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FUEL LEVEL CONTROL SYSTEM

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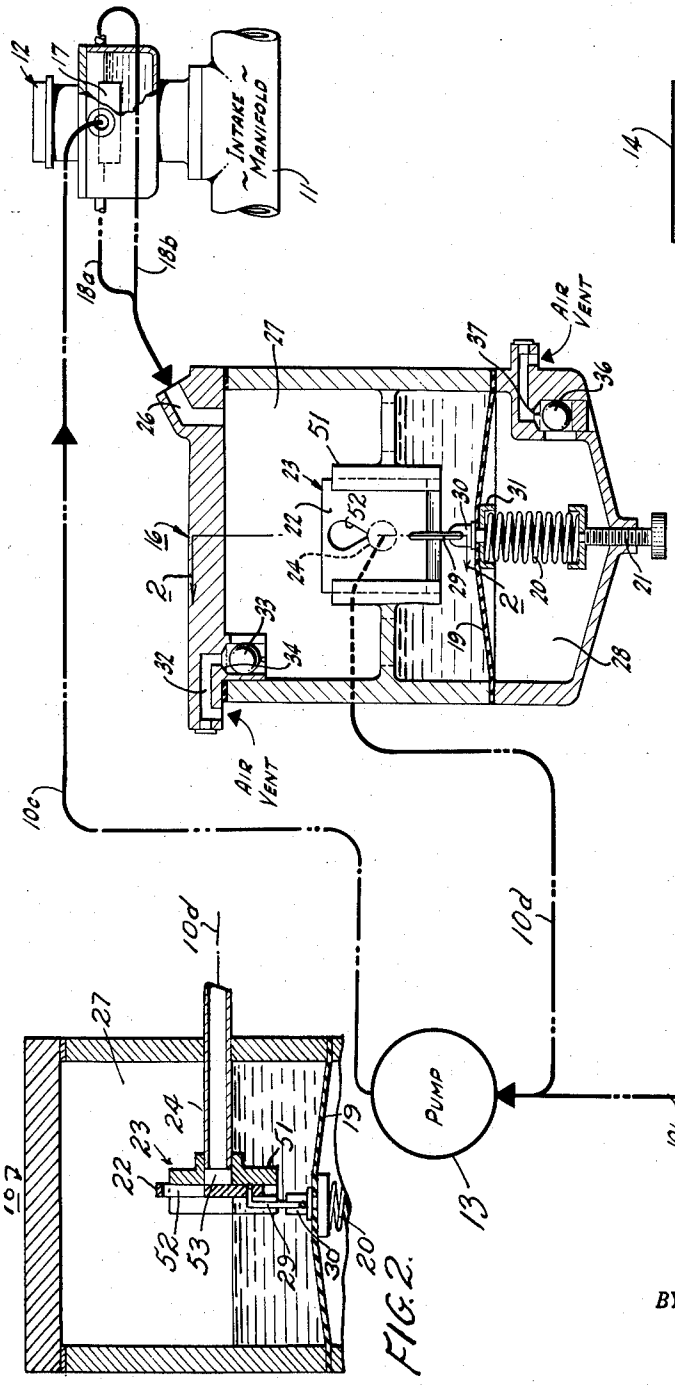


FIG. 1.

FIG. 2.

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FUEL LEVEL CONTROL SYSTEM

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This invention relates to the field of internal combustion engines, and more particularly to fuel level control systems for carburetors and other fuel metering devices.

As discussed in considerable detail in my copending application, Serial No. 814,426, filed on May 20, 1959, now Patent No. 2,998,056, the conventional internal combustion engine often is unduly subject to flooding when the air-fuel ratio becomes too rich due to sudden lurches, stops, stalls, etc. In the abovenoted system, the problem of flooding is overcome by providing a plurality of overflow orifices about the periphery of the carburetor bowl which act to drain off temporary excess of gasoline resulting from the vibrations, sharp acceleration, deceleration, and/or parking on hills. In accordance with that invention, these orifices are placed at least at the forward and rearward side of the carburetor bowl so that any temporary high level of gasoline at the rear or forward wall will flow through the overflow orifices into an auxiliary tank or fuel level controller. Such an overflow permits the level of gas in the carburetor to be lowered to permit the carburetor float to open for compensatory pumping by the fuel pump, and otherwise permits the carburetor to function in its proper and intended manner.

The auxiliary overflow tank which collects the overflow gasoline is connected through a two-way, float-operated valve to the fuel pump so that whenever the level in the auxiliary tank reaches a predetermined height, the fuel pump is switched to the auxiliary tank and pumps fuel from it rather than from the fuel tank. By the use of this combination including a conventional carburetor, the overflow orifices, an auxiliary tank, and the two-way float valve, which is operated by the level of fuel in the auxiliary tank, it is possible to provide a system which is substantially free from the propensity to flood that plagues so many internal combustion engines.

In one sense the present invention constitutes an improvement over my previous invention, and, in another, a different invention. One of the shortcomings of the previous system occurs when the auxiliary overflow tank and other system components are associated with an internal combustion system in which the fuel storage tank is either well below or well above the fuel pump. In such a situation, the system, as disclosed in my previous application, requires the fuel pump of the truck or other vehicle to pump the gasoline out of the fuel tank up to the level of the fuel level controller device at the overflow tank and thereafter through the pump and up to the carburetor. In many situations, fuel pumps employed as standard equipment on automobiles and trucks are not adequate to pump against such a head. Thus, it has been necessary to redesign the present fuel level controller system in order to accommodate systems wherein the fuel storage tank is either well above or well below the fuel pump and carburetor. As a result, in the present system a modified fuel level controller at the overflow tank cooperates with an automatic shut-off valve connected intermediate the fuel tank and the connection of the overflow tank to the fuel pump. By modifying the fuel level controller at the auxiliary tank, and incorporating it into a system employing an independent shut-off valve, it is possible to provide a system satisfactory for a variety of adverse pumping conditions. In the present system the fuel pump normally pumps gasoline through the automatic

shut-off valve from the fuel tank and, when the level in the auxiliary overflow tank rises to a predetermined level, it pumps gasoline from the auxiliary overflow tank, and, at the same time, the shut-off valve automatically closes to prevent further pumping from the fuel storage tank.

This system not only works automatically but prevents the fuel pump from having to pump gasoline from the fuel tank up to the level of the fuel level controller, and thereafter back through the pump and up to the carburetor, a pumping requirement which has been found to be too great, in many cases, for the standard-supplied fuel pumps of conventional internal combustion systems.

Objects of the invention, therefore, are to provide a carburetor fuel level control system which acts to prevent absolutely the conventional float-operated carburetor from flooding, and which will operate satisfactorily with a variety of engine systems, irrespective of the relative height of the fuel tank, fuel pump, carburetor, and auxiliary tank. Other objects relate to the auxiliary tank and the automatic shut-off valve which are readily adaptable to cooperate with large numbers of existing internal combustion engines, their carburetors, fuel pumps, and fuel storage tanks, to simply, economically and effectively prevent flooding therein.

Features of the invention principally pertain to the improved diaphragm-type auxiliary tanks employed in the present fuel level control system, the automatic shut-off valve and the combination of these devices in the overall system to attain one or more of the objects stated above.

These and other objects and features may be more fully understood when the following detailed description is read with reference to the drawings.

FIG. 1 illustrates the fuel level control apparatus in the condition where the level of fuel in the overflow tank is below the level required to open the overflow valve and the fuel pump suction is connected to the storage tank through a shut-off valve which is in an open position.

FIG. 2 illustrates the partial cross-section taken on the line 2—2 of FIG. 1 indicating the operation of the slide valve.

Considering first generally the system disclosed in FIG. 1, it will be seen that the exemplary system consists of an intake manifold **11**, a conventional float-operated carburetor **12**, a fuel pump **13**, a fuel or storage tank **14**, an automatic shut-off valve **15**, and an auxiliary tank or fuel level controller **16**.

In normal operation and as illustrated in FIG. 1, gasoline is pumped from the fuel tank **14** through the automatic shut-off valve **15** by the pump **13** to the float-operated carburetor **12**, as shown by the lines **10***a*, **10***b*, and **10***c*. From there, the gasoline is fed through to the intake manifold **11** and into the combustion chambers of the engine. Whenever a sudden acceleration, deceleration, or other change in motion causes the level of the fuel floating the carburetor float **17** to shift, the excess gasoline flows through tubes **18***a* and **18***b* into auxiliary tank **16**. After the level of gasoline in the auxiliary tank **16** reaches a level determined by the loading placed on the diaphragm **19** which reduces the tension placed on the diaphragm **19** by the helical spring **20** through the adjustable means **21**, the diaphragm **19** flexes downward to slide the sliding member **22** of the overflow valve **23** into a position which will place the aperture **52** into communication with the tube **24**, thereby opening the overflow valve **23**. This permits the excess fuel to be drawn through the tube **24** by the fuel pump **13** through the connection **10***d*. As soon as the fuel pump **13** is able to pump gasoline from the auxiliary tank **16**, the shut-off valve **15** closes automatically—as will be explained below—and remains closed until such time as the overflow valve **23** associated with the auxiliary tank **16** closes.

More particularly, the gasoline from the overflow lines 18*a* and 18*b* of the carburetor 12 are joined through a Y-connection to the carburetor input orifice 26 that connects to the interior chamber 27. The auxiliary tank 16 includes the upper chamber 27 and a lower chamber 28, in which is positioned the helical spring 20, and its degree of compression is adjustable by threaded member 21. The two chambers are separated by the diaphragm 19, which is formed of a metal or other type of flexible material affixed at its outer periphery to the edges of the tank 16. For a fuller understanding of the operation of the diaphragm and its connecting parts reference should be made to FIG. 2 as well as FIG. 1. The center portion of the diaphragm 19 has a button 30 to which is connected a driving link 29 which further connects to a sliding member 22 of the overflow valve assembly 23, whereby the movement of the diaphragm 19 is imparted to the sliding member 22. A support member 31 is affixed to the back or lower side of the diaphragm 19, and acts to maintain the helical spring 20 between the diaphragm proper and the adjustable means 21. When the level of gasoline resting on the upper side of the diaphragm 19 reaches a level, as determined by the amount of compressive strength stored in helical spring 20, the diaphragm 19 flexes downwardly through the action of the connecting member 29 to move the apertured sliding valve member 22 within its slotted support 51 so that the aperture 52 of the sliding member 22 is moved into a position overlying the opening 53 at the end of the tube 54, thereby permitting fuel within the overflow tank to flow into the tube 24 and to the pump 13 via the connection 10*d*. Obviously the setting of the spring 20 should be such that the level of fuel within the overflow chamber is at least at the level of the opening 53 before the diaphragm moves the sliding member 22 to position the aperture 52 across the end of the tube 24 and open the valve 23. The sliding-type valve has the advantage of minimizing the pressure necessary to overcome the frictional resistance of the valve structure proper. The aperture 52 is formed in a heart-shape to permit more sensitive control of the flow from the tank 16.

Both the upper and lower chambers 27 and 28 have air vents cooperating with them in order to equalize pressure between the two chambers during operation. The upper air vent 32 includes a float ball or other device 33—staked in a restricted vertical space—which acts to seal the air vent when gasoline in the auxiliary chamber 27 reaches the height of the air vent itself. Thus, ball 33 is hollow and bears against the valve seat 34 if fuel rises too high in the auxiliary chamber 27. A similar float ball 36 is contained in a limited space 37 in the lower chamber 28, and acts to block the flow of gasoline into the region surrounding the engine in the event the diaphragm 19 ruptures and gasoline enters the lower chamber 28.

Turning to the automatic shut-off valve 15, it can be seen to include a vertically movable valve and stem 41 cooperating with a valve seat 42. The upper part of the valve 41 supports one end of a helical spring 43, which is adjustably compressed by rotating member 44, as illustrated. The other end or stem of the valve 41 is connected to a flexible plate 46, which is connected at its outer surfaces by screw or other members 47 to the valve body 48. The adjustment screw 44 is set so that as long as the fuel pump 13 is not pumping fuel from the auxiliary tank 16 the vacuum within the body of the shut-off valve 15 below the valve seat 42 is such that the differential pressure between the interior of the fuel pump line and the atmosphere bearing on the outside of flexible member 46 is sufficient to maintain the valve 41 opens against the force of the spring 43. However, as soon as the valve 23 of the auxiliary tank 16 opens there is a loss of vacuum in the line 10*b* which reduces the pressure differential between the two sides of the flexible member 46 and the spring 43 is sufficiently strong to close valve 41 against its seat 42. Thereafter, as soon as the pump has lowered the level of gasoline in the auxiliary tank 16 to a proper level, the valve 23 closes and the pump capacity increases the vacuum in line 10*b*. As a consequence, a pressure differential across the two sides of the flexible member 46 is increased so that the member 46 is flexed inwardly to unseat the valve 41 and open the shutoff valve assembly 15 so that the pump 13 draws gasoline from the fuel tank 14.

As explained in greater detail in my prior application, the equilibrium condition, with the pump pulling gasoline from the fuel tank 14 (through the shut-off valve 15), continues until such time as a sudden interruption of the equilibrium in the carburetor 12 occurs and the fuel level in the carburetor bowl rises above the normal operating level. In the present system, this causes gasoline to flow through tubes 18*a* and 18*b* into the auxiliary tank or fuel level controller 16. As soon as the level of the gasoline in auxiliary tank 16 reaches a point where the valve 23 is open, the fuel pump 13 transfers its pumping action to that tank, and the shut-off valve 15 interrupts flow from the fuel tank 14. Subsequent closure of valve 23 causes the pump 13 to re-establish the supply from the tank 14 through valve 15.

While one exemplary system in accordance with the present invention has been described in detail, it should be aparent to those skilled in the art that changes and modifications in the system components may be made without departing from the spirit and scope of the invention. Thus, the invention should be limited only by the scope of the appended claims.

What is claimed is:

1. A fuel level control apparatus for a carburetor having overflow means comprising

a storage tank,

a suction pump,

a fuel supply line connecting said storage tank to the suction side of said pump,

a vented overflow tank mounted beneath said carburetor and having an inlet and an outlet,

means connecting the inlet of said overflow tank to receive overflow from said carburetor,

means connecting the oulet of said overflow tank to the suction side of said pump,

overflow valve means operable in response to the level of fuel within said overflow tank controlling the communication between said overflow tank and said outlet and permitting overflow fluid to flow to said outlet only when the level of fuel within said tank is at least at a predetermined level,

an independent shut-off valve interposed in said fuel supply line between said storage tank and the connection of said outlet to said pump, and

valve operating means responsive to the pressure differential between the outlet side of said shut-off valve and the atmosphere to hold said shut-off valve open when said pressure differential is above a predetermined level while said pump is evacuating only said fuel supply line,

said valve operating means including biasing means normally closing said shut-off valve when said pressure differential falls below said predetermined level.

2. A fuel level control apparatus as described in claim 1 wherein said overflow tank includes a flexible diaphragm separating said overflow tank into an upper and a lower portion, said inlet and outlet being located in said upper portion and the vertical position of said diaphragm being dependent upon the level of fuel contained within the upper portion of said overflow tank; and said overflow valve means includes an apertured member movable transversely to an opening associated with said outlet such that communication between said outlet and said overflow tank is blocked except when said aperture overlies said opening, said apertured member being operably connected to said diaphragm whereby the opening from the overflow tank to said outlet is closed until the weight of a predetermined amount of fuel acting on said diaphragm

causes said member to slide into a position whereby the aperture overlies said opening.

3. A fuel level control apparatus as described in claim 2 wherein said shutoff valve comprises a first and a second chamber connected by a passage defining a valve seat, one of said chambers connecting to said storage tank and the other to said fuel pump, a flexible diaphragm forming one wall of said first chamber whereby the position of said diaphragm is dependent upon the pressure differential between said first chamber and the atmosphere, a poppet valve cooperating with said valve seat and operably connected to said diaphragm, and resilient means urging said diaphragm against said valve seat, whereby said valve is seated and unseated by the movement of said diaphragm as the pressure differential across said diaphragm changes, said valve being held off its seat by the vacuum within said first chamber when said overflow valve means closes the outlet to said overflow tank

and said fuel pump is being fed from said storage tank through said shutoff valve, and said valve being seated by the force of said resilient means in opposition to said diaphragm when the pressure differential across said diaphragm decreases due to the opening of said overflow valve means connecting said overflow tank to the fuel line.

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