April 28, 1942. W. E. HAAST 2,281,283

VAPOR SEPARATOR

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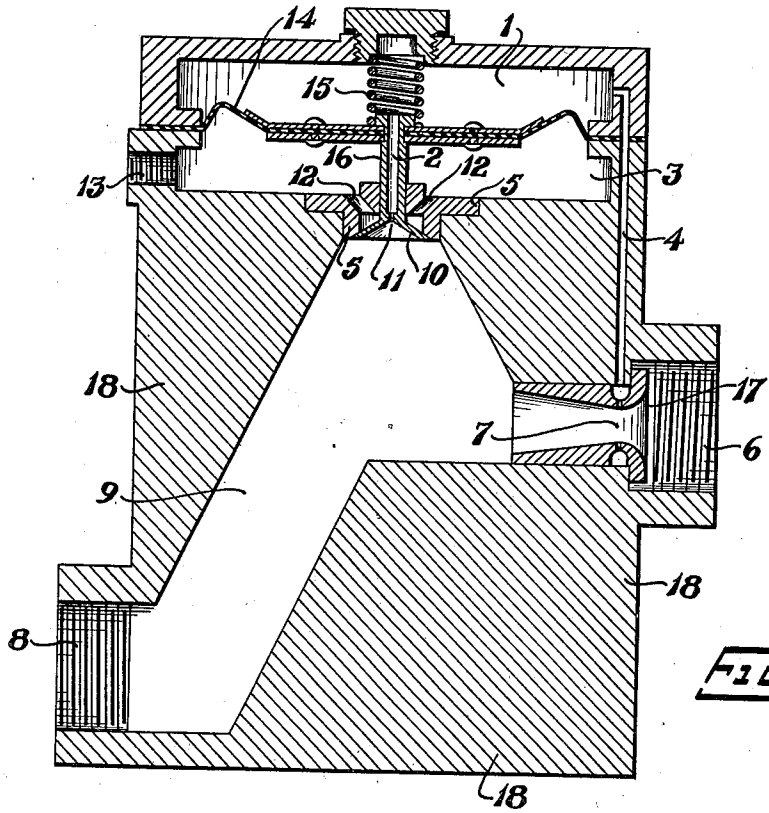


Fig. 1

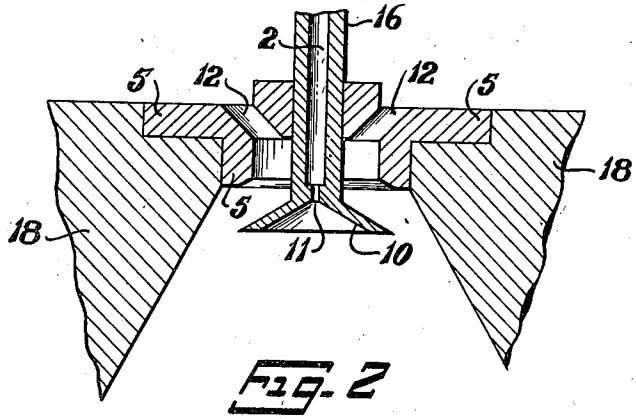


Fig. 2

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VAPOR SEPARATOR

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11 Claims. (Cl. 137—69)

This invention applies generally to vapor separators and especially to the type employed for removing gases from pipe-lines carrying liquids. One of the applications of the device is its use in conjunction with fuel lines of internal combustion engines where the presence of vapors frequently causes motor troubles or loss in efficiency.

The advantages of the device may be fully appreciated when considered in conjunction with the present day aviation engine. As a result of the use of high octane gasoline, and substratosphere flying, the development of vapors in the fuel system is greatly increased. The presence or excessive accumulation of such vapors under those circumstances is of a serious nature since failure of the fuel supply may result. Consequently the importance of providing means for removing vapors from the fuel line during motor operation, cannot be underestimated.

Fig. 1 is a front elevation in section showing the elements of the proposed vapor separator.

Fig. 2 is an enlarged view of the valve detail in its open position.

When the device is used on an internal combustion engine gasoline or other types of fuel in liquid form are fed into the separator from the source of fuel supply, through the inlet 6. Said fuel passes through the venturi 17, into the chamber 9 within the body 18 where it is momentarily interrupted in its flow before continuing through the outlet 8 to the carburetor. In case vapors are present in the supply line the interruption in flow occurring in chamber 9 tends to separate the vapors from the liquid, the former rising to the upper portion of the chamber 9 adjacent the valve 10 out of contact with the main stream flow.

A valve 10 in combination with seat 5 and ports 12 has been provided for removing the vapors from chamber 9 as illustrated. Since these vapors are rich in fuel they are preferably discharged into a vapor compartment 3 which communicates with the fuel supply through connection 13. As a matter of fact liquid fuel enters the compartment 3 through the ports 12 for a short interval preceding the closing of valve 10.

The most important features of my invention are incorporated in the valving mechanism. In order to make the device foolproof and fully automatic it is necessary to provide a valve for opening the vapor discharge port 12 only when the troublesome vapor is present in the fuel line. Therefore, one of the objects of this invention is to provide a vapor remover in which the vapor discharge valve is actuated by virtue of the presence of the vapor at the valve.

By reference to the drawing the auxiliary chamber includes a valve operating compartment 1 partitioned off from the vapor compartment by the diaphragm 14. A partial vacuum is established in the valve operating compartment 1 through the passage 4 extending from the throat 7 of venturi 17 to said compartment. The operating compartment is also directly connected to the separating chamber 9 by passage 2 in valve stem 16. Said passage 2 opens at its upper end into the compartment 1 and is provided with a reduced or restricted portion 11 where the passage 2 communicates with the chamber 9 at its lower end.

The object of reduced portion 11 of passage 2, hereinafter called the restriction, is to present a substantial barrier to impede the flow of liquid fuel without hindering or obstructing the flow of vapor through the opening. In other words 11 is a simple or preferred form of liquid check which nevertheless will permit vapors to pass.

Due to the suction set up in passage 4 and compartment 1 resulting from liquid fuel flowing through the throat 7 of venturi 17, the diaphragm 14 will be constantly urged upward tending to hold the valve 10 against its seat 5, and thereby closing the vapor exhaust ports 12. So long as the chamber 9 is filled with liquid the vacuum is maintained since the flow of liquid through the restriction 11 is small as compared with the evacuation through passage 4 into the main fuel stream at Venturi throat 7.

However when vapor occurs in the chamber 9 adjacent the valve 10 and displaces the liquid, the pressure balance is changed since the vapor may pass freely through the restriction 11 and break the vacuum in compartment 1. The free passage of the vapor through the passage 2 in valve 16 breaks the vacuum in compartment 1 thereby permitting the diaphragm 14 to drop due to the counter action of the spring 15. As the diaphragm 14 drops the valve 10 is moved of its seat thereby opening ports 12 as illustrated in Fig. 2. The difference in pressure between vapor compartment 3 and separating chamber 9 causes the vapors pocketed in chamber 9 adjacent the valve 10 to be discharged through the ports 12 and returned to the source of fuel supply through connection 13.

When the vapor has been exhausted from chamber 9, and the liquid reached the valve 10 in displacing the vapor, some of the liquid will

probably escape into compartment 3 before the valve 10 is closed. This creates no difficulty for the liquid is merely returned to the tank or source of supply. The vapor may be condensed for further use or discarded if necessary. The vapors or liquids drawn into the operating compartment 1 through passage 2 are returned to the system through passage 4 at the Venturi throat 7.

However as the liquid reaches the restriction 11 in the pasage 2 of valve 16 a gradual increase in vacuum will be built up in compartment 1. This will raise the diaphragm 14 and eventually close valve 10 thereby bringing the apparatus back to its normal operating position when the fuel line is free of vapor. Another feature tending to close the valve is the frictional drag of the liquid against the side of the passage or restriction 11, as it flows from chamber 9 into compartment 1.

The above description and illusration have been confined to or emphasized the use of the invention for removing vapor from liquid fuel and particularly in conjunction with aviation internal combustion motors. I do not intend to limit the scope of this invention to that field alone but broadly to any field where a liquid and a gas are both present at the same time.

Although I have illustrated and described my invention employing a venturi 17 for the purpose of establishing a vacuum in compartment 1 for operating valve 10, it is evident that any type of device capable of creating a vacuum in the operating compartment will answer the purpose.

Further, although the preferred structure disclosed includes a valve 10 having a passage 2 extending through its stem 16 and provided with a restriction 11, the passage need not be carried through the valve so long as it connects chamber 9 at a point adjacent valve 10 to the vacuum or valve operating compartment 1.

I claim:

1. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

2. A device of the type described including a fuel line, an exhaust valve located in said line, a separation chamber located in said fuel line for interrupting the flow and allowing the vapors to separate from the liquid, vacuum operated means for controlling said valve, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

3. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve including an operating compartment, a diaphragm associated with said compartment and linked to said valve, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

4. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, including an auxiliary chamber, a diaphragm dividing said auxiliary chamber into two parts namely an operating compartment and a vapor compartment, said diaphragm being linked to said valve, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

5. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, including an operating compartment, a diaphragm associated with said compartment and linked to said valve, a venturi located in said fuel line, a passage extending from the throat of the venturi to said operating compartment for evacuating said compartment, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

6. A device of the type described including a fuel line, a separator chamber located in said fuel line for interrupting the flow and allowing the vapor to separate from the liquid, an exhaust valve located in said chamber, an auxiliary chamber divided into two parts by a diaphragm thereby providing an operating compartment and a vapor compartment, said diaphragm being linked to said valve for operating the same, a venturi located in said fuel line, a passage extending from the throat of the venturi to said operating compartment for evacuating said compartment, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

7. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, a passage located in said valve and extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in

the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening said exhaust valve, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

8. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, a passage extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening the vapor exhaust valve in the fuel line, and means for impeding the flow of liquid from the fuel line into said vacuum operated means for maintaining the vacuum and thereby retaining the vapor exhaust valve closed in the absence of vapors in the fuel line.

9. A device of the type described including a fuel line, an exhaust valve located in said line, vacuum operated means for controlling said valve, a passage located in said valve and, extending from the fuel line to said vacuum operated means and adapted to permit any vapor occurring in the fuel line to flow freely into said vacuum operated means for breaking the vacuum and thereby opening the vapor exhaust valve in the fuel line, and means for impeding the flow of liquid from the fuel line into said vacuum operated means for maintaining the vacuum and thereby retaining the vapor exhaust valve closed in the absence of vapors in the fuel line.

10. A device of the type described including a fuel line, an interrupting chamber located in said fuel line for interrupting the flow and allowing the vapors to separate from the liquid, an auxiliary chamber, a diaphragm dividing said auxiliary chamber into two compartments including operating and vapor compartments respectively, a venturi located in the fuel line and connected to the operating compartment for evacuating the air from the operating compartment and creating a vacuum therein for actuating said diaphragm, a port connecting said interrupting chamber to said vapor compartment for exhausting vapors from the fuel line, a valve for controlling said port and adapted to be closed by said diaphragm when a vacuum is maintained in said operating compartment, a spring for opening said valve when said vacuum is broken, an operating passage extending from said interrupting chamber through said valve to said operating compartment, a restricted section in said operating passage adapted to permit the free flow of vapor through said passage for the purpose of breaking the vacuum in the operating compartment thereby opening the valve for exhausting the vapor from the interrupting chamber, but adapted to impede the flow of liquid through said passage for the purpose of maintaining the vacuum in the operating compartment and retaining the valve in its closed position when only liquid in place of vapor occurs in the interrupting chamber.

11. A device of the type described including a supply line, an exhaust valve located in said line, a spring for opening said valve, vacuum operated means for closing said valve, means for producing a vacuum in said vacuum operated means, a passage extending from said supply line to said vacuum operated means for allowing any vapor in the supply line to pass freely into said vacuum operated means whereby the vacuum in said means will be broken and the vapor exhaust valve opened for removing the vapor from the supply line, and a restriction in said passage for impeding the flow of liquid through said passage for maintaining the vacuum and thereby retaining said exhaust valve closed in the absence of vapors in the fuel line.

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