April 12, 1938. E. C. HORTON 2,114,249

FUEL FEEDING SYSTEM

Filed June 15, 1933

Fig. 1

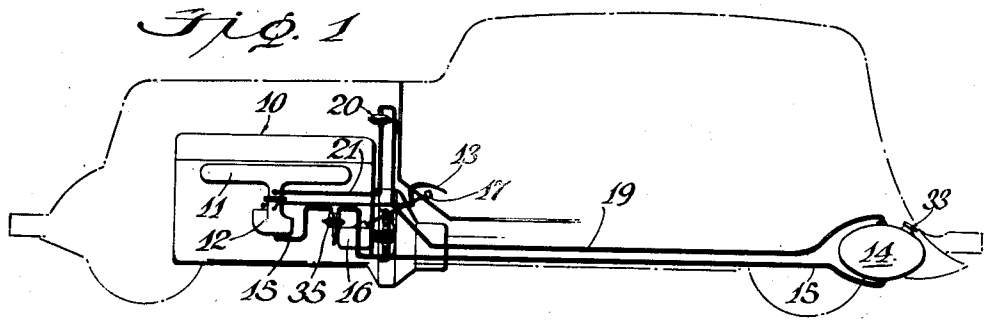


Fig. 3

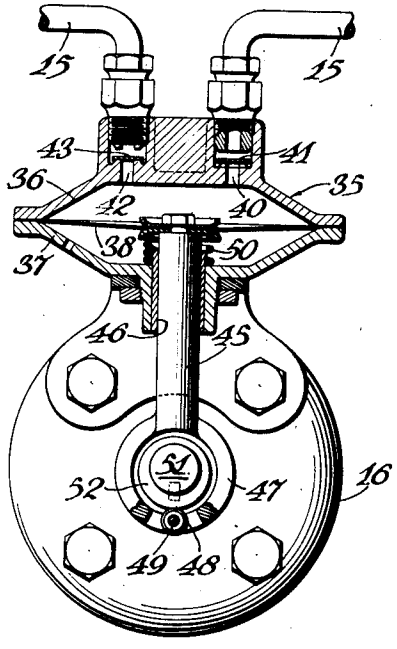


Fig. 2

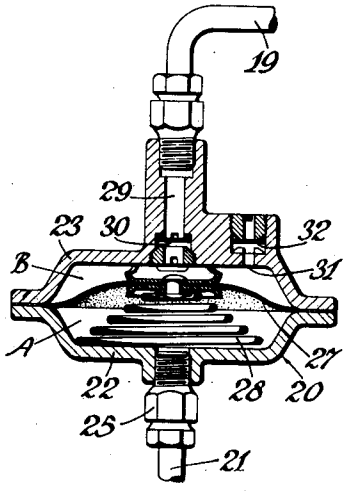


Fig. 5

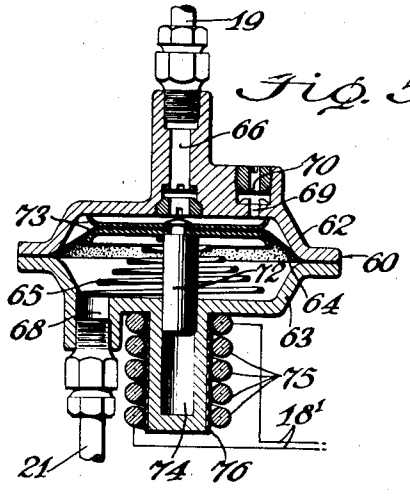
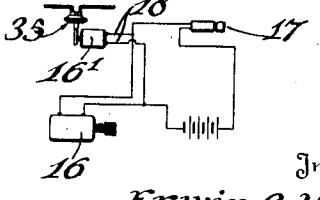


Fig. 4



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FUEL FEEDING SYSTEM

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12 Claims. (Cl. 123—179)

This invention relates to fuel feeding systems for internal combustion engines for use on automotive vehicles, and more particularly to a fuel feeding system which operates by means of pressure applied to the fuel storage tank.

Because of the particular construction of the automobile at the present time with the fuel supply tank located at the rear of the vehicle and at a level lower than the carburetor, it is necessary to provide some means for moving the fuel from the tank to the engine. There are two general classes of devices in use for this purpose, namely, the vacuum tank and the fuel pump. The former comprises a secondary or reserve tank situated at a level above the carburetor, so that, upon drawing the fuel from the storage tank to this secondary tank, it will feed by gravity to the engine. In the latter type of fuel feeding system various sorts of pumps are in use having as their primary operating means either electricity, mechanical power, or fluid pressure. It is to this last mentioned type that this invention is most analogous.

It is the aim of the present invention to provide a fuel feeding system which will be simple in construction having a minimum number of parts, economical to manufacture, and efficient in operation, and one which will overcome some of the disadvantages inherent in the systems now in use. The invention further contemplates the provision of a fuel feeding system in which pressure is preferably applied to the fuel tank to force the fuel to the engine, thus providing a constant, direct and positive flow.

Another object of this invention is to provide an additional fuel pumping means which will become operative upon a reduction of pressure in the above mentioned system, and will thus take care of any emergency.

Other objects and advantages will become apparent from the following description of a typical embodiment of this invention shown in the accompanying drawing in which:

Fig. 1 is a phantom showing of a motor vehicle equipped with the invention;

Fig. 2 is a vertical section through the pressure applying means;

Fig. 3 is a vertical section through the auxiliary pumping means, shown attached to a special cam on the shaft of an engine starter;

Fig. 4 is a diagrammatic showing of another form of electrical circuit for use with the auxiliary pump shown in Fig. 3; and

Fig. 5 is a vertical section through another form of pressure applying means.

In practicing this invention, an internal combustion engine 10, provided with an intake manifold 11 and a carburetor 12 having a throttle pedal 13 connected thereto, is mounted in a conventional manner in a motor vehicle, which is equipped with a fuel storage tank 14. The motor vehicle is further equipped with a self starter 16 having a starting switch or button 17 connected thereto and mounted within the motor vehicle. The storage tank 14 is shown at the rear of the vehicle and is connected to the carburetor by means of a conduit 15, thus providing a means for conveying the fuel from the tank to the engine. However, in the usual construction of motor vehicle, with the fuel supply tank in the rear thereof, it is generally at a level lower than the carburetor and the fuel will not flow by gravity to the engine. Such a condition makes necessary the provision of some other means to force the fuel to the engine.

Connected to the storage tank 14 by a suitable conduit 19 is a pressure applying means 20 which comprises upper and lower casing sections 23 and 22 respectively. Separating the upper section 23 from the lower section 22 is a diaphragm piston 27 which thus divides the inside of the pressure means 20 into a motor chamber A and a pump chamber B, and is constantly urged in an upward direction, or into chamber B by a spring 28. Chamber A is the motor side of the unit and is directly open to a convenient source of fluctuating pressure, such as the intake manifold 11, through a conduit 21 which is attached to section 22 through a suitable fitting 25. Preferably, the pumping means 20 is positioned adjacent the motor vehicle engine, so that the pressure fluctuations in the intake manifold will more freely ebb and flow through the conduit 21 and into the motor chamber A. The pump chamber B has connection with the conduit 19 and storage tank 14 by means of a passage 29 in which is provided a check valve 30 to permit unidirectional flow from the chamber into the tank. An inlet port 31 having a valve 32 therein establishes communication between the pump chamber and the outside atmosphere to permit the inflow of air when the pressure is below atmospheric.

In operation, assuming that the internal combustion engine is operating in a normal manner, there will be created in the intake manifold a sub-atmospheric pressure which will prevail upon the pressure applying means 20 by means of the conduit connection 21 thereto. This sub-atmospheric condition will obtain in the chamber A, and will draw the piston 27 in a downward direc-

tion into the chamber in opposition to the spring 28. Such a movement will intake air through port 31 to be expelled on the next up stroke of the piston. In normal driving conditions of the vehicle the internal combustion engine provides variable suction influences in its intake manifold as the engine throttle is opened and closed. These general variations in the suction influences are utilized to produce fluctuations in the motor chamber A by reason of the sole port connection from the latter to the only source of pressure. In other words, the passage 21 constitutes an ebb and flow connection in which the fluid flow is back and forth as the pressure differential reverses in the two zones, namely, the motor chamber A and the intake manifold 11.

When the piston 27 has been drawn downwardly, as above described, by an increased suction, and the cooperating action of the atmospheric pressure in chamber B, and such suction is released to any degree, as when the engine throttle is opened, the spring 28 will urge the piston upwardly into chamber B, thereby forcing the fluid from that compartment into the fuel storage tank 14 by means of the passage 29 and conduit 19; and one cycle of operation is completed. Upon an increase in suction the piston will again be drawn downwardly, allowing more air to be drawn into chamber B, and a decrease in suction will force this fluid into the storage tank. It can readily be seen that in a comparatively short period of time, a pressure will be built up in the tank 14, and will be maintained therein by means of the valve 30 which prevents any backflow into the pressure applying means. In order that the pressure built up in the tank 14 may be completely held within the tank, the tank is further provided with an airtight cap 33 for its filling opening, rather than the usual type of cap having an air vent. The degree of maximum pressure will be determined by the power of spring 28 which latter is insufficient to unseat the usual carburetor float valve (not shown).

By means of the pressure built up and maintained within the tank 14, the fuel in said tank will constantly be forced through the conduit 15, leading from the bottom of the tank, and into the carburetor to insure a constant supply at all times. When the engine is stopped, the pressure will remain in the system and be sufficient to force more fuel to the engine at re-starting. Usually there will be a sufficient supply of fuel in the carburetor itself to take care of starting conditions, and immediately upon starting of the engine, a push or two upon the throttle pedal 13 will have added a sufficient pressure to the tank to make certain a continuous operation.

However, if any unanticipated condition of leakage, either in the carburetor or in the fuel tank pressure, should render the carburetor supply inadequate for starting, or should the entire supply of fuel become exhausted and a fresh supply of fuel be furnished, necessarily releasing the tank pressure, then to avoid considerable wear on the starter system an additional pumping means may be provided to take care of such emergency. Such a fuel pumping means is shown in Fig. 3 and is indicated generally by the numeral 35.

As shown in this figure, this additional pumping means may comprise an upper casing section 36 and a lower casing section 37, said upper and lower sections being separated by a piston or diaphragm 38. The pump is thus formed with a fuel or fluid chamber in its upper half, and is provided with an inlet port 40 having a valve 41 and an outlet port 42 having a valve 43. With the pump 35 interposed in the conduit 15 as described, the fuel forced from the tank 14 during the normal operation of the system will enter the upper section 36 of the additional pumping means through the valve 41 and the port 40 and pass out through the port 42 past the valve 43, thence again into the conduit 15 and on to the carburetor.

Attached to the piston 38 is a shaft 45 mounted for reciprocatory movement in a bearing 46, and being provided with a yoke 47 at its outer or lower end, said yoke having a roller 48 mounted thereon by means of a pin 49. A spring 50 constantly urges the shaft 45 and the piston 38 attached thereto in an upward direction. Depending upon the use to which this auxiliary pump is to be put, its means of actuation may be either the shaft of the self starter or some moving part of the engine itself. If it is desired to have the pump take care of insufficient pressure conditions at starting, then the shaft of the starter should be used. If the additional pumping means is to be used to facilitate any unanticipated loss of pressure during driving, the actuating means ought to be some moving part of the engine.

As shown in Fig. 3, the auxiliary pumping means is being used in conjunction with the self starter 16 of the internal combustion engine. The starter is provided with an extended shaft 51 on which is mounted a cam 52, and the yoke 47 of the pump encircles the shaft 51 in such a manner that the roller 48 may be moved into and out of contact with the cam 52. When the roller is in contact with the cam, and the starter is actuated by means of the starter button or switch 17, the piston will be given a reciprocatory movement within the casing 36, 37. Downward movement of the piston will draw in fuel from the storage tank 14, and an upward movement will force the fuel thus present in the upper section of the pump casing into the carburetor through the conduit 15.

If it is not convenient to use the auxiliary pump 35 in conjunction with the self starter of the engine because of inaccessibility due to location on the vehicle, and it is still desired to use the pump to take care of starting conditions, then a small electric motor may be hooked into the starter circuit of the vehicle and used as the means of actuation of the pump. Such a circuit is shown in Fig. 4 in which 16 represents the regular self-starter, 16' the auxiliary electric motor, and 17 is the switch or starter button, the motor 16' being connected into the circuit by the lead wires 18.

Assuming that the pressure applying means connected to the fuel supply tank is functioning in its normal manner, then the fuel in the tank and in the supply conduit 15 will be under pressure. Since the additional pumping means is interposed in the conduit 15, the upper fuel section 36 will also contain fuel under pressure, and the piston 38 will be depressed downwardly in opposition to the spring 50 an amount dependent on the pressure in the system. Under these circumstances the roller 48 will be out of contact with the cam 52, and such a condition of pressure in the fuel feeding system will be maintained during normal operation of the vehicle. If for any reason, the pressure in the system should be released, the piston 38 and shaft 45 would be pushed upwardly by the spring 50 thus moving the roller 48 into registry with the cam

52 to be actuated thereby. If a fresh supply of fuel is passed into an exhausted system, then upon rotation of the starter shaft 51, the pump 35 will be operated and fuel will be fed to the carburetor thereby. However, when the engine is started, the pressure will be built up in a very short interval by the pressure pump 20, thus forcing the piston 38 downwardly and bringing the roller out of contact with the cam.

Thus it will be obvious that by bringing the starter system into operation, auxiliary means are set into action to assist the pressure operated pump in its efforts to move fuel from the storage tank 14 to the engine. Such a means has been shown to comprise a separate auxiliary pumping means, as 35, interposed in the conduit 15 and operative upon closing the starter circuit. The two pumping elements 27 and 38 may be one and the same element in a pump unit. Such a common pumping element is illustrated in Fig. 5.

In this figure is shown another form of the invention in which the auxiliary pumping means, to be operated in conjunction with the starter system, is incorporated directly within the pressure applying means, and comprises a self return piston operated by an electro-magnet or solenoid which latter is energized when the starter system is brought into use. Such a fuel feeding device is indicated generally at 60, and comprises upper and lower casing sections 62 and 63, separated by a common piston 64, which is constantly urged in an upward direction by a spring 65. Thus, by means of the piston 64, the inside of the pump 60 is divided into an upper or pump chamber and a lower or motor chamber, the former being connected to the conduit 19 and tank 14 through a passage 66 having a valve 67, and the latter being connected to the source of suction through the ebb and flow passage 68 and the conduit 21. The pump chamber is also connected to the atmosphere by means of a port 69 containing a valve 70 permitting unidirectional air flow into the chamber.

It will be apparent that the above described construction is thus far directly similar to the pressure applying means 20. In addition to the above-described similar features, however, the pump 60 has its piston 64 provided with a guiding stem 72 attached thereto through a pair of reinforcing discs 73 preferably made of steel or other magnetic material. The stem 72 has a loose guiding fit in a well 74 in the lower casing section 63, which is formed of a non-magnetic material. Such a stem is particularly desirable where the piston has rather large displacement.

When starting the engine, after the first supply of gasoline has been poured into the storage tank and before the fuel has reached the carburetor, one or two operations of the starter by successive closings of the starter circuit will operate the piston 64 to provide sufficient air pressure on the fuel in the tank 14 to cause it to flow to the carburetor. Where the piston displacement is large, it may be advantageous to assist the manifold suction in moving the piston against the tension of the spring 65. For this purpose several windings 75 of rather large wire (preferably of 11/32 of an inch in diameter or greater) are placed around the well 74 and insulated therefrom by a layer of insulation 76. These windings 75 are connected into the starter circuit by wires 18' and form an electro-magnet, so that when the current passes therethrough, which ranges between 150 and 400 amperes, ample attractive force is provided to materially assist the manifold suction, and will in fact provide sufficient power in itself to attract the piston downwardly and the stem 72 into the well 74 for intaking air through the inlet valve 70.

The guiding stem 72 therefore constitutes a core or armature for the solenoid 75 and, together with the steel reinforcing discs 73, serves to increase the attractive effort of the windings 75. Upon releasing the starter switch to open the circuit the magnetic attraction will disappear to permit the spring to urge the piston on its air expelling stroke. This construction provides an emergency or auxiliary device which operates with the starter circuit to help create the fuel forcing pressure in the tank 14. It is obvious that such an electromagnet could be used in conjunction with the auxiliary pumping means 35, shown in Fig. 3, by having the windings encircle the shaft or stem 45 as a core.

Thus, in either form of the invention, the fluid pressure operated pump will have some assistance from the power plant, which assistance is only operative when the pressure operated pump requires such aid, and is preferably operative only with the operation of the self starter system. Further, it will be observed that the assisting pump may be combined with the pressure operated pump as a unit and that the two pistons may be incorporated into a single one which is common to both pumps.

From the foregoing description it will be apparent that this invention provides a means for supplying fuel to the internal combustion engine of an automotive vehicle in which there is a minimum number of moving parts, and hence it is a mechanism which will require little, if any, care. It will further be apparent that by means of this invention a fuel feeding system is provided in which there will be a constant and positive flow of fuel to the engine at all times, such flow being maintained incidental to the normal control and driving of the vehicle since every time the throttle is opened and closed the pump 20 is actuated; and finally there is provided an emergency fuel pumping means to be used in cooperation with the pressure applying means to take care of any unanticipated situation of operation.

Although only the preferred forms of the invention have been shown and described in detail, it will nevertheless be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a fuel feeding system for an internal combustion engine, a fuel tank in communication with the engine, means for creating a pressure in the tank to force fuel from the tank to the engine, and pumping means for mechanically pumping fuel from the tank to the engine, said pumping means having associated therewith means responsive to deficiency of the tank pressure to render the pumping means operable.

2. In a fuel feeding system for an internal combustion engine, a fuel tank in communication with the engine, means for creating a pressure in the tank to force fuel from the tank to the engine, a mechanically driven wet pump for moving fuel from the tank to the engine, and means associated with said pump and responsive to deficiency of the tank pressure for rendering said pump operable.

3. In a fuel feeding system for an internal combustion engine, a fuel tank, means for conducting fuel from the tank to the engine, means for applying pressure to the tank to force fuel to the engine, and fuel pumping means interposed in said conducting means between the tank and the engine, the fuel pumping means having means associated therewith effective upon deficiency of pressure in the system to render the fuel pumping means operable.

4. In combination with a tank pressure operated fuel feeding system for an internal combustion engine, of auxiliary means in a fuel line between the tank and engine for pumping fuel to the engine, and means associated with the auxiliary means and effective upon deficiency of pressure in the system to render said auxiliary means capable of operation.

5. In combination with an internal combustion engine having a starting system, a fuel tank, conduit means between the tank and engine, means for applying pressure to said tank for forcing fuel to the engine, and fuel pumping means associated with said conduit means for pumping fuel from the tank to the engine, said fuel pumping means having associated therewith means effective upon a reduction of pressure in the tank for rendering said fuel pumping means operable by said starting system.

6. In a fuel feeding system for an internal combustion engine, a fuel storage tank, conduit means establishing communication between the tank and engine for the passage of fuel, means connected to the tank for creating a pressure therein to force fuel therefrom to the engine, pump means in said conduit means for mechanically moving fuel through said conduit means from the tank to the engine, said pump means including a power drive and pressure controlled means for rendering the pump operable by said drive when the pressure in the tank is insufficient and inoperable when such pressure is sufficient.

7. In a fuel feeding system for an internal combustion engine, a fuel storage tank, conduit means for conducting fuel from the tank to the engine, means for creating pressure in the tank for forcing fuel therefrom to the engine through the conduit means, an engine starting motor, and pump means in said conduit means for pumping fuel through the conduit to the engine, said pump means including a pressure responsive drive connection with the starting motor for rendering the pump means operable by the starting motor when the pressure in the tank is insufficient and inoperable by the starting motor when such pressure is sufficient.

8. In a fuel feeding system for an internal combustion engine having a starting motor, a fuel tank and a conduit for conducting fuel from the tank to the engine, primary means for urging fuel through the conduit under a moving pressure, and auxiliary pumping means in said conduit for urging fuel through the conduit, said auxiliary means including pumping elements adapted to be operated through drive means by the starting motor and drive means responsive to the pressure in said conduit rendering the pumping elements operable by the starting motor when said pressure is insufficient and inoperable by the starting motor when said pressure is sufficient.

9. In a fuel feeding system for an internal combustion engine, a fuel storage tank, conduit means establishing communication between the tank and the engine, fluid pressure operated means for applying pressure to said tank, means in said conduit means and including a piston for forcing fuel to the engine, and auxiliary means for exerting a moving urge upon the piston.

10. In a fuel feeding system for an internal combustion engine, a fuel tank, a fuel conduit extending from the tank to the engine, means for forcing fluid under pressure into the fuel tank, and a fuel pump in the fuel conduit for pumping fuel through said fuel conduit, said pump having pressure responsive valve means associated therewith for enabling fuel to pass through said conduit to the engine when said fuel pump is not operating.

11. In a fuel feeding system for an internal combustion engine, a fuel storage tank, a conduit establishing communication between the tank and the engine, means having a source of operating energy for applying pressure to said tank, and means in said conduit for propelling fuel through the latter, said last mentioned means having a source of operating energy independent from the first mentioned source of operating energy.

12. In a fuel feeding system for an internal combustion engine, a source of variable fluid pressure, a fuel storage tank, conduit means establishing communication between the tank and engine, means operable by the variation in fluid pressure of said source for applying pressure to said tank for forcing fuel to the engine, and means associated with said conduit means for at times propelling fuel through the latter.

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