Sept. 26, 1944. B. WALKER 2,358,840

VEHICLE FUEL TANK BREATHER SYSTEM

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Fig. 1

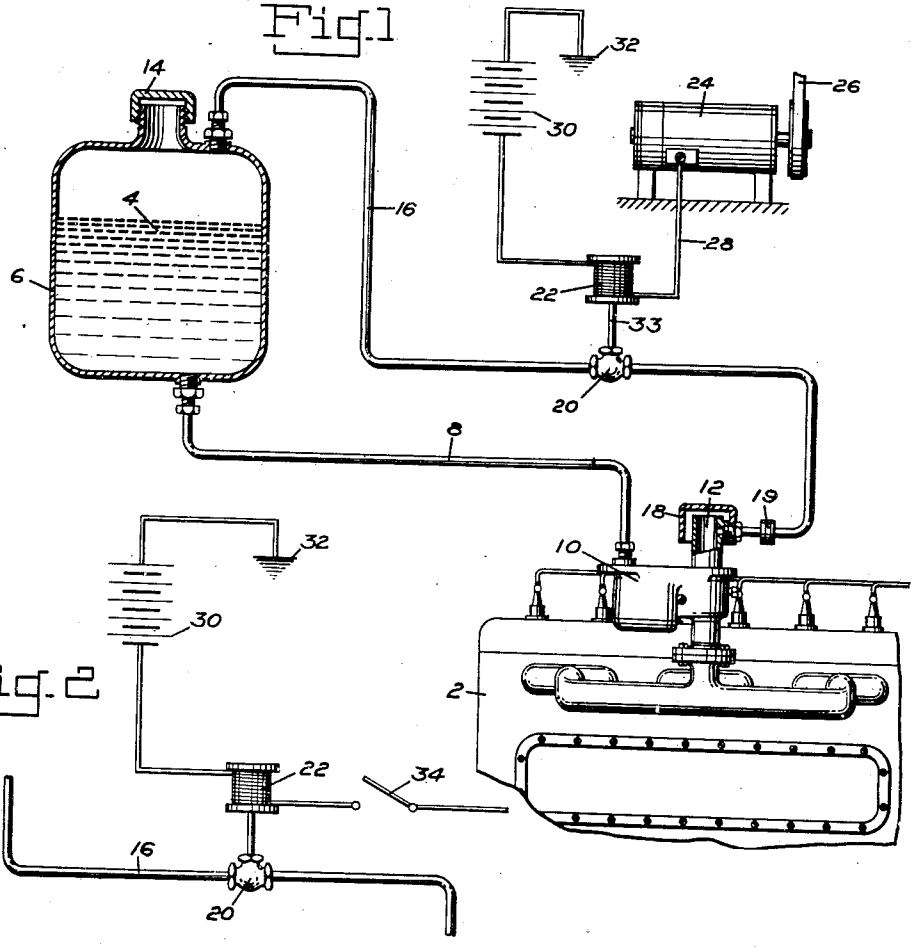

Fig. 2

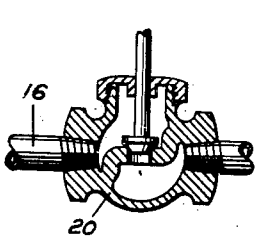

Fig. 3

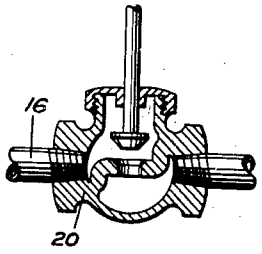

Fig. 4

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VEHICLE FUEL TANK BREATHER SYSTEM

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10 Claims. (Cl. 123—121)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to the fuel system of an internal combustion engine, particularly to an economical method of venting the fuel storage tank.

Developments in the engineering of internal combustion engines in recent years have included some rather marked changes in the character of the fuel used. With increasing demands for more power per unit weight, engine designs have been tending toward types requiring higher and higher octane fuels. The high octane fuels, however, are highly volatile, and their use increases the fire hazard as well as the loss due to vaporization.

It is the object of this invention to provide a fuel system for internal combustion engines in which the fuel storage tank vent is automatically closed when the engine is not running, and is opened when the engine starts up; when the valve opens, any vapor which might be lost through the vent in ordinary systems is fed to the engine through the carburetor air intake opening. This object is accomplished by a conduit connecting the vapor space of the fuel tank to the carburetor air intake, and a valve in the conduit. The valve is automatically opened when the engine starts. The opening and closing of the valve is effected by a solenoid which is preferably connected to be energized when the generator charges the battery; alternatively, the solenoid may be energized by the closing of the ignition switch.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing in which:

Fig. 1 of the drawing shows a fuel system of an internal combustion engine embodying the invention.

Fig. 2 shows an alternative means to operate the vapor conduit valve.

Figs. 3 and 4 are longitudinal center sectional views of the vapor conduit valve, shown closed and open, respectively.

Referring to Fig. 1 in detail, there is shown an engine 2 adapted to utilize liquid fuel 4 supplied from a storage tank 6 through a liquid conduit 8. A conventional carburetor 10 having an air inlet tube or opening 12 is supplied to atomize the fuel, where a carburetor is necessary.

The filler opening of tank 6 is preferably tightly closed by a cap 14. The tank is vented through a vapor conduit 16 which communicates the vapor space above the liquid level in the tank with the atmosphere through the air intake opening 12 of the carburetor. This air intake opening is preferably restricted, as for example by a cap 18 over the end. A fire screen of any suitable conventional type may be supplied in conduit 16 at 19 to protect the system against any flash due to back-firing of the engine.

A valve 20 in the vapor conduit permits sealing of the tank vent to prevent loss due to evaporation while the engine is not running. An operator 22 may be provided to open and close the valve in accordance with engine conditions. This operator is shown as being electrical; specifically, it is shown as an electromagnet or solenoid. In the preferred form, the solenoid is connected in the circuit of generator 24 which is adapted to be driven by the engine through any suitable medium such as belt 26. The drive connection to the engine is not shown. A conventional electric cable conduit 28 makes one path for the current between the generator and the battery 30. The other path is provided through the frame by the ground 32. As shown in the drawing, cable 28 is wound around a core to form solenoid 22 which acts upon a armature 33 to open the valve when the solenoid is energized. The valve may be closed by gravity, or alternatively by a suitable spring, not shown.

Fig. 2 shows a modification, in which operator 22 of valve 20 in conduit 16 is connected in the ignition circuit of the engine. The solenoid is energized when ignition switch 34 is closed to complete a circuit to the plugs. Inasmuch as the rest of the ignition system is conventional, it is not shown here.

Figs. 3 and 4 show the vapor conduit valve 20 enlarged and in section. In Fig. 3 the valve is shown closed, as it would be with the engine not running. In Fig. 4 the valve is shown open, or as it would be with the engine running. Inasmuch as valve 20 and solenoid 22 are standard items, a detailed discussion of their structure is not warranted here.

Operation.—Taking Fig. 1 first, when the engine is not running, the generator is likewise not running. Operator 22 is deenergized, and valve 20 is closed as in Fig. 3. Vapor conduit 16 is therefore sealed, and loss of fuel 4 because of vaporization is prevented. When engine 2 starts up, generator 24 also runs, and the charging current energizes solenoid 22 to open the valve, as seen in Fig. 4. The fuel vapor is thereupon admitted to the air

intake opening 12 of the carburetor; so long as the pressure above the liquid is greater than atmospheric, vapor will flow to the carburetor. After the engine has run for a time and considerable fuel has been withdrawn from the tank, conduit 16 will serve to admit air to the vapor space above the liquid in the tank. Air will thus be admitted around cap 18 and through opening 12 to the tank.

The operation of the embodiment shown in Fig. 2 is similar to that shown in Fig. 1, except that in the embodiment shown in Fig. 2, valve 20 opens when ignition switch 34 is closed.

Thus I have shown a fuel tank breather system which has general application to engines, and particular application to internal combustion engines. It is especially advantageous to employ my system in boats, planes, tanks, or other closed spaces to keep fuel fumes out of the enclosure. For example, it is very important on boats to keep fumes out of the bilge or hold, where they tend to accumulate.

Of the two embodiments shown, it will be appreciated by those skilled in the art that one embodiment has advantages over the other, and vice versa. For example, in the use of the embodiment shown in Fig. 1, it is noted that the vapor conduit valve opens only after the engine has actually started running, thus preventing flooding the engine with rich vapor by a fuel tank under pressure; such flooding might occur in warm or hot climates with the embodiment shown in Fig. 2, where the vapor conduit valve is opened as soon as the ignition switch is closed. Therefore, the embodiment of Fig. 1 might be more desirable in hot climates, and the embodiment of Fig. 2 in cold climates.

In connection with the embodiment shown in Fig. 2, it is noted that the vapor conduit valve could be connected mechanically to switch 34, and be actuated by this direct mechanical connection instead of the electrial means shown.

It may further be pointed out that, if I desire, I may provide a safety valve for tank 6, such a valve being operable to limit both the maximum and minimum pressures in the tank.

I claim:

1. In combination, a storage tank for volatile liquids, a liquid utilizer, a liquid conduit to conduct liquid from the tank to the utilizer, a vapor conduit to connect the vapor space above the liquid level with the utilizer, a valve in the vapor conduit, a valveless vent in the vapor conduit between said valve and the liquid utilizer, and a valve operator to open the valve when the utilizer is consuming liquid and to close it when the utilizer is not consuming liquid, said conduit and valve constituting the sole venting means from said tank.

2. An engine, a fuel tank to store fuel for the engine, a liquid conduit to conduct liquid fuel from the tank to the engine, a single vapor conducting conduit between said fuel tank and said motor, a valve controlled by a function of the engine operation to control vapor flow through said vapor conduit, and a constant vent to the atmosphere in the vapor line.

3. An engine, a fuel tank to store fuel for the engine, a liquid conduit to conduct liquid fuel from the tank to the engine, a single vapor conducting conduit between said fuel tank and said motor, a valve controlled by a function of the engine operation to control vapor flow through said vapor conduit, a constant vent to the atmosphere in the vapor conduit between said valve and the engine, and an operator to open the valve and hold it open when the engine is running.

4. In combination, an engine, a fuel storage tank connected to supply liquid fuel to the engine, a conduit connected to communicate the engine with the vapor space above the liquid level in the storage tank, a valve in the conduit, an electromagnet adapted to operate the valve, and a generator driven by the engine and connected to energize the electromagnet.

5. In combination, an engine having an electric ignition system, a fuel storage tank connected to supply liquid fuel to the engine, a conduit connected to communicate the engine with the vapor space above the liquid level in the storage tank, a valve in the conduit, and a valve operator adapted to hold the valve open when electric power is being supplied to the ignition system.

6. In combination, an engine having a carburetor fuel system, a fuel storage tank connected to supply liquid fuel to the carburetor, a conduit communicating the carburetor with the vapor space above the liquid level in the fuel tank, a valve in the conduit, an electrical operator for the valve, and a generator driven by the engine and connected to actuate the electrical operator.

7. The combination as in claim 6, and a vent to the atmosphere in the conduit near its junction with the carburetor.

8. In combination, an internal combustion engine, a carburetor for the engine and having an air intake tube, a fuel storage tank connected to supply liquid fuel to the carburetor, a conduit communicating the carburetor intake tube with the vapor space above the liquid level in the storage tank, a solenoid operated valve in the conduit, and a generator driven by the engine and connected to energize the solenoid.

9. The combination of claim 8, in which the air opening of the carburetor intake tube is restricted.

10. In a fuel system for an internal combustion engine, a carburetor having an air intake tube, and a fuel storage tank constantly vented to the atmosphere through the air intake tube, said vent being the only vent to said tank, a valve in said vent line, and a control for said valve operated as a function of engine operation.

BROOKS WALKER.