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Remarks:
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(54) **Boiler and pilot system**

(57) A pilot and burner assembly includes a burner assembly and a blower for supplying combustion air to the burner assembly. The system further includes a pilot assembly and a fuel supply for providing fuel to the pilot assembly. A pilot fan provides pilot air to the pilot assembly, the pilot fan being separate from the blower and provides air only to the pilot assembly.

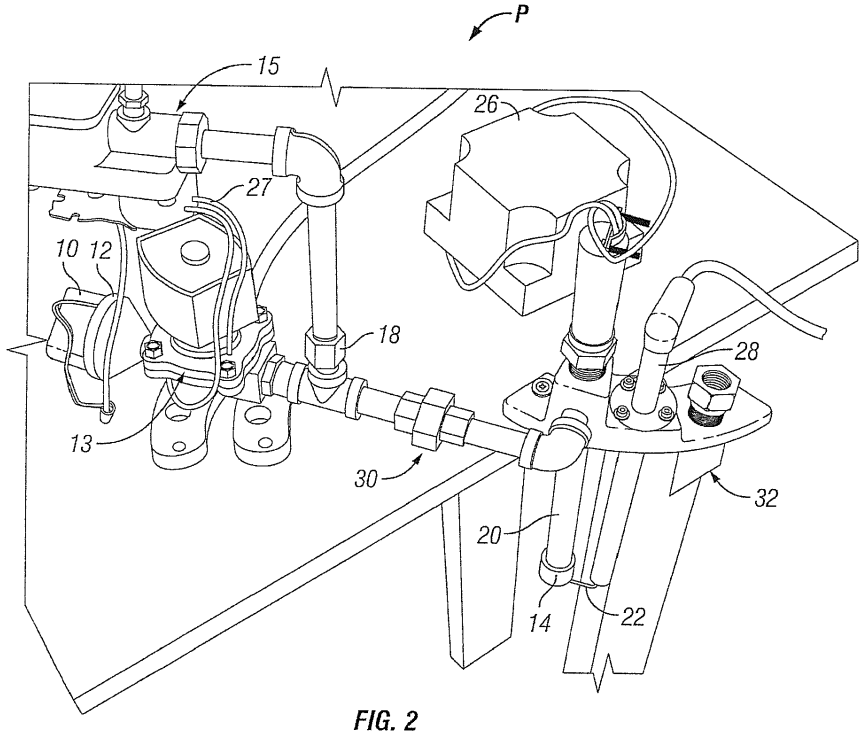

FIG. 2

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Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 61/090,302, filed on August 20, 2009, and is herein incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to boiler and burner apparatuses and, more particularly, to pilots used in connection with cylindrical premix burners.

BACKGROUND OF THE INVENTION

[0003] Burners which combust gas or other fuel are widely known. Gas burners, incorporated for example into indirect heating devices, utilize the combustion of a gas or similar fuel (e.g., propane, natural gas, or fuel oil) for heating a work substance, oftentimes a flowable substance such as air or water. For example, heated water may be directed into the interior of a home for general comfort heating purposes or for providing hot water for bathing, laundering, cooking, and the like.

[0004] In operation, natural gas or other fuel is controllably forced through a nozzle or jet portion of the burner, where it is intermixed (most typically) with air from a blower, forming a gas spray or aerosol for enhancing combustion. In premix burners, some or all of the air required for combustion is mixed with some or all of the fuel prior to burning. To start the burner, a pilot is ignited, which in turn is used to ignite the main burner on demand. Known pilot systems incorporate various ignition means, such as a spark electrode, wherein a high-voltage electrode is mounted so that its tip is in close proximity to the grounded pilot. As a blower forces the air/gas mixture through a pilot tube, a spark is applied and the pilot flame ignites. This flame is then used to ignite the main burner. In the case of an indirect heater, the combustion product (heated air/plasma) is directed into a heat exchanger, where the energy produced by the combustion process is transferred to the work substance to be heated. The combustion exhaust is then moved to an exhaust exit, possibly after one or more recirculation steps or the like to further recapture heat from the combustion product. A cylindrical housing is often employed to cover most or all of the components.

[0005] One common concern with the design of burners is the potential for "flashback," i.e. when the flame pops back through the premix burner nozzle and runs upstream through the air/gas mixture. In a worst-case scenario, flashback can result in an explosion. To minimize the potential for flashback, many prior art burners use bleed air from the main burner for the pilot to ensure that positive flow through the pilot is maintained at all times. However, supplying the pilot with air from the main burner limits flexibility in choosing main burner ignition inputs since pilot pressure requirements control main burner operation during the ignition sequence.

[0006] Past practice for pilots used in connection with cylindrical premix burners has been to locate them within the burner or, if located outside the burner, to use air bled from the main blower to supply the pilot. One problem or drawback with locating the pilot within the burner is the "shadow" created by the components of the pilot, which affects the burning pattern on the burner surface. This uneven burning pattern may lead to local hot spots within the burner and reduced burner life. Another disadvantage with locating the pilot within the burner is that servicing the pilot becomes very difficult, as the fuel/air components of the main burner must be removed to access the pilot.

[0007] With the forgoing problems and concerns in mind, it is the general object of the present invention to provide a boiler apparatus with an improved pilot burner that minimizes the potential for flashback, maximizes pilot component life, allows flexibility in choosing main burner components, and facilitates easy servicing of the pilot.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a boiler apparatus.

[0009] It is another object of the present invention to provide a boiler apparatus with an improved pilot burner.

[0010] It is another object of the present invention to provide a boiler apparatus with an improved pilot burner that minimizes the potential for flashback.

[0011] It is another object of the present invention to provide a burner apparatus with an improved pilot burner that maximizes pilot blower life.

[0012] It is another object of the present invention to provide a boiler apparatus with an improved pilot burner that maximizes pilot component life.

[0013] It is another object of the present invention to provide a boiler apparatus with an improved pilot burner that allows for flexibility in choosing main burner components.

[0014] It is another object of the present invention to provide a boiler with an improved pilot burner that minimizes noise and ignition losses.

[0015] It is another object of the present invention to provide a boiler with an improved pilot burner to facilitate the direct viewing of the pilot flame, ignition spark and main burner.

[0016] It is another object of the present invention to provide a boiler with an improved pilot burner to achieve an improved robustness of pilot ignition.

[0017] It is yet another object of the present invention to provide a boiler with an improved pilot burner that allows for easy servicing of the pilot.

[0018] These and other objections of the present invention, and their preferred embodiments, shall become

clear by consideration of the specification, claims and drawings taken as a whole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention will be better understood from reading the following description of non-limiting embodiments, with reference to the attached drawings, wherein below:

[0020] FIG. 1 is a schematic view of a boiler and burner assembly, in accordance with one embodiment of the present invention.

[0021] FIG. 2 illustrates a specific configuration of the schematic representation shown in Figure 1, in accordance with one embodiment of the present invention.

[0022] FIG. 3 illustrates the pilot assembly of Figure 2, as ignited.

[0023] FIG. 4 illustrates component elements of the pilot assembly of Figures 2 and 3.

[0024] FIG. 5 illustrates a enlarged view of a flame disc of the pilot assembly, in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0025] As shown in Figure 1, and in accordance with a preferred embodiment of the present invention, a boiler apparatus includes a housing 1 defining an interior boiler chamber 2 and a burner assembly 4 arranged to be in thermal communication with the boiler chamber 2. A fuel valve assembly 6 controls a flow of fuel (from an unillustrated supply of the same) to the burner assembly 4, while a blower assembly 7 directs air through an air valve assembly 9 to the burner assembly 4. An ignition device 8 is provided for instigating combustion of an inlet gas/air stream, and is arranged adjacent one edge of the burner assembly 4. This ignition device 8, commonly known as a "pilot" or "pilot burner" is in turn used to light the main burner.

[0026] Figure 1 is a schematic representation of a boiler apparatus and as such, it will be readily appreciated that the constituent elements of the boiler apparatus may be at differing locations within and around the housing 2, without departing from the broader aspects of the present invention.

[0027] As depicted in Figure 1, both the supply of fuel and the supply of air are controlled, and isolated, from the burner assembly 4 via the integrated fuel valve and air valve assemblies, 6 and 9 respectively.

[0028] As will be discussed in more detail later, it is an important aspect of the present invention that the integrated fuel valve and air valve assemblies, 6 and 9, isolate the ignited fuel/air mixture from 'blowing back' into either the air supply or the fuel supply, thus significantly increasing the safety and operability of the present invention.

[0029] Figure 2 illustrates a specific configuration of the schematic representation shown in Figure 1, in accordance with one embodiment of the present invention. Turning now to Figure 2, a pilot assembly P of the present invention comprises a mixing tube section 30 where a supply of fuel and air are initially mixed. A pilot block 32 is generally shown in Figure 2 and itself includes a pilot tube 20 and an ignition means 26, to be described in more detail later.

[0030] In accordance with one preferred embodiment of this invention, air is provided to the mixing tube 30 via a dedicated pilot fan 10, and is directed through an air funnel 12 and thereafter through an air valve 13. The air funnel 12 meters the correct amount of air through an internal orifice . Moreover, the air valve 13 may be one of many types known in the art, such as a solenoid valve, although the present invention is not limited in this regard.

[0031] As indicated in Figure 2, it is another important aspect of the present invention that a dedicated pilot fan 10 is utilized to supply air to the mixing tube 30 of the pilot assembly P, as opposed to known apparatuses which utilize a single blower for supplying air to the burner assembly 4, as well as directing 'bleed air' to the pilot assembly P.

[0032] It will be readily appreciated that by utilizing a separate and dedicated pilot fan 10 (instead of having a single air blower for use in supplying both the burner assembly 4 and the pilot assembly P), the pilot fan 10 may be designed to the precise requirements (pressure, and the like) of the pilot assembly P and may be controlled to a more precise degree.

[0033] It is yet another important aspect of the present invention that the separate and dedicated pilot fan 10 enables the pilot fan 10 to be wholly located outside of the boiler chamber 2 and the burner assembly 4, thus making repairs of the pilot assembly P more easily accomplished. Likewise, repair or replacement of the burner assembly 4 may also be effectuated without disrupting the pilot assembly P.

[0034] Still yet another important aspect of utilizing the dedicated pilot fan 10 lies in the ability to control the operational status of the pilot fan 10, apart and separate from the operation of the blower used to supply air to the burner assembly 4. Thus, the pilot fan 10 may be switched off even while the blower for the burner assembly 4 remains active, saving both power as well as increasing the operational life of the pilot fan 10.

[0035] Returning again to Figure 2, air from the pilot fan 10 is passed through the air valve assembly 13 (or, 9 in Figure 1), and mixes with fuel in the mixing tube 30. The fuel itself is also passed through a fuel valve assembly 15 (or, 6 in Figure 1) prior to entering the mixing tube 30, via an inlet port 18.

[0036] It is yet another important aspect of the present invention that both the supply of air, as well as the supply of fuel, are isolated from the pilot fan 10 and fuel source 19 via the integrated air valve assembly and fuel valve assembly, 13 and 15 respectively. In this manner, any possibility of 'blow back' of the ignited mixture of air/fuel

within the mixing tube 30 is eliminated, and the overall safety of the pilot assembly P is greatly increased.

[0037] As will be understood, after the air/gas mixes in the mixing tube 30, it is forced downstream to the pilot block 32. The pilot block 32 comprises a pilot tube 20 and an operationally integrated ignition means (22, 26 and 28, as described below).

[0038] The mixing tube 30 is connected to the pilot tube 20, which receives the air gas mixture and directs the flow of the air/gas mixture out the end of the pilot tube 20, where an adjacent ignition source 22 ignites the mixture, thus producing a flame 40, as best shown in Figure 3.

[0039] It will be readily appreciated that the mixing tube 30, as well as the other components comprising the piping connecting the air/gas mixture to the pilot block 32, may be made of any suitable material known in the art such as steel, aluminum, etc, without departing from the broader aspects of the present invention. Aluminum is preferably utilized because this will allow the present invention to have two compression fittings for easy disassembly.

[0040] As again shown in Figure 2, a pressure switch and tube assembly 27 is utilized to operationally connect the supply of fuel with the active supply of air from the pilot fan 10. Thus, the pressure switch and tube assembly 27 will coordinate the activation of the fuel valve assembly 15 with the activation of the pilot fan 10. As will be appreciated, upon sensing air flow from the pilot fan 10, the pressure switch and tube assembly 27 will send a signal to the fuel valve assembly 15 to open, which will allow gas/fuel to pass through the gas orifice 18 and into the mixing tube 30.

[0041] A further important aspect of the present invention lies in the use of a pilot tube retaining collar 14, as best seen in Figures 2, 4 and 5. The pilot tube retaining collar 14 is provided at the end of the pilot tube 20 and includes an integrated pilot flame disc 16. The pilot flame disc 16 is a substantially flat disc containing numerous holes 24 through which the air/gas mixture from the mixing tube 30 passes.

[0042] The use of the pilot tube retaining collar 14 and integrated pilot flame disc 16 is yet another important aspect of the present invention. The holes 24 of the flame disc 16 adds additional turbulence to the air/gas mixture as it passes out the end of the pilot tube 20. Moreover, the flame disc 16 itself provides a backstop to the more-perfectly mixed and ignited air/fuel mixture, thus assisting the direction of the flame 40 into the burner assembly 4.

[0043] As indicated previously, the ignition means includes a solid state igniter 26 connected to a spark electrode 28, although other ignition means known in the art may be alternatively utilized without departing from the broader aspects of the present invention. In a preferred embodiment, a solid state igniter 26 with a minimum output voltage of 9,000 volts is connected to the spark electrode 28. An electrode tip 22 (best seen in Figure 2) extends from the electrode 28 to an inner periphery of the pilot tube retaining collar 14. To effect ignition, a voltage from the solid state igniter 26 is applied to the electrode 28 which causes as spark to arc from the electrode tip 22 to an inner periphery of the pilot tube retaining collar 14.

[0044] In a preferred embodiment, the spacing of the electrode tip 22 is 1/8 inch from an inner periphery of the pilot tube retaining collar 14. The maximum spacing is 1 /4 inch from an inner periphery of the pilot tube retaining collar 14. These settings allow the electrode tip 22 to be placed anywhere from the center of the pilot tube retaining collar 14, to within 1/8 inch from either side, and still ignite the pilot flame 40, while the most preferred depth of the electrode tip 22 is flush to 1/16 inch inside the pilot tube retaining collar 14.

[0045] Upon ignition, the flame 40 burns in a torch-like fashion with approximately a 6,000 BTU input. The pilot assembly P may then be operated at minimum gas pressures under two inches and maximum pressures of over five inches. The fuel valve assembly 15 has a full adjustment within these parameters and the pilot is easily set in the field by one simple gas pressure adjustment, preferably set at about three inches water column. With the present invention, the flame 40 of the pilot burner is extremely tolerant to maladjustment, and will ignite at full input (about 4,000,000 BTUs) without igniting low fire first (although such a scenario is not preferred).

[0046] As described above, the pilot gas and air flow are isolated from the combustion chamber, and their respective sources, via integrated valves 13 and 15 following main burner ignition. Thus, increased combustion chamber pressure due to variations in boiler input or downstream conditions cannot create reverse flow, i.e. flashback, of combustion chamber gases through the pilot assembly P. As previously mentioned, the fact that the pilot gas and air flow are isolated from the combustion chamber via valves also allows the pilot fan 10 to be turned off during burner operation, increasing pilot fan life.

[0047] A further advantage of the independent pilot is that the main blower can be lit at optimum conditions for reduced noise and ignition losses.

[0048] In addition to the advantages described above, the pilot burner orifice is specifically designed with an aperture of sufficient size to allow direct viewing of the pilot flame, ignition spark, and main burner. Sight glass may be positioned directly on top of the pilot tube to allow for direct viewing of the main flame and pilot flame. This provides significant aid in troubleshooting pilot ignition issues. The pilot burner orifice is also designed to optimize fuel flow past the spark igniter to enhance ignition over a wide range of pilot conditions, improving robustness of pilot ignition.

[0049] An infra-red flame detector may also be positioned to detect the pilot as well as main flame.

[0050] As the entire pilot system/assembly P may be mounted in a single housing, outside of the boiler and main burner housing, the pilot assembly P may be easily

removed for service without disturbing other system components.

[0051] Although this invention has been described in terms of its application to boiler burners, it will be apparent that it may also be applied to other types of burners. In addition, while the invention has been described with reference to the preferred embodiments, it will be understood by those skilled in the art that various obvious changes may be made, and equivalents may be substituted for elements thereof, without departing from the essential scope of the present invention. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention includes all embodiments falling within the scope of the appended claims.

Claims

1. A pilot and burner assembly, comprising:

a burner assembly (4);
a blower (7) supplying combustion air to said burner assembly (4);
a pilot assembly (8, P);
a fuel supply providing fuel to said pilot assembly (8); and
a pilot fan (10) providing pilot air to said pilot assembly (8), wherein said pilot fan is separate from said blower (7) and provides air only to said pilot assembly, wherein

a fuel valve assembly (15) is positioned between said fuel supply and said pilot assembly (8), said fuel valve assembly (15) permitting only unidirectional flow of said fuel into said pilot assembly (8),
an air valve assembly (9, 13) is positioned between said pilot fan (10) and said pilot assembly, said air valve assembly (9, 13) permitting only unidirectional flow of said pilot air into said pilot assembly,
and wherein a pressure switch assembly (27) is operably connected between said fuel valve assembly (15) and said air valve assembly (9, 13), said pressure switch assembly triggering actuation of said fuel valve assembly (15) when said air valve assembly (13) is actuated.

2. The pilot and burner assembly of claim 1, wherein:

said pilot assembly (P) includes a pilot tube (20), said pilot tube accepting a mixture of said fuel from said fuel supply and said air from said pilot fan (10); and
a flame disc (16) positioned in fluid communication with said pilot tube (20), said flame disc (16) containing apertures so as to create turbulence in said fuel and air mixture.

3. The pilot and burner assembly of claim 2, further comprising:

an electrode (28) positioned downstream of said flame disc (16), said electrode being controllable to ignite said mixture.

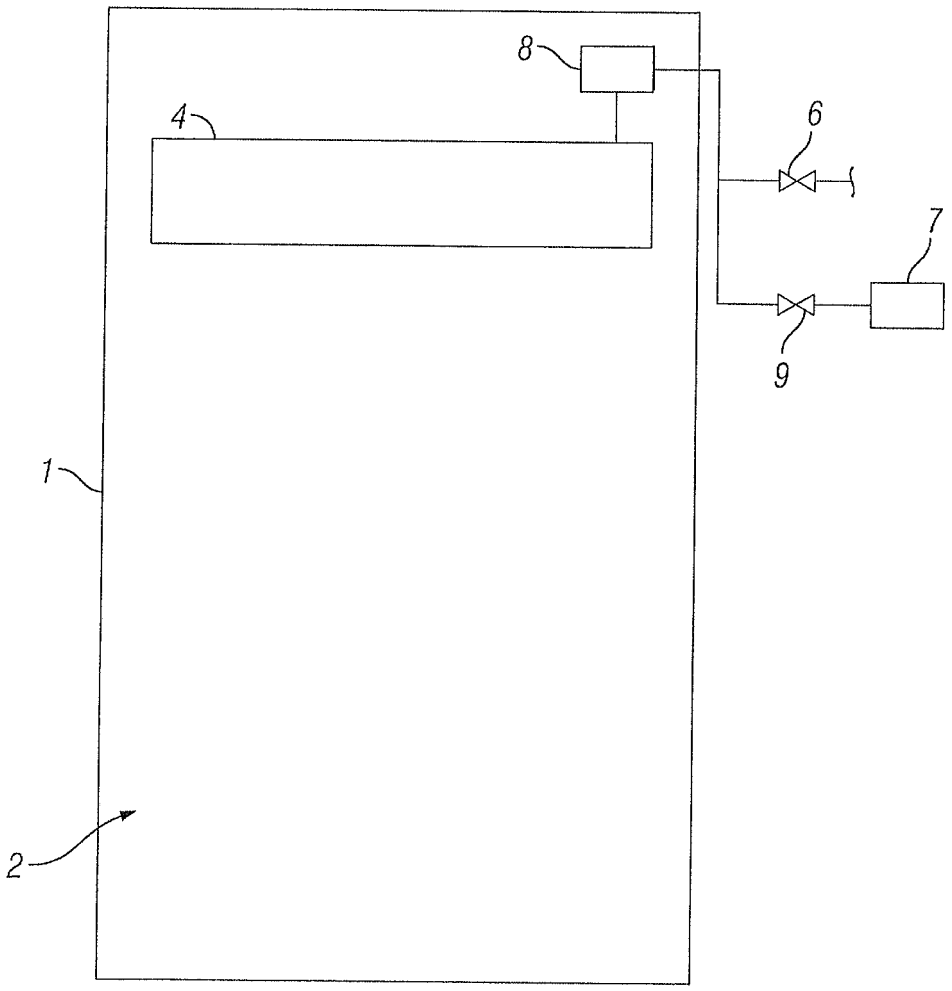

FIG. 1

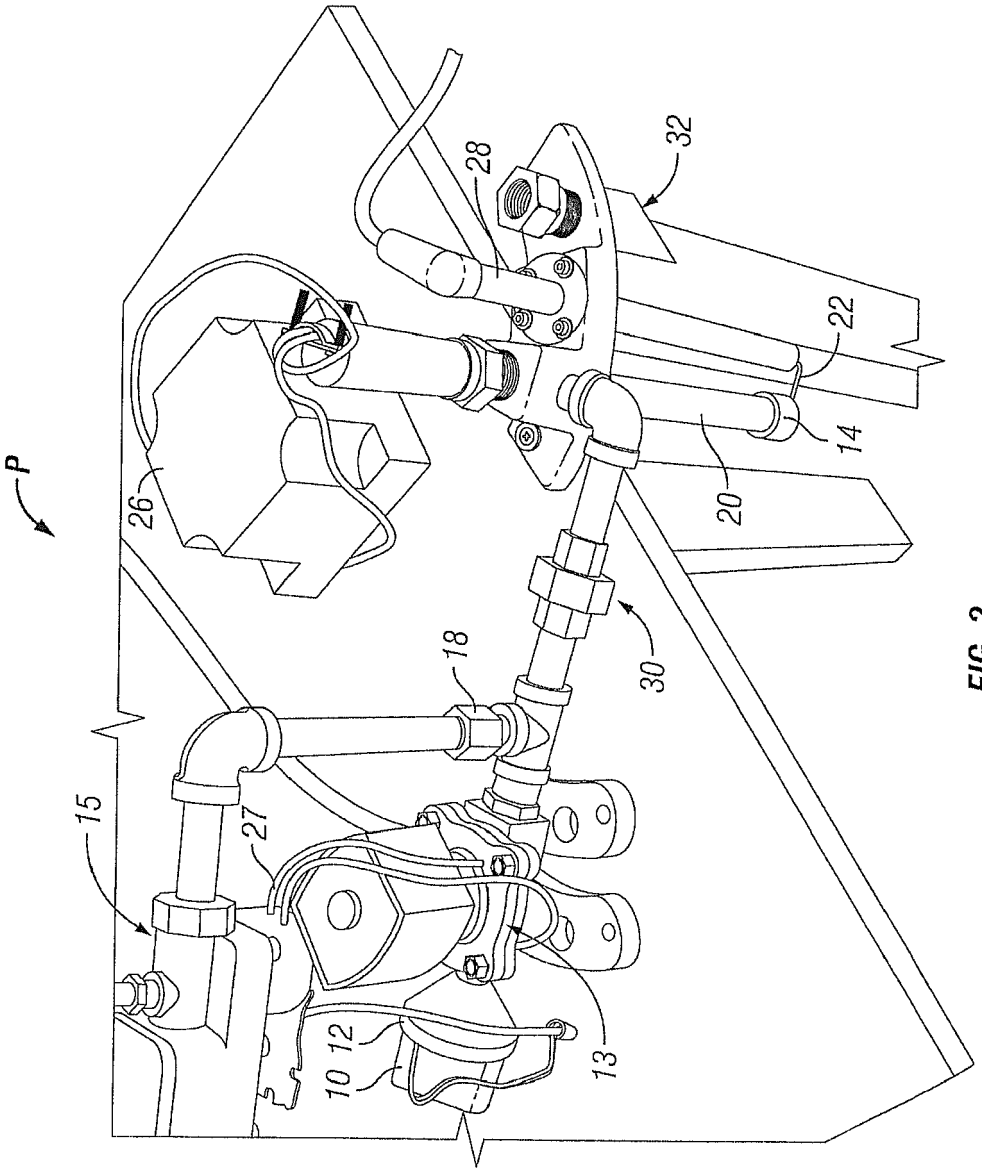

FIG. 2

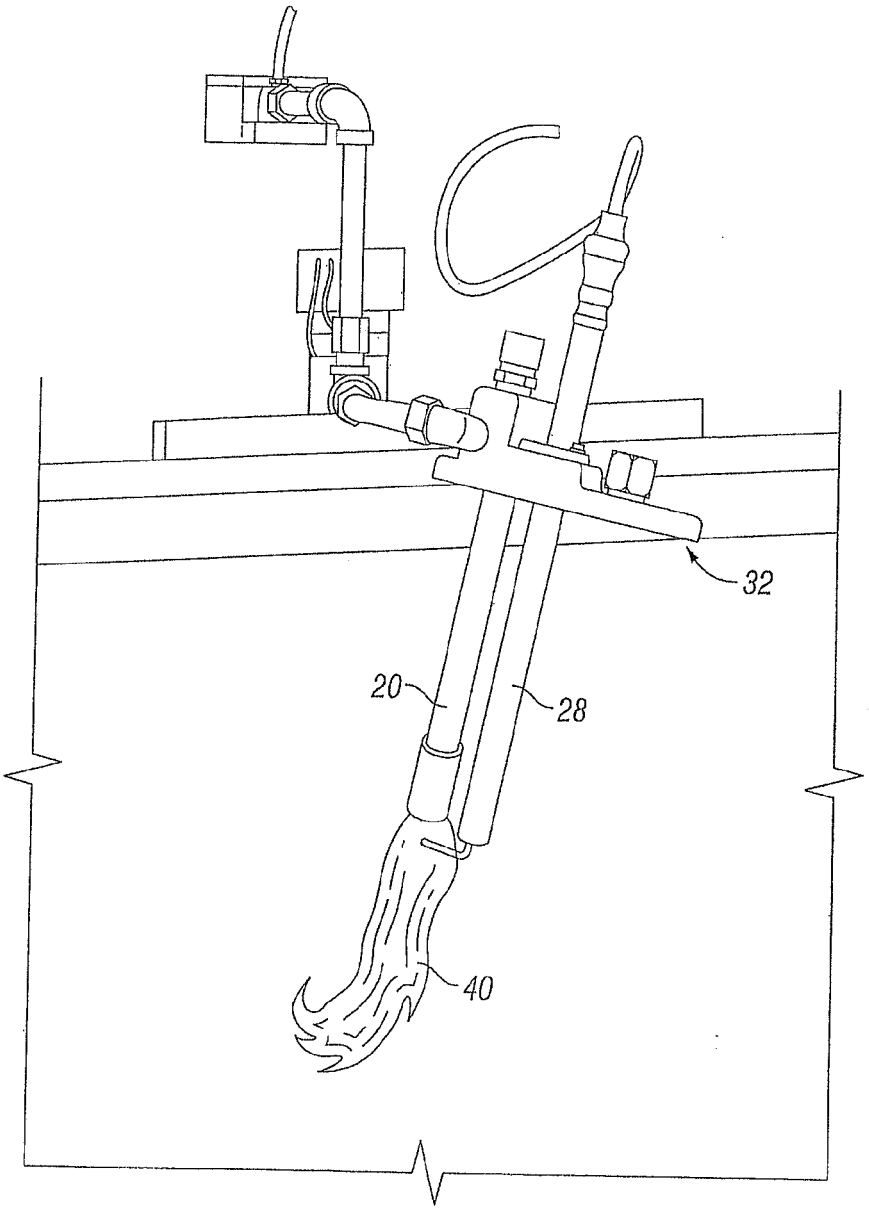

FIG. 3

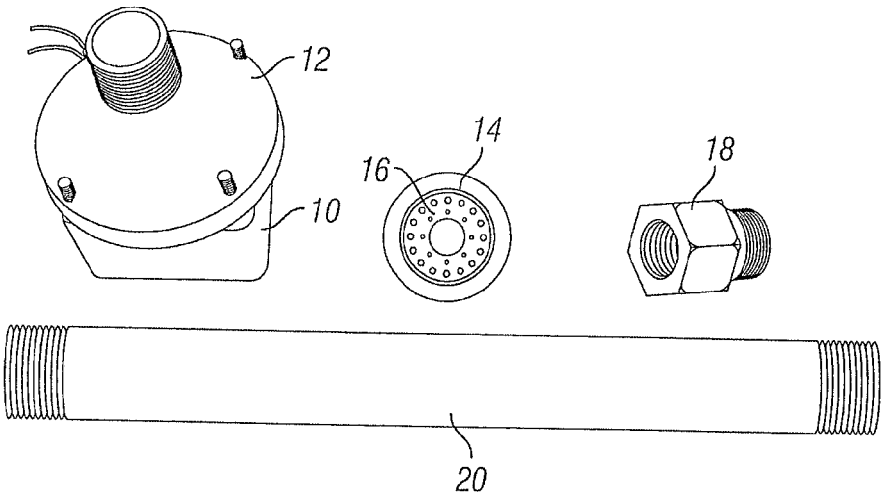

FIG. 4

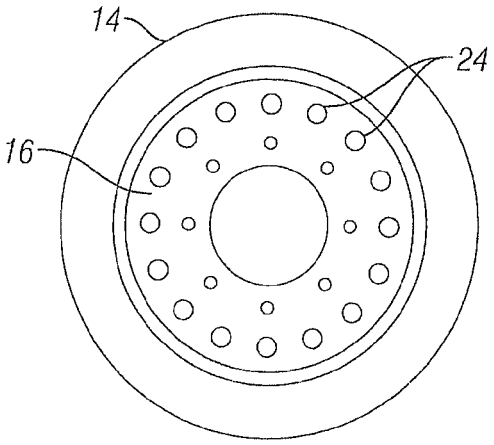

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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