel and the air. The fan 22 also affects the mixture of the gaseous fuel and the air to produce the air/fuel mixture. Furthermore, the fan 22 forces the air/fuel mixture to the outlet 20, and accordingly, into the burner 12.

[0017] A motor 24 is operatively connected to the fan 22 for turning the fan 22. The motor 24 may be one of the many types (e.g., AC, DC, brushless, synchronous, asynchronous, etc.) that are known to those skilled in the art. Furthermore, the coupling between the motor 24 and the fan 22 may be accomplished using techniques that are also well known to those skilled in the art.

[0018] A variable speed drive 26 is operatively connected to the motor 24. The variable speed drive 26 preferably facilitates movement of the motor 24 at a plurality of speeds which may range from stopped (i.e., zero speed) to full speed (i.e., the fastest speed capable by the motor 24). As the motor 24 is operatively connected to the fan 22, the variable speed drive 26 also facilitates rotation of the fan 22 at a plurality of speeds. Accordingly, the variable speed drive 26 and the fan 22 are utilized to control and vary a flow rate of the air/fuel mixture into the outlet 20, and accordingly, into the burner 12. The variation of the flow rate corresponds to a firing rate of the air/fuel mixture in the burner 12.

[0019] A ratio of gaseous fuel and air in the air/fuel mixture, i.e., an air/fuel ratio, is preferably kept constant over the various flow rates of the air/fuel mixture into the burner. Maintaining a constant or near constant air/fuel mixture is critical for proper performance of the burner 12. The techniques for accomplishing this constant air/fuel ratio is described in further detail below.

[0020] In the illustrated embodiment, a gas pipe 26, supplying the gaseous fuel, is connected to the gas inlet 16. A gas orifice plate 28 is disposed inline with the gas pipe 26 and immediately upstream from the gas inlet 16. The gas orifice plate 28 defines a gas orifice 30 through which the gaseous fuel passes.

[0021] A regulating control valve 32 is also disposed inline with the gas pipe 26. As such, the regulating control valve 32 is in fluid communication with the gas inlet 16. In the illustrated embodiment, the regulating control valve 32 is disposed immediately upstream from the gas orifice plate 28. The regulating control valve 28 regulates the gaseous fuel at a specified pressure to the gas orifice 30. During normal conditions at a high flow rate of the air/fuel mixture, this specified pressure of the gaseous fuel is preferably kept constant.

[0022] The regulating control valve 32 preferably includes a servo regulator (not shown) for controlling the pressure and flow of the gaseous fuel. A pneumatic sensing tube 34 is connected between the air inlet 18 and the servo regulator of the regulating control valve 32. The connection of the tube 34 allows the servo regulator to sense the pressure of the air in the air inlet 34. By sensing the pressure of the air in the air inlet 34, the servo regulator of the regulating control valve 32 adjusts the pressure of the gaseous fuel at the gas inlet 16 in accordance with the pressure of the air at the air inlet 34. As such, a generally constant air/fuel ratio may be maintained.

[0023] The gas line 26 of the illustrated embodiment also includes a safety shutoff valve 36 and a main gas regulator 38. The safety shutoff valve 36 and main gas regulator 38 are disposed inline with the gas line 26 and upstream of the regulating control valve 32. The main gas regulator 38 produces a first, coarse pressure drop for the gaseous fuel 38. The safety shutoff valve 36 is operable to completely shut off the flow of the gaseous fuel for system maintenance or other conditions as realized by those skilled in the art.

[0024] In the illustrated embodiment, an air duct 40 is connected to the air inlet 18. As such, the air duct 40 supplies the air to the housing 14 to be mixed with the gaseous fuel. An air orifice plate 42 is disposed inline with the air duct 40 and immediately upstream from the air inlet 18. The air orifice plate 42 defines an air orifice 44 through which air passes.

[0025] A restrictor device 46 is also disposed inline with the air duct 40 26. As such, the restrictor device 46 is in fluid communication with the air inlet 18. In the illustrated

embodiment, the restrictor device 46 is disposed immediately upstream from the air orifice plate 44. The restrictor device 46 controls an air inlet pressure of air drawing through the air inlet 18 and into the housing 14.

[0026] The restrictor device 46 is operable to lower the air inlet pressure of the air drawn through the air inlet 18 by reducing an area of the air duct 40 ahead of the air inlet 18. Reducing this area creates a pressure drop ahead of the air inlet 18, thus lowering the pressure of the air at the air inlet 18. This pressure drop is sensed by the regulating control valve 32, which reduce gaseous fuel pressure accordingly, to maintain a constant air/fuel ratio.

[0027] Preferably, the restrictor device 46 operates at low firing rates of the burner 12. These low firing rates are characterized by low speeds of the fan 22. By reducing the pressure at the air inlet 18, the system 10 decreases the flow rate to a point where the regulating control valve 32 can properly react to pressure changes in the air at the air inlet 18. Without the restrictor device 46, the fan 22 would stall at lower speeds. As such, operation of the restrictor device 46 increases the range at which the fan 22 can operate, thus allowing the burner 12 to function at a wider range of air/fuel mixture flow rates.

[0028] In one embodiment, operation of the restrictor device 46 is based on the speed of the fan 22. That is, the restrictor device 46 only restrict when the speed of the fan 22 falls below a predetermined level. Furthermore, the amount of restriction of air flow caused by the restrictor device 46 is based on the speed of the fan 22. The speed of the fan 22 may be determined by a fan speed sensor (not shown) or the variable speed drive 26. Of course, other techniques for predicating operation of the restrictor device 46 may be implemented.

[0029] Although the system 10 is described above with references to a method of operation, for convenience and clarity, a recitation of the method of the subject invention is recited below.

[0030] Preferably, the method of maintaining flow of the air/fuel mixture to 1 burner 12 requires that the burner 12 is fed from a premix chamber 14 enclosing a variable speed fan 22. The premix chamber 14 defines an air inlet 18, a fuel inlet 16, and an outlet 20 in fluidic communication with the burner 12.

[0031] The method includes the step of regulating a flow of gaseous fuel through the fuel inlet 16 with a regulating control valve 32 to maintain a specified pressure. The specified pressure is based on the pressure at the air inlet 18 to maintain a constant air/fuel ratio.

[0032] The method also includes the step of drawing the gaseous fuel and air into the premix chamber 14 with the fan 22. Mixture of the gaseous fuel and the air is affected in the premix chamber 14 with the fan 22 to produce an air/fuel mixture. Furthermore, the air/fuel mixture is forced to the outlet 20 with the fan 22. The method preferably includes the step of maintaining a constant ratio of gaseous fuel and air in producing the air/fuel mixture.

[0033] The method further includes the step of lowering an inlet air pressure of air drawn through the air inlet 18 by reducing the area of an air duct 40 ahead of the air inlet 18 to decrease the flow rate of the air/fuel mixture. In one embodiment, this is accomplished by first monitoring the speed of the fan 22 and then lowering the inlet air pressure in response to the speed of the fan 22 falling below a certain speed.

[0034] The present invention has been described herein in an illustrative manner, and it is to be understood that the terminology that has been used is intended to be in the nature of words of description rather than of limitation. Obviously, many modifications and variations of the invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims.

What is claimed is:

1. A method of maintaining flow of an air/fuel mixture to a burner, the burner fed from a premix chamber enclosing a variable speed fan and defining an air inlet, a fuel inlet, and an outlet in fluidic communication with the burner, said method comprising the steps of:

sensing a pressure of air at the air inlet;  
 regulating a pressure and flow of gaseous fuel through the fuel inlet with a regulating control valve;  
 drawing the gaseous fuel and air into the premix chamber by operation of the fan;  
 affecting mixture of the gaseous fuel and the air in the premix chamber by operation of the fan to produce an air/fuel mixture;  
 forcing the air/fuel mixture to the outlet by operation of the fan; and  
 lowering an inlet air pressure of air drawn through the air inlet by reducing the area of an air duct ahead of the air inlet to decrease the flow rate of the air/fuel mixture.

2. A method as set forth in claim 1 further comprising the step of monitoring the speed of the fan.

3. A method as set forth in claim 2 wherein said step of lowering an inlet air pressure is done in response to the speed of the fan falling below a certain speed.

4. A method as set forth in claim 1 further comprising the step of maintaining a constant ratio of gaseous fuel and air in producing the air/fuel mixture.

5. A method as set forth in claim 1 further comprising the step of sensing the pressure of air at the air inlet;

6. A method as set forth in claim 5 wherein said step of regulating a pressure and flow of gaseous fuel through the fuel inlet with a regulating control valve is done in accordance with the sensed pressure of the air at the air inlet.

7. A premix burner control system comprising:

a housing defining a gas inlet for receiving a gaseous fuel, an air inlet for receiving air, and at least one outlet for connection to a burner;

a fan disposed in said housing for drawing the gaseous fuel and the air into said housing, affecting mixture of the gaseous fuel and the air to produce an air/fuel mixture, and forcing the air/fuel mixture to the outlet;

a motor operatively connected to said fan for turning said fan;

a variable speed drive operatively connected to said motor for turning said fan at a plurality of speeds to control a flow rate of the air/fuel mixture into the outlet;

a regulating control valve in fluid communication with said gas inlet for regulating the flow and pressure of the gaseous fuel; and

a restrictor device in fluid communication with said air inlet for controlling an air inlet pressure of air drawing through said air inlet and into said housing;

said restrictor device operable to lower the air inlet pressure of the air drawn through said air inlet by reducing the area of an air duct ahead of said air inlet to decrease the flow rate of the air/fuel mixture.

8. A system as set forth in claim 7 wherein said regulating control valve regulates the pressure of the gaseous fuel based on the pressure of air drawing through said air inlet.

9. A system as set forth in claim 8 further comprising a pneumatic sensing tube connected between said air inlet and said regulating control valve such that said regulating control valve can sense the pressure of the air at said air inlet.

10. A system as set forth in claim 7 further comprising a gas orifice plate disposed between said gas regulator and said gas inlet and defining a gas orifice through which the gaseous fuel passes.

11. A system as set forth in claim 7 further comprising an air orifice plate disposed between said restrictor device and said air inlet and defining an air orifice through which the air passes.

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