Sept. 12, 1944. G. GERSON 2,357,947

FUEL FEED SYSTEM

Filed Jan. 2, 1942 2 Sheets-Sheet 1

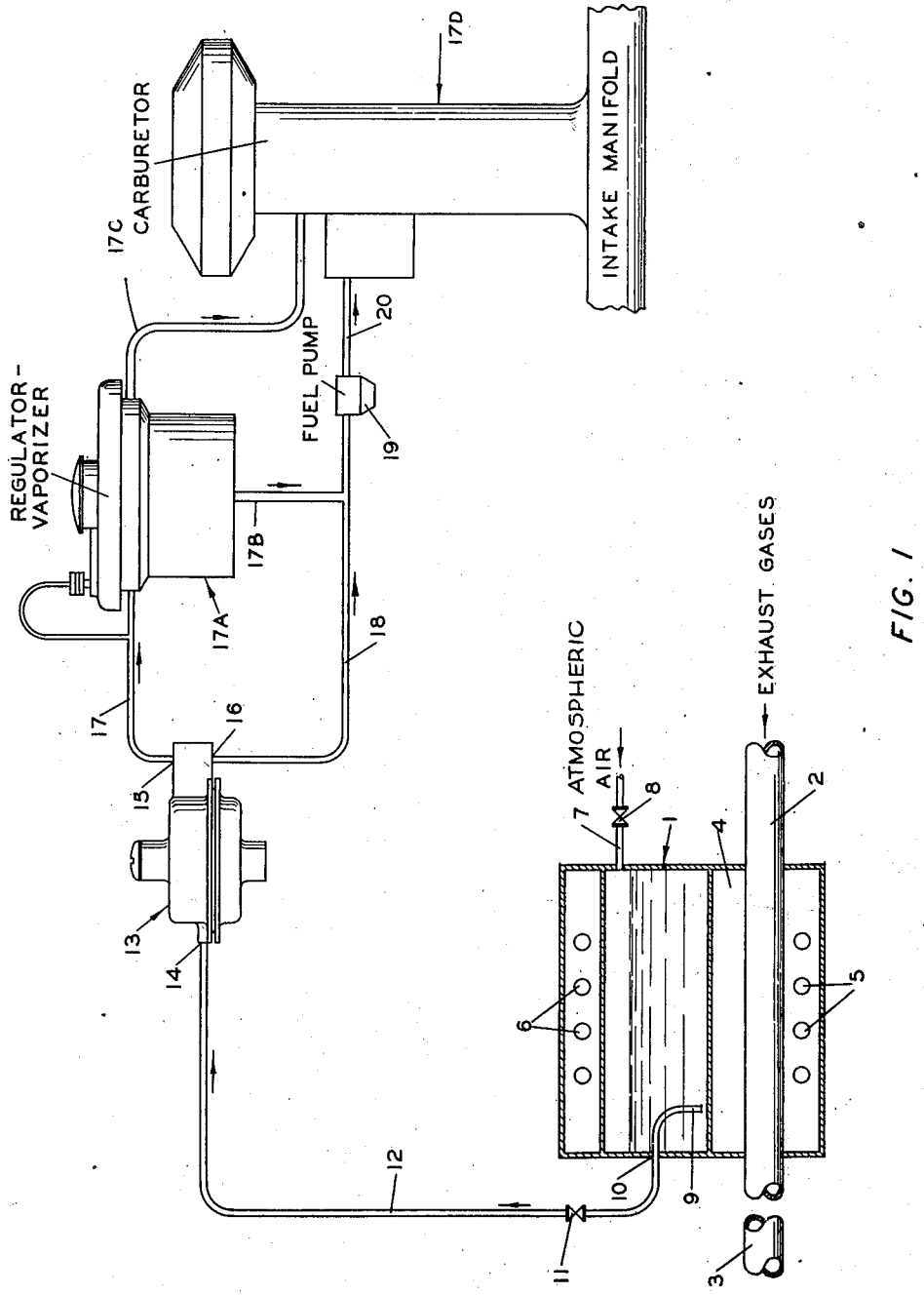


FIG. 1

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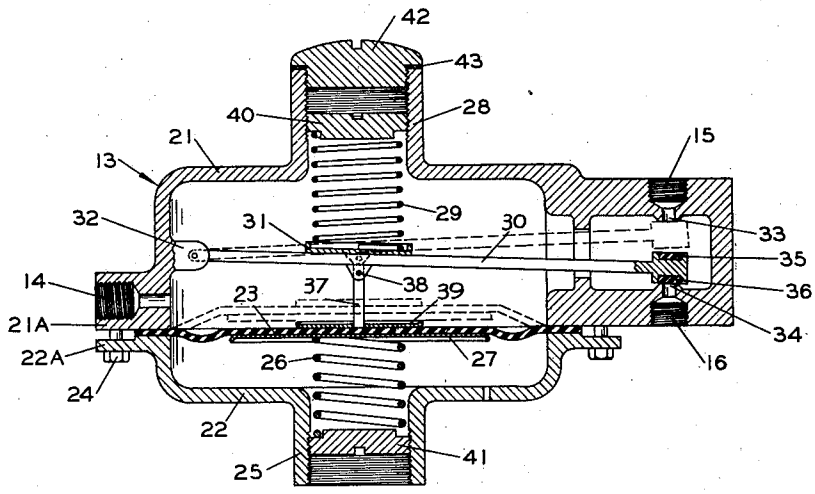


FIG. 2.

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Patented Sept. 12, 1944

2,357,947

UNITED STATES PATENT OFFICE

2,357,947

FUEL FEED SYSTEM

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Application January 2, 1942, Serial No. 425,449

3 Claims. (Cl. 123—139)

My invention relates to fuel systems in which the use of natural gasolines and other high vapor pressure fuels in internal combustion engines is contemplated.

Various carburetor and fuel system ideas have recently been evolved to handle and utilize 26 to 40 pounds per square inch Reid vapor pressure gasoline, as well as other fuels of still higher vapor pressure, such as butane, propane, and mixtures thereof. Typical examples of these devices are my co-pending application Serial No. 402,417, filed July 14, 1941, and the copending joint application of myself and D. B. Byers Serial No. 403,462, filed July 21, 1941 and now abandoned.

A serious operating difficulty is experienced with all such devices under certain conditions of low temperature, due to the fact that the vapor pressure of the fuel has been relied upon to supply the requisite pressure to deliver the fuel from the supply tank to the carburetor, vaporizer, or whatever equipment may be employed prior to introduction of the fuel into the engine manifold. At low atmospheric temperatures, however, there may not be enough vapor pressure to assure delivery of the fuel to the desired point. Propane would almost never give this trouble; butane would sometimes give trouble, and frequent trouble would be encountered with the natural gasolines in cold climates.

Various means to overcome this sort of trouble have been proposed previously. One popular remedy has been to inject a charge of compressed air in the fuel tank by means of a tire pump, or from an air compressor at a gasoline filling station This arrangement has the disadvantage that air tends to go into solution with the fuel, resulting in rapid dissipation of the pressure, and the tank must, therefore, be charged with air at frequent intervals.

Certain types of high pressure fuel carburetors require a fuel pump in any event to insure positive delivery of the separated liquid phase from the vaporizer to the carburetor. Electrically operated pumps are obviously very expensive for the purpose in question, and furthermore, impose an undue load on batteries, particularly where two are necessary to deliver liquid fuel to the carburetor.

Conventional wobble type fuel pumps, as used for delivering regular gasoline motor fuel on most automobiles today would be too frail for the higher pressures obtained with the fuels in question when high temperatures prevail. However, by employment of my present invention, the conventional gasoline fuel pump as now produced for motor cars at small cost can be used satisfactorily or dispensed with entirely as will be obvious from the ensuing disclosure.

A primary object of my invention is to provide for positive delivery of fuels of wide boiling range from the supply source to the point of utilization under all conditions of temperature and attendant vapor pressure.

It is further an object to effect positive delivery of fuel under all conditions of temperature without requiring any attention or manipulation on the part of the operator other than replenishment of the exhausted supply.

A still further aim is to provide a device which will automatically change the course of fluid flow in response to a change in pressure conditions. Another object is to provide means in a carburetor-vaporizer system for delivery of liquid fuel directly to the carburetor rather than to the vaporizer under certain conditions of temperature and pressure.

A yet further object is to supply heat to the fuel supply from an external source, thus insuring ample tank pressure for flowing the fuel under conditions of low atmospheric temperature.

Another object is to provide mechanical aid to flow the fuel in any situation where the pressure on the fuel is insufficient to perform this function.

Many other objects and advantages will be apparent from a study of the following description of the structure and its operation.

In the drawings: Figure 1 is a diagrammatic outline, with the fuel tank in section, showing the novel fuel tank and changeover arranged in a carbureting system which is the subject of my copending application Serial No. 402,417, filed July 14, 1941. Figures 2 and 3 are detailed sections of the changeover device 13 shown in the organization of Figure 1. Figure 2 shows the changeover in its normal position when the highly volatile liquid fuel is at a normal temperature, so that its vapor pressure is sufficient to force it through the system. Figure 3 shows the changeover in the position it assumes when the vapor pressure of the liquid fuel is too low to force it through the system.

The numeral 1 in Figure 1 refers generally to a tank of liquid fuel whose pressure may be high or low, depending upon the particular composition and temperature of the same. This tank may be part of the fuel system of any internal combustion engine, whether stationary or in a vehicle. The exhaust from the engine is com-

municated through a pipe 2 to a point near the fuel tank, and is discharged to the atmosphere at some point 3 which is at a safe and judicious distance from the fuel tank, this point being dependent upon the particular installation. An air jacket 4 is placed around the fuel tank and also embraces a sufficient portion of the exhaust pipe to effect the desired degree of heating. Openings may be placed in the air jacket as at 5 and 6 so as to induce circulation of heated air around the fuel tank. The location of these air portholes may be varied to suit the peculiar requirements of any given installation.

In a vent pipe 7, which communicates with the upper vapor space in tank 1, is located a check valve 8. This valve may be of any of several well known forms. Its disposition and reaction is such as to prevent escape of vapors under pressure from within the tank, at the same time being capable of admitting air from the outside atmosphere to the tank when required to prevent the formation of a subatmospheric pressure within.

A liquid eduction pipe 9 has its open end disposed in proximity of the fuel tank bottom so that it will draw off liquid fuel only. This pipe leads out of the tank through a pressure-tight joint at any desired point on the tank shell, as at 10, for example. A manual valve 11 of any desired form (globe, gate or other) may be installed outside the tank, for emergency shut-off in case of a broken fuel line, or to permit repairs or alterations to the same without emptying the fuel tank. If the conditions warrant this valve 11 may also be in the form of an automatic excess flow valve which would prevent wholesale escape of high pressure fuel upon breakage in the fuel line downstream from that point. Valve 11 is not necessary to my invention, and may be varied in form or omitted altogether, at the option of the operator.

The fuel transmission pipe 12 is attached either to the valve 11, if employed, or else directly to the liquid eduction pipe 9. Optionally the fuel line 12 may pass in direct heat exchange relationship with the exhaust pipe. At any convenient point in the pipeline 12 is installed an automatic changeover device 13 which is fitted with an inlet connection 14, a high pressure outlet 15, and a low pressure outlet 16.

The transmission pipe 12 discharges to the automatic changeover valve 13 through the inlet connection 14. A fuel line 17 leads from the high pressure outlet connection 15 directly to the inlet of a utilization system, in this case regulator-vaporizer 17A. Another line 18 leads from the outlet connection 16 to the inlet of a fuel pump 19, the outlet of which may be connected by a line 20 to the same point as the discharge of line 17, or may be connected to a different portion of the utilization system.

For purposes of illustrating a useful adaptation of the subject of this application to a fuel conditioning and utilization system, I have shown the high pressure fuel line 17 as leading to the inlet of a combined regulator and vaporizer 17A. This latter unit may be, for example, the same unit that appears in the drawing accompanying my co-pending application Serial No. 402,417. The line 20 is shown as being connected directly to the float chamber of the liquid fuel side of a dual feed carburetor 17D such as is also shown in my above identified application. From regulator-vaporizer 17A a line 17C conveys the vapor formed therein to the vapor phase utilization section of dual phase carburetor 17D. Also from unit 17A a line 17B conveys the liquid separated in unit 17A to liquid fuel pump 19. Unit 17A is not described in detail herein because it does not per se constitute any part of the present invention, it being sufficient to state that it simply serves to effect separation of the high vapor pressure liquid fuel fed to it via line 17 into a vaporous phase and, usually, a liquid phase.

Referring to the changeover valve indicated generally by the numeral 13, detailed in Figures 2 and 3, 21 and 22 are sepectively the upper and lower sections of the valve body. A flexible synthetic rubber diaphragm 23 is peripherally clamped securely between the members 21 and 22 by means of the flanges 21A and 22A and bolts 24. Within a housing 25 formed coaxially on the member 22 is a spring 26, the upper end of which bears upon the diaphragm through the medium of a backup plate 27. On the upper cover 21 is formed another housing 28, likewise containing a spring 29. The lower end of this spring bears upon the lever 30 through the medium of a circular plate 31 attached thereto. The lever 30 is pivotally mounted on a lug projecting internally from the cover 21, as at 32. In continuous fluid communication with the connections 15 and 16 are provided the valve seats 33 and 34, respectively. Cooperating with these seats are resilient valve discs 35 and 36, which are vulcanized or otherwise secured to the lever 30. A thrust member or strut 37 is pivotally attached to the lever 30 by means of a pin 38. A circular pressure plate 39 is affixed to the lower end of the strut 37 and normally contacts the upper face of diaphragm 23. The springs 26 and 29 may be provided with adjusting screws 40 and 41, if desired; however, this is not necessary. In any event, a gas-tight seal must be maintained at the top of housing 28 by means of a seal cap 42 and gasket 43. In the case where the adjusting screw 40 is omitted, the closure at 42 could, of course, be an integral end in the housing 28 instead of using a separate seal cap and gasket. Housing 25 preferably vents to the atmosphere whether the adjusting screw 41 is employed or not. In all events, as indicated by Fig. 3, spring 26 must be loaded substantially more heavily than spring 29, whether this preferential loading be provided by fixed or adjustable means.

In operation, liquid fuel stored in the tank 1 will have a vapor pressure which will be in direct proportion to the surrounding temperature. In order to best describe the operation of my improved fuel system, I will take the case where the atmospheric temperature is low, the engine which consumes the fuel has not been operated for a substantial period of time previously, and hence, the vapor pressure in the tank 1 may be very low. The position of the changeover 13 under this condition is indicated in Figure 3.

In the above outlined condition, liquid fuel at little or no pressure above atmospheric will be in communication with the changeover valve 13 by virtue of the open system comprised of the eduction pipe 9, the valve 11, and the fuel line 12, which latter enters the changeover valve through the connection 14. Since the spring 26 is loaded more heavily than is spring 29, the lever 30 will be held upwardly as in Fig. 3, with the result that the seat 33 will be closed by the disc 35, and seat 34 will be open. Fuel in liquid form will thus have access via line 18 to the in-

let of the fuel pump 19 and will be discharged to the line 20 upon operation of the pump. The check valve 8 will meanwhile admit atmospheric air to the fuel tank through line 7 at any time such action might be required to prevent creation of a subatmospheric pressure in the tank. In this way continuous delivery of fuel by the pump is assured.

Suppose now the engine which is served by the subject fuel system is started. The fuel pump draws low pressure liquid from the tank and delivers it to the carburetor or any intervening device via the low pressure fuel line 20. Upon continued operation of the engine, heat discharged through the exhaust pipe 2 will induce a circulation of heated air within the air jacket 4, with the result that the fuel in tank 1 is gradually heated. Upon increase of temperature of the fuel, the vapor pressure of the fuel will increase accordingly. When the pressure reaches a value which, when acting on the diaphragm 23, will overcome the spring 26, then the valve seat 34 will be closed and seat 33 will be opened. Changeover 13 will then have the position shown in Fig. 3. Fuel in liquid form will now progress by its own pressure through the line 17 to the desired point.

The pressure in the fuel tank will continue to increase until a condition of equilibrium with the air temperature maintained in jacket 4 is attained. Further increase in pressure over that required to effect the changeover from pump transmission to vapor pressure transmission of the liquid fuel will not cause damage to the disc 36 or the seat 34, because contact between these two elements is maintained only by the force of the spring 29. The lever 30 is not attached positively to the diaphragm 23, and the powerful force of this diaphragm under high pressure cannot be imposed on the lever.

By virtue of closure of the seat 34, the fuel pump is protected from damage by high pressure which would otherwise be admitted to it through the line 18.

It is to be understood that I do not limit my invention to the particular form illustrated and described, since obviously the present device would possess great utility in other fields. Neither is it my intention to limit its application to a dual feed liquid and vapor carburetor system such as is shown in faint outline in my drawings. The lines 17 and 20 could just as well be connected to various points in some other type of carburetor system, such as a straight liquid feed carburetor, for example. My present disclosure shows a preferred embodiment as applied to a particular carburetor installation. The teachings of the invention could be applied in many different ways without avoiding the spirit of the following appended claims.

I claim:

1. A fuel system for delivering a high vapor pressure liquid fuel to an internal combustion engine comprising, in combination, a carburetor connected to the engine, a fuel tank capable of withstanding pressure of said fuel, means for heating said tank by heat exchange with the exhaust gases of said engine, vaporizing means for separating liquid fuel delivered thereto into liquid and gaseous phases, conduit means for delivering said gaseous phase to the carburetor, a liquid fuel pump, conduit means connecting the outlet of said fuel pump to the carburetor, conduit means for delivering said liquid phase to the inlet of said fuel pump, and changeover means comprising an inlet connected to the liquid fuel in said fuel tank, a first outlet connected to said vaporizing means, a second outlet connected to the inlet of said fuel pump, and means responsive to the vapor pressure of said liquid fuel in said fuel tank for delivering said fuel in liquid form alternately to said first outlet when vapor pressure attains or exceeds a predetermined value and to said second outlet when said vapor pressure is less than said value.

2. A fuel system for delivering a high vapor pressure liquid fuel to an internal combustion engine at low atmospheric temperatures at which the vapor pressure of the fuel alone is insufficient to assure delivery of the fuel in liquid form from the supply tank to the engine comprising, in combination, a pressure-resisting fuel supply tank, means for heating the same, conduit means for withdrawing liquid fuel from said tank and delivering same to a changeover, a changeover comprising an inlet connected to said conduit means, two outlets, pivoted valve means movable about a fixed pivot to alternately close one or the other of said outlets and open the other and permit flow of liquid fuel from said inlet to the open one of said outlets, first spring loading means for moving said valve means to close the first of said outlets, second spring loading means opposed to and loaded substantially more heavily than said first spring loading means for moving said valve means to close the second of said outlets, and diaphragm means responsive to the vapor pressure of the liquid fuel for acting in conjunction with said first spring loading means to overcome said second spring loading means and thereby close said first outlet, means connected to said second outlet for delivering liquid fuel delivered by said second outlet to said engine, and a liquid fuel pump connected to said first outlet for pumping liquid fuel from said tank through said conduit means, said inlet, and said first outlet when said fuel is at a temperature so low that its vapor pressure is insufficient to cause said diaphragm means to overcome said second spring loading means and for delivering the liquid fuel so pumped to said engine.

3. The system of claim 1 further including check-valved conduit means for admitting atmospheric air to the gaseous space in said fuel tank without allowing escape of the contents of said tank for thereby preventing development of subatmospheric pressure within said tank.

GERHARD GERSON.