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FUEL SUPPLY SYSTEM FOR INTERNAL COMBUSTION ENGINES

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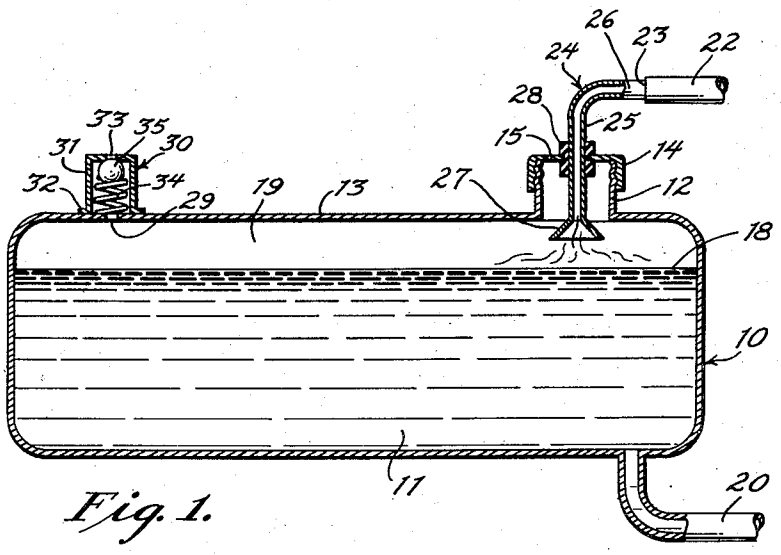



Fig. 1.

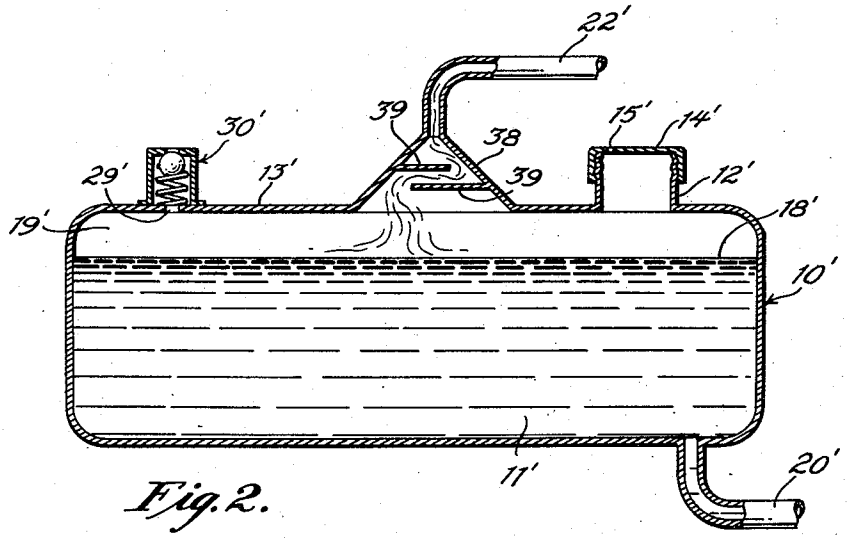



Fig. 2.

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# FUEL SUPPLY SYSTEM FOR INTERNAL COMBUSTION ENGINES

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This invention relates generally to fuel supply systems for internal combustion engines, and is particularly directed to such a system as supplies relatively rich fuel vapor directly from a fuel tank to an internal combustion engine.

As is well known to those versed in the art, the most valuable and highly combustible portion of gasoline and similar liquid fuels is commonly wasted, as it escapes from the fuel reservoir or tank in the form of vapor. While prior devices have attempted to prevent or reduce this waste by conveying the vaporized fuel from the tank to the engine, such devices have been unsatisfactory in practice and have not found public acceptance for various reasons. For example, previous fuel vapor supply systems for internal combustion engines required relatively complex and delicate apparatus, which was subject to frequent malfunctioning under the most favorable conditions, and entirely unsatisfactory under the adverse conditions of motor vehicle usage. A further difficulty inherent in the prior devices was the need for eliminating the safety vent or opening necessarily provided in all automotive gasoline tanks to permit the escape of gasoline vapor, and thereby reduce the hazard of fire.

It is, therefore, a general object of the present invention to provide a fuel line system of the type described which overcomes the above mentioned difficulties, which is extremely simple in construction, requiring a minimum of moving parts, and which is durable and reliable in use, being capable of completely automatic operation throughout the life of a motor vehicle with little or no maintenance.

It is another object of the present invention to provide a fuel line system having the advantageous characteristics mentioned in the foregoing paragraph which is equally well adapted to be built into new automotive vehicles and installed on existing vehicles. Further, the instant fuel supply system may be employed in conjunction with a fuel tank having the conventional vapor escape vent, so that there is no danger of fire or explosion.

It is a more particular object of the present invention to provide a fuel line system for an internal combustion engine, wherein a conduit conducts vapor from a fuel tank to the intake manifold of the engine by employing the manifold vacuum, and an automatic valve is provided to admit air to the tank for mixture with the fuel vapor and to increase vaporization of the fuel.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the construction hereinafter described, and of which the scope will be indicated by the appended claims.

In the drawings:

Figure 1 is a sectional elevational view showing a fuel tank and the fuel supply system of the present invention associated with the tank; and

Figure 2 is a sectional elevational view showing a slightly modified form of fuel supply system and fuel tank constructed in accordance with the present invention.



Referring now more particularly to the drawings, and specifically to Figure 1 thereof, **10** designates generally a hollow fuel tank adapted to contain a quantity of liquid fuel **11**, such as gasoline or the like. An upstanding tube or filler neck **12** is provided on the upper side or top wall **13** of the tank **10** and communicates between the interior and exterior of the tank. Threadedly engaged or otherwise secured over the upper end of the filler neck **12** is a removable or detachable cap **14**, which is provided with any conventional escape vent or safety opening, as at **15**, enabling the highly combustible gasoline vapor to pass out from the tank.

While the fuel surface **18** is illustrated as being spaced below the upper wall **13** of the tank **10**, it is appreciated that sufficient fuel may be introduced into the tank to engage with the top tank wall and enter into the filler neck **12**. However, in all tank constructions there will be some space interiorly the tank, above the fuel surface, within which vaporized fuel will gather; and, for purposes of illustration, this region of vaporized fuel is shown as being below the upper tank wall **13**, as at **19**. Connected to a lower region of the tank **10** is a conduit **20**, which communicates between the interior of the fuel tank and an internal combustion engine (not shown), say the carburetor thereof.

A conduit **22**, which may be fabricated of flexible material, has one end (not shown) adapted to be connected to an internal combustion engine, say for fluid communication with the intake manifold thereof. The other end **23** of the conduit **22** is connected in fluid communication, as by a tube generally designated **24**, with the upper region **19** interiorly of the tank **10**.

In particular, the tube **24**, which is preferably fabricated of rigid material, includes a generally vertically disposed portion **25** extending through the tank cap **14**, and a laterally or generally horizontally extending portion **26** on the upper end of the tube portion **25** connected to the end **23** of the conduit **22**, as by snug insertion into the latter. The generally vertical tube portion **25** extends slidably through a bushing **28**, fabricated of rubber or other suitable material, and is provided on its lower end, interiorly of the tank **10**, with a downwardly flaring portion or funnel **27**. The bushing **28** serves to frictionally retain the tube portion **25** in any selected position of its vertical sliding movement, so that the downwardly opening funnel **27** can be selectively adjusted relative to the fuel surface **18**.

Also formed in the upper tank wall **13**, appreciably spaced from the filler neck **12** and funnel **27**, is a through opening **29**. A one way valve, generally designated **30**, is secured exteriorly of the tank top wall **13** over the aperture **29**. The valve **30** is preferably of the spring pressed ball type and includes a generally cylindrical upstanding casing or housing **31** having its lower end and fixedly secured to the exterior surface of the tank top wall **13**, as by a peripheral flange **32**. The upper end of the housing **31** is closed, except for a central aperture or opening **33**. Interiorly of the housing **31** is disposed a coil compression spring **34** which has its lower end seated on the upper surface of the tank top wall. A spherical valve closure element or ball **35** is interposed between the upper end of the spring **34** and the upper end wall of the housing **31**, and resiliently biased upwards into closing relation with respect to the housing aperture **33**. That is, the ball **35** normally seats against the underside of the upper housing wall to close the opening **33**, and is resiliently retained in closing relation by the spring **34**. The spring is of such strength that the application of vacuum from the intake manifold of the internal combustion engine through the conduit **32** and tube **24** to the interior tank region **19**, will permit the ambient or external atmospheric pressure to depress the

ball 35 away from the opening 33 to open the latter. Hence, the valve 30 is of the suction type and automatically operated in response to the communication of vacuum from the intake manifold of the engine to the interior of the fuel tank 10.

When the engine is being operated, the manifold vacuum will be applied to the interior of the tank 10 in the region 19 above the fuel surface 18, and serve to open the valve 30 for admitting air into the tank region 19 to mix with the fuel vapor. Thus, a highly combustible air-fuel mixture is formed in the region 19, and drawn by the manifold vacuum through the tube 24 and conduit 22 to the engine. As the top wall opening 29 is spaced apart from the intake funnel 27 of the tube 24, the air admitted through the valve 30 passes over a substantial area of the fuel surface 18 and thereby serves to increase or accelerate vaporization of the fuel.

The bushing 28 serves to frictionally hold the vertical portion 25 of the tube 24 in any selected position of vertical adjustment, while allowing the tube to be manually shifted up and down to position the downwardly flaring tube end or funnel 27 in proximity with the fuel surface 18. It has been found that the downwardly flaring configuration of the funnel 27 allows a greater quantity of air fuel vapor mixture to reach the engine; and further, that location of the funnel 27 adjacent to the fuel surface 18, in the region of the most dense fuel vapor, produces a richer air-fuel mixture in the conduit 22.

It will be noted that the presence of the safety vent 15 does not in any way hamper or impair operation of the system. That is, the vent 15, being open at all times, constantly prevents an increase in pressure within the tank 10 beyond atmospheric pressure; and, during normal operation the vent permits the ingress of a small additional quantity of air for mixture with the fuel vapor.

As the valve 30 remains open under normal engine operating conditions, it will now be understood that a continuous supply of air-fuel mixture will flow through the conduit 22 to the engine.

In Figure 2 is illustrated a slightly modified fuel supply system of the present invention, wherein a tank 10', containing liquid fuel 11', is provided in its top wall 13' with an upstanding filler neck 12' having a conventional, detachable closure cap 14'. A liquid fuel supply line 20' is connected to a lower region of the tank 10' and adapted to communicate between the tank and an internal combustion engine (not shown).

A conduit 22' has one end portion (not shown) adapted to be connected to an internal combustion engine, in fluid communication with the intake manifold of the engine, and has its other end portion shaped to flare or diverge downwards, defining a funnel opening downwards through the upper tank wall 13'. Viewed otherwise, the upper tank wall 13' may be considered as formed with a conical dome 38 communicating between the conduit 22' and the upper interior region 19' of the tank 10'. Interiorly of the funnel 38 are provided one or more generally horizontal baffle plates 39 arranged to intercept and catch the heavier particles or droplets of fuel vapor.

The valve 30' is substantially identical in structure with the valve 30 of the first described form of the invention illustrated in Figure 1, and is arranged over an opening or hole 29' formed in the upper tank wall 13' spaced from the funnel 38.

The cap 14' is formed with a safety vent 15' which remains open at all times to prevent the build up of pressure in the tank 10' and admit a small quantity of air to the tank during operation of the engine for mixture with the full vapor.

The valve 30' operates or opens to admit air to the tank 10' under the same conditions as described in connection with the valve 30, i. e., in response to the vacuum of an intake manifold being applied to the interior of the tank. The air thus admitted mixes with the fuel vapor in the tank region 19' to form a highly combustible air-fuel mixture, and passes over the fuel surface 18' and through funnel 38 and conduit 22' to the engine. The passage of air over the fuel surface 18' serves to increase vaporization of the fuel; and, the funnel baffles 39 effectively prevent the movement of relatively large droplets through the funnel 38, so that a rich and well vaporized air-fuel mixture is continuously conveyed to the engine during engine operation.

From the foregoing, it is seen that the present invention provides a fuel line supply system which fully accomplished its intended objects, and is well adapted to meet practical conditions of manufacture and use.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A fuel line system for an internal combustion engine, said system comprising a conduit having one end adapted for connection to the intake manifold of an internal combustion engine, the other end of said conduit communicating with the interior of a liquid fuel holding tank in the region above the fuel surface, the intake manifold vacuum serving to draw vaporized fuel from said tank inwards through said other conduit end to said manifold, and a normally closed one way suction valve located in a wall portion of said tank above said fuel surface to automatically admit air to said tank for mixture with the fuel vapor being conducted to said manifold, whereby a continuous supply of fuel vapor-air mixture is adapted to be conducted to said manifold, said other conduit end being mounted in said tank for vertical movement, whereby said other conduit end is adapted to be adjusted into proximity with said fuel surface for receiving relatively dense fuel vapor.

2. A fuel line system for an internal combustion engine and a liquid fuel-holding tank having a removable closure cap on an upper region of said tank, said system comprising a conduit having one end adapted for connection to the intake manifold of an internal combustion engine, a tube connected at one end to the other end of said conduit and passing downwards through the cap into the interior region of said tank above the fuel surface, the intake manifold vacuum serving to draw vaporized fuel from said tank inwards through said tube and conduit to said manifold, and a normally closed spring biased one way valve located in a wall portion of said tank above said fuel surface, said valve opening in response to vacuum communicated to said tank from said intake manifold to admit air to said tank for mixture with the fuel vapor being conducted to said manifold, whereby a continuous supply of fuel vapor-air mixture is adapted to be conducted to said manifold during engine operation.

3. A fuel line system according to claim 2, wherein said tube is slidable up and down in said cap and frictionally retained at any selected position of its sliding movement, thereby enabling the lower end of said tube to be positioned adjacent to the fuel surface for receiving relatively dense fuel vapor.

4. A fuel line system according to claim 2, wherein said valve is spaced from said tube to draw the admitted air over the liquid fuel and increase vaporization of the latter.

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