

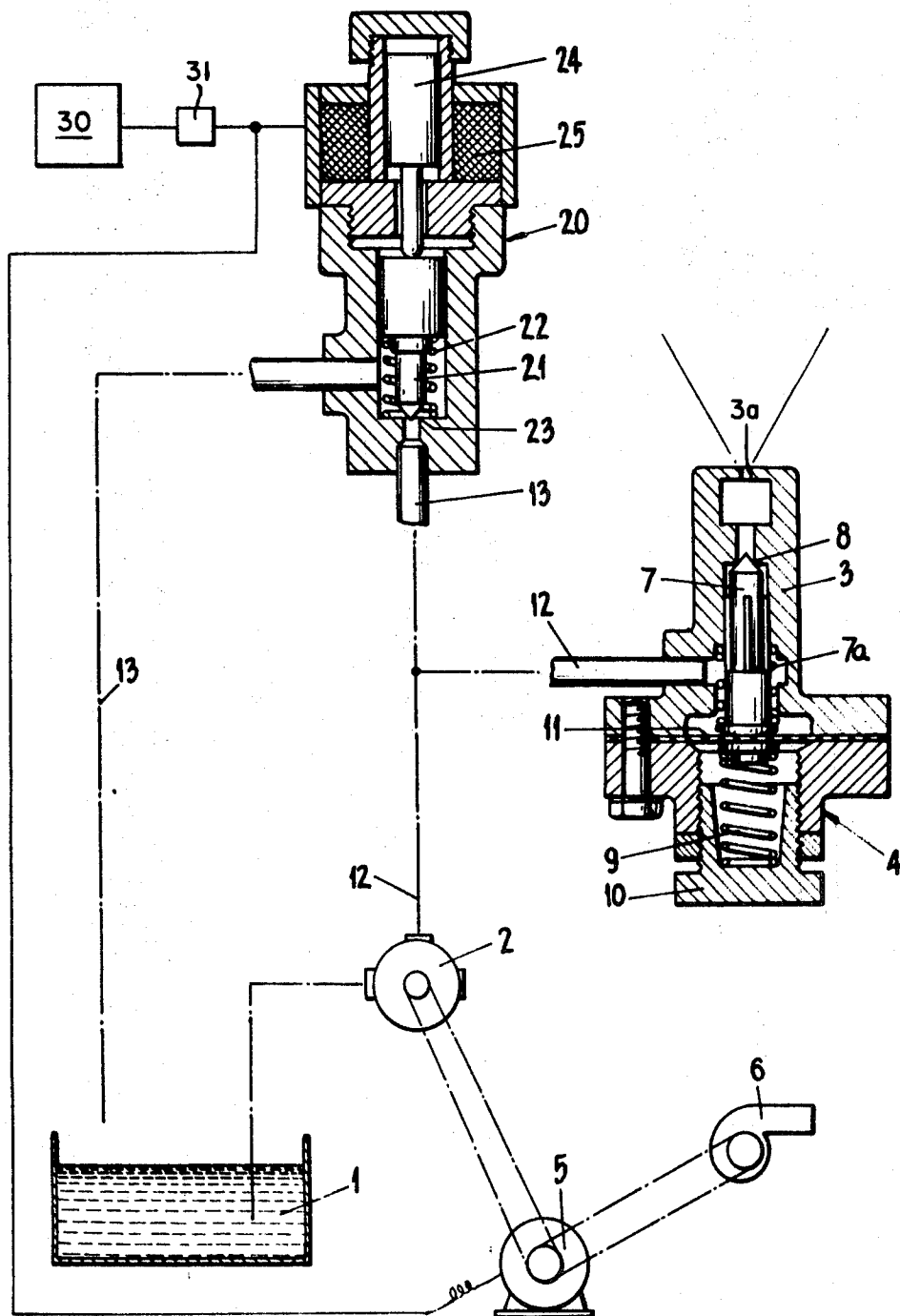
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PRESSURE JET BURNER CONTROL SYSTEMS

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1

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PRESSURE JET BURNER CONTROL SYSTEMS

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5 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to pressure jet burner control systems including a motor driven fuel pump which stops and starts according to the fuel requirements of the burner and in which cut-off and start-up of the fuel spray in the burner is abrupt and the pressure of fuel is maintained above a predetermined minimum pressure of the volume. Fuel supply to the burner is controlled by a quick cut-off valve arranged to start and cut off fuel at predetermined fuel pressure and also includes a by-pass line connected in the fuel line between the cut-off valve and the pump, said bypass line being controlled by a solenoid valve which simultaneously relieves fuel trapped in said fuel line under pressure when the fuel pump is deenergised.

This invention relates to pressure jet burner control systems and in particular relates to burner systems comprising motor driven fuel pumps which stop and start according to the fuel requirements of the burner. With systems of this type, it is important that cut-off and start-up of the fuel to the burner be abrupt so that any fuel flow through the burner should be above a predetermined minimum pressure and volume.

If fuel begins to flow through the burner at low pressure, then a poor spray of fuel issuing from the burner nozzle will result to cause poor starting thereof and inefficient burning of fuel. Furthermore with existing systems, it has proved difficult to overcome the problem of jet nozzle dribble after the fuel pump has been de-energised in that in a practical situation, it is impossible for the fuel pump to immediately cease pumping. Many systems are in use, all of which do not completely overcome the abovementioned problems, and those that do, must contend with new problems inherent in their construction.

A control system is known utilising a solenoid fuel valve near the jet nozzle and adapted to open when the burner is energised, and close when the burner is de-energised. With this system, starting of the burner can be poor in that it opens immediately the burner is energised whereby initial fuel flow is at lower than optimum pressures. Furthermore, because of its electrical operation, overheating of the solenoid fuel valve must be avoided and thus it cannot be placed close to the jet nozzle to minimize fuel dribble caused by residual fuel in the lines.

A simple mechanical sharp cut-off valve is also known comprising a spring loaded diaphragm, plunger or valve installed between the fuel pump and the jet nozzle and is arranged to cut off fuel at a predetermined fuel pressure less than the optimum fuel pressure. However, since the fuel pump is unable to immediately stop pumping upon shut off, the cut-off valve is unable to stop all fuel pumped to the burner until the pump slows sufficiently so that all pumped fuel can be leaked back through the system.

Before this takes place, the action of the cut-off valve can be to take up a steady or unsteady throttling position which does not act to cut off the fuel sharply as desired.

A control system which uses a mechanical valve and a solenoid fuel valve in series between the fuel pump and the jet can suffer in practice from the fault that, on shut

2

down, fuel can be trapped in the pipeline between the two valves. On re-start, when the solenoid valve is last in line, the burner may be relit due to the release of the trapped fuel but at an undesirably low fuel pressure. This action can take place before fuel begins to arrive from the fuel pump and through the mechanical valve. Alternatively, when the mechanical valve is last in line, weeping of fuel at the jet can take place after shut off if the pressure of trapped fuel increases for any reason.

The problem of trapped fuel can be overcome by the fitting of a fuel line containing a one way valve which can lead the otherwise trapped fuel back to the delivery side of the fuel pump. This is an undesirable additional complication.

In general, the action of a solenoid shut-off fuel valve can be upset by the inertia of the fuel in the pipelines which may cause bouncing of the valve on its seat.

It is an object of the present invention to provide an improved pressure jet burner control system in which the abovementioned disadvantages and complications are overcome.

With the above objective in view, there is provided according to the present invention a pressure jet burner control system comprising a fuel pump, a burner, a fuel line connecting said pump and burner, a burner valve including a plunger acting in cooperation with a seat disposed in said fuel line, said plunger being biased toward said seat to prevent fuel under a predetermined minimum pressure to flow to said burner, a fuel line for by-passing said pump connected into said fuel line between said pump and said burner valve, and a by-pass valve adapted to instantly close and open upon respective energisation and de-energisation of said fuel pump and disposed in the by-pass line, whereby upon said fuel pump being de-energised, pressure between said burner valve and said pump is instantly relieved through said by-pass line.

Conveniently, the by-pass valve includes a solenoid actuated needle plunger acting in cooperation with a seat opening to prevent passage of fuel in the by-pass line when the solenoid winding is energised. The needle plunger is biased by spring means towards an open valve position. Preferably, the by-pass fuel line is situated near the burner valve to minimise the effect of fuel hammer caused by inertia of fuel in the lines upon shutting of said burner valve. It has been found that the effects of fuel inertia is also serious where the fuel shut off valve is not adjacent the burner jet nozzle. The fuel inertia causes fuel to continue flowing out of the nozzle even after cut-off by the valve.

The burner valve needle plunger is spring biased to close against said seat. The pressure of fuel flowing in said fuel line is adapted to act on a diaphragm connected to said needle plunger to compress said biasing spring and thereby move said needle plunger away from its seat and allow fuel flow to burner.

In order that the construction of the control system of the invention may more readily be understood, reference will be made to a practical arrangement as herein-after described having reference to the accompanying drawing. The arrangement can be used in any external combustion application and particularly in a steam engine where the fuel pump is continually switched on and off according to requirements of the engine boiler.

The system includes a source of fuel 1, a pump 2, a burner jet body 3 in which a burner fuel valve 4 is preferably integrally mounted. This ensures that the valve is arranged closely adjacent to the burner jet 3a, thus minimizing the effects of fuel inertia in the passage between the burner valve and the burner jet. A burner motor 5, energized by battery 30 and controlled by switch means 31, driving said pump 2 and an air fan 6 connected to the

3

air register (not shown) supplying air to the burner. The burner valve 4 includes a needle plunger 7 biased to instantly close against seat 8 by spring 9, the spring bias being adjustable by screw nut 10 to set the valve to a predetermined minimum fuel pressure, the valve including a fuel and air impervious diaphragm 11 upon which said plunger 7 is mounted for movement between an open and closed position. The plunger 7 is surrounded by a follower spring 7a which ensures that the plunger 7 follows movement of the diaphragm 11. Connected into the fuel line 12 between the pump and the burner valve is a by-pass line 13 leading back to the fuel source 1 and in which is disposed a solenoid actuated valve 20 including a needle plunger 21. Valve plunger 21 is arranged with a quick-acting means disposed to constantly bias the valve plunger to the open position, for example biased by a spring 22 to an open valve position off seat 23. The armature 24 of the solenoid bypass valve 20 is adapted to act against and overcome said spring bias so as to close said seat opening. The winding 25 of the solenoid valve is connected into the electrical circuit, including battery 30 and switch means 31, of the burner motor 5 or alternatively is arranged to be energised and de-energised simultaneously upon starting and stopping respectively of the fuel pump 2. It will be understood that the simultaneous control of the fuel pump 2 and solenoid valve 20 can be carried out in many ways and this practical arrangement should not be construed as limiting on the present invention in its more general forms.

In operation of this arrangement, the burner motor 5 is energised to drive the air fan 6 and fuel pump 2, and simultaneously the solenoid winding 25 is energised to force the armature 24 to instantly move the needle plunger 21 of said solenoid actuated by-pass valve 20 to a closed position. Upon closure of said valve, fuel pressure in the line 12 to the burner valve 4 increases until the force exerted on the valve diaphragm 11 is greater than that exerted by said biasing spring 9 acting in opposition thereon whereby the plunger 7 moves to an open position to allow fuel to flow to the burner jet 3a. This condition indicates that the pressure of fuel has reached an acceptable minimum pressure for efficient atomisation and burning in the combustion space surrounding the burner 3. The force of the biasing spring 9 can be varied to arrive at an acceptable minimum pressure.

Upon stopping of the fuel pump 2 as by switching off the burner motor 5 by a thermostat boiler pressure switch or similar means 31 as shown schematically in the drawing, the winding 25 of said solenoid valve 20 is simultaneously de-energised whereby the needle plunger 21 thereof is lifted instantly from its seat by spring 22 to relieve the pressurised fluid in said fuel line 12 back to said fuel source 1 and in turn said burner valve 4 is closed rapidly through drop in fuel pressure to prevent any undesirable low pressure flow of fuel to the burner 3. The short distance between the seat 8 and the burner jet 3a in the burner body ensures that only a relatively small amount of fuel remains at the burner jet and accordingly fuel dribble at cut-off, and the effects of fuel inertia are at a minimum. Also since the solenoid valve is opened immediately the fuel pump is stopped, fuel pressure is relieved from behind the plunger 7 and the plunger will quickly close. The plunger 7 will not lift off the seat 8 until sufficient fuel pressure is built up on the diaphragm

4

11 when pumping is recommenced. Thus sharp cut-off and starting of fuel flow to the burner jet is obtained by the present invention.

I claim:

1. A pressure jet burner control system comprising a fuel pump, a burner, a jet nozzle in said burner, a fuel line connecting said pump and burner, a burner valve including a plunger acting in cooperation with a seat opening disposed in said fuel line closely adjacent to said burner nozzle, said plunger being biased by quick-acting means toward said seat opening to close said burner valve instantly to prevent fuel under a predetermined minimum pressure to flow to said burner jet nozzle, a fuel line bypassing said pump connected into said fuel line between said pump and said burner valve, and a by-pass solenoid valve having a valve opening and disposed in the by-pass line, switch means arranged in an electric circuit to control energisation and de-energisation of said fuel pump and said solenoid valve, the solenoid valve being adapted to close and open its valve opening simultaneously upon respective energisation and de-energisation of said fuel pump, so that upon said fuel pump being de-energised, pressure between said burner valve and said pump is relieved instantly simultaneously through said by-pass line, so that all of the by-pass line fuel passes through said by-pass solenoid valve opening upon the opening thereof.

2. A pressure jet burner control system as claimed in claim 1 wherein said by-pass solenoid valve includes a solenoid actuated needle plunger co-operable with a seat type opening to prevent passage of fuel in the by-pass line when the solenoid winding is energised.

3. A pressure jet burner control system as claimed in claim 2 wherein said by-pass solenoid valve includes quick-acting spring means for biasing its needle plunger towards an open valve position, and the solenoid is arranged so that upon being energised it compressingly opposes said spring means and holds said by-pass valve needle plunger closed in its seat opening, and upon de-energisation releases said spring to effect quick opening of said by-pass valve seat opening to permit said by-pass fuel to pass therethrough.

4. A pressure jet burner control system as claimed in claim 1 wherein said burner includes quick-acting spring means co-operable with said valve needle plunger to spring bias it to close against said seat so that the pressure of fuel flowing in said fuel line is adapted to act on a diaphragm operably connected to said plunger tending to compress said biasing spring means and thereby move said needle plunger away from its seat and allow fuel flow to said burner jet.

5. A pressure jet burner control system as claimed in claim 1 wherein said burner valve is integrally mounted in said burner.

References Cited

UNITED STATES PATENTS

1,263,654	4/1918	Doble	137—563
3,073,115	1/1963	Cowles et al.	60—39.28
3,390,522	7/1968	Whitehead	60—39.28

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