

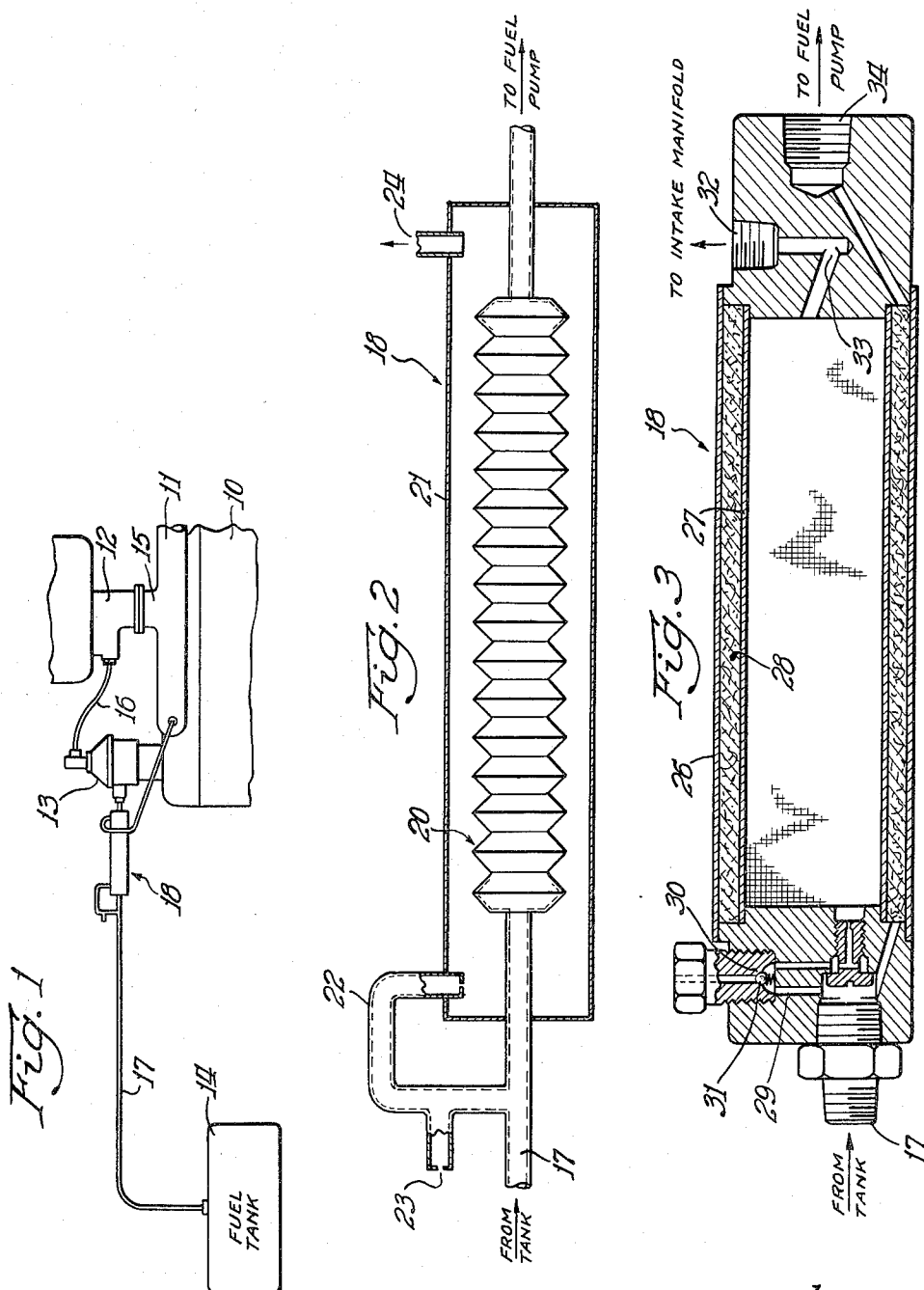
March 27, 1962

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3,026,862

ENGINE FUEL SUPPLY COOLER

Filed Sept. 6, 1960



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ENGINE FUEL SUPPLY COOLER

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Filed Sept. 6, 1960, Ser. No. 54,233

9 Claims. (Cl. 123—136)

This invention relates to a fuel supply cooling system for an internal combustion engine and more particularly to a device for preventing vapor lock in such a system. This invention represents a continuation-in-part of my previously filed application, Serial No. 692,085 filed October 24, 1957, for an "Anti-Vapor Lock Device," now Patent 2,963,013, issued December 6, 1960.

The principle utilized in both cases is basically the same, that is, to vaporize the portion of the fuel used for engine idle in a unit preceding the fuel pump in the fuel supply system.

It is well-known that in the operation of an internal combustion engine having a fuel pump and a carburetor, or in fuel injection system, vapor lock often occurs in the fuel pump or carburetor which prevents fuel from reaching the intake manifold or fuel injector in a sufficient quantity to satisfy the engine demand. This condition usually occurs in automotive vehicles when the temperature of the vehicle engine, fuel pump, or fuel is relatively high.

By means of the device disclosed herein, upon vaporization of a portion of the fuel the latent heat of vaporization is taken from the remaining fuel as it flows into the fuel pump. This temperature reduction substantially reduces or entirely eliminates the danger of vapor lock or vaporization in the fuel pump inlet or the carburetor.

As has been explained in co-pending application, Serial No. 692,085, in conventional fuel pump design the volume of fuel pumped may be approximately thirty times the volume required to satisfy engine demand. Such a pump, therefore, can pump a volume of fuel vapor that is up to twenty-nine times the volume of liquid fuel required by the engine. In the event the temperature of the fuel pump is sufficiently high to cause a vaporization of the liquid fuel in excess of this amount so that the vapor to fuel ratio exceeds twenty-nine to one, vapor lock occurs and insufficient fuel reaches the carburetor to satisfy engine demand.

With regard to the present invention, a small portion of fuel is taken into a cooling chamber or casing by virtue of the low pressure in the chamber caused by the intake manifold. The chamber partially fills with gasoline cooled by the expansion to a vapor of part of the gasoline. This cool gasoline and vapor removes heat from the hot gasoline passing through a heat exchange type structure which shall be hereinafter described in detail and which is part of the main fuel conduit. Another distinction over the co-pending application resides in the vacuum pressure of the chamber due to communication with the intake manifold.

Gasoline vapor formed in the cooling chamber ultimately passes to the intake manifold and is burned by the engine. It has been found that by bleeding or regulating an amount of air into the fuel passing to the cooling chamber, the flow can be varied to either increase or decrease the amount of coolant fuel with changes of temperature of the incoming gasoline.

Since the coolant fuel is taken into the engine paralleling the normal idle system, a nearly constant flow must be maintained or the engine idle will not operate satisfactorily. Any of the simple methods of restricting or controlling this flow by means of a small tube have the same inherent problem; that when the gasoline is warm, bubbles form in the tube causing a restriction and reducing the mass or weight in flow. At lower gasoline tem-

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perature, fewer or no bubbles form and the mass flow increases. This invention incorporates means to facilitate flow control and these means shall be also set forth in detail in the description of the device. Suffice it to say at this point that the problem as discussed above is remedied by including in the embodiments presented herein, an orifice adjacent to the incoming fuel supply line and, by means of this orifice, to allow small amounts of air to be mixed with the portion of gasoline entering the coolant chamber.

In at least one embodiment of the present invention the orifice referred to above is formed in a secondary fuel conduit or, more specifically, a T-fitting located at a point above the main fuel conduit. The positioning of this secondary fuel conduit and orifice with respect to the main fuel conduit is to facilitate taking the light ends of the fuel passing through the main conduit into the secondary conduit and from there to the coolant chamber resulting in increased cooling or efficiency.

The configuration of the chambers of the present device may be such as to allow maximum turbulization of the fuel passing therethrough. This turbulization may also be accomplished by having a copper mesh, fins, or the like disposed within the chamber in which this turbulization is desired.

It has been found that, due to the liquid fuel level in the coolant chamber there will at times be a surge of this liquid fuel to the carburetor through the intake manifold outlet port formed in the coolant chamber. To remedy this somewhat undesirable condition it was found that a trap may be formed adjacent to the outlet port which would allow only very small amounts of liquid fuel to surge into the carburetor.

It is an object of the present invention to provide a device for preventing or reducing vapor lock in the fuel pump or carburetor for a fuel supply system of an internal combustion engine.

It is another object of the present invention to provide a device for cooling the fuel supplied to a fuel pump for an internal combustion engine using either a carburetor or fuel injection system.

Still another object of this invention is to provide a cooling device disposed in the main fuel conduit in the form of a heat exchanger either contained within or surrounded by a chamber in which a controlled portion of gasoline passing to the engine vaporizes to cool the remaining portion of gasoline passing to the engine through the heat exchanger.

Another object of the invention is to provide a flow control means formed in a secondary fuel conduit to facilitate the flow control of coolant fuel passing to the vaporization chamber located in the fuel supply system.

It has been found that the device disclosed herein affords an improvement over the device as set forth in co-pending application Serial No. 692,085. The lowering of temperature of the gasoline passing through the fuel supply system is increased and therefore the practical application of the device, and the utility thereof, is greatly increased also.

FIG. 1 is a diagrammatic illustration of a fuel system for an internal combustion engine showing the structure comprising the present invention as appearing in such a system.

FIG. 2 is a schematic view of a device incorporating the principles of the present invention.

FIG. 3 is a sectional view of the device illustrated schematically in FIG. 2 wherein the coolant chamber is disposed within the main fuel conduit.

Referring now to FIG. 1 there is illustrated an internal combustion engine 10 for an automotive vehicle. Fuel is supplied to the engine 10 by a fuel supply system which comprises an intake manifold 11, a carburetor 12, a fuel

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pump 13, and a fuel tank 14. The intake manifold 11 is connected to the carburetor 12 by means of a conventional air passage 15. The carburetor 12 is connected to the fuel pump 13 by means of a fuel conduit 16, and the fuel pump 15 is connected to the gas tank 14 by means of a main fluid conduit 17. A cooling device 18 of the present invention is disposed in the main fuel conduit 17.

Although, for purpose of illustration, the system disclosed herein utilizes a carburetor, it is to be understood that the device comprising the present invention has similar application in a fuel injection system.

Referring now to FIG. 2 the device representing the present invention, shown schematically, generally comprises a main fuel conduit 17, a heat exchanger portion 20 formed in the main fuel conduit 17, and a casing 21 surrounding the heat exchanger portion 20 of the main fuel conduit 17.

A secondary fuel conduit 22 branches from the main fuel conduit 17 and leads to one end of the casing 21 to afford fluid communication therebetween. The secondary fuel conduit 22 is disposed at a point higher than the main fuel conduit 17 and is formed with an orifice 23 to afford atmospheric communication therein. The casing 21 is formed with an outlet port 24 at its other end thereof in communication with the intake manifold 11.

One end of the main fuel conduit 17 is in fluid communication with the fuel tank 14 and the other end of the main fuel conduit is in fluid communication with the fuel pump 13.

FIG. 3 is a cross sectional view of a specific embodiment of the device schematically shown in FIG. 2 wherein the coolant chamber is disposed within the main fuel conduit (as in co-pending application Serial No. 692,085). The cooling device of the present invention, generally indicated by the reference numeral 18, comprises a housing portion 26 having a coolant chamber 27 disposed therein and maintained in spaced relationship to the inner wall of the housing portion 26 to define an annular passageway 28 therebetween.

A secondary fuel conduit 29 formed in the casing portion branches from the main fuel conduit 17 and leads to one end of the coolant chamber 27. The secondary conduit 29 is formed with an orifice 30 to allow air intake into the secondary conduit 29 to control the flow of coolant fuel therethrough and also to effect turbulization therein. A ball check 31 is disposed adjacent the orifice 30 to prevent liquid fuel leakage therethrough.

The coolant chamber 27 is formed with an opening at one end thereof in fluid communication with the main fuel conduit 17 by means of secondary fuel conduit 29 and an outlet port 32 at its other end thereof in fluid communication with the intake manifold.

The outlet port 32 to the intake manifold 11 is formed with a trap 33 to reduce surges of liquid fuel to the intake manifold.

A baffle means such as meshwork is shown disposed within the passageway 28 and the coolant chamber 27 to effect turbulization therein.

Passageway 28 is shown in fluid communication with the fuel pump 13 through outlet port 34.

In operation the device, as shown in FIG. 3 comprising the present invention, is preferably attached to the fuel pump 13. The fuel pump 13 is driven by the vehicle engine or other means 10 and draws liquid fuel from the tank 14 through the main fuel conduit 17. As the fuel passes through the main fuel conduit 17, a small portion of the fuel is drawn off and enters the secondary fuel conduit 29. This small portion of fuel enters the secondary fuel conduit because of the low pressure zone affected in the coolant chamber 27 by the intake manifold 11. The main portion of the fuel continues through the passageway 28 of the cooling device to the fuel pump.

The small portion of fuel drawn off the main fuel conduit is regulated by the ball check 31 in the secondary

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fuel conduit 29 which opens at a predetermined vacuum created in the manifold thereby admitting air. This controlled amount of fuel then enters the coolant chamber 27 and vaporizes therein. This vaporization affords a cooling of the fuel passing through the main fuel conduit. The small portion of fuel vapor then passes through the outlet port 32 formed at the other end of the coolant chamber and proceeds to the intake manifold 11 to be used by the engine 10. To prevent surges of liquid fuel to the carburetor, a trap 33 is formed adjacent to outlet port 32. It is to be noted that the secondary fuel conduit 29 and orifice 30 formed thereon are disposed above the main fuel conduit. This is desirable since the light ends of the gasoline will rise into the secondary conduit and enter the coolant chamber, allowing the heavy ends to proceed through the passageway 28 to the engine 10.

It will be understood that the amount of cooling produced by vaporization of the coolant fuel will be dependant upon the temperature of the main fuel supply. It is for this reason that maximum cooling will be obtained during hot weather and minimum cooling during cold weather. This feature is advantageous because vapor locking does not appear to be an appreciable problem during cold weather.

I have described this invention in connection with the specific embodiments shown and it is to be understood that this is by way of illustration and not by way of limitation and the scope of my invention is defined solely by the appended claims which should be construed as broadly as the prior art will permit.

I claim:

1. In a fuel supply system for an internal combustion engine having an air intake manifold, the combination of fuel supply means including; a main fuel conduit for supplying liquid fuel to the engine, a heat exchanger in series with said conduit, a casing surrounding said heat exchanger, a secondary fuel conduit branching from said main fuel conduit to one end of said casing affording fluid communication therebetween, said secondary fuel conduit having means formed thereon adapted to allow leakage of air therethrough to control the flow of fuel through said secondary conduit to said casing, outlet means formed at the other end of said chamber adapted to be connected to said intake manifold whereby, due to the low pressure zone effected by said intake manifold, a small portion of the fuel passing through said fuel supply conduit enters said secondary fuel conduit, is mixed with air through said air leakage means, and enters said cylindrical casing to vaporize therein to cool the remainder of fuel passing through said heat exchanger to said engine.

2. In a fuel supply system for an internal combustion engine having an intake manifold and a fuel pump; the combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, a heat exchanger in series with said conduit and disposed between said main fuel conduit and said fuel pump, a casing surrounding said heat exchanger, a secondary fuel conduit branching from said main fuel conduit to a point of entry of said casing affording fluid communication therebetween, said secondary conduit having means formed thereon adapted to allow leakage of air therein to thereby control the flow of fuel through said secondary conduit into said casing, means defining an outlet formed at the other end of said casing adapted to be connected to said intake manifold whereby, due to the low pressure zone effected by said intake manifold, a portion of the fuel passing through said main fuel conduit enters said secondary fuel conduit, becomes mixed with air entering said secondary fuel conduit through said air leakage means and enters said casing to vaporize therein cooling the remainder of the fuel passing through said heat exchanger to said engine.

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3. In a fuel supply system for an internal combustion engine having an air intake manifold, the combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, a fuel pump, a heat exchanger in series with said main fuel conduit and disposed between said main fuel conduit and said fuel pump, a cylindrical casing closed at its ends surrounding said heat exchanger, a secondary fuel conduit branching from said main fuel conduit to one end of said cylindrical casing affording fluid communication therebetween, said secondary fuel conduit having means thereon adapted to allow leakage of air therethrough to control the flow of fuel through said secondary conduit into said casing, outlet means formed at the other end of said cylindrical casing adapted to be connected to said intake manifold whereby, due to the low pressure zone effected by said intake manifold, a small portion of the fuel passing through said fuel supply conduit enters said secondary fuel conduit, becomes mixed with air through said air entering through said air leakage means and proceeds into said cylindrical casing at a point below liquid level in said cylindrical casing to vaporize therein cooling the remainder of fuel passing through said heat exchanger to said engine.

4. In a fuel supply system for an internal combustion engine having an air intake manifold, a combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, a heat exchanger in series with said main fuel conduit, means defining a chamber surrounding said heat exchanger, secondary fuel conduit means branching from said main fuel conduit to one end of said chamber to afford fluid communication therebetween, said secondary fuel conduit having means formed therein adapted to allow leakage of air therethrough to control the flow of fuel through said secondary conduit into said cylindrical casing, outlet means formed at the other end of said chamber adapted to be connected to said intake manifold whereby due to the low pressure zone effected by said intake manifold a small portion of the fuel passing through said fuel supply conduit enters said secondary fuel conduit and passes to said cylindrical casing vaporizing therein to cool the remainder of fuel passing to the engine.

5. In a fuel supply system for an internal combustion engine having an air intake manifold, the combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, heat exchange means in series with said main fuel supply conduit including a heat exchange surface formed in said conduit, a casing surrounding said heat exchange surface, secondary fuel conduit means for affording fluid communication between said main fuel conduit in one end of said casing, an outlet port formed in the other end of said casing affording communication between said casing and said intake manifold, means formed in said secondary conduit affording atmospheric communication to said secondary conduit to control the flow of fuel therethrough, whereby a small portion of liquid fuel flowing through said main conduit enters said secondary conduit, becomes mixed with air in said secondary conduit, enters said casing and evaporates therein to cool the remainder of fuel passing through said main fuel conduit.

6. In a fuel supply system for an internal combustion engine having an air intake manifold, the combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, heat exchange means in series with said main fuel supply conduit, including a heat exchange surface formed in said conduit, a casing surrounding said surface, secondary conduit means affording fluid communication between said main fuel conduit and one end of said casing, an orifice open to atmospheric pressure in said secondary fuel conduit means and means defining an outlet port formed in the other end of said casing in communication with said intake manifold.

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7. In a fuel supply system for an internal combustion engine having an intake manifold, a combination of fuel supply means including a main fuel conduit for supplying liquid fuel to the engine, heat exchange means in series with said main fuel conduit, said means including a bellows type heat exchange surface formed in said conduit, a cylindrical casing defining a chamber surrounding said bellows type heat exchange surface, means affording fluid communication between said main fuel conduit and said chamber, an orifice open to atmospheric pressure in said means to control the flow of fuel through said means by allowing leakage of air therethrough, an outlet port formed in the other end of said casing affording communication between said casing and said intake manifold whereby a portion of the liquid fuel flowing through said main fuel conduit entering into said means, becomes mixed with a portion of air entering said means through said orifice, said small portion of fuel passing to said casing and vaporizing therein to cool the remainder of fuel passing through said main fuel conduit.

8. A cooling device for use in a liquid supply system including a main fuel conduit, an intake conduit and a fuel pump comprising; a housing portion open at one end to receive said main fuel conduit and at its other end to afford fluid communication with said fuel pump, a cooling chamber disposed within said housing portion maintained in spaced relationship to the inner wall of said housing portion to define an annular passageway therebetween, said cooling chamber being formed with an opening at one end to afford fluid communication between said chamber and said intake manifold, a secondary fuel conduit formed in said housing portion to afford fluid communication between said main fuel conduit and the other end of said cooling chamber, an orifice formed in said secondary conduit to control the flow of coolant fuel therethrough, means formed in said first-named opening of said cooling chamber to reduce surges of liquid fuel through said opening to said intake manifold whereby a small portion of the liquid fuel passing through said housing portion through said main fuel conduit enters said secondary fuel conduit, becomes mixed with air entering said secondary fuel conduit through said orifice and passes into said cooling chamber to vaporize therein and cool the remainder of liquid fuel passing through said annular passageway to said fuel pump.

9. A cooling device for use in a liquid supply system including a main fuel conduit, an intake conduit and a fuel pump comprising; a housing portion open at one end to receive said main fuel conduit and at its other end to afford fluid communication with said fuel pump, a cooling chamber disposed within said housing portion maintained in spaced relationship to the inner wall of said housing portion to define an annular passageway therebetween, said cooling chamber being formed with an opening at one end to afford fluid communication between said chamber and said intake manifold, a secondary fuel conduit formed in said housing portion to afford fluid communication between said main fuel conduit and the other end of said cooling chamber, an orifice formed in said secondary conduit to control the flow of coolant fuel therethrough, means formed in said first-named opening of said cooling chamber to reduce surges of liquid fuel through said opening to said intake manifold, turbulizing means disposed in said passageway and said cooling chamber, whereby a small portion of the liquid fuel passing through said housing portion through said main fuel conduit enters said secondary fuel conduit, becomes mixed with air entering said secondary fuel conduit through said orifice and passes into said cooling chamber to vaporize therein and cool the remainder of liquid fuel passing through said annular passageway to said fuel pump.