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Lowrey

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[54] FUEL HEATING MEANS

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123/142.5; 158/36 O; 165/108, 71

[56] References Cited

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1,384,512 7/1921 Buchi 123/122 E

3,209,816 10/1965 McQuerry 123/122 F X
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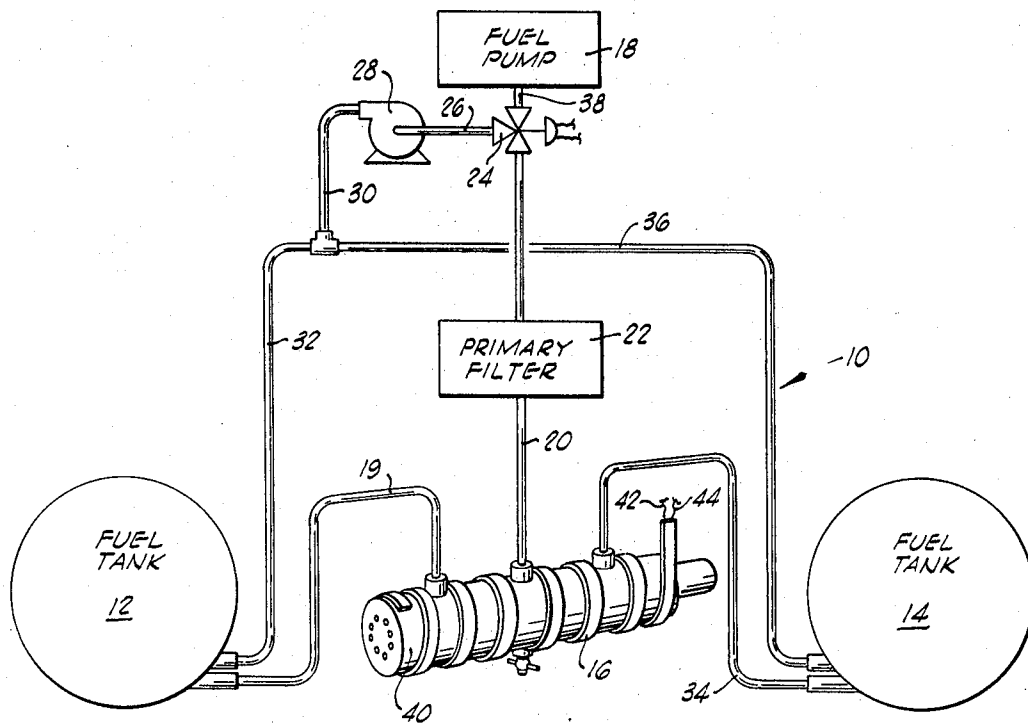
Primary Examiner—Al Lawrence Smith

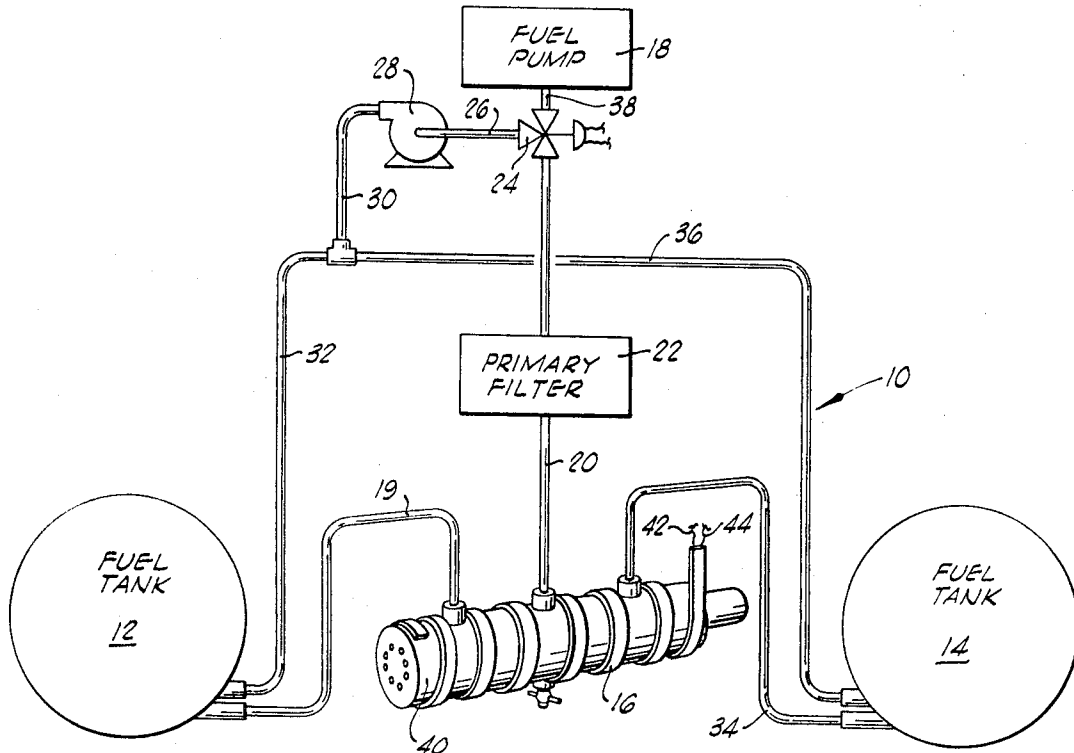
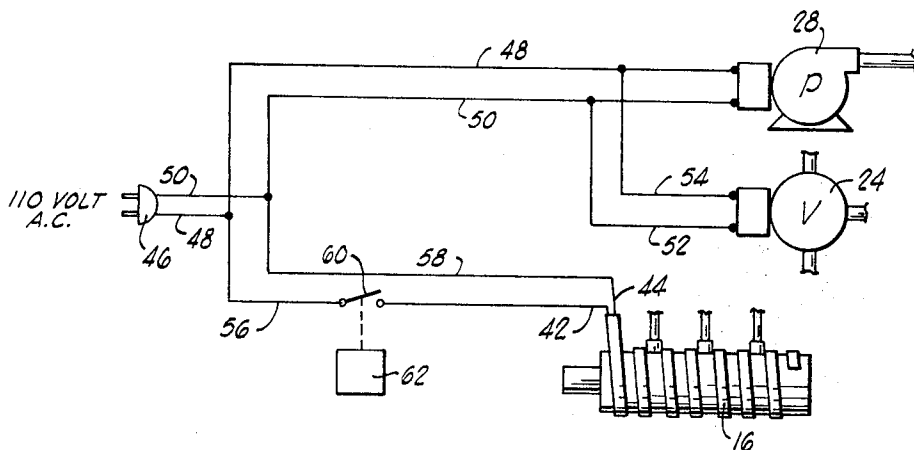
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[57] ABSTRACT

A fuel heating means for use in liquid fuel systems is provided which will maintain the fuel fluid in a low temperature environment when the vehicle is not in use. The heating means comprises a recycle means which is in fluid communication with the fuel in the fuel tank of the vehicle, and a heating means which cooperates with said recycle means so that fuel withdrawn from the fuel tank is returned thereto in a heated state.

5 Claims, 2 Drawing Figures





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FUEL HEATING MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a fuel heating means for liquid fuel systems. In one aspect, this invention relates to a fuel heating means for diesel fuel systems. In another aspect, this invention relates to a fuel heating means for diesel fuel systems which will prevent the diesel fuel from becoming viscous and congealed in a low temperature environment when the vehicle is not in use.

2. Brief Description of the Prior Art

The difficulties encountered in the operation of motor vehicles, such as diesel powered vehicles, in a low temperature environment have long been recognized. One major difficulty has been that low temperatures cause the diesel fuel to become more viscous, and to often congeal. When this happens, the efficient operation of the diesel engine is severely hampered. At times, too, diesel fuel will contain an unacceptably high water content which will cause inefficient combustion, and some design efforts have been directed toward the removal of at least a portion of any entrained water from the fuel. Many attempts have been made to solve or minimize the foregoing problems, such as the use of chemical fuel additives or the development of many types of apparatus for use as fuel heaters and/or water separators.

While much attention has been directed to the solving of the problems encountered in the operation of the diesel engine in low temperature environments, a problem still remains when the vehicles are parked for several hours, such as overnight. Since, in general, the prior art fuel heaters are dependent upon the actual operation of the diesel engine, it has been customary to park or store diesel vehicles in indoor storage or parking. This is necessary because, if the vehicle were parked or stored outside, the diesel fuel would become viscous and congeal to an extent that it would be difficult, if not impossible, to get the vehicle back in operation. Due to the size of most diesel powered vehicles, it is expensive to provide and maintain indoor parking and storage for such vehicles.

OBJECTS OF THE INVENTION

An object of the present invention is to provide a fuel heating apparatus for use in liquid fuel systems which is not dependent upon the operation of the vehicle's engine.

Another object of the invention is to provide a fuel heating apparatus which will provide sufficient heat to maintain diesel fuel liquid; is economical to operate; can readily be incorporated into existing diesel fuel systems with minimal expense; and which will require a minimum of maintenance.

A further object of the invention is to provide a static (as contrasted with a dynamic, over-the-road system) fuel heating system which can be used to concurrently heat and remove water from diesel fuel while diesel powered vehicles equipped therewith are parked.

These and other objects, advantages, and features of the present invention will become apparent to those skilled in the art as the following detailed description is read in conjunction with the accompanying drawing wherein like reference numerals denote like parts in all views.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a fuel heating means for use in liquid fuel systems which comprises a recycle means through which fuel from the fuel tank of a vehicle is passed, and a heating means which heats the fuel passing through the recycle means prior to the fuel returning to the fuel tank.

Further according to the present invention, there is provided a recycle pump positioned so as to be in fluid communication with fuel passing through the recycle means to force the fuel through the recycle means. A directional valve means is likewise provided in said recycle means to prevent the fuel from passing to the fuel pump of the vehicle when the heating

means and/or the recycle pump is in operation, and conversely, to prevent any recycling of fuel when the diesel engine is in operation. In addition, the recycle pump and the directional valve means are electrically connected, so that the recycle pump and the valve means are energized at substantially the same time. The heating means is also electrically connected to the recycle pump and directional valve means so that all three elements can be energized at substantially the same time, or, when the fuel is already in a heated state, only the pump means and valve means are energized to merely recirculate the heated fuel.

Still further according to a preferred embodiment of the present invention, a fuel heater and water separator device employed during operation of the vehicle is likewise in fluid communication with the fuel passing through the recycle means, and said heating means is positioned adjacent the exterior surface of said fuel heater and separator device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a diesel engine fuel system depicting the fuel heating means of the present invention as it is used in a preferred arrangement in combination with a fuel heater and water separator device which functions to remove water from the diesel fuel as it is heated and recycled.

FIG. 2 is a schematic diagram of the electrical circuitry of the fuel heating means of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, and to FIG. 1 in particular, a fuel system, generally designated as 10, comprises basically dual fuel tanks 12 and 14, heating means 16, vehicle fuel pump 18, and associated conduits for recycle of fuel from either tank 12 or 14 through heating means 16 and back to the fuel tanks. Although dual fuel tanks are shown, it is obvious that the invention is applicable to one tank, or to any number of fuel tanks.

In the drawing, one fuel recycle path is from tank 12 via a conduit 19 to heating means 16, through a conduit 20, a primary filter 22, a control valve 24, a conduit 26, a recycle pump 28, a conduit 30, and a conduit 32 back to tank 12. The other recycle path is from tank 14 via conduit 34 to heating means 16, then into conduit 20, through filter 22, valve 24, conduit 26, recycle pump 28, conduit 30, and a conduit 36 back to tank 14.

When the motor vehicle upon which the fuel system is located is in operation, fuel flows through the fuel valve 24 and a conduit 38 to the vehicle fuel pump 18. When it is desired to park the vehicle in a cold environment, the control valve 24 is actuated so as to isolate the fuel recycle paths from communication with conduit 38, and conversely, the control valve functions during over-the-road operation to direct all fuel from conduit 20 to the fuel pump 18 and prevent any fuel flow into the conduit 26.

Although a recycle fuel pump 28 is shown, it is obvious that fuel circulation can be obtained through use of thermosiphon without a recycle pump. Also, the filter 22 is not essential to the present invention.

The heating means 16 is preferably associated with a fuel heater and separator device 40 depicted and described in U.S. Pat. No. 3,209,816, issued Oct. 5, 1965, which is hereby incorporated by reference. This preferred construction is illustrated in FIG. 1 of the drawing. As explained in U.S. Pat. No. 3,209,816, the fuel heater and separator device 40, already in use on many diesel powered trucks, functions to heat the diesel fuel by directing exhaust gases into heat exchange relation to the fuel while the truck is being operated. Concurrently, internal baffles in the device cause water entrained in the fuel to be separated therefrom, and to collect at a location in the bottom of the device facilitating its removal.

It may be here noted that though the heating means 16 is preferably used in combination with the described fuel heater and separator device 40, the heating means may be positioned

at any suitable place along the recycle paths for heating fuel moving through one or both of these paths. While any suitable heating means 16 can be employed, desirable results are obtained where the heating means is an electrical tape member having a number of resistance heating coils therein, and having leads 42 and 44 which can be connected to any electrical socket where there is available electrical power. Diesel trucks employing the system of the invention are frequently parked in a location at which an electrical power supply is accessible.

Although heating means 16 can be selected so that the heat output will be sufficient without thermostatic control to heat the fuel within the recycle path to a predetermined temperature, especially desirable results are obtained by incorporating a thermostat control means into the fuel systems 10 to thermostatically control heating means 16. By employing the thermostat control means, electrical power can be conserved because when the fuel being heated attains a predetermined temperature, electrical current to heating means 16 will be interrupted, and will not commence again until the temperature of the fuel drops below a predetermined value, at which time the thermostat control means will reactivate heating means 16. The thermostat control means discussed above can be any suitable means which are known in the art. In addition, the thermostat control means can be positioned at any point within the fuel heating means of the present invention.

In the operation of the heating means of the invention in combination with the fuel heater and water separator device 40, the diesel fuel is maintained fluid and easily pumpable at all times, whether the truck equipped with the system is in operation, or is parked out-of-doors in a very cold environment. During over-the-road operation of the vehicle, the fuel is drawn from the fuel tanks 12 and 14 through the heater and separator device 40 by the fuel pump 18. Hot exhaust gases from the diesel engine are directed through the device 40 where they heat the fuel moving through the device in a sinusoidal or undulating path. The heat imparted to the fuel, coupled with the separatory effect of changes in the direction of flow of the fuel, result in water being separated from, or knocked out of, the fuel, and accumulating in the lower portion of the device 40 where it can be removed by opening a petcock or other suitable drain device. During such operation of the vehicle, the directional control valve 24 is in a status such that recycle of fuel to the tanks 12 and 14 does not occur, and in fact, none of the fuel flowing in the line or conduit 20 is diverted into the conduit 26.

When the vehicle is parked, the hot exhaust gases are not, of course, available to heat the fuel, nor can circulation of fuel be developed by the use of the fuel pump associated with the engine. At this time, electrical power is supplied to the pump 28, the control valve 24 and the heating means 16, all of which may be semi-permanently installed on the trucks, along with the associated recycle conduits. The control valve is thus thrown to admit fuel from the conduit 20 to the conduit 26, and isolate the fuel pump of the engine. The recycle pump 28 is energized and the fuel is thereby caused to circulate through the two described recycle paths. In recycling fuel in this manner, the fuel enters the heater-water separator device 40, and in this location is heated by the tape 16. This elevates the temperature of the fuel and together with its movement through the separator device 40 causes water to be thrown out of the fuel. Thus, warm, easily pumped and water-free fuel is available at the time that the truck is to be started.

Referring now to FIG. 2, the electrical circuitry of the fuel heating means of the present invention will be discussed in detail with further reference to the operation of said fuel heating means. Electrical power source 46, such as a common 110 volt A-C outlet (or in some instances, a vehicle battery) is connected by electrical leads 48 and 50 to recycle pump 28. A junction is provided in electrical leads 48 and 50 from which electrical leads 52 and 54 extend, and are operatively connected to control valve 24. Therefore, when electrical leads 48 and 50 of fuel system 10 are operatively connected to electrical power source 46, control valve 24 is activated, as well as

recycle pump 28, so that the circulation of the fuel is commenced by withdrawing the fuel from the fuel tanks 12 and 14 and passing same through the fuel heating means and the recycle paths as described hereinbefore. A second junction is provided from electrical leads 48 and 50 from which extend electrical leads 56 and 58, and are operatively connected to heating means 16. While not absolutely necessary, it is desirable to provide a switch unit 60 in electrical lead 56, and a thermostatic control means 62 which is operatively connected to switch unit 60, and is positioned to be responsive to the temperature of fuel flowing through the recycle paths. By employing switch unit 60 and thermostatic control means 62, one can thermostatically control the heating means 16 of the present invention so that when the fuel attains a predetermined temperature, current to the heating coil will be interrupted, and power thus conserved. Through the use of the above concept one can readily see that the control valve 24, recycle pump 28 and heating means 16 can be operated simultaneously, or valve 26 and recycle pump means 28 can be operated without power to heating means 16 where the fuel is already in a heated state, and only circulation of the fuel is desired. By employing the fuel heating means of the invention, one can readily maintain the fuel fluid when the vehicle is standing outdoors in an extremely cold environment.

The foregoing discussion and description of the fuel heating means of the present invention have been directed to certain preferred embodiments of the invention. However, it is to be understood that the discussion and description is only intended to teach those skilled in the art how to practice the present invention, and modification of the elements of the invention may be made without departing from the scope and spirit of the invention.

Having thus described the invention, I claim:

1. A fuel heating means for use in motor vehicle fuel systems which comprises:

- a. a fuel tank means;
- b. recycle conduit means operatively connected to, and in fluid communication with, said fuel tank means, said recycle conduit means allowing fuel to be withdrawn from said fuel tank means and returned thereto;
- c. a recycle pump in said recycle conduit means to pass fluid therethrough;
- d. heating means cooperating with said recycle conduit means to heat fuel passing therethrough prior to the fuel returning to said fuel tank means; and
- e. valve means for selectively connecting and disconnecting said recycle conduit means to the fuel pump of said vehicle, said valve means and said recycle pump being electrically connected so that each of them is actuated at substantially the same time whereby fuel may be selectively diverted from said recycle conduit means to the engine of said vehicle via said fuel pump.

2. The fuel heating means of claim 1 wherein said heating means comprises resistance heating tape operatively connected to a power source and to said valve means and said recycle pump for concurrent energization of said heating tape, recycle pump and valve means.

3. The fuel heating means of claim 1 and further characterized as including thermostatically actuated switch means connected to said heating means and in thermal communication with said recycle conduit means for controlling said heating means in response to the flow of fuel in said recycle conduit means.

4. A diesel power plant system for mounting on trucks comprising:

- a diesel engine;
- a fuel pump for pumping diesel fuel to the engine;
- a fuel tank for supplying diesel fuel;
- a fuel heater and water separator device connected between the fuel tank and the engine for heating the diesel fuel and concurrently removing water therefrom, said heater and water separator device comprising:
- a pair of concentric tubular members; and

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baffle means disposed between said tubular members, the innermost of said tubular members being connected to said engine for receiving hot exhaust gases therefrom, and the outer of said tubular members being connected to said fuel tank for receiving diesel fuel therefrom and passing said fuel through said baffle means;

A recycle conduit system for receiving fuel from said fuel heater and water separator device positioned upstream from said fuel pump, and for recycling the received diesel fuel to said fuel tank;

a recycle pump positioned in said recycle conduit system for moving diesel fuel therethrough independently of said fuel pump;

a valve for alternately permitting diesel fuel to pass from said water separator device to said fuel pump, or, from said water separator device to said recycle conduit system; and

heating means extending around the outermost of the tubular members of said fuel heater and water separator device, and operative to heat fuel passed between said tubular members when said engine is inoperative, and hot engine exhaust gases are not passed through the innermost of said tubular members, whereby diesel fuel may be continuously heated, de-watered and circulated when said diesel engine is stopped, and also said heating and de-watering of the diesel fuel may be automatically accom-

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plished when said engine is running by the common use of said fuel heating and water removal device in both statuses of the engine.

5. In a diesel power plant system which includes a diesel engine, a fuel pump for pumping diesel fuel to the engine, a fuel tank for supplying diesel fuel, and a device connected between the fuel tank and the engine for removing water from the diesel fuel and concurrently heating the fuel, the improvement which comprises:

10 a recycle conduit system for receiving diesel fuel from the water removal device upstream from the fuel pump and recycling the received diesel fuel to the fuel tank;

a recycle pump positioned in said recycle conduit system for moving diesel fuel therethrough independently of said fuel pump;

a valve for alternately permitting diesel fuel to pass from said water removal device to said fuel pump, or from said water removal device to said recycle conduit system;

means for heating fuel passing through said water removing device; and

electrical control circuitry connected to said recycle pump, valve and heating means for selectively energizing the recycle pump, valve and heating means concurrently, or alternatively, the recycle pump and valve.

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