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FUEL SUPPLY SYSTEM

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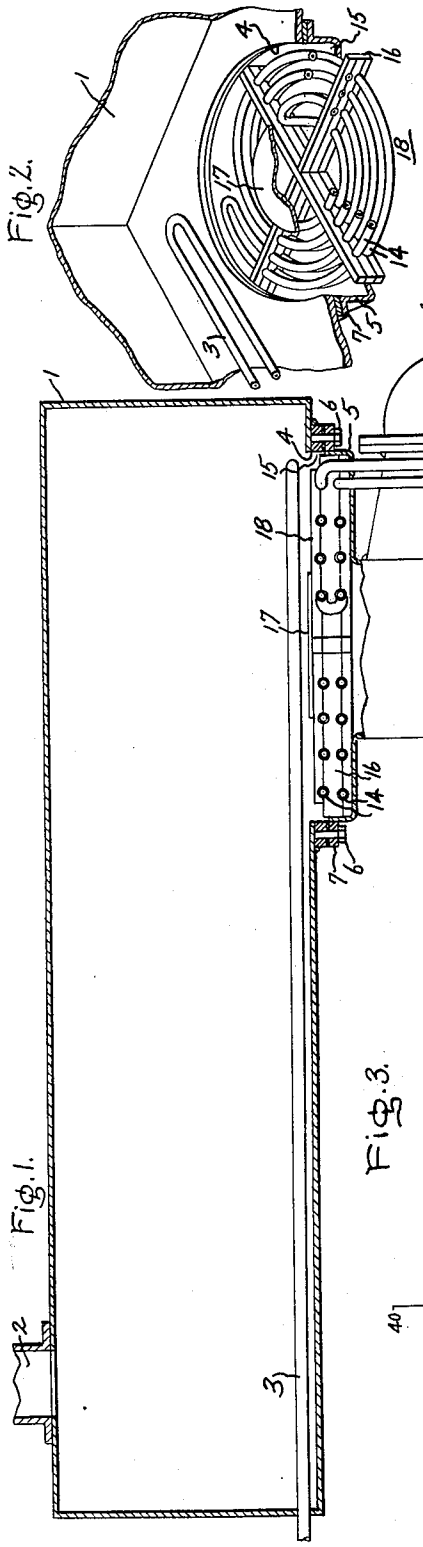


Fig. 1.

Fig. 2.

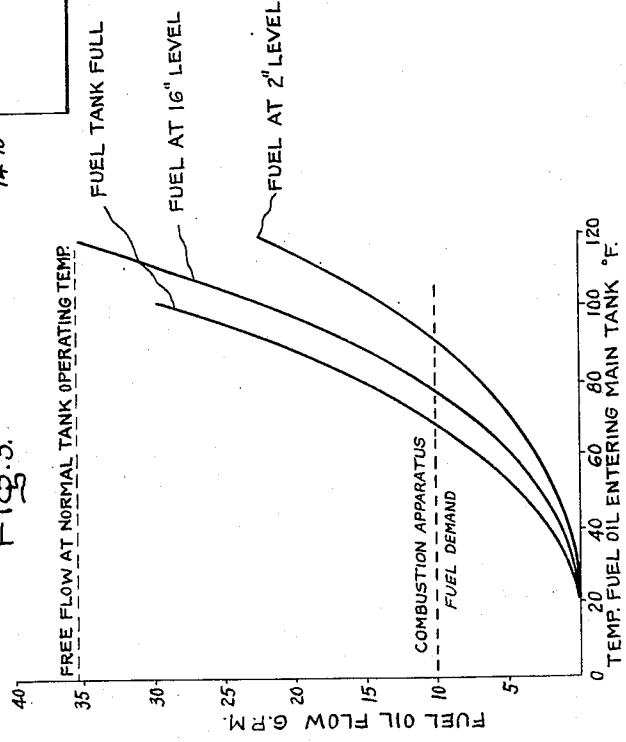


Fig. 3.

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FUEL SUPPLY SYSTEM

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4 Claims. (Cl. 158—36)

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This invention relates to fuel supply systems for fluid fuel combustion apparatus such as gas turbine power plants and the like.

In fluid fuel combustion apparatus such as gas turbines, particularly when such apparatus is utilized as a prime mover in a railway locomotive, the fuel oil in the fuel storage tank under normal operating conditions is held at a temperature satisfactory for the pumps and other combustion equipment. However, in filling the fuel storage tank, fuel oil is frequently introduced which is much too cold to be handled by the pumps. The cold fuel oil will immediately settle to the bottom of the fuel storage tank and will then flow into the pumps blocking the flow of fuel oil to the power plant and shutting down the locomotive. It is, therefore, desirable in the design of such fuel supply systems to restrict the flow of cold fuel oil to the combustion apparatus and to only pass fuel oil having a temperature high enough to be handled by the pumps and other equipment.

An object of this invention is to provide an improved self-regulating fuel supply system for fluid fuel combustion apparatus.

Another object of this invention is to provide an improved fuel supply system for fluid fuel combustion apparatus wherein the flow of fuel to the apparatus is restricted to temperatures which can be handled thereby.

A further object of this invention is to provide an improved self-regulating fuel supply system for producing a constant flow of fluid fuel at a predetermined rate and temperature to fluid fuel combustion apparatus wherein the flow of fuel to the apparatus is restricted to viscosities which can be handled thereby and wherein cold fuel is heated to lower the viscosity to the point where it will pass to the apparatus.

A still further object of this invention is to provide an improved fuel supply system for fluid fuel combustion apparatus wherein a constant flow of fuel at a predetermined rate and temperature is furnished to said apparatus regardless of the temperature of the fuel in the storage tank.

Further objects and advantages of this invention will become apparent and the invention will be better understood from the following description referring to the accompanying drawings, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In accordance with this invention there is provided a fuel storage tank having an inlet for introducing new fuel and heating coils arranged in the bottom thereof for heating the main body of fuel oil to the proper temperature to be handled by the pumps and other apparatus. A sump tank is provided having its discharge connected to the combustion apparatus and heating coils are positioned in its lower portion. A fuel passage interconnects the sump tank and the fuel storage tank. A screen heater formed of heating fluid coils is arranged in the fuel passage between the fuel storage tank and the sump tank, the heating fluid coils being closely spaced that they permit the flow of fuel oil at a rate adequate to meet the demand of the combustion apparatus only at a temperature of the fuel oil high enough to be handled by the pumps and other combustion equipment. When the temperature of the oil in the fuel storage tank drops below that which the pumps and other combustion equipment can handle, as a result of the introduction of cold fuel into the fuel storage tank, the heating fluid coils of the screen heater restrict the flow of fuel oil to the sump tank to viscosities which can be heated to operating temperature therein and at the same time the heating fluid coils heat the cold fuel to lower the viscosity to the point where it will be passed to the sump. Therefore, when cold fuel is introduced into the fuel storage tank and before the main body of the fuel therein can be heated to the proper temperature by the storage tank heating coils, the restriction of the flow of cold fuel oil offered by the heating fluid coils of the screen heater and the heating effect thereof permits the discharge to the sump of a reduced quantity of fuel oil having a sufficiently high temperature level so that the fuel oil passed to the sump can be heated to operating temperature by the sump tank heating coils. The difference between the reduced rate of discharge from the screen heater and the demand of the combustion apparatus is made up by the storage capacity of the sump tank.

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In the drawing, Fig. 1 is a side elevational view, partly in section, illustrating the improved fuel supply system of this invention; Fig. 2 is a broken-away view in perspective further illustrating the construction of the screen heater; and Fig. 3 shows a set of curves of the flow of fuel oil through the screen heater at various temperatures.

Referring now to Fig. 1 there is shown a fuel storage tank 1 having an inlet 2 for introducing new fuel. Heating fluid coils 3 are arranged in the bottom of the fuel storage tank 1 for maintaining the main body of fuel oil therein at the

proper operating temperature. An opening 4 is formed in the bottom of the fuel storage tank 1 and a chamber member 5 is positioned thereunder and secured to the bottom of the fuel storage tank 1 in any suitable manner, as by bolts 6 which engage a flange portion 7. A sump tank 8 is provided having its discharge 9 connected to the fuel pump 10 which in turn is adapted to be connected to the combustion apparatus through fuel line 11. Heating fluid coils 12 are arranged in the bottom of the sump tank 8 and serve to heat the fuel oil in the sump tank to the proper operating temperature to be handled by the pump 10 and the subsequent combustion equipment. A fuel passage 13 connects the bottom of the chamber member 5 and the top of the sump tank 8.

During normal operating conditions, the heating fluid coils 3 in the main fuel storage tank 1 maintain the fuel oil at the proper operating temperature to be handled by the pump 10 and the combustion equipment. However, when a large quantity of cold fuel oil is introduced through the inlet 2, the fluid heating coils 3 are unable to instantaneously heat this new fuel to the proper temperature and the heating capacity of the heating fluid coils 12 in the sump tank 8 is also insufficient to heat the cold oil to a temperature at which it will not clog the pump 10. In order to insure that only fuel oil of the proper temperature to be heated to operating temperature in the sump tank 8 is passed thereto, the arrangement now to be described is provided. A screen heater 18 is provided having a two layer spiral fluid heating coil 14 positioned in the recess 15 formed by the chamber member 5. The heating fluid coil 14 is held in assembled positon by spacer members 16 which also support a baffle member 17 over the center portion of the heating fluid coils 14. The heating fluid coils 14 are closely spaced to form a screen having an effective mesh size to prevent the passage of lumps of cold oil. In this way, the flow of fuel oil to the sump tank 8 is restricted to viscosities which can be heated to operating temperature by the sump tank heating fluid coils 12. The heating fluid coils 14 of the screen heater 18 also heat the cold oil in the bottom of the tank and lumps of cold oil caught therein to lower the viscosity thereof to the point where it will flow through the screen heater 18 to the sump tank 8. Thus, when a large quantity of cold fuel is introduced into the main fuel storage tank 1, and before this fuel can be heated to operating temperature by the main fuel storage tank heating coils 3, the restriction to the flow of fuel oil of viscosities which cannot be heated to operating temperature by the sump tank heating coils 12, offered by the screen heater coils 14 and the heating effect of these coils permits the flow to the sump tank 8 of a reduced quantity of fuel oil having a temperature and viscosity which permits it to be heated to operating temperature by the sump tank heating fluid coils 12. In order to provide for a constant flow of fuel of the required temperature and at a rate adequate to meet the demand of the combustion apparatus, the sump tank 8 is provided with sufficient capacity to make up the difference between the reduced rate of discharge of the screen heater and the demand of the combustion apparatus for the period of time required for the main fuel storage tank heating coils 3 to heat the main body of fuel to the proper temperature.

It will be understood that the screen heater 18 is designed for a specific condition, i. e., when the main fuel storage tank 1 has some fuel oil therein at operating temperature and the sump tank 8 is full of fuel oil at operating temperature. Under these conditions, relatively cold fuel oil is introduced into the main fuel storage tank 1 through the inlet 2 in order to fill the tank. Referring now to Fig. 3 there is shown a set of curves plotted for a fuel oil with a viscosity in Saybolt universal seconds from 37 to 41 SU at 100° F. Here, the flow of fuel oil in gallons per minute which will be passed by the screen heater 18 is plotted against the temperature of new fuel oil introduced into the main fuel storage tank 1 for various amounts of fuel in the main fuel storage tank. The fuel demand of the combustion apparatus is assumed to be 10 gallons per minute and the free flow of fuel oil through the screen filter at normal operating temperature is assumed to be 35 gallons per minute. It will be seen that if the fuel level in the main fuel storage tank 1 is 2'' above the bottom of the tank and fuel oil is introduced at 90° F., the screen heater 18 will pass the minimum flow demanded by the combustion apparatus. If the storage tank 1 were full, the screen heater 18 will pass approximately twice the flow demanded by the combustion apparatus. If, however, fuel oil is introduced into the main fuel storage tank 1 at the 2'' level at 70° F., the screen heater 18 will pass to the sump tank 8 approximately half the flow demanded. The object of this system is to supply a constant flow of fuel oil at a predetermined required rate and temperature from the sump tank 8 to the pump 10 over all conditions including the introduction of cold fuel oil into the main fuel storage tank 1. The main fuel storage tank heating coils 3 in the main fuel storage tank 1 are provided to maintain the fuel oil at the proper operating temperature during normal operation. It was found impractical to introduce into the sump tank 8 sufficient heating capacity to heat the fuel demand of the pump 10, for instance 10 gallons per minute at 110° F., from the temperature of the coldest fuel oil which might be introduced through the inlet 2. The sump tank 8 is provided with sufficient storage capacity to supply the pump 10 for thirty minutes or more so that the reduction in fuel oil flow to the sump tank 8 from the screen heater 18 while the fuel oil in the main fuel storage tank 1 is being heated to operating temperature will not stop the power plant operation.

It is, however, feasible to provide sufficient heating capacity in the sump tank heating coils 12 to heat to operating temperature the reduced flow of fuel oil passed by the screen heater 18, the fuel oil so passed having a temperature level by virtue of the heating effect of the screen heater coils 14 higher than that of the cold fuel oil in the main storage tank 1.

While the heating coils 3, 12 and 14 are shown as being of the heating fluid type adapted to have steam or some other medium passed therethrough, it will be readily understood that electrical heating elements or any other suitable heating elements may be utilized.

It will now be seen that this invention provides within the limitations of practical design a self-regulating fuel supply system without the use of regulating valves or other moving parts wherein a constant flow of fuel at a predetermined rate and temperature is supplied to the combustion apparatus regardless of the temperature of the fuel in the main storage tank.

While I have illustrated and described a particular embodiment of this invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not to be limited to the particular arrangement disclosed, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A self-regulating fuel supply system for producing a constant flow of fluid fuel at a predetermined rate and temperature to fluid fuel combustion apparatus comprising a fuel storage tank having inlet means for introducing new fuel, a sump tank having discharge means for feeding fuel to said apparatus, fuel heating means positioned in said sump tank for heating said fuel to the proper operating temperature to be handled by said apparatus, fuel passage means connecting said storage tank and said sump tank, heating elements positioned in said passage, and means for passing a heating medium through said heating elements, said heating elements being closely spaced forming a screen for preventing the passage of lumps of cold fuel so that the flow of fuel to said sump is restricted to viscosities which can be heated to operating temperature in said sump, said heating elements heating cold fuel caught thereby to lower the viscosity thereof to the point where said fuel will be passed to said sump whereby fuel which can be heated to operating temperature in said sump is passed thereto regardless of the temperature of the fuel in said storage tank.

2. A self-regulating fuel supply system for producing a constant flow of fluid fuel at a predetermined rate and temperature to fluid fuel combustion apparatus comprising a fuel storage tank having inlet means for introducing new fuel, a sump tank having discharge means for feeding fuel to said apparatus, fuel heating means positioned in said sump tank for heating said fuel to the proper operating temperature to be handled by said apparatus, fuel passage means connecting said storage tank and said sump tank, heating fluid coils positioned in said passage, and means for passing a heating fluid through said coils said heating fluid coils being closely spaced forming a screen for preventing the passage of lumps of cold fuel so that the flow of fuel to said sump is restricted to viscosities which can be heated to operating temperature in said sump, said heating fluid coils heating cold fuel caught thereby to lower the viscosity thereof to the point where said fuel will be passed to said sump whereby fuel which can be heated to operating temperature in said sump is passed thereto regardless of the temperature of the fuel in said storage tank.

3. A self-regulating fuel supply system for producing a constant flow of fluid fuel at a predetermined rate and temperature to fluid fuel combustion apparatus comprising a fuel storage tank having inlet means for introducing new fuel, fuel heating means positioned in said storage tank, a sump tank having discharge means for feeding fuel to said apparatus, fuel heating means positioned in said sump tank for heating said fuel to the proper operating temperature to be handled by said apparatus, fuel passage means connecting said storage tank and said sump tank, heating fluid coils positioned in said passage, and means for passing a heating fluid through said coils, said heating fluid coils being closely spaced forming a screen for preventing the passage of lumps of cold fuel so that the flow of fuel to said sump is restricted to viscosities which can be heated to operating temperature in said sump. said heating fluid coils heating cold fuel caught thereby to lower the viscosity thereof to the point where said fuel will be passed to said sump whereby fuel which can be heated to operating temperature in said sump is passed thereto regardless of the temperature of the fuel in said storage tank.

4. A self-regulating fuel supply system for producing a constant flow of fluid fuel at a predetermined rate and temperature to fluid fuel combustion apparatus comprising a fuel storage tank having inlet means for introducing new fuel, fuel heating means positioned in said storage tank, a sump tank having discharge means for feeding fuel to said apparatus, fuel heating means positioned in said sump tank for heating said fuel to the proper operating temperature to be handled by said apparatus, fuel passage means connecting said storage tank and said sump tank, heating elements positioned in said passage, and means for passing a heating medium through said heating elements said heating elements being closely spaced forming a screen for preventing the passage of lumps of cold fuel so that the flow of fuel to said sump is restricted to viscosities which can be heated to operating temperature in said sump, said heating elements heating cold fuel caught thereby to lower the viscosity thereof to the point where a reduced amount of said fuel will be passed to said sump whereby fuel which can be heated to operating temperature in said sump is passed thereto regardless of the temperature of the fuel in said storage tank, said sump tank having sufficient capacity so that the fuel demand of said apparatus is supplied thereby until said storage tank fuel heating means has heated the fuel in said storage tank to a temperature at which the fuel demand of said apparatus will be passed by said screen heater.

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