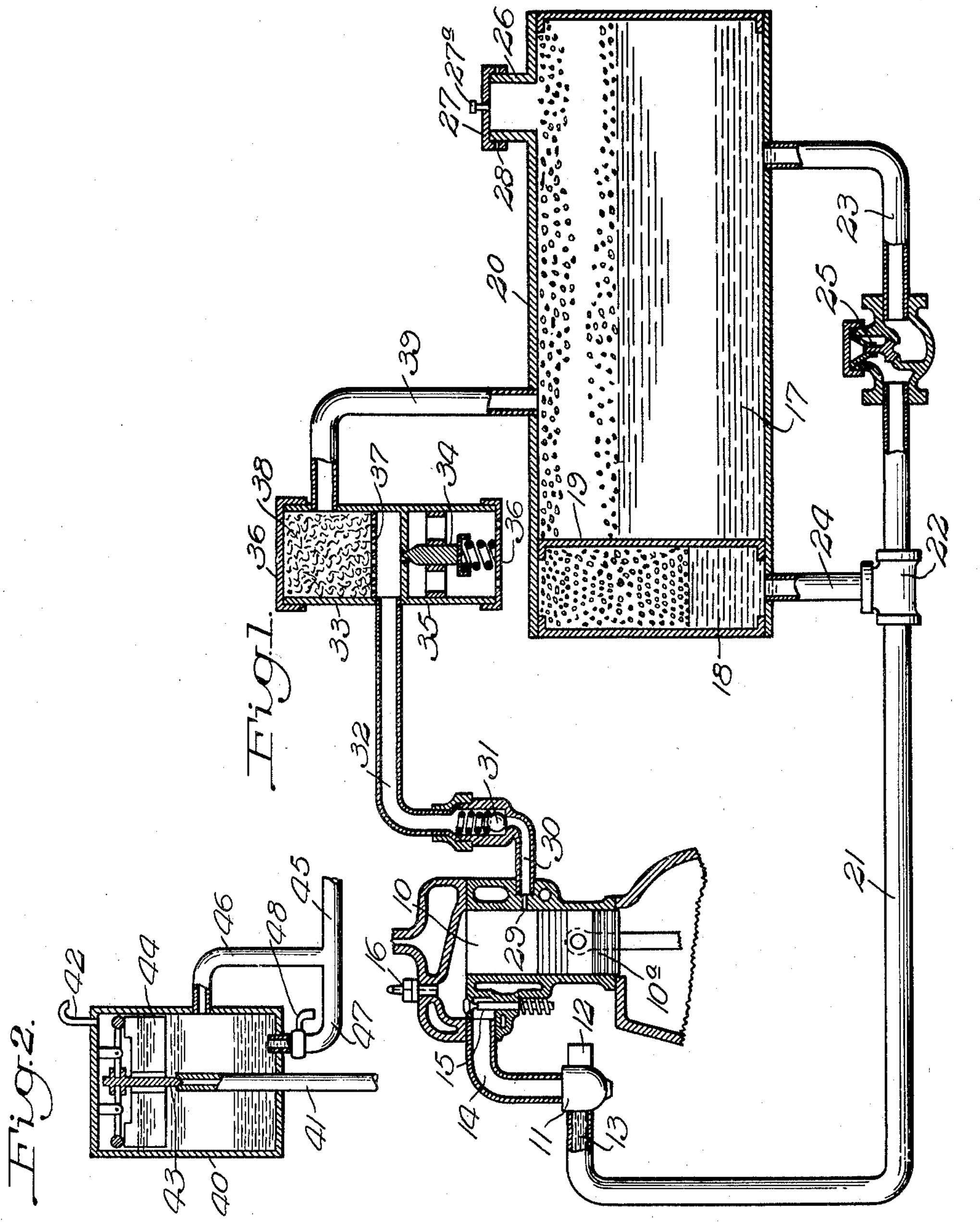
April 3, 1934. C. H. KENNEWEG 1,953,808

LIQUID FUEL STORAGE AND SUPPLY SYSTEM

Filed April 21, 1931



INVENTOR

Christian H. Kenneweg

by his attorneys

Byrnes, Stebbins, Parmelee & Blenko

Patented Apr. 3, 1934 1,953,808

UNITED STATES PATENT OFFICE

1,953,808

LIQUID-FUEL STORAGE AND SUPPLY SYSTEM

Christian H. Kenneweg, Millvale, Pa.

Application April 21, 1931, Serial No. 531,837

3 Claims. (Cl. 123—136)

My invention relates to engines and, in particular, to engines of the internal combustion type, and to a supply and storage system for the liquid fuel commonly used thereby.

Numerous types of fuel supply systems have been proposed heretofore for engines of the type mentioned. Some of these systems work on the vacuum principle, others employ mechanical pumps, and still others apply superatmospheric air pressure to a closed reservoir containing the fluid. None of these systems, however, so far as I am aware, have proved satisfactory and, furthermore, they are all complicated in construction, expensive to manufacture and lack certainty and continuity of operation.

I have invented a system for storage and supply of fuel for engines which overcomes the above mentioned objections to systems of this character known to the prior art. In addition, my invention provides for rendering the fuel non-explosive, and entirely fire-safe while it is maintained under certain conditions to be discussed hereinafter, without affecting the combustibility of the fuel when supplied to the engine for the generation of power.

According to my invention, I provide an airtight reservoir for the fuel, such as gasoline. I create a pressure above the surface of the liquid fuel in the reservoir by diverting thereto a portion of the combustion products from the engine, under the pressure of the explosions occurring therein, after passing the products through suitable cooling and cleaning devices. The accumulated pressure above the body of fuel in the reservoir serves to force the fuel through suitable passages to the carbureter of the engine, or other equivalent vaporizing device whereby it is converted into the vapor form and supplied to the engine cylinders for ignition and combustion.

The combustion products from an internal combustion engine consist almost entirely of inert gases. I have found that, under pressures which can easily be obtained according to the present invention, many volumes of inert gases will be absorbed by a liquid fuel such as gasoline. A gauge pressure of 50# per square inch, for example, will cause the absorption of around eleven volumes of CO_2 in one volume of gasoline. The absorption of inert gas by the liquid gasoline renders the latter non-explosive and fire-proof as long as the pressure of inert gas is maintained, and for some time thereafter. When gasoline which has absorbed inert gases, such as CO_2 under pressure, is released from said pressure, the gasoline is freed from the inert gases. The latter tend to form a smothering blanket thereabout which will prevent the occurrence of combustion until it is dissipated. The formation of the smothering blanket may be aided by the addition of a small portion of lubricating oil or other suitable material to the liquid gasoline. After the pressure has been released for a short time from the gasoline in which inert gas has been absorbed, however, the latter is entirely discharged from the gasoline, which then regains its normal characteristics of inflammability and explosibility.

In addition to providing a fire-proof system of fuel supply for an internal combustion engine, the invention also contemplates a fuel supply system which is characterized by extreme simplicity, low cost of manufacture, and practical certainty and continuity of operation.

For a complete understanding of the invention, reference is made to the accompanying drawing in which,

Figure 1 is a diagrammatic illustration with parts broken away of a fuel supply system embodying the present invention; and

Figure 2 is a sectional view through an additional piece of apparatus which may be used in connection with my invention when exceptionally high pressures are utilized.

Referring in detail to the drawing and in particular to Figure 1, illustrating the present preferred embodiment of the invention as adapted for application for use on motor vehicles, a cylinder of the usual type of internal combustion engine is indicated at 10. The cylinder 10 is adapted to receive fuel in the form of combustible vapor from a carbureter 11 having an air inlet 12 and a liquid fuel inlet 13. The carbureter 11 is connected to the cylinder 10 through a conduit 14 which is closed by a poppet valve 15 of the usual type. A spark plug 16 for igniting the combustible mixture supplied to the cylinder from the carbureter is employed in accordance with accepted practice.

Liquid fuel is supplied to the carbureter 11 from a reservoir 17 or, alternatively from a reservoir 18. The reservoirs 17 and 18 are formed by locating a transverse partition 19 in an air-tight tank 20. The carbureter 11 is connected to the reservoirs 17 and 18 through a common conduit 21 branching at 22 into separate conduits 23 and 24. A check valve 25 is located in the conduit 23 and is adapted to close automatically when the pressure tending to send fuel therethrough toward the carbureter falls below a predetermined value. The tank 20 is provided with an inlet 26 having a cap 27. The cap 27 has a downward flange perforated by holes 28, the purpose of which is to release the pressure accumulated, by means to be described shortly, within the tank 20 before the cap is entirely removed from the inlet. Thus, if the cap 27 is threaded on the inlet 26, there will be no danger of the cap being blown off in the hands of an attendant attempting to fill the tank. The pressure will be released gradually and safely.

The means for supplying the products of combustion from the engine cylinder 10 to the reservoirs 17 and 18 under the pressure of the explosions in the cylinder includes an auxiliary exhaust port 29 in the cylinder 10. This port is positioned so as to be uncovered by the piston 10*a* only when the latter approaches the lower limit of its stroke. The port 29 communicates with a conduit 30 leading to a ball check valve 31. From the check valve 31 a cooling and condensing conduit 32 extends to a filtering and cleaning device 33 having an excess pressure relief valve 34 incorporated therein. The device 33 comprises a tubular portion 35 having removable ends 36. A transverse perforated partition 37 defines a space for receiving filter, fire stopping and cleaning material 38. The valve 34 may be adjusted by any convenient means, such as by threading the cap 36 on the tube 35, so as to release at the desired pressure. A conduit 39 communicates with the cleaning device 33 and leads directly to the reservoir 17 above the level of the liquid therein.

The operation of the invention will now be described, assuming first that the engine is operating in a normal manner, as a result of the successive explosions in the cylinder 10 of a combustible mixture supplied thereto from the carbureter 11, through the conduit 14 and the valve 15. As the piston 10*a* descends in the cylinder 10 on the explosion stroke, and uncovers the auxiliary exhaust port 29, a portion of the combustion products formed in the cylinder as a result of the explosion, pass through the port 29 and the conduit 30 and displace the ball check valve 31. As soon as the pressure within the cylinder 10 is reduced by the opening of the main exhaust valve (not shown), the ball check valve 31 reseats. As often as the explosion stroke of the engine piston is repeated, a portion of the combustion products is admitted to the conduit 32 in the manner just described.

The conduit 32 may be of any suitable length to afford an opportunity for cooling the exhaust gases passing therethrough and condensing any water vapor that might be suspended therein. With the continued operation of the engine, the building up of pressure within the conduit 32 forces the cooled gas from the condensed liquid into the device 33. Since the excess pressure relief valve 34 is normally closed by its spring, the pressure within the conduit 32 forces the gas and liquid through the perforated partition 37 and the filtering and cleaning material 38. The latter filters the condensed liquid from the inert gas which is then forced out of the device 33 and into the upper portion of the reservoir 17 through the conduit 39.

A quantity of inert gas (largely CO_2 and N_2) is thus accumulated in the reservoir 17 above the level of the liquid fuel. The pressure built up within the reservoir depends upon the adjustment of the relief valve 34 which remains closed until the pressure in the system comprising the conduits 30, 32 and 39, and the chambers 33 and 17, reaches the value at which the relief valve is adjusted to operate.

Generally, I prefer to operate the system with the valve 34 adjusted to provide a pressure of about 5 to 7 pounds per square inch in the reservoir 17. I have found that this pressure produces a saturation of the liquid fuel with inert gas sufficient to impart the desired combustion preventing characteristic thereto, to prevent "vapor lock" or blocking of the fuel-supply conduits by accumulation of vapor, and, at the same time, to force the liquid fuel positively from the reservoir to the carbureter in the required volume.

Under the pressure of gas within the reservoir 17, the liquid fuel therein tends to flow through the conduit 23, the check valve 25, the T connection 22 and the conduit 21 to the carbureter 11 which, as illustrated, may be located above the level of the liquid fuel in the reservoir 17. The conduits 23 and 24 may extend down from the top of the tank almost to the bottom thereof, instead of upwardly through the bottom, as shown. When the fuel reaches the carbureter 11, it is at substantially atmospheric pressure, the initial pressure on the fuel having been expended in overcoming the liquid friction effect and the hydrostatic head between the carbureter and the liquid level in the reservoir. The decrease in pressure on the liquid fuel as it advances toward and into the carbureter float chamber permits the absorbed inert gas to escape and the fuel thereby regains its usual combustible character. Upon being drawn into the cylinder 10 with the required amount of air, therefore, the proper explosive mixture is obtained.

The reservoir 18 serves to provide a reserve source of fuel under pressure which becomes effective when the pressure in the main reservoir 17 is released, as, for example, by the opening of the cap 27 for the purpose of filling the reservoir. Under these circumstances, the check valve 25 closes due to the release of the pressure on the fuel in the reservoir 17, so that a continuous supply of fuel to the carbureter is maintained by the fuel accumulated in the reservoir 18 under the same pressure that exists in the chamber 17 under normal operating conditions. Sufficient fuel is carried in the reservoir 18 to operate the engine during the period of filling the tank 17 and a sufficient time thereafter to restore the normal operating pressure in the reservoir 17. When the system is first used, air or gas under pressure must be applied to the reservoir 17 from a separate source. The cap 27 has a valve 27*a* for this purpose.

Referring now to Figure 2, I have illustrated therein an auxiliary device which may be found desirable when a fuel supply system of the present invention is designed for operation with higher pressure, for example, between 50 to 100 lbs. per square inch, which might be useful in marine or aviation work. The device consists of a chamber 40 into which extends a fuel supply conduit 41 corresponding to the conduit 21 in Figure 1. The chamber 40 is vented at 42 to the atmosphere. The supply of fuel under pressure through the conduit 41 to the chamber 40 is controlled by a needle valve 43 actuated in the known manner by a float 44 supported on the body of fluid accumulated within the chamber. In the chamber 40, the high pressure under which the liquid fuel is supplied is released and the absorbed inert gas escapes to the atmosphere through the vent 42. Liquid fuel is supplied to a carbureter such as that shown at 11 through a conduit 45 having one connection 46 to the chamber 40 adjacent the midportion thereof, and another connection 47 to the bottom thereof having a valve 48 therein. Normally the valve 48 is closed and liquid fuel is supplied to the carbureter through the branch 46 of the conduit 45. In case of failure of the pressure system, or exhaustion of the fuel supply, however, the entire contents of the chamber 40 may be supplied to the carbureter to maintain the engine in operation, by opening the valve 48. The chamber 40 is located above the carbureter 11 so that flow of fuel is effected by gravity.

It will be apparent from the foregoing description and the accompanying drawing that I have provided a fuel supply system in which fuel is forced from a reservoir to the engine by means of the pressure of inert gas applied to it and obtained by diverting a portion of the combustion products from the engine and properly cooling and cleaning the latter. It will be obvious that the invention is characterized by extreme simplicity so that the installation involves only a comparatively small expense. The simplicity of the system and the small number of parts required thereby contribute to the certainty and safety of operation. By saturating the fuel in the main reservoir with an inert gas to prevent combustion thereof, temporarily, the fire hazard is practically entirely removed from the operation of internal combustion engines. This hazard has proved in recent years to be a particularly great one especially in cases of airplane accidents, as well as automobile and marine casualties.

Since I provide a positive pressure on the fuel in the main reservoir, it is impossible for the fuel supply to fail by reason of a so-called "vapor lock". The pressure of inert gas on the liquid fuel also precludes the vaporization and escape of the lighter fractions of the fuel.

While I have illustrated and described herein but a single present preferred embodiment of my invention with a modification of a portion thereof, it will be obvious that numerous changes in the embodiment shown and described may readily be resorted to without departing from the spirit of the invention or the scope of the appended claims, and without sacrificing the advantages hereinabove set forth.

I claim:

1. A fuel supply system for an internal combustion engine comprising a main fuel tank, an auxiliary fuel tank, means including check valves, a condenser and a condensate filter for trapping in said tanks above the surface of the liquid fuel therein, a portion of the products of combustion from said engine, a carbureter and a conduit for supplying fuel thereto from said tanks, and means for preventing the release of pressure from the auxiliary tank when said main tank is opened for filling.

2. A fuel storage and supply system for an internal combustion engine comprising a tank divided into main and auxiliary fuel-receiving chambers, means including a check valve, a condenser and a filter for supplying inert gas from the products of combustion of said engine, under pressure, to the fuel in said tanks, a common supply line from said chambers to a carbureter for said engine, said carbureter being effective for freeing the fuel of absorbed inert gas, and a check valve between said line and said main chamber to prevent the release of the pressure in the auxiliary chamber when said main chamber is opened for filling.

3. The combination with an engine having an air-tight fuel tank and a carbureter, of a connection for conveying combustion products from said engine to the tank under partial explosion pressure and discharging them freely in the tank, to saturate the fuel, and a conduit for carrying fuel from the tank to the carbureter under the pressure maintained in the tank, including an auxiliary reservoir for continuing the supply of fuel under pressure when said tank is opened to atmosphere for filling.

CHRISTIAN H. KENNEWEG.