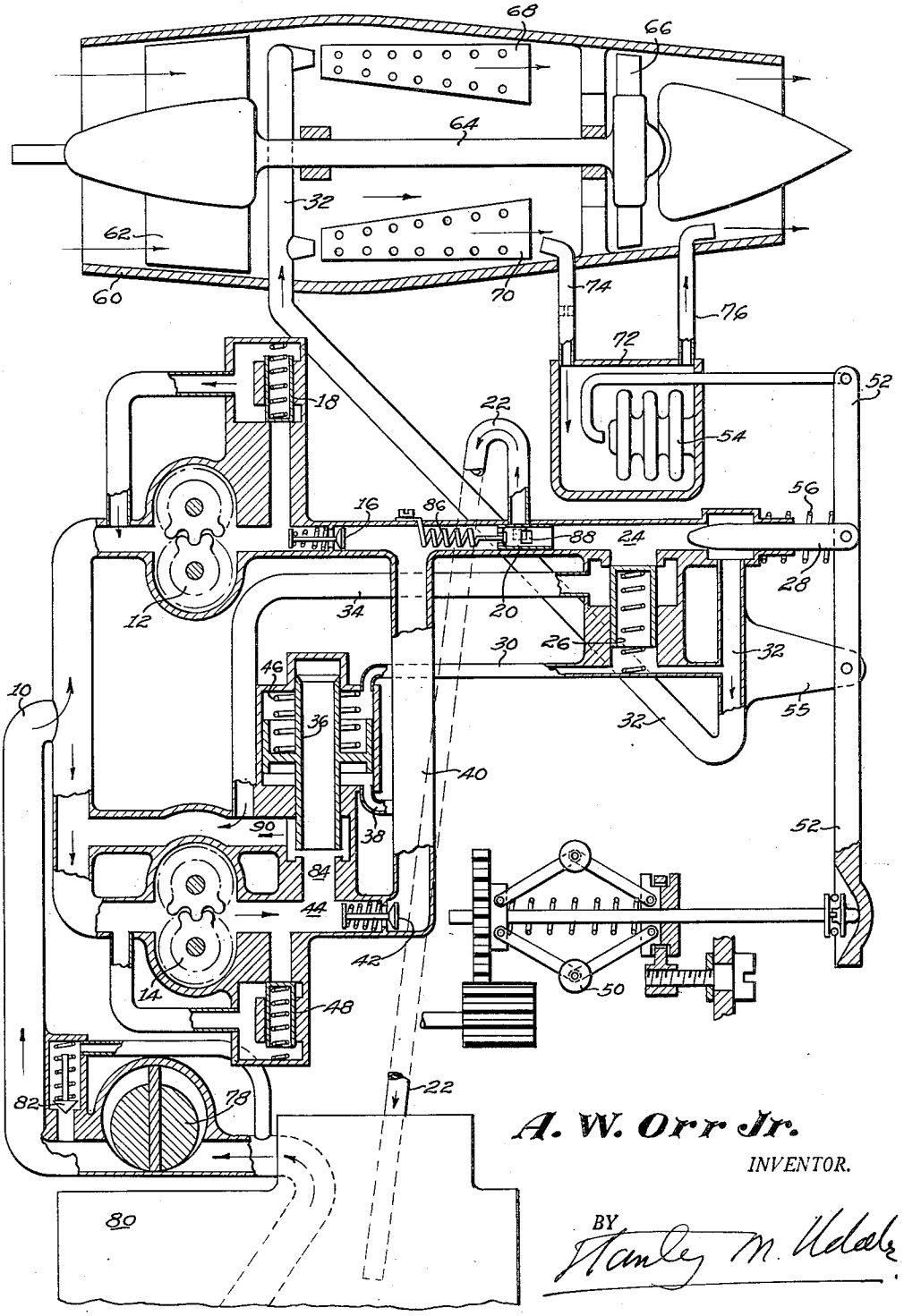
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TEMPERATURE CONTROLLED FUEL
PUMP FOR GAS TURBINES

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TEMPERATURE CONTROLLED FUEL PUMP FOR GAS TURBINES

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10 Claims. (Cl. 103—11)

1

The object of this invention is to transfer automatically sufficient heat units from a pump to keep the temperature of the fluid below a dangerous critical point.

A further object of this invention is to provide a main pump and an emergency pump combination such that fuel is furnished to the engine fuel control unit under conditions of partial or complete failure of the main fuel pump.

The figure shows diagrammatically the preferred form of my invention as applied to a gas turbine engine.

One of the objects of this invention is to keep the temperature of the fuel being bypassed by the engine fuel control below that temperature at which vapor lock in the common pump inlet line 10 or cavitation in the pumping elements would occur.

In the figure, 10 is the common fuel entrance to primary pump 12 and the emergency pump 14. 16 is a check valve in the outlet from pump 12, 18 is a safety bypass valve from pump 12 leading back to the pump inlet 10, 46 is a check valve in the outlet from pump 14 leading back to the pump inlet 10. 78 is a fuel transfer pump supplying fuel from the fuel tank 80 to the main and primary fuel pump inlet line 10. 82 is a bypass valve around transfer pump 78.

26 is a constant pressure valve which establishes a constant pressure drop across the speed and temperature controlled valve 28 in the main fuel control system. The passage 30 is connected with the fuel outlet passage 32 and with the underside of the constant pressure valve 26. 34 is the return path for the fuel bypassed by this constant pressure valve 26 to the common fuel inlet 10.

36 is the unloading valve. This valve is opened by the pressure transmitted through a passage 38 connected to a passage 40. An emergency pump 14 delivers fuel to the passage 44 and to the passage 40 through a check valve 42 whenever the unloading valve 36 closes the unloading passage 84.

A spring 46 together with the pressure in line 30 tends to close the unloading valve 36 against the action of the pressure in passages 38 and 40.

The valve 28 may be controlled by any one of a large number of available controls. I have chosen to illustrate this invention with a conventional control consisting of a centrifugal governor 50, a beam 52, a temperature responsive element 54 and a fixed fulcrum 55. A compression spring 56 engages with the beam 52 and maintains contact between the centrifugal governor 50 and the beam 52.

2

The gas turbine 60 is provided with a compressor 62 revolving on a shaft 64 which carries the gas turbine 66. Two of the combustion chambers 68 and 70 are shown, actually there are quite a number of others. The pipe 32 is provided with burners for each of the combustion chambers.

The chamber 72 encloses the temperature responsive element 54. The products of combustion circulate through the chamber 72 entering passage 74 and issue out of passage 76.

Fuel supply pump 78 draws its fuel from the tank 80 into which the receiving tank 21 discharges.

Control valve 20, having a port 88, in the pump fuel outlet passage 24 is a rotary valve actuated by a thermostat element 86 also located in fuel outlet passage 24. Valve 20 returns fuel to the fuel tank 80 through passage 22 when open.

Operation

Assume that the emergency pump 14 is out of action, as shown, and that the normal pump 12 is supplying the fuel to run the gas turbine. As the speed increases the valve 28 closes and as the temperature of the exhaust gases increase the element 54 which is liquid filled expands and at any given revolutions per minute the speed becomes more effective to cut down fuel consumption by moving valve 28 to the left. The spring loaded valve 26 maintains a constant pressure drop at the valve 28.

As long as this constant pressure drop is maintained across valve 28, unloading valve 36 remains open and pump 14 circulates fuel at low pressure through passage 84 and passage 28. However, if main pump 12 cannot satisfy the demand of fuel valve 10 or if pump 12 fails, valve 26 closes and the lessened pressure differential between passages 38 and 30 together with spring 46 causes valve 36 to close and pump 14 supplies fuel to the fuel system. When this occurs valve 36 takes over the function of valve 26 to maintain a very slightly lower pressure drop across valve 28. If main pump 12 fails completely, pressure in line 40, from pump 14 closes check valve 16. The check valve 42 is closed at all times when pump 14 is not delivering fuel to passage 40.

Under these conditions when pumps 12 and 14 are running at high speed and valve 28 is almost closed, most of the fuel delivery is bypassed back to pump inlet 10 by valve 26 through passage 34. Alternatively when pump 12 is not operating then the bypass valve 36 controls the flow through passage 90 and pump 14 delivers fuel to the main fuel control valve 28. Either of these conditions results in the addition of con-

siderable heat to the fuel system and a rise in temperature of the fuel in the critical inlet passage **10**. When the temperature rises to a point below where vapor lock or cavitation would take place, thermostat element **86** rotates and opens the port **88** in the rotary valve **20** thereby passing fuel back to the fuel tank **80** through passage **22**. Colder fuel from the tank **80** is thus brought into the system to reduce the temperature of the fuel below the critical point.

What I claim is:

1. A pumping system for a fuel supply to a prime mover comprising a source of fuel, a main fuel pump having an outlet, a thermostatically controlled fuel valve located in the said fuel outlet and responsive to the temperature of the fuel flowing past said valve, a return passage connected to said outlet controlled by said fuel valve and discharging into said fuel source, an emergency fuel pump arranged in parallel to said main fuel pump so as to discharge into the outlet from said main fuel pump, a non-return check valve at the point of discharge, an unloading valve for said emergency pump, yieldable means for closing said unloading valve, means responsive to the pressure in the outlet from said main fuel pump to hold said unloading valve open in opposition to said yieldable means until the pressure in the outlet from said main fuel pump falls due to the opening of said thermostatically controlled valve or to the failure of said primary pump.

2. Fuel control means for a gas turbine of the type in which an air pump driven by said turbine supplied compressed air to a combustion chamber comprising a main fuel pump and an emergency fuel pump arranged in parallel, a common outlet from said pumps, a control valve in said outlet, control means for said valve, an unloading valve for said emergency pump comprising a moving wall connected to said unloading valve, a chamber on one side of said moving wall connected to the pressure upstream of said control valve, a chamber on the other side connected to the downstream side of such control valve, yieldable means engaging with said unloading valve and opposing the motion of said moving wall in response to the pressure drop at said control valve, a non-return valve located in the outlets from each of said pumps.

3. A device as set forth in claim 2 in which there is a thermostatically operated additional control valve located in the common fuel outlet from said pumps responsive to the temperature of the fuel in the fuel outlet, a return fuel passage connected to said outlet and controlled by said additional control valve and discharging into said fuel source.

4. A device as set forth in claim 2 in which there is a speed responsive device driven by said prime mover and connected to said control valve so as to tend to close the control valve at high speeds of said prime mover.

5. A device as set forth in claim 2 in which there is a chamber in restricted communication with the combustion chamber downstream of the point of combustion and in unrestricted communication with the exhaust outlet downstream of said gas turbine, a temperature responsive element in said chamber linkage connecting said element to said control valve so as to move said valve into its flow restricting position as the temperature in said combustion chamber increases.

6. A device as set forth in claim 2 in which there is a speed responsive device driven by said prime mover and connected to said control valve so as to tend to close the control valve at high speeds of said prime mover and in which there is a chamber in restricted communication with the combustion chamber downstream of the point of combustion and in unrestricted communication with the exhaust outlet downstream of said gas turbine, a temperature responsive element in said chamber linkage connecting said element to said control valve so as to move said valve into its flow restricting position as the temperature in said combustion chamber increases.

7. A device as set forth in claim 2 in which there are temperature responsive means responsive to the temperature in said combustion chamber connected to said control valve so as to move said valve into its flow restricting position as the said temperature increases.

8. A device as set forth in claim 2 in which there is a speed responsive device driven by said prime mover and connected to said control valve so as to tend to close the control valve at high speeds of said prime mover and in which there are temperature responsive means responsive to the temperature in said combustion chamber connected to said control valve so as to move said valve into its flow restricting position as the said temperature increases.

9. A pumping system for a fuel supply to a prime mover comprising a source of fuel, a main fuel pump, an outlet therefrom, a non-return valve therein, an emergency fuel pump, an outlet therefrom, a non-return valve therein, a common outlet passage from both pumps downstream from said non-return valves, a thermostatically controlled fuel valve located therein responsive to the temperature of the fuel flowing therethrough, a return passage connected to said common outlet controlled by said thermostatically controlled fuel valve and discharging into said fuel source, a second control valve located in the discharge end of said common outlet passage.

10. A device as set forth in claim 9 in which there is an unloading valve for said emergency pump comprising a moving wall connected to said unloading valve, a chamber on one side of said moving wall connected to the pressure upstream of said second control valve, a chamber on the other side connected to the downstream side of said second control valve, yieldable means engaging with said unloading valve and opposing the motion of said moving wall in response to the pressure drop at said second control valve which tends to open the unloading valve.

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