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EVAPORATION CONTROL DEVICE-PRESSURE BALANCE VALVE

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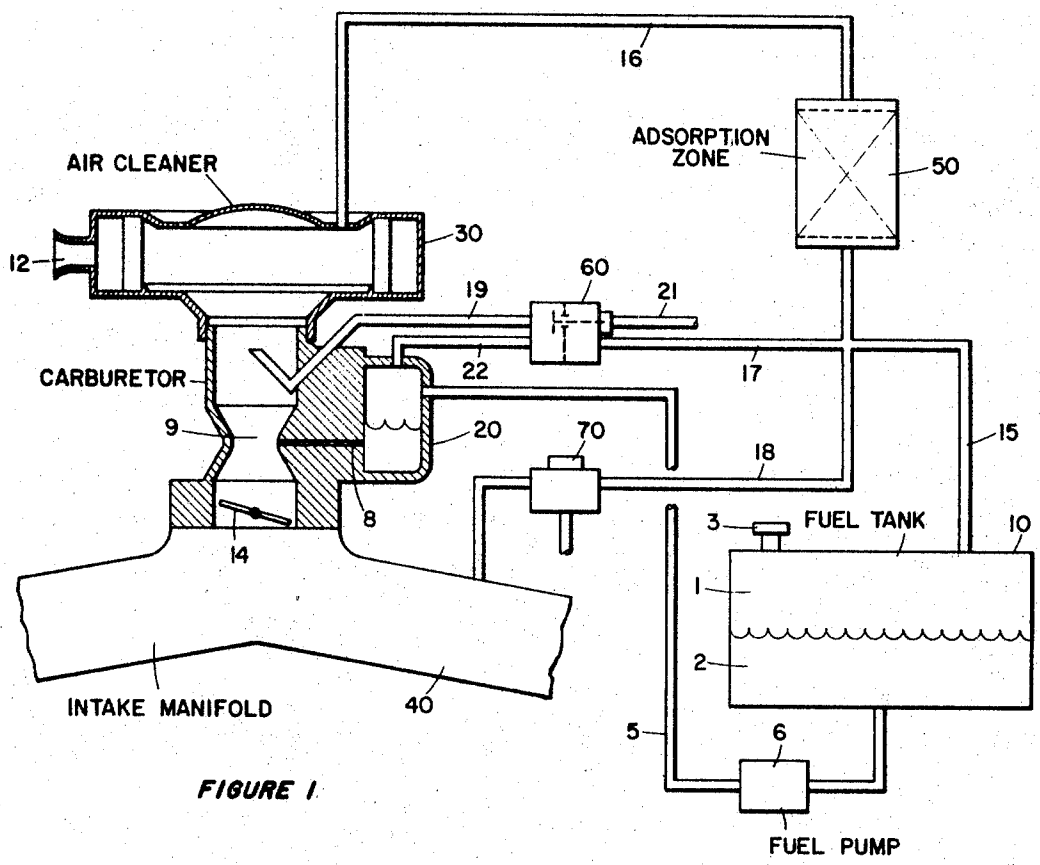



FIGURE 1

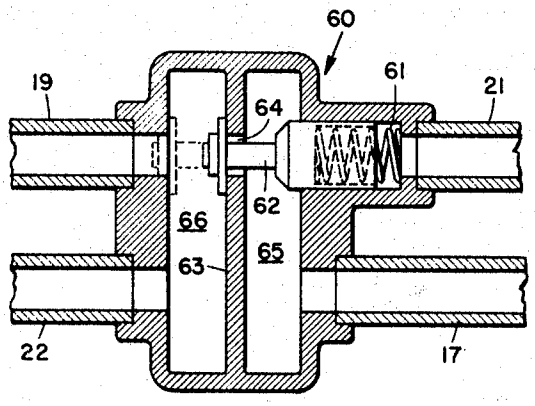



FIGURE 2

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# EVAPORATION CONTROL DEVICE-PRESSURE BALANCE VALVE

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## ABSTRACT OF THE DISCLOSURE

Apparatus for preventing loss of fuel constituents into the atmosphere from an internal combustion engine which comprises in combination an adsorption zone adapted to adsorb vaporous fuel constituents during engine nonoperation and wherein said constituents are desorbed during engine operation by back flowing atmospheric air therethrough and wherein a valve assembly is provided so as to provide free communication between the carburetor and the vaporous area of the carburetor bowl during engine operation and wherein during engine nonoperation to provide free communication between said vaporous area and said adsorption zone.

The present invention is broadly concerned with an improved method of operating an internal combustion engine wherein fuel vapors are prevented from venting into and polluting the atmosphere. The invention is also concerned with an improved apparatus or device for attaining this result. A more specific adaptation of the invention is a method of operating the internal combustion engine wherein fuel constituents normally lost to the atmosphere are combusted in the engine to secure greater mileage. In essence, the method and apparatus of the present invention utilize at least one adsorbent bed to adsorb vaporized fuel constituents and then desorbs these fuel constituents and combusts the same in the engine.

In accordance with one specific adaptation of the present invention, excellent carburetion of the fuel is secured by maintaining a pressure balance valve in the system between the area of the carburetor's air horn and the area above the fuel in the carburetor bowl. This is secured by a communication means between these areas controlled by a pressure balance valve. When the engine is not operating, communication is provided between the area above the fuel in the carburetor bowl and the adsorbent in the canister, also controlled by the pressure balance valve.

It is well known that air pollution presents health, nuisance, and economic problems and that the fumes, vapors, and gases evolved from internal combustion motor vehicles contribute significantly to air contamination. It is also known that generally these fumes and vapors are emitted into the atmosphere from the motor vehicle as exhaust gases discharged through the tailpipe or are due to unburned fuel constituents which are emitted through the vent in the fuel storage tank and through vents from the carburetor bowl. For example, it has been estimated that from about 10 to 20% by volume as, for example, about 15%, by volume of the total vapors and fumes emitted unburned to the atmosphere from an internal combustion motor vehicle, are evaporated from the gasoline tank and the carburetor bowl.

The present invention is particularly concerned with the elimination of fuel losses from the vehicle fuel tank and carburetor bowl and with their ultimate use in the combustion chamber. In accordance with the present invention, fuel vapors, such as hydrocarbon fuel vapors, alcohol vapors, and the like, which are emitted either



from the fuel tank or the carburetor bowl, are adsorbed on an adsorbent and thereafter desorbed and combusted in the engine.

The losses from the fuel reservoir tank are caused by factors which include the rising temperature of the fuel as the vehicle is operated and rising atmospheric temperatures which cause the reservoir or fuel tank to breathe through the vent, or vents, in the fuel tank thereby emitting unburned fuel constituents into the atmosphere. In many instances, the temperature of the fuel reservoir may be from about 20° to 40° F. higher than the atmospheric or ambient temperature.

Furthermore, after the engine has been operated for a period of time and then turned off, the temperature of the fuel in the carburetor bowl rises as heat flows to the carburetor from the hot engine. The fuel is said to undergo a "hot soak." Data have shown that the temperature of the fuel in the carburetor bowl can rise to as high as about 200° F. after the hot engine has been turned off. It has been estimated that the loss from a gasoline tank may range from about 2 to 150 grams per day and that the "hot soak" loss from the carburetor bowl may range from about 2 to 50 grams per hot soak.

Thus, in accordance with the present invention as hereinbefore mentioned, these fuel vapors are adsorbed on an adsorbent and then desorbed and combusted in the internal combustion engine. The process and apparatus of the present invention may be more fully understood by reference to the drawings illustrating embodiments of the same. FIGURE 1 illustrates the overall apparatus and technique while FIGURE 2 illustrates the preferred pressure balance valve in some detail.

Referring specifically to FIGURE 1, fuel tank or fuel reservoir **10**, has a vapor space **1** and a liquid fuel phase **2**. Fuel tank **10** contains a conventional cap **3** permitting fuel to be introduced into the tank **10**. Fuel cap **3** also contains a conventional vent which normally permits the tank to breathe whereby expanding vapors are emitted into the atmosphere. The vent on the tank **10** may be placed in other positions. In accordance with one conventional method liquid fuel is withdrawn from reservoir **10** by means of line **5**, fuel pump **6** and introduced into carburetor bowl **20**. A conventional float, or equivalent means (not shown) positioned in carburetor bowl **20**, controls the level of the liquid fuel in the carburetor bowl. Carburetor bowl **20** is normally supplied with a vent (not shown) which permits vapors to pass into the atmosphere.

In accordance with conventional operation, atmospheric air is introduced by means of line, or conduit, **12** and passes through an air filter **30**. The air passes downwardly through the carburetor wherein fuel is withdrawn from bowl **20** by means of line **8** and passed into a carburetion means **9** where the same is mixed with the incoming air. A choke element (not shown) is positioned normally ahead of the carburetion means **9**. A flapper valve or element **14** controls the introduction of the fuel-air mixture into the intake manifold **40** which element distributes the fuel-air mixture into the respective cylinders. Fuel is introduced into carburetor **9** by means of conduit **8** as required.

As pointed out heretofore, due to temperature variations and fuel tank breathing, fuel vapors pass from the tank **10** through the vent in the tank and are lost into the atmosphere thereby causing contamination of the atmosphere. Also as pointed out heretofore, after the engine has been run for a time period the entire engine block is very hot and when the engine is turned off, the fuel in the carburetor bowl becomes quite warm reaching temperatures as high as 200° F. and greater. This causes a portion of the fuel to be vaporized. The vapors are

vented through the carburetor vent and further contaminate the atmosphere. Also, in addition, valuable fuel constituents are lost rather than combusted in the engine.

In accordance with the present invention, the tank vent and the carburetor vent, and any other open vents which would allow loss of vapors from the fuel system to the atmosphere are closed off. A conduit **15** is affixed to the fuel tank to provide communication to one end of an adsorption zone **50**. Adsorption zone **50** contains a suitable adsorbent therein for adsorbing vaporous fuel constituents. Adsorbents may be activated charcoal, silica gel and the like. A line **16** is provided at the other end of adsorption zone **50** which provides communication to the atmosphere, preferably through the air filter. The quantity of adsorbent provided is sufficient to adsorb all vaporous fuel constituents emitted from tank **10** and to prevent any breakthrough of these constituents through line **16**.

The quantity of adsorbent required will be a function, among other factors, of the particular engine design, environmental conditions, and particular adsorbent or adsorbent mixture utilized. One preferred adsorbent is activated carbon.

Thus, when the fuel in tank **10** emits vapors due to temperature rise, change in pressure, etc., and when the engine is not operating, these vapors are adsorbed on the adsorbent in adsorption zone **50**. When the engine is operating, the suction pressure or vacuum in manifold **40** not only will draw atmospheric air into air filter zone **30** but also will draw air in through vent **16**, conduit **18**, and into manifold **40**. This will backwash or backflow air through adsorption zone **50** from the other end to the one end in a manner to desorb the fuel constituents which were adsorbed previously on the adsorbent. As pointed out heretofore, the amount of adsorbent provided is sufficient so that when fuel constituents are being adsorbed none of these fuel constituents will pass into the atmosphere by means of line or vent **16**. The amount of backwash air passed through vent **16** is sufficient to desorb a portion of the previously adsorbed fuel constituents.

Referring to the carburetor bowl **20** when the engine is turned off after running, fuel constituents will vaporize and flow through line **22** through pressure balance valve **60**, through line **17** and into one end of adsorption bed **50** which, as pointed out, is provided with an adsorbent which will adsorb the vaporized fuel constituents. Sufficient adsorbent is provided so as to prevent any breakthrough of the fuel constituents into line or conduit **16** provided near the top or at the other end of zone **50**. Line **19** provides communication between the carburetor and the pressure balance valve **60**. Line **21** provides communication between the balance valve **60** and the intake manifold **40**. Valve control desorption means **70** may be positioned in line **18** as illustrated in order to control or reduce the intake of gasoline-rich vapor from the canistor when desired, particularly when the engine is idling. Thus, as illustrated in FIGURE 1, vapors from tank **10** and bowl **20** are adsorbed on the adsorbent in zone **50** when the engine is not operating. These vapors during engine operation are desorbed by backflowing air through line **16**, then through line **18** into manifold **40**.

Referring specifically to FIGURE 2 the pressure balance valve assembly is illustrated in some detail. Lines similar to the lines illustrated in FIGURE 1 are similarly numbered. Pressure valve assembly **60** comprises a portion **63** dividing the valve into areas **65** and **66**. A port **64** provides communication between the respective areas. Valve **62** is spring loaded by means of spring **61** so as to seal off line **19** communicating with the carburetor when the engine is not running. Under these conditions the vapor space of the carburetor bowl is in communication with the adsorbent in zone **50** by means of line **22**, area **66**, port **64**, area **65** and line **17**. Thus, vapors boiling from the carburetor bowl will be adsorbed on the adsorbent. When the engine is operating and a manifold vacuum or reverse pressure is exerted through line **21**, valve **62** is caused to move from **19** and close port **64**. Vapors from the carburetor bowl **20** will then pass through line **22**, area **66** and line **19** into carburetor and thence into the engine. Thus a pressure balance will exist between these two areas.



What is claimed is:

**1.** Apparatus for preventing loss of fuel constituents into the atmosphere from an internal combustion engine which comprises in combination: (1) a carburetor fuel bowl associated with (2) a carburetor, (3) an intake manifold, (4) a pressure balance valve assembly, (5) an adsorbent bed of material of the character which will adsorb fuel vapor constituents having a one end and another end, (6) a first conduit means providing communication between the vapor space of said carburetor fuel bowl and said pressure balance valve assembly, (7) a second conduit means providing communication between said pressure balance valve assembly and said one end of said adsorbent bed, (8) a third conduit means providing communication between said pressure valve assembly and said carburetor, (9) an actuating connection means between said intake manifold and said pressure balance valve assembly and adapted to actuate (10) a valve between a first position and a second position in said pressure balance valve assembly; said first position assumed when said engine is operating permitting communication between said first conduit means and said third conduit means and preventing communication between said first conduit means and said second conduit means; said second position assumed when said engine is not operating, permitting communication between said first conduit means and said second conduit means and preventing communication between said first conduit means and said third conduit means.

**2.** Apparatus as defined by claim **1** which comprises, (**11**) a fuel tank, and (**12**) a fourth conduit means for introducing fuel from, (**13**) a fuel tank into said carburetor bowl.

**3.** Apparatus as defined by claim **1** where, (**14**) a fifth communication means provides communication between the other end of said bed and the atmosphere.

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