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OIL BURNER PURGE METHOD AND SYSTEM

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This invention relates to a method and system for purging an oil supply line to a burner nozzle and more particularly such a method and system applied to a burner using a heavy oil as fuel.

Two problems exist in shutting down a heavy oil burner. The first is that on shut down, the radiation from the furnace would cause the oil in the nozzle passages to be partially volatilized. Thus, a coke is left on the passage walls which may build up more on each shut down and eventually cause high oil pressures due to the partial plugging of the passages. The second problem is that oil loses heat rapidly and becomes more and more viscous. After a shut down, the cooled oil, being more viscous, causes a pressure drop through the supply lines higher than for hot oil. The oil supply to the burner is controlled by a metering valve and should the viscous oil cause a different pressure drop across the valve than the hot oil, the oil firing rate may be low. In such instances, a flame may not be established upon starting up the burner after a shut down period.

The second problem could be eliminated by maintaining the oil hot during the shut down of the burner by some agency such as an electrical heater. The first problem, however, cannot be eliminated in this manner.

The present invention has to do with the removal of the oil from the line supplying the nozzle so that it is burned in the furnace and does not remain in the supply line to create a problem. The removal must be accomplished in a proper manner, however, for, though the quantity involved may be as little as two cubic centimeters, it is enough to cause puffbacks or heavy smoke if not properly controlled. Prior purging systems have not provided a proper control.

It is the primary object of this invention to provide a controlled oil purging method and system for shutting down an oil burner.

Another object is to provide such a system which will operate automatically without attention.

A further object is to purge the supply line to an oil burner nozzle with air controlled in pressure to flow the oil out of the line at the firing rate so as to avoid scouring of the walls of the supply line.

Other objects, features and advantages of the present invention will be obvious from the following description of a preferred embodiment taken in conjunction with the accompanying drawing in which the figure of the drawing illustrates a diagrammatical flow sheet of an oil burner with its oil and air supply and embodying the purging system of the present invention.

Referring to the drawing, the oil burner nozzle 10 is equipped to extend within a furnace and be supported by an elongated housing 11 through which an oil supply line 12 is connected through a common terminal 13 to supply branch 14 and air for atomizing the oil at the nozzle is supplied through the housing from a supply line 15.

The oil which is burned at the nozzle 10 is supplied from a bulk source such as a tank (not shown) from which the

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oil is drawn through a supply line 16 and a strainer 17 by a pump 18. This oil follows the path of the arrows beside line 19 to a preheater 20.

A particular problem in firing furnace burners with a heavy oil is that the oil should be preheated in order to reduce its viscosity. This is accomplished in the preheater 20 in the initial stages by electrical heaters having an exposed terminus 21 and which may be controlled by a thermostat placed on the outlet line 22 from the preheater. After the boiler builds up sufficient steam pressure if it is used for making steam, steam admitted through solenoid valve 23 on steam line 24 may be substituted for the electrical heating means. The steam thermostat 25 controls the amount of steam supplied and condensate returned through line 26. Assuming that the oil has been heated in the preheater 20, it is discharged from the preheater through the line 22 through a modulating valve 27 which controls the amount of oil to be sent through a short stub line 28 and the main fuel valve 29 on to the burner. In the drawing, the stub 28 is shown of considerable length only for the purposes of clarity whereas in fact it will be quite short in order that the oil, during shut down at the valve 29, which remains in the stub may be heated by conduction of heat from the metering valve.

It will be, of course, understood that all oil coming through the modulating valve 27 must either pass on to the burner or through a bypass line 30 and back pressure valve 31 to the return line 32 to the tank or other source of supply. The incoming oil flowing toward the preheater may also be bypassed to the return line in the event the pump 18 supplies it at too great a pressure. The short bypass line 33 and back pressure control valve 34 are connected between the supply line 19 and return line 32 for this purpose.

The parts of the circuit just described are provided for supplying oil to the burner nozzle 10 for combustion within the furnace. Combustion is supported by air. The present flow sheet illustrates the air supplied for atomizing the oil at the nozzle. An intake 35 leads through a line 36 to a compressor 37 having an outlet 38 into an air receiver and lubricating oil separator 39. Oil from the unit 39 may be conducted through line 40 to seal and lubricate the compressor 37. Air from the separator is conducted by a stub 40 to a branch 15 leading into the nozzle by way of the housing 11 supporting the nozzle.

As thus described, the burner nozzle may be supplied with both heated oil and atomizing air. It will be understood that additional air may be supplied by a blower as required in the furnace to complete combustion of the oil within the furnace.

The sequence of operation upon shut down of the burner takes approximately 15 seconds of time, and, although the time is thus very short, it is important that the burner be left in a proper condition for again starting up and supplying heat.

In the sequence of shut down, the main fuel valve 29 is closed by its solenoid 29a and almost instantaneously therewith, an air purging control valve 41 is opened by its solenoid 41a. It will be noted that air from the separator 39 is connected to a line 42 having in it an orifice 43, the control valve 41 and a check valve 44. Under normal conditions of operation, the air pressure for atomizing the oil is about 2 p. s. i. g. above the pressure of the oil being fed to the burner. The orifice 43 is so designed to reduce the air pressure to the level of the oil pressure. Immediately upon closing of the fuel valve and opening of the purging valve, air that has accumulated in the stub 45 of the line between the orifice and valve 41 surges into that portion 46 of the line between the valve and check valve to snap it open. There is thus a very brief increase of the pressure on the oil which is in the line portion 47

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between the check valve and fuel line 14 which insures that the oil continues to flow out of the nozzle and combustion is maintained. Almost immediately thereafter, the air expands so that it is controlled by the air flowing through the orifice 43 and thus is at the same pressure as the oil during its normal firing. The flame will thus be continued for about 2 to 4 seconds. When the air pushing the oil through the supply line to the nozzle passes the nozzle, it does not increase its velocity since it is controlled by the orifice.

The result of the above described purge system is that a very thin film of oil is left on the surface of the oil supply line 14. The atomizing air purges the nozzle 10 preventing any coking of the nozzle passages but does not scour the thin film of oil from oil lines 14 and 12 after the main body of oil passes so as to pass droplets or particles of oil through the nozzle on to hot refractories to cause puffs. After the purging cycle is completed, the compressor 37 shuts down.

In order to keep the burner in readiness for another start, all of the oil lines below the main fuel valve 29, as illustrated in the drawing, are kept heated and oil is maintained in a constant flow in these lines. The stub 28 between the modulating valve and main valve is kept short so that that portion of oil in stub 28 will be heated by conduction.

The operation of the purge system is automatic since the proper controls are provided for the solenoids of the control valve and for the motors of the pumps and compressors. The purging valve 41 opens with closing of the main fuel valve and is closed after the purging cycle is finished. The very small amount of oil left in the supply line beyond the main valve may settle in the bottom of the line but constitutes such a small volume that it does not change the pressure in the lines and thus does not change the firing rate or the operation of the burner on starting.

While this invention is susceptible of embodiments in many different forms, there is shown in the drawing and is herein described in detail one specific embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

I claim:

1. The method of purging an oil line to a burner nozzle upon shut-down, comprising the steps of stopping flow of oil at a predetermined pressure from a source into the oil line and substantially simultaneously introducing air under pressure to the oil line; regulating the pressure of the introduced air to substantially the pressure of the oil in the oil line during the just previous operation of the burner; and continuing to supply air to the oil line at the regulated pressure to purge the oil line without scouring the line.

2. The method of purging an oil supply line to a burner nozzle upon shut-down, comprising the steps of sequentially stopping flow of oil at a predetermined rate from a source into the oil supply line, introducing an initial momentary surge of air under pressure to the supply line without substantial time delay; regulating the air pressure to maintain generally continuous flow of oil in the supply line to be purged at the rate of oil flow during firing; maintaining the flow of air at said regulated pressure through the nozzle during and after purging the supply line to prevent scouring of the supply line; and then stopping flow of air into the supply line.

3. The method of purging an oil supply line to a burner nozzle upon shut-down, comprising the steps of sequentially stopping flow of oil at a predetermined pressure from a source into the supply line, introducing air into the supply line at a pressure generally of the order of the oil pressure during firing to continuously advance the oil in the line through the burner nozzle

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without interruption of the flame, continuing flow of air at said pressure into the supply line until the major portion of the oil has been forced out of the line and the flame extinguished, thereafter maintaining the air at said pressure to prevent scouring of the supply line, and then stopping the flow of said air.

4. The method of purging an oil supply line to a burner nozzle upon shut-down comprising the steps of: stopping flow of oil from a source into the supply line, introducing air into the supply line at a pressure sufficient to maintain oil flow in the supply line to the nozzle and continuous burning of the oil, continuing flow of air at said pressure into the supply line until the flame is extinguished and the oil line opened to allow escape of air through the nozzle, maintaining the air at said pressure to prevent scouring of the line and passing of oil particles through the nozzle onto hot refractories, then stopping flow of air into the oil supply line.

5. In an oil burner having a nozzle, an oil line to the nozzle and a main fuel valve in the oil line, means for purging the oil line upon closing the main fuel valve for burner shut-down, comprising: an air purge line connected to a source of air under pressure and to the oil line adjacent to and on the nozzle side of the main fuel valve; a check valve in the purge line for preventing flow of oil into the purge line; a pressure reducing member in the air purge line adapted to reduce the air passing therethrough to substantially the pressure of the oil in the oil line; and an air valve between the pressure reducing member and check valve for opening the air line upon closing of the main fuel valve, opening of said air line permitting a temporary surge of air to open the check valve and the pressure reducing member maintaining the purging air at a pressure to deliver the oil to the nozzle at substantially the same rate as during firing.

6. In an oil burner having a nozzle, an oil line to the nozzle and a main fuel valve in the oil line, means for purging the oil line upon closing the main fuel valve for burner shutdown, comprising, an air purge line connected to the oil line adjacent to and on the nozzle side of the main fuel valve, a source of air under pressure for supplying air at a predetermined pressure to the air purge line, a check valve in the purge line adjacent its connection with the oil line for preventing flow of oil into the purge line, a pressure reducing orifice in the air purge line adapted to reduce the air passing therethrough from said predetermined pressure to substantially the pressure of the oil in the oil line, and an air valve between the orifice and the check valve for opening the air line upon closing of the main fuel valve, there being a substantial length of air purge line between the check valve and the air valve to form a chamber permitting a temporary surge of air into said chamber from the length of air purge line between the air valve and the orifice on opening the air valve so as to open the check valve and to immediately sustain the flow of oil to the nozzle, the orifice in the air purge line thereafter functioning to maintain the purging air at a pressure to deliver the oil to the nozzle at substantially the same rate as during firing.

7. The method of purging an oil burner nozzle and an oil supply line to the nozzle upon burner shutdown in a system wherein oil is supplied from a source to the oil supply line at a predetermined pressure and wherein oil at the nozzle is atomized by atomizing air supplied from a source of air under pressure greater than the pressure of oil in the supply line, comprising the steps of: stopping the flow of oil from the oil source into the supply line, withdrawing air from said source of air under pressure, reducing the pressure of the withdrawn air to substantially the pressure of oil in the supply line, introducing air at the reduced pressure into the supply line to maintain continuous oil flow in the supply line

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to the nozzle at substantially the rate of oil flow during the just previous operation of the burner, and continuing the flow of air into the supply line at the reduced pressure after the main body of oil passes from the nozzle to purge the supply line and the nozzle without scour-

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ing the line and to avoid passing oil droplets through the nozzle onto hot refractories.

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