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[54] **EVAPORATION-INHIBITING DEVICE FOR A CARBURETOR**
3 Claims, 6 Drawing Figs.

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123/136
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123/136

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ABSTRACT: The present invention relates to a device for inhibiting fuel evaporation in a carburetor, said device comprising a variable-capacity bag which communicates with a float chamber in the carburetor and the internal volume of which can be varied by an operating device, a first one-way valve is positioned between said bag and said float chamber, and a second one-way valve through which said bag is connected to a fuel supply line located upstream of a fuel pump, said operating device being so controlled as to increase or decrease the internal volume of said bag in dependence on whether the engine is running or stopped. A certain amount of the fuel in the float chamber is introduced into the sealed variable capacity bag outside of the float chamber when the engine is stopped so as to minimize the amount of fuel in the float chamber, to inhibit the evaporation of fuel and thereby prevent the release of unburnt hydrocarbons.

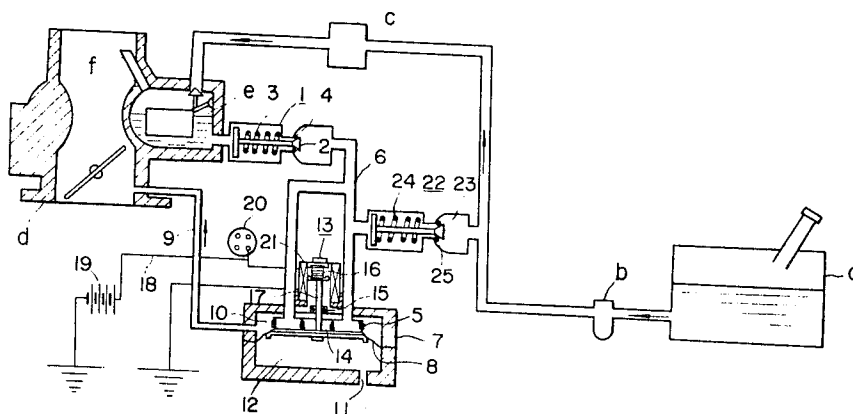


FIG. 1

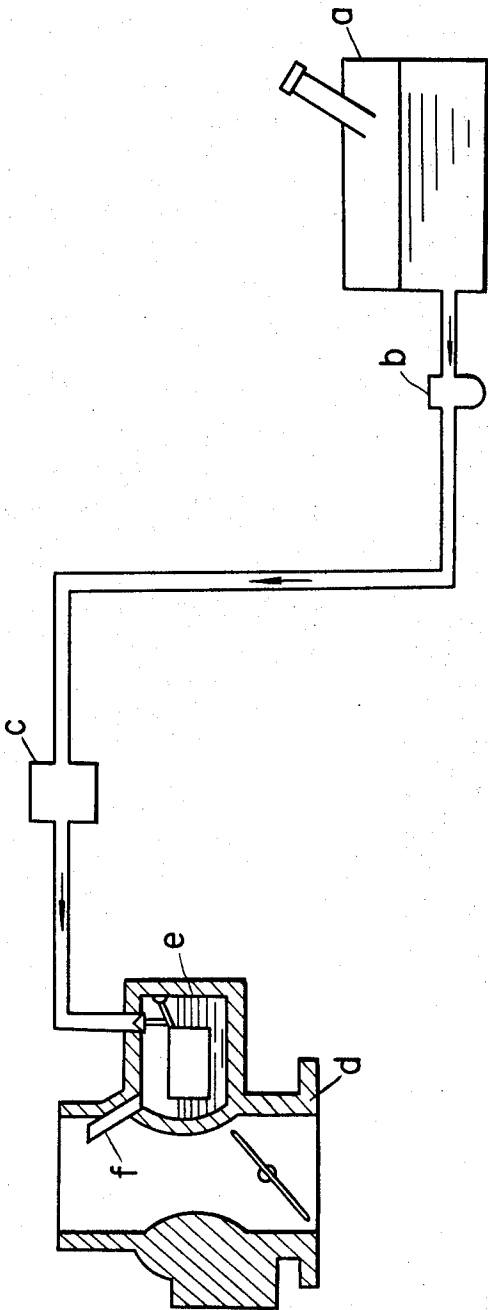


FIG. 2

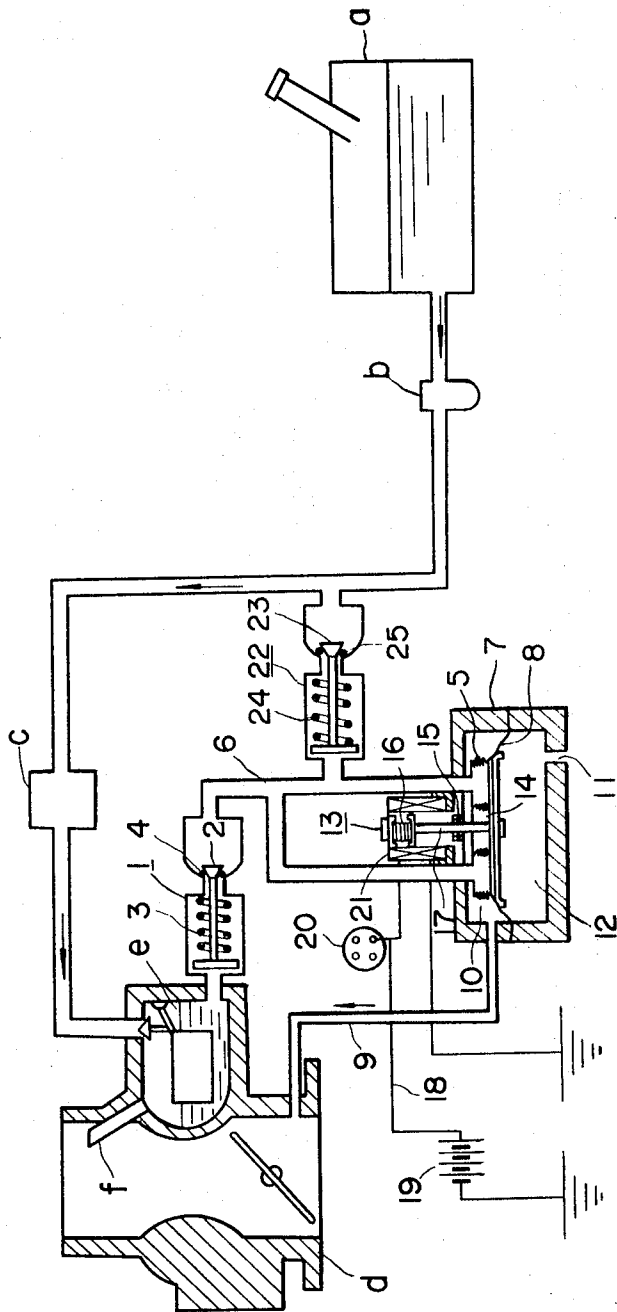
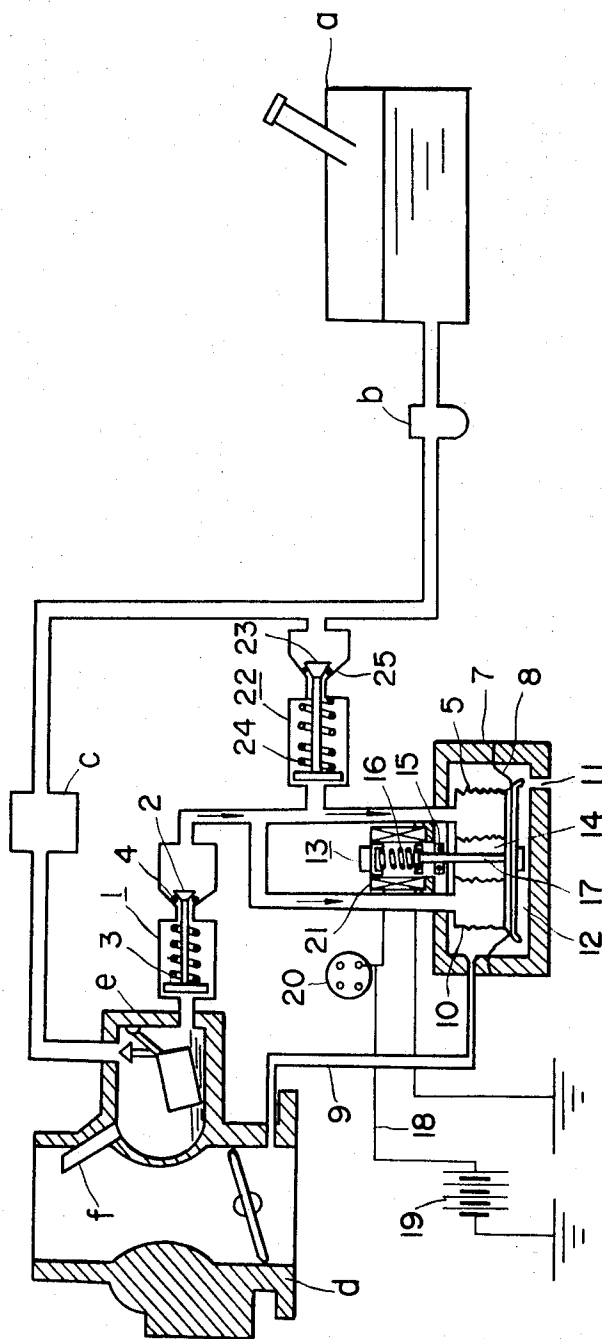


FIG. 3



SHEET 4 OF 5

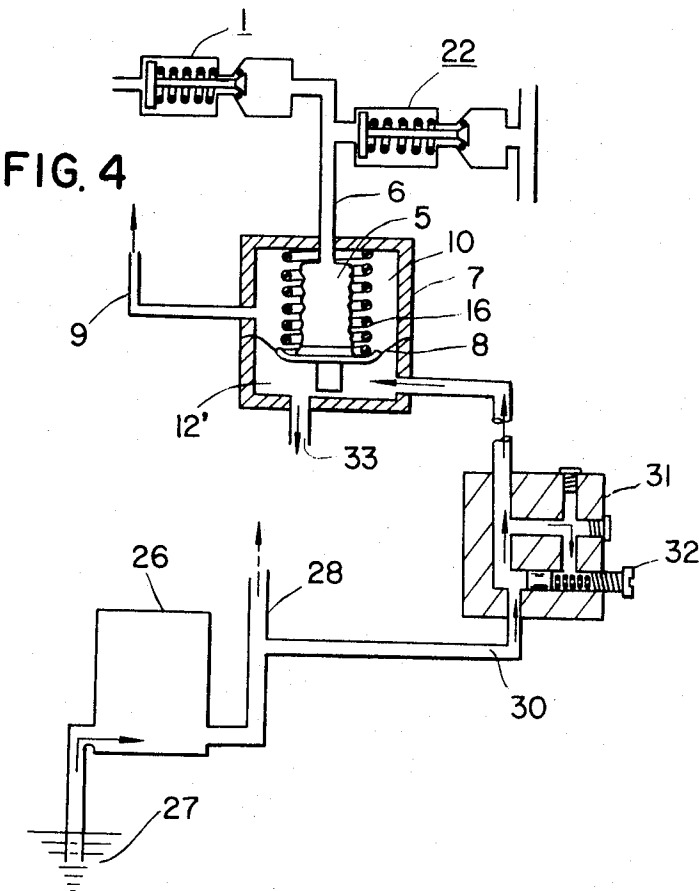


FIG. 5

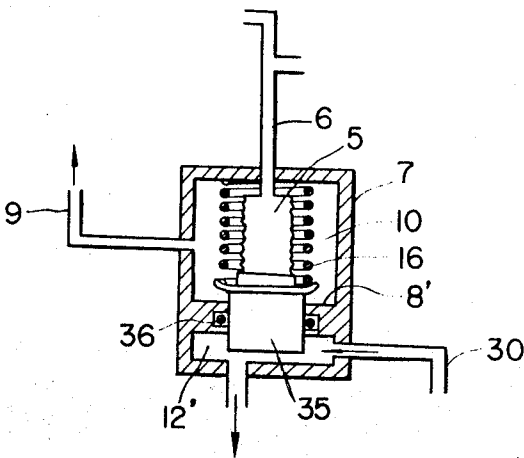
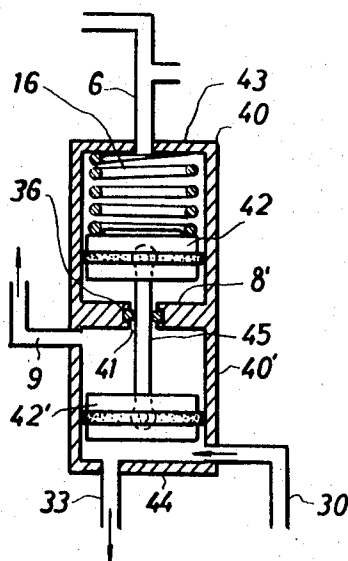


FIG. 6



EVAPORATION-INHIBITING DEVICE FOR A CARBURETOR

SUMMARY OF THE INVENTION

The present invention relates to a device for inhibiting the evaporation of fuel from a carburetor, which causes the release of unburnt hydrocarbons, which represent the major cause of air pollution, in the case of engines equipped with a carburetor.

In the fuel supply system of a conventional engine equipped with a carburetor, which is provided with a fuel supply system consisting of a fuel tank, filter, fuel pump, and the float chamber of the carburetor, the well-known fuel supply action and oil level control in the float chamber take place. Unburnt hydrocarbons are released into the atmosphere through the air vent which relieves the pressure in the float chamber which results from heating. When this vent is internal, the evaporating fuel is sucked into the engine suction system, while the engine is running and it can be prevented from escaping into the atmosphere. However, after the engine has stopped running, the fuel in the float chamber is warmed up by the air below and around the carburetor due to the residual heat in the exhaust manifold, and the evaporation of fuel is promoted, with the result that large volumes of unburnt hydrocarbons are discharged via the air vent and air cleaner into the atmosphere. The amount of unburnt hydrocarbons discharged generally depends on the quality of the fuel in the float chamber, the fuel temperature, the storage capacity of the float chamber, etc. In particular, the storage capacity of the float chamber, which is a variable structural factor, has a vital significance in the prevention of unburnt hydrocarbons from being released. It has been confirmed through experiments that the amount of fuel in the float chamber is a primary factor governing the amount of hydrocarbons released. For this reason it is proposed as a measure of minimizing the release of unburnt hydrocarbons after the engine has stopped running to minimize the fuel storage capacity in the float chamber when the engine is stopped.

The major object of this invention is, in accordance with the above theory, to provide an ordinary oil level control by keeping a normal amount of fuel in the float chamber while the engine is running and, when the engine is stopped, to divert a certain amount of the fuel in the float chamber into a sealed bag outside of the float chamber, thereby reducing the amount of fuel in the float chamber to a minimum and preventing the release of unburnt hydrocarbons by inhibiting fuel evaporation. The other object of this invention will be clear from the following description of several embodiments of this invention.

FIG. 1 shows the fuel supply system of a conventional carburetor;

FIG. 2 shows a system similar to the one illustrated in FIG. 1, equipped with an evaporation-inhibiting device according to this invention, with the valves shown in the positions occupied when the engine is running;

FIG. 3 shows the same system with the valves in the positions occupied when the engine is stopped;

FIGS. 4, 5 and 6 are enlarged partial views of other embodiments of this invention.

Like reference characters denote like parts throughout the several views.

The fuel supply system illustrated in FIG. 1 is a conventional one for an engine supplied through a carburetor. It consists of the fuel tank *a*, filter *b*, fuel pump *c*, and float chamber *e*, of carburetor *d*. In this system, fuel is supplied and the oil level controlled in the float chamber in a conventional manner, *f* being the air vent.

In FIGS. 2 and 3, reference numeral 1 indicates a first one-way valve which communicates with the bottom of float chamber *e*. Reference numeral 2 indicates the valve member of this valve, which is biased to the left of the figure by a spring 3 and rests against an O-ring 4 in the valve seat when the valve 1 is in its closed position. Reference numeral 5 indicates a

variable-capacity bag which communicates through a divided duct 6 with the one-way valve 1. This bag consists of a bellows made of oil-proof, pressure-resistant material or the like. A protective casing 7 encloses the bag 5 and is located in a position preferably free from the influence of engine heat. A diaphragm 8 is mounted between the bottom plate of the bag 5 and the surrounding wall of the protective casing 7, and separates the upper airtight chamber 10 (which communicates through a connecting pipe 9 with the suction pipe downstream of the throttle valve of the carburetor) from the lower open chamber 12 which communicates through the orifice 11 with the atmosphere. Reference numeral 13 indicates an operating device for the variable-capacity bag 5. This device is composed of an actuating rod 17 which is attached to the bottom plate of the bag 5, extends through the central portion 14 of the bag and passes through an O-ring 15 in the top wall of the airtight chamber 10. The upper end of the rod is biased by a spring 16 toward a position in which said bag 5 is held in its expanded position. An electromagnetic device 21, located near the top of said actuating rod 17, is supplied through an electric circuit 18. The switch 20 between said device and battery 19 controls the starting and stopping of the engine. When this switch is closed, the rod 17 is attracted against the resistance of the spring 16, thereby contracting the bag 5. Reference numeral 22 indicates a second one-way valve similar to the first one-way valve, and comprises a valve member 23, a spring 24 and an O-ring 25. This second one-way valve opens into the forked duct 6 and upstream of the fuel pump *c* in the fuel supply line, and the spring 24 is at least stronger than the suction of the fuel pump *c* so that even when the fuel pump *c* is operating, the valve member 23 can be held in the seated position, thereby preventing the fuel in the float chamber *e* from flowing back through the second one-way valve 22 into the fuel supply line.

In this embodiment of our evaporation-inhibiting device, when the engine is running, as illustrated in FIG. 2, closing of the switch 20 energizes the electromagnetic device 21 to attract the actuating rod 17 against the resistance of the spring 16 and at the same time brings the airtight chamber 10 into communication with the suction pipe at negative pressure downstream of the throttle valve. As the result, the variable-capacity bag 5 can remain reduced in size. Moreover, since both the one-way valves 1 and 22 are held closed by the springs 3 and 24, the fuel supply system can act in the same way as the conventional system illustrated in FIG. 1. When the engine stops, as shown in FIG. 3 the electromagnetic device 21 is deenergized and the negative pressure in the suction pipe communicating with the airtight chamber 10 vanishes. Consequently the bag 5 is expanded by the spring 16 which pushes down the diaphragm 8. Expansion of the bag 5 opens the first one-way valve 1 to admit a certain amount of the fuel in the float chamber *e* into the bag 5. (When the effect when the engine is starting is considered, it would be advantageous to retain some fuel. However, it is obvious that the maximum retention of fuel depends on the restricted release of unburnt hydrocarbons).

When the engine is restarted, contraction of the bag 5 exerts pressure on the valve member 23 of the second one-way valve 22 to open the valve against the force of spring 24. As a result the fuel in the bag 5 is forced into the fuel supply pipeline and again passes through the fuel pump *c* from which it flows rapidly into the float chamber *e* via the needle valve kept open in the carburetor. Thus fuel is supplied smoothly immediately after the engine is started. The first one-way valve 1 closes when the fuel pressure from said bag 5 is applied, so that there is no hazard of overflowing even when the fuel suddenly rushes into the float chamber *e*.

In FIG. 4 the device 13 which expands and contracts the bag 5, instead of being electromagnetically actuated, utilizes the pressure of the engine-lubricating oil. Reference numeral 26 indicates a lubricating oil pump which pumps the lubricating oil from the tank 27 through a pipe 28 to each part to be lubricated. Pipe 30, which comes out of said pump 26, leads to

an oil pressure chamber 12' which corresponds to said open chamber 12. Reference numeral 31 indicates a pressure-regulating valve of conventional construction in said pipe 30, which valve serves both as a reducing valve and as a stabilizing valve, and is equipped with a pressure-set screw 32. Reference numeral 33 indicates a return pipe leading to the tank. When the engine starts and the oil pressure rises, in this arrangement the constant oil pressure (commonly regulated to within 0.1-0.5 kg./cm.² by the pressure-regulating valve 31) forces up the diaphragm 8 to contract the bag 5 against the resistance of spring 16. While the engine is stopped the oil pressure is set to zero, so that the diaphragm 8 is forced back and an action similar to the one illustrated in FIGS. 2 and 3, then takes place.

In FIG. 5, the diaphragm 8 in FIG. 4 is replaced by a plunger 35 fitted to the lower surface of the bottom plate of the bag 5. Reference numeral 8' indicates a partition wall substituted for the diaphragm 8. The plunger is slidable in an O-ring 36 seated in said wall. In this construction, the plunger 35 is moved vertically by the pressure of the lubricating oil forced into the oil pressure chamber 12', which causes the bag 5 to operate as shown in FIG. 4. In FIGS. 4 and 5, the duct 6 is a single pipe. The actuating rod 17 is omitted. The spring 16 is housed within the airtight chamber 10 and so mounted as to embrace the bag 5. In each embodiment described above, the airtight chamber 10 communicating with the suction pipe downstream of the throttle valve in the carburetor is provided as auxiliary to the device 13 for receiving a high negative pressure at the instant the engine is started to help contract the bag 5 and keep the bag 5 contracted under a certain negative pressure against the force of spring 16, while the engine is running.

As described above, this invention consists of a variable-capacity bag which communicates with the float chamber of a carburetor and the internal volume of which can be varied by the operating device, a first one-way valve which is located between the bag and the float chamber and permits a flow in the direction of the bag and a second one-way valve which connects the bag with the fuel supply line at least upstream of the fuel pump and permits a flow in the direction of the fuel supply line. This operating device increases or decreases the internal volume of the bag in response to the starting or stopping of the engine. Thus, the cooperative action of the first and second one-way valves during engine operation assures normal, smooth fuel supply without introducing the fuel from the float chamber into the bag, while when the engine is stopped it allows fuel to flow from the float chamber into the bag. Thus, in spite of the residual heat of the air surrounding the carburetor the evaporation of fuel out of the float chamber is minimized, thereby effectively preventing the release of unburnt hydrocarbons which pollute the atmosphere.

The bag is constructed as a flexible bellows made of pressure-resistant material in case the bag itself is heated by an unknown cause when the engine is stopped and the fuel therein consequently becomes hot and increases in pressure and volume. The bag will then follow and absorb the change without being ruptured, and because of the spring biasing the second one-way valve, the fuel will not overflow into the fuel supply line. Accordingly there is no possibility that the fuel once held in the bag will be evaporated to be dispersed into the atmosphere.

In the preferred embodiment of this invention, the device for operating the bag is an electromagnetic device such as a solenoid, which is controlled by the ignition switch for starting and stopping the engine and, when energized, holds the bag in its contracted position against the resistance of the spring. Thus, the desired object can be readily attained by adding a simple device to a conventional system and the action of the device is practically trouble-free.

Moreover, in the embodiment comprising the electromagnetic device the variable-capacity bag is housed in an airtight chamber, which communicates with the air intake pipe downstream of the throttle valve in the carburetor. Therefore the instantaneous power consumption required to actuate the

electromagnetic device is small; the contraction of the bag is very swift; and when the engine is running the bag can be reliably held in contracted position overcoming the spring force, thereby assuring the inhibiting effect of the device.

In the alternative embodiment in which the operating device for the variable-capacity bag is a pressure-response device which communicates via a pressure-regulating valve with the engine lubricating oil pressure supply line; and in which the lubricating oil pressure is transmitted through said line, the bag can be held contracted against the pressure of the spring. Thus, the operating device can act uniformly at a specified oil pressure; and since the oil pressure can be very easily controlled, this arrangement has the advantage of adequately controlling the fuel evaporation in dependence on the fuel quality and other factors.

Furthermore, in this invention, since the variable-capacity bag in the above-mentioned pressure-responsive device is housed in an airtight chamber, which communicates with the air intake pipe downstream of the throttle valve in the carburetor, both the pressure response device and the airtight chamber can be compactly housed in a relatively small protective casing. And since all the units in said protective casing are hydraulic pressure devices, the volume-changing action of said bag does not take place abruptly. The action does not damage, for instance, the diaphragm which partitions the pressure response device from the airtight chamber and accordingly the service life of the equipment as a whole can be prolonged.

A piston and cylinder arrangement may be utilized as a chamber having a variable volume instead of the variable capacity bag.

An embodiment of this arrangement which is illustrated in FIG. 6, will now be described.

Cylinders 40 and 40' in a tandem system are separated from each other by the partition wall 8' pierced by a hole 41. The O-ring 36 is seated in hole 41 and forms a pressure-tight gasket encircling a rod 45 which is slidably mounted in the hole. Pistons 42 and 42' which fit into the cylinders 40, 41' are respectively connected to the opposite ends of the rod 45. The upper end of the cylinder 40 is closed by an end plate 43 pierced by the duct 6 communicating with the first one-way valve 1 (FIG. 3). The spring 16 between the end plate 43 and the piston 42 biases the piston 42 in the direction of the lower end of the cylinder 40.

In the cylinder 40', an airtight chamber formed by the piston 42' and the partition wall 8' is connected, through the connecting pipe 9, with the suction pipe downstream of the throttle valve in the carburetor. Moreover, in the cylinder 40', the part below the piston 42' is closed by an end plate 44 pierced by the pipe 30 communicating with the pressure-regulating valve 31 and the return pipe 33 which opens into the tank 27, thereby forming an oil pressure chamber. This construction provides means which is actuated by pressure of the engine lubricating oil and in which a negative pressure can be utilized as an auxiliary source of power to force up the piston 42'.

What is claimed is:

1. Device for inhibiting the evaporation of fuel in a fuel supply system comprising a carburetor having a float chamber, a fuel supply line connecting said carburetor to a fuel tank, and a fuel pump in said fuel supply line, said device comprising:

a variable-volume bag in communication with said float chamber,

an operating device for varying the volume of said bag,

a first one-way valve through which said bag is connected to said float chamber and which permits flow only in the direction of said bag,

a second one-way valve through which said bag is connected to the fuel supply line upstream of the fuel pump and which permits flow only in the direction of said fuel supply line,

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an airtight chamber housing said bag and connected to the
air intake for the carburetor downstream of the throttle
valve in said carburetor,
said operating device being connected to decrease the inter-
nal volume of said bag when said engine is started and
said bag being so mounted within said chamber that the
negative pressure received by said chamber from said air
intake at the instant the engine is started assists in con-
tracting said bag.
2. Device as claimed in claim 1, in which said operating
device is an electromagnetic device which is actuated by the

ignition switch of an engine, said bag is spring biased toward
an expanded position, and said electromagnetic device is
adapted, when actuated, to overcome said bias and contract
said bag.

3. Device as claimed in claim 1, wherein said operating
device is a pressure responsive device and is connected
through a pressure-regulating valve to an engine lubricating
oil supply line, whereby the pressure of the lubricating oil in
said line causes contraction of said bag.

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