Dec. 27, 1966 H. B. ALVARADO 3,294,148

FUEL FEEDING SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed March 2, 1965

FIG. 1.

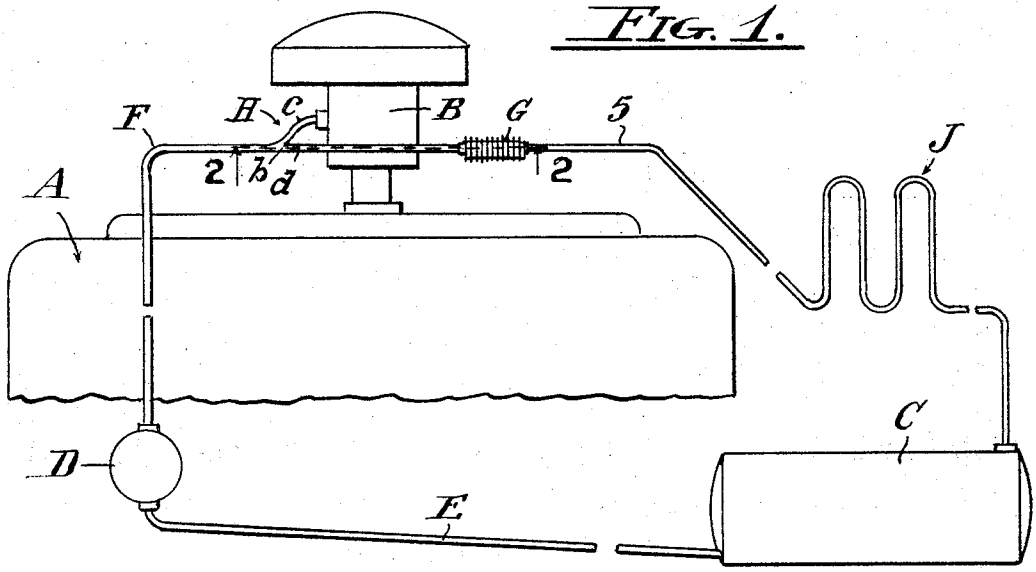


FIG. 2.

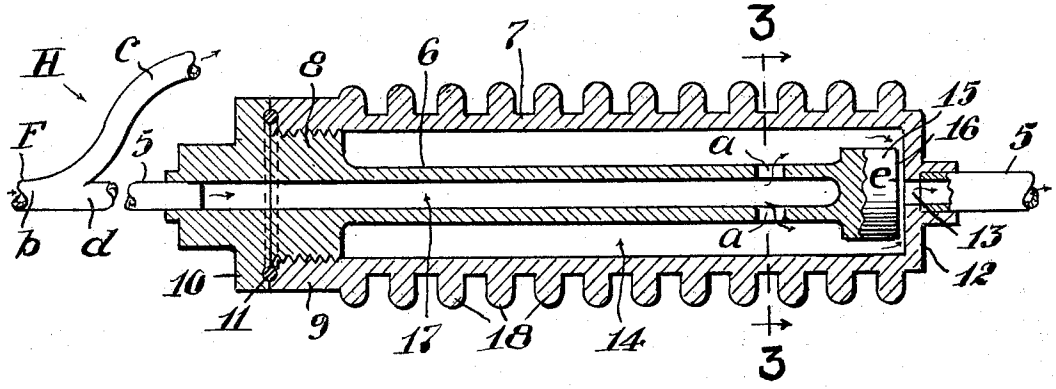
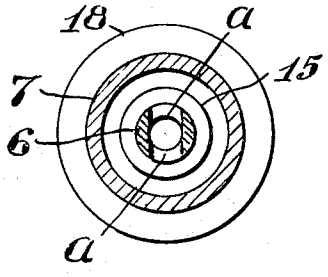


FIG. 3.



INVENTOR

Humberto B. Alvarado;

BY R. S. Berry

ATTORNEY

United States Patent Office

3,294,148

Patented Dec. 27, 1966

3,294,148
FUEL FEEDING SYSTEM FOR INTERNAL COMBUSTION ENGINES

Humberto B. Alvarado, 1221 W. 66th St., Los Angeles, Calif. 90044

Filed Mar. 2, 1965, Ser. No. 436,505
7 Claims. (Cl. 158—36.4)

This is a continuation-in-part of application Serial No. 274,070, filed April 19, 1963, now abandoned.

This invention relates to the fuel feeding system of internal combustion engines and particularly pertains to an appliance to the fuel feeding lines of engines employed in the operation of motor vehicles for preventing liquid fuel in the feed conduit from getting hot under the action of heat to which the conduit is exposed, whereby the conversion of liquid fuel in the conduit into vapors will be prevented. Such engines are generally equipped with a fuel feeding system embodying a fuel pump which delivers liquid fuel under pressure from a fuel tank to a carburetor through a fuel line consisting of a feed conduit leading from the tank to the pump and a delivery conduit leading from the pump to the carburetor. The fuel pumped to the carburetor is delivered to the engine under float control in the carburetor and the amount of fuel delivered through the system is only that which is fed to the carburetor while the engine is running and varies according to engine requirements. This condition puts the fuel in almost stand still condition while it is being fed to the carburetor through the delivery conduit. During the engine operation the fuel delivery conduit leading to the carburetor is subjected to heat generated by and radiating from the engine. Such heated condition sometimes becomes of such intensity as to vaporize the small amount of slowly moving volatile fuel in the delivery conduit before it reaches the carburetor, resulting in the condition known as vapor lock, which interferes with the operation of the engine.

The primary object of the present invention is the provision of means for preventing the formation of vapors from a liquid fuel while in the fuel delivery conduit occasioned by the excessive heat of the engine environment; the purpose of the invention being to render the fuel incapable of becoming vaporized in the delivery conduit leading to the carburetor under conditions to which it is normally subjected while traversing such conduit, thereby insuring against and rendering impossible the creation or development of vapor lock.

Another object is to provide a construction whereby the desired result is attained by withdrawal of heated fuel from the delivery conduit before it reaches the carburetor at gassing temperature and replacing the withdrawn heated fuel by fuel the temperature of which is below its vaporizing point.

Another object is to provide an arrangement whereby the desired cooling action is effected by circulation of fuel pumped from the fuel tank wherein heated fuel is diverted from the delivery conduit from adjacent the carburetor and returned to the fuel tank, and wherein the temperature of the translated heated fuel will be decreased before its re-delivery to the tank.

A further object is to provide a structure for accomplishing the above recited purpose which can be economically applied to the fuel feeding system of an internal combustion engine without changing or altering the parts of the system other than such as is involved in effecting attachment of the structure thereto.

In forestalling the formation of vapors in the delivery conduit a by-pass is connected to the conduit close to the carburetor intake which by-pass is in open communication at all times with the fuel tank and a volume of fuel is delivered through the conduit by the fuel pump in excess of engine demands such that while maintaining a flow of an adequate quantity of fuel to the carburetor a contsant flow of fuel will be diverted from the conduit through the by-pass and returned to the fuel tank.

The invention is illustrated in the accompanying drawing in which:

FIG. 1 is a view in side elevation with parts removed showing the invention as applied to the fuel feeding system of the internal combustion engine of a motor vehicle:

FIG. 2 is an enlarged longitudinal sectional view taken on the line 2—2 of FIG. 1 with portions broken away showing the by-pass connection to the fuel delivery conduit and a variable thermostatically controlled restriction in such by-pass; and

FIG. 3 is a view in cross section taken on the line 3—3 of FIG. 2.

Referring to the drawing more specifically, A indicates generally the conventional internal combustion engine which is equipped with a liquid fuel supply system embodying the usual carburetor B, fuel tank C, fuel pump D, fuel feed conduit E leading from the tank C to the pump D and a fuel delivery conduit F leading from the pump D to the carburetor B, all in the well known fashion. The engine A is operated by a volatile liquid fuel, such as gasoline, delivered by the pump D to the carburetor B through the conduit F.

In carrying out the invention means are provided adjacent the carburetor B for dividing the current of liquid fuel flowing through the conduit F under the urge of the pump D whereby one portion of the divided fuel is directed into the carburetor and the other portion thereof is directed into the fuel tank, which means embodies a conduit 5 connected to the delivery conduit F adjacent the connection of the latter into the carburetor B. The conduit 5 leads to the upper portion of the fuel tank C through a normally open variable thermostatically controlled or heat responsive restrictor element G and constitutes a by-pass whereby, when the pump D is in operation, a continuous flow of fuel will pass from the discharge end of the conduit F through the by-pass conduit 5 and restrictor element G and be re-delivered to the tank C.

The restrictor element G here shown embodies a pair of spaced apart concentric cylindrical inner and outer tubular members comprising a core 6 encompassed by a shell 7, which members are formed of metals having different co-efficients of expansion under heat; the metal of the shell 7 having a greater degree of lineal expansion than that of the core 6.

Since aluminum has a high co-efficient of expansion under heat, the shell 7 is preferably formed thereof, and since stainless steel or an alloy of iron and nickel has the smallest co-efficient of expansion under heat than any other metal or alloy known, the core 6 is preferably formed thereof. Manifestly any other suitable material having the requisite difference in co-efficient of expansion may be employed in forming the core 6 and shell 7. The tubular core 6 has an externally enlarged cylindrical outer end embodying a threaded inner end portion 8 screwed into engagement with an internally

threaded end portion 9 on the shell 7 with the outer end of the shell 7 abutting a flange 10 on the end portion 8, whereby the score 6 is supported within the shell in spaced relation thereto.

A sealing ring 11 is interposed between the flange 10 and the adjacent end portion 9 of the shell 7. The shell 7 is provided with an inner end wall 12 having an axial port 13 opening therethrough with which the main length of the by-pass conduit 5 connects thereby providing an open communication between the chamber 14 interiorly of the shell 7 and the fuel tank C.

The inner end of the core 6 is closed by a cylindrical head 15 having a flat end face 16 presented to but permanently spaced from the inner side of the end wall 12 of the shell 7 and port 13; the end face 16 being normally spaced such distance from the end wall 12 as to afford a restricted passage *e* leading to the port 13 to retard yet permit flow of liquid fuel therethrough from the chamber 14 at all times during operation of the fuel pump D, as will be later described.

The interior of the core constitutes a passage 17 which opens at the outer end of the core and is closed at the inner end of the core by the head 15. However the core 6 is provided adjacent its closed inner end with discharge passages *a* communicating the passage 17 and chamber 14.

Connecting with the passage 17 at the outer end thereof is a short length 5′ of the conduit 5 leading from the delivery conduit F and affording a communication between the interiors of the conduit F and core 6. The junction of the conduits 5′ and F comprises a Y-connection H of which the stem *b* consists of the main portion of the conduit F, the branch *c* consists of the end portion of the conduit F leading to the carburetor B, and the branch *d* consists of the portions 5′ of the conduit 5 connecting the conduit F and the restrictor element G.

The shell 7 is designed to be subjected to the action of heat in the compartment of the motor vehicle in which the engine is housed, particularly such heat as is radiated from the engine A. The element G is accordingly arranged adjacent the upper surface portion of the engine A in a location where it will be apt to be exposed to the maximum heat radiated by the engine, and the element G is preferably arranged rearward of the carburetor where it will be shielded to some extent from the cooling action of the fan with which the engine is equipped.

As a means for amplifying the heat absorbing surface area of the expansible shell 7, the latter has formed integral therewith a multiple of spaced circumferentially extending fins 18.

The by-pass conduit 5 leading from the element G to the fuel tank which is usually remote from the engine, is of such length as to absorb and dissipate heat from fuel flowing therethrough and thereby effect a cooling action thereon, so that the temperature of the fuel will be substantially normal when re-delivered to the fuel tank. In event it be desired to increase the cooling action on the fuel flowing through the by-pass conduit 5, such is effected by equipping the by-pass with a cooling unit as by providing the conduit 5 with a requisite number of return bends or coils, as indicated at J in FIG. 1, thereby increasing the length of the by-pass conduit with consequent increased cooling action on its fuel content. The cooling unit J will be located on the vehicle where it will be exposed to air in motion generated by movement of the vehicle.

From the foregoing it will be seen that the invention resides in the by-pass appliance consisting of a length of conduit 5 with the variable restrictor G interposed therein, with or without the cooling unit J, together with the manner of its mounting in the conventional fuel feeding system of the internal combustion engine of a motor vehicle, and all that is necessary to carry the invention into effect is to install the by-pass appliance or assembly by connecting one end of the conduit 5 to the fuel delivery conduit F adjacent the discharge end thereof and connecting the other end of the conduit 5 with the fuel tank C, all of which is effected without altering or changing any of the elements of the fuel feeding system.

In the operation of the invention, on starting the engine A and setting the pump D in operation, liquid fuel will be pumped from the tank C through the feed conduit E and forced through the delivery conduit F by the pump D in the usual manner, except that the pumped fuel will be in greater volume and velocity than ordinary, due to the open by-pass 5.

The fuel flowing through the conduit F will be divided at the Y-connection H, a portion of the fuel being delivered to the carburetor B through the branch *c* and another portion being delivered to the by-pass conduit 5 through the branch *d*. The fuel thus delivered to the conduit 5 will pass through the tubular core 6 of the restrictor element G and enter the chamber 14 of the shell 7 through the passages *a* in the core 6 from which chamber the fuel will flow through the permanently open but restricted passage *e* and port 13 and thence through the elongate portion of the conduit 5 to discharge into the fuel tank C. A continuous circulation of the fuel through the fuel feeding system will be maintained throughout the operation of the fuel pump D.

During the above recited operation the restriction to the flow of the fuel through the passage *e* of the restrictor element will retard or oppose free flow of the fuel through the by-pass conduit 5 such as to establish back pressure at the fork of the Y-connection H thereby insuring the flow of a requisite volume of the fuel through the branch *c* to the carburetor B to maintain the engine in operation.

The circulation of the fuel through the by-pass conduit and at the same time supply of an adequate volume of the fuel to the carburetor is insured by reason of the pump D with which the fuel feeding systems of motor vehicles are commonly equipped, has a capacity to deliver a volume of fuel greatly exceeding the requirements for engine operation; such pumps ordinarily being capable of delivering a volume of fuel as much as fifteen times greater than that needed to meet engine requirements.

In the fuel feeding systems of internal combustion engines of motor vehicles, the fuel delivery conduit F comprises a highly heat conductive tubing having an internal diameter of approximately one-eighth inch, through which the liquid fuel ordinarily flows very slowly while the engine is in operation due to the small quantity of fuel needed to supply the carburetor bowl. This condition exposes a small amount of liquid fuel for a considerable time to heat radiating from the engine, since the delivery conduit F ordinarily extends from the pump D to the carburetor B through the engine compartment in proximity to the engine where the conduit is exposed to engine temperature and may be heated thereby sufficiently to vaporize the liquid fuel in the conduit.

In event the highly volatile liquid fuel is thus heated in the conduit F to a temperature at or exceeding its vaporizing point the fuel will become vaporized thereby developing the condition known as vapor lock which interrupts engine operation. This condition develops mostly when the weather is hot and the engine is operating at low speed.

As before stated, the purpose of the invention is to prevent vaporization of the fuel as it flows from the pump D to the carburetor B through the conduit F, which is accomplished by the provision of the by-pass conduit 5 and its assembly as above described.

This by-pass permits, when necessary, a considerable amount of liquid to be circulated throughout the whole fuel feeding system and in providing an outlet in the fuel delivering conduit F adjacent the carburetor intake as herein set forth, a rapid flow of a substantial volume of liquid fuel in the delivery conduit may be created whereby a major portion of the heat absorbed by the fuel in the conduit F will be translated and carried away through

the by-pass. At the same time, the increased volume and rapidity of flow of the fuel through the conduit F decreases the extent to which the fuel can be heated by heat absorbed or convected by the walls of the conduit F which with the constant incoming flow of comparatively cool fuel supplied by the pump D insures against the fuel being heated to its vaporizing temperature. The fuel flowing through the delivery conduit F will thus be maintained at such low temperature as to forestall all possibility of the fuel being vaporized in the conduit F so that the development of vapor lock in the fuel feeding system will be prevented.

By the provision of the variable heat responsive flow restrictor element G in the by-pass conduit **5**, the flow of fuel through the by-pass will be governed according to variations of the temperature of the engine environment, increase of such temperature above a determined point, such as 150° F., acting to enlarge the restricted passage *e* and thereby effecting increase in the volume of fuel being pumped and directed back to the fuel tank C; increase in the temperature of the air surrounding the element G above the stated temperature acting to elongate the shell **7** relative to the core **6**, thereby moving the end wall **12** away from the end face **16** of the heat **15** and thus widening the passage *e* and reducing the restriction to the flow of liquid therethrough and conversely increasing such flow.

The increased temperature thus actuating the restrictor element G will also be imposed on the conduit F and transmitted to the fuel flowing therethrough, but by reason of the increased volume and rapidity of flow of the fuel in the conduit F resulting from enlargement of the restricted passage *e* no appreciable increase in temperature of the fuel in the conduit F will occur.

The higher the temperature of the engine compartment the greater the volume of fuel will be by-passed from the conduit F back to the fuel tank C. The greater the volume of liquid fuel and the faster its flow through the by-pass conduit **5** the more rapid the translation of heated fuel from the conduit F.

When sufficient liquid fuel has been by-passed to bring colder liquid from the fuel tank C into the restrictor element G such will have a cooling action on the shell **7** such as to contact the latter and thereby reduce the restricted passage *e* so as to effect a reduction in the volume of liquid fuel flowing through the by-pass **5**. Such flow will thus be very small at times and at others will be quite considerable depending on the temperature of the air directly over the engine where the restrictor element G is located.

The herein described by-pass assembly not only functions to prevent the formation or generation of vapor lock, but also serves to prevent flooding of the carburetor to which it is applied, since the by-pass conduit **5** is always open to discharge through the passage *e* of the element G, thus relieving the pressure from the conduit F which is the cause of flooding.

I claim:

1. In combination in a motor vehicle for preventing vapor lock in the vehicle where such vapor lock results from the vaporization of fuel for driving the motor vehicle where the motor vehicle includes a fuel pump, a fuel reservoir, a carburetor and a motor and where the fuel pump, the fuel reservoir, the carburetor and the motor are disposed within an enclosure,

means for providing for the introduction of fuel from the fuel reservoir to the carburetor,

means disposed in contiguous relationship to the carburetor for providing a by-pass of a portion of the fuel from the carburetor,

means responsive to the difference in temperature between the fuel in the by-pass means and the atmosphere within the enclosure for providing a port with progressively increasing dimensions for the by-pass means in accordance with progressive differences between the temperature of the fuel in the by-pass means and the atmosphere, and

means for providing for the introduction of the fluid in the by-pass means to the reservoir and for providing for the cooling of such fluid during such introduction of the fluid to the reservoir.

2. The combination set forth in claim **1** wherein the means responsive to the difference in temperature includes a first member with a relatively low thermal coefficient of expansion for receiving the by-passed fluid and includes a second member exposed to the atmosphere and provided with a higher thermal coefficient of expansion than the first member and wherein the second member envelops the first member to define a chamber between the members and wherein the first member is constructed to define a passage.

3. The combination set forth in claim **2** wherein the first member is provided with at least one discharge passage to provide a communication between the passage defined by the first member and the chamber between the first and second members.

4. In combination in a motor vehicle for preventing vapor lock in the vehicle where such vapor lock results from vaporization of fuel for driving the motor vehicle and where the motor vehicle includes a fuel pump, a fuel reservoir, a carburetor and a motor and where the fuel pump, the fuel reservoir, the carburetor and the motor are disposed within an enclosure,

a restrictor disposed in contiguous relationship to the carburetor for providing a by-pass for the fuel passing to the carburetor, the restrictor including:

a first member having a passage for the flow of the by-passed fuel, the first member having a relatively low thermal coefficient of expansion and being expansible in accordance with the temperature of the by-passed fluid,

a second member enveloping the first member to define a chamber between the first and second members, the second member having a higher thermal coefficient of expansion than the first member and being exposed to the temperature within the enclosure to expand in accordance with such temperature,

the first member being displaced from the second member to define a restricted passage which is expansible in accordance with the differences in the thermal expansion of the first and second members, and

means providing a communication between the passage in the first member and the chamber in the second member to provide a flow of the by-passed fuel through the passage in the first member, the chamber and the restricted passage.

5. The restrictor set forth in claim **3** wherein the second member is provided with fins and the means providing a communication between the passage in the first member and the chamber constitutes a passage.

6. In combination in a motor vehicle for preventing vapor lock in the vehicle where such vapor lock results from vaporization of fuel for driving the motor vehicle and where the motor vehicle includes a fuel pump, a fuel reservoir, a carburetor and a motor and where the fuel pump, the fuel resrvoir, the carburetor and the motor are disposed within an enclosure:

first means for providing for the introduction of fuel to the carburetor,

second means for providing a by-pass from the introduction of the fuel to the carburetor,

a restrictor including a first member and a second member disposed in enveloping relationship to the first member to define a chamber between the first and second members, the first member having a lower thermal coefficient of expansion than the second member, the first member being constructed to define a passage for receiving the by-passed fluid and the second chamber being disposed in exposed relationship to the atmosphere within the enclosure, the first

and second members being disposed relative to each other to define a restricted passage having a variable dimension in accordance with the differences in thermal expansion between the first and second members, there being a passage between the first and second members, and

means communicating with the restricted passage in the restrictor for providing for a return of the by-passed fuel to the fuel reservoir and for providing for a cooling of the fuel during such return.

7. The combination set forth in claim 6 wherein the second member in the restrictor is provided with fins and the first and second members are linearly expansible.

References Cited by the Examiner

UNITED STATES PATENTS

2,116,337	5/1938	Broeze et al.	158—36.4 X
2,241,931	5/1941	Potter.	
2,545,856	3/1951	Orr	158—36.4
2,872,120	2/1959	Weiland	236—93
2,881,747	4/1959	Gehner	158—36.4 X
2,917,110	12/1959	Brohl	158—36
2,997,180	8/1961	Loveday	158—36.3 X
3,186,470	6/1965	Korte	158—36.3

FREDERICK KETTERER, *Primary Examiner.*