United States Patent

Cornelius

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[54] EVAPORATIVE LOSS CONTROL APPARATUS

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[52] **U.S. Cl.** **123/136,** 123/DIG. 2
[51] **Int. Cl.** **F02m 19/00**
[58] **Field of Search** .... 123/136 AR

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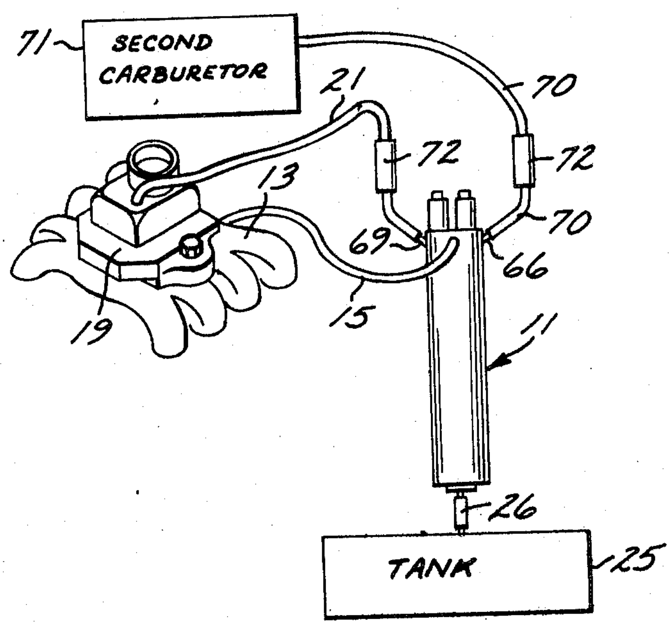
[57] **ABSTRACT**

An evaporative loss control apparatus for draining the gas remaining in the carburetor of an internal combustion engine after the engine is stopped to prevent evaporation thereof by the residual engine heat. The evaporative loss control apparatus includes a vacuum tank connected with the intake manifold of an internal combustion engine and a check valve permits flow toward such manifold only. The vacuum tank is connected with the carburetor and a fuel control valve admits flow to such tank when the engine is stopped. The vacuum tank is connected with the automobile gas tank and a dump valve admits flow to the gas tank after the engine is stopped and the carburetor drained. Thus, when the engine is operating the vacuum tank is in communication with the intake manifold to pull a vacuum in such tank. When the engine is stopped the vacuum in such tank is effective to pull the residual gasoline from the carburetor and, when the vacuum tank approaches atmospheric pressure, the gasoline therein will be dumped into the automobile gas tank.

12 Claims, 12 Drawing Figures



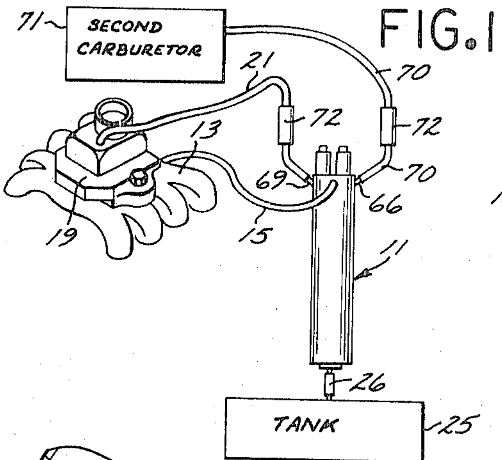


FIG. 1

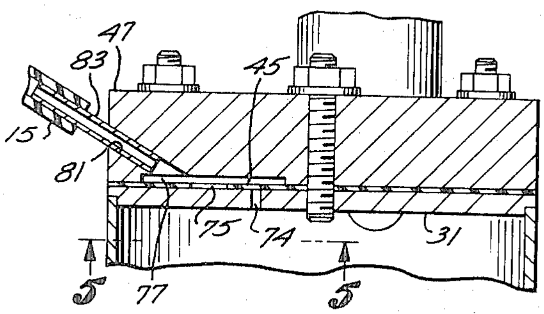


FIG. 4

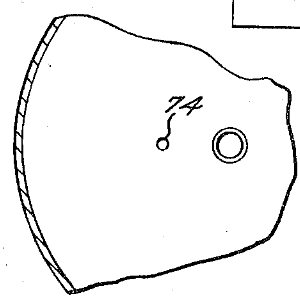


FIG. 5

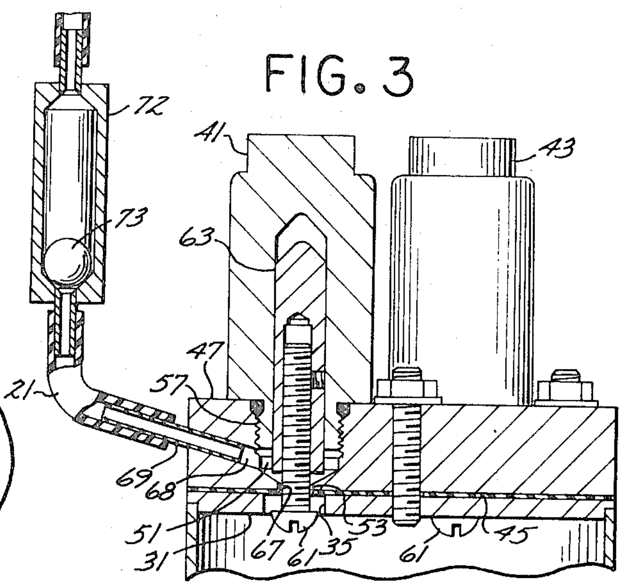


FIG. 3

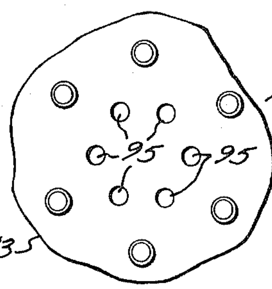
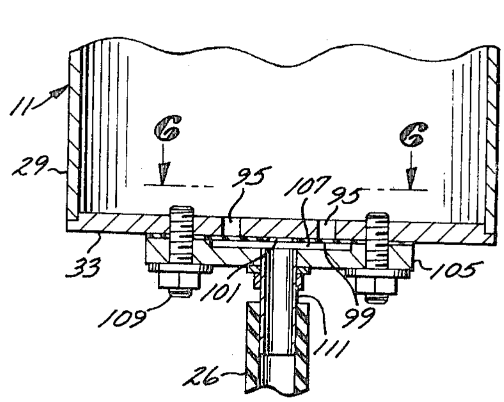


FIG. 6



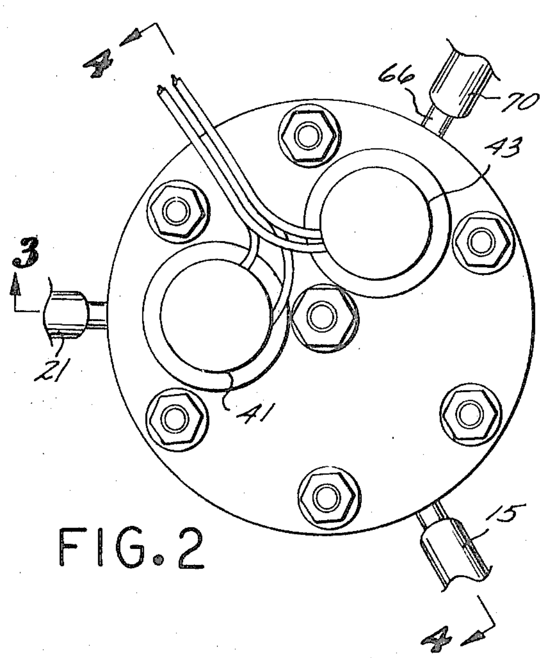


FIG. 2

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FIG.7

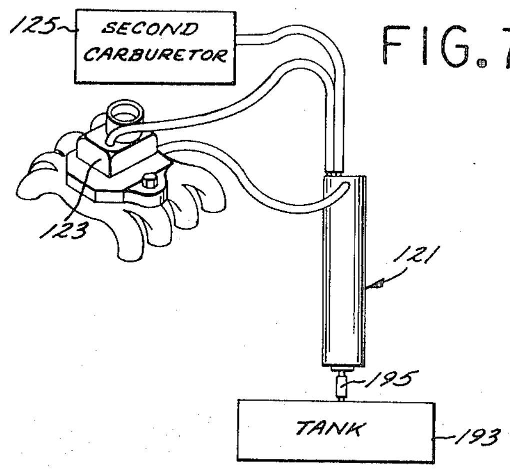


FIG.8

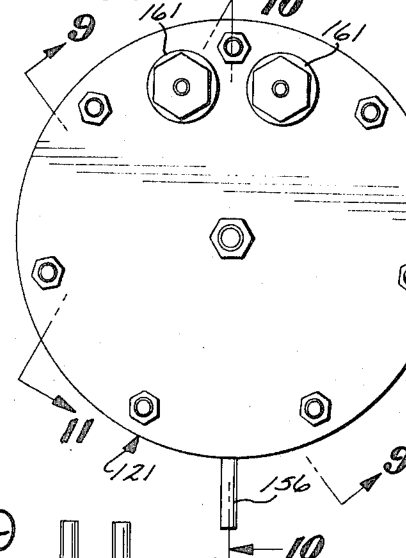


FIG.9

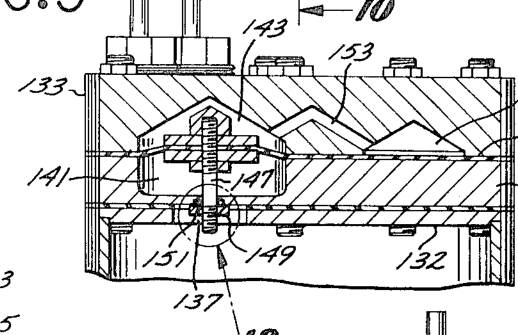
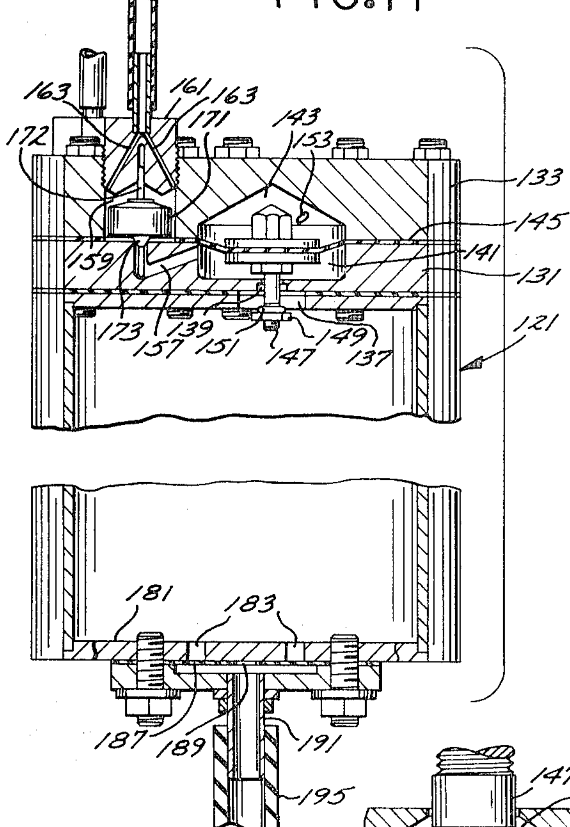


FIG.11



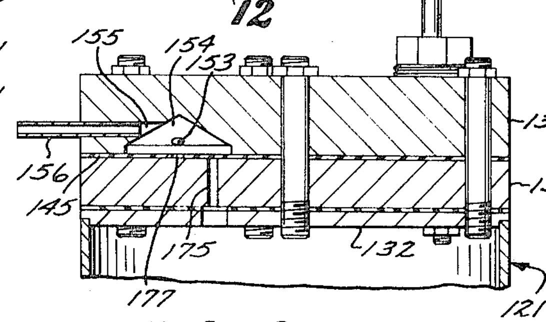
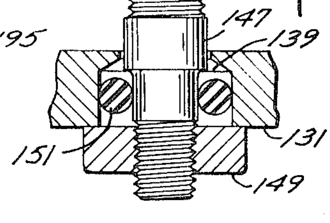


FIG.10

FIG.12



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EVAPORATIVE LOSS CONTROL APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to smog control devices and, more particularly, to a device for preventing evaporation of gasoline from an automobile carburetor after the engine is stopped.

2. Description of the Prior Art

There are no prior art evaporative loss control devices known to applicant which include a vacuum tank that utilize the vacuum from the intake manifold of an internal combustion engine to pull the residual gasoline from the engine carburetor when said engine has been stopped.

SUMMARY OF THE INVENTION

The present invention is characterized by a vacuum tank which is in communication with the intake manifold of an internal combustion engine when such engine is in operation to effect a vacuum in such tank. When the engine is stopped, the tank is placed in communication with the carburetor to pull the residual gasoline therefrom and, when the tank approaches atmospheric pressure, such gasoline will be dumped back into the engine gas tank.

An object of the present invention is to provide an evaporation control apparatus for draining the carburetor of an internal combustion engine after such engine has been stopped.

Another object of the present invention is to provide an evaporative loss control apparatus of the type described that utilizes the vacuum available from the intake manifold to draw such gasoline from the carburetor.

Still another object of the present invention is to provide an evaporate loss control apparatus of the type described which will operate automatically each time the engine is stopped.

These and other objects and the advantages of the present invention will become apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic view of an evaporative loss control apparatus embodying the present invention;

FIG. 2 is a top view, in enlarged scale, of a vacuum tank included in the evaporative loss control apparatus shown in FIG. 1;

FIG. 3 is a broken vertical sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view taken along the line 4—4 of FIG. 2;

FIG. 5 is a horizontal sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a horizontal sectional view taken along the line 6—6 of FIG. 3;

FIG. 7 is a diagrammatic view of a second embodiment of the evaporative loss control apparatus of present invention;

FIG. 8 is a top view, in enlarged scale, of the vacuum tank included in the evaporative loss control apparatus shown in FIG. 7;

FIG. 9 is a vertical sectional view taken along the line 9—9 of FIG. 8;

FIG. 10 is a vertical sectional view taken along the line 10—10 of FIG. 8;

FIG. 11 is a vertical sectional view taken along the line 11—11 of FIG. 8; and

FIG. 12 is a detail view, in enlarged scale, similar to FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the evaporation control apparatus of present invention includes a cylindrical upright vacuum tank **11** which is connected with the intake manifold **13** of an internal combustion engine by a vacuum tube **15**. The tank **11** is connected on its top end with the carburetor **19** by a gasline **21** and has its bottom end connected with the engine gas tank **25** by a dump line **26**. Valves are provided for controlling flow between the vacuum tank, the intake manifold and the gas tank whereby during engine operation the intake manifold **13** will pull a vacuum on the tank **11** and when the engine is stopped, the vacuum in the tank **11** will draw the residual gasoline from the carburetor **19** for subsequent drainage into the gas tank **25**.

Referring to FIG. 3, the vacuum tank **11** is formed by an upstanding pipe **29** having a top wall **31** and a bottom wall **33**. A pair of ports **35** are formed in the top wall **31** and flow therethrough is controlled by a pair of respective solenoid operated gas valves **41** and **43**. A resilient gasket **45** overlies the top wall **31** and is sandwiched between such top wall and a mounting flange **47**. The mounting flange **47** includes a pair of threaded bores **51** extending down from its top side and in communication with the respective ports **35** by means of reduced-in-diameter bores **53**.

The solenoid valves **41** and **43** include downwardly projecting threaded mounting bosses **57** which are screwed into the respective bores **51**. Vertical screws **61** are carried from the armatures **63** of the respective valves **41** and **43** and the shank of such screws **61** project downwardly through the reduced-in-diameter bores **53** and through bores **67** in the resilient gasket **45** whereby energization of the valves **41** and **43** will raise the respective armatures **63** to pull the heads of the respective screws **61** against the gasket **45** surrounding the bores **67** to seal such bores **53**.

As best seen in FIG. 3, a bore **68** angles in from the side of the mounting flange **47** to each of the bores **51** under the respective valves **41** and **43**. Referring to FIG. 3, the bore **68** leading to valve **41** receives one end of a tube insert **69** and the projecting end of such tube insert is connected with the gasline **21** leading to the carburetor **19**. Referring to FIGS. 2 and 3, the bore **68** leading to valve **43** receives one extremity of a tube insert **66** and the projecting end of such insert is connected with a gas line **70** leading to an afterburner carburetor **71** of a smog control device.

Float valves **72** are included in the gasline **21** and **70** and include balls **73** (FIG. 3) which are sufficiently buoyant to float in gasoline to permit gasoline flow from such valves but to seat when all the gasoline has been drained from one of the carburetors **19** or **71** to restrict flow of air from the carburetor **19** or **71** which is first to drain to maintain the vacuum in the tank **11** while the other carburetor drains.

Referring to FIG. 4, a vacuum port **74** is drilled in the upper vacuum tank wall **31** and is normally covered by the resilient gasket **45**. The gasket **45** is formed with a perforation **76** which is offset from the vacuum port **74** and the mounting flange **47** is formed with a recess **77** disposed over both the vacuum port **74** and the perforation **75** whereby the gasket **45** will rise off the port **74** when vacuum is applied to the top side thereof and will seal on the port **74** when the pressure in the recess **77** approaches atmospheric pressure and a subatmospheric pressure exists within the tank **11**. An inclined bore **81** leads in from the side of the mounting flange **47** to the recess **77** and receives a tube insert **83** which is connected with the vacuum line **15** leading to the intake manifold **13**. The vacuum line **15** and associated fittings offer sufficient resistance to airflow from the vacuum tank **11** to the intake manifold **13** to prevent an in-rush of air to such manifold when the engine is first started.

Referring to FIGS. 3 and 6, the bottom wall **33** of the tank **11** includes a plurality of central dump ports **95** arranged in a circular pattern and confronted on their bottom end by a resilient gasket **99**. The gasket **99** is formed with an opening **101** disposed centrally of the circular pattern defined by the ports **95**. The gasket **99** is sandwiched between the lower tank wall **33** and the annular rim of a dump fitting **105** having a central recess **107** which confronts the central opening **101** in the diaphragm **99**. The dump fitting **105** is secured to the bottom wall **33** by means of a plurality of studs **109** and is formed with a central bore which has one end of a tube insert **111** received therein, the other end of such insert connecting with a dump tube **26** leading to the top of the gas tank **25**.

In operation, the vacuum tank **11** is preferentially mounted in an upright position at a higher elevation than the gas tank **25**, as for instance, in the trunk of an automobile, and must be connected with the gas tank **25** by means of the dump tube **26**. The vacuum port **74** is then connected with the intake manifold **13** by means of the vacuum line **15**. The gas port to the solenoid valve **41** is then connected with the carburetor **19** by means of the gas line **21**. If the engine is connected with an afterburner smog device having a carburetor **71**, such carburetor will be connected with the port to the gas valve **43** by means of a conduit **70**. The solenoids of the valves **41** and **43** are then connected in series with the engine ignition switch.

When the ignition switch is closed to energize the electric starter, the vacuum line **15** will offer substantial resistance to airflow from the tank **11** to the intake manifold **13** thereby preventing an in-rush of air and upsetting the carburetor balance. Closing of the ignition switch will energize the solenoid valves **41** and **43** to pull the respective armatures **63** upwardly to press the heads of the respective screws **61** firmly against the surrounding gasket **45** to seal the ports **53** thus shutting off communication between the tank **11** and the carburetors **19** and **71**.

The vacuum communicated through the vacuum line **15** will effect a subatmospheric pressure in the recess **77** (FIG. 4) thus partially lifting the diaphragm **45** from sealing contact with the upper end of the vacuum port **74** to permit flow of air from the tank **11** to the intake manifold **13**.

The gasket **99** normally blocks the lower ends of the dump ports **95** and as the vacuum builds up in the tank **11**, such diaphragm will be pulled into firm sealing engagement with such dump ports **95** thus preventing admission of air from the gas tank **25**. During operation of the engine the highest vacuum experienced by the manifold **13**, usually during deceleration, will be communicated to the tank **11** and will be trapped thereby by the flapper valve effect of the diaphragm **45** over the upper end of the vacuum port **74**.

When the ignition switch is turned off, the gas valves **41** and **43** will drop open to the position shown in FIG. 3, and vacuum from the tank **11** will be communicated to the carburetors **19** and **71** thereby drawing residual gasoline from the bowls thereof. It will be noted that the balls **73** in the valves **72** will float in the gasoline and permit passage thereof into the gas tank **11**. When the first carburetor **19** or **71** is emptied, the associated float valve **72** will be closed by means of the ball **73** seating thus restricting admission of air from the carburetor which is first to empty. The other carburetor will then continue draining until the entire residual gasoline is communicated to the tank **11**.

After drainage of both the carburetors **19** and **71**, air will continue to seep past the balls **73** and into the tank **11** until such tank approaches atmospheric pressure. As the tank **11** approaches atmospheric pressure, the weight of the gasoline therein will deflect the central portion of the diaphragm **99** covering the dump ports **95** downwardly thereby permitting flow of gasoline downwardly through the opening **101** and through the dump tube **26** to the gasoline tank **25**.

The evaporative loss control apparatus shown in FIGS. 7 through 12 is similar to that shown in FIGS. 1 through 6 and includes an upstanding vacuum tank, generally designated **121**, for selectively drawing fuel from the engine carburetor **123** and an afterburner carburetor **125**. Referring to FIG. 9, the tank **121** includes an intermediate top plate **131** sandwiched between a top plate **132** and a cover plate **133**. Referring to FIGS. 9, 11 and 12, the top plate **132** is formed with a pair of inlets **137** which confront respective ports **139** leading to poppet chambers **141** formed by recesses in the plate **131**. Recesses **143** formed in the cover **133** confront the respective poppet chambers **141** and are partitioned therefrom by a flexible diaphragm **145** sandwiched between the intermediate plate **131** and the top plate **133** to define vacuum chambers. A valve stem **147** is carried by the diaphragm **145** and projects downwardly through the port **139** (FIG. 12) and has a threaded extremity which receives a nut **149** that holds an O-ring **151** which seals with such port when the stem **147** is raised. Leading from the vacuum cavities **143** are vacuum passages **153** which terminate at a collector cavity **154** having a passage **155** (FIG. 10) leading to a vacuum tube **156** connected to the intake manifold.

Referring to FIG. 11, leading from each of the fuel cavities **141** is a drain passage **157** which opens upwardly into a bore **159** formed in the top cover **133**. An insert **161** is screwed into the threaded upper portion of the bore **159** and is formed with a plurality of divergent passages **163** which eject fuel downwardly into the bore **159** on opposite sides of a float **171** which carries a vertical stem **172** formed with a conical portion **173** that seals against the upper extremity of the passage **157** when the fuel has been fully drained from the respective carburetors **123** and **125**. The conical portion **173** provides for slight seepage therearound when in its sealing position to enable air to seep into the tank **121**. Referring to FIG. 10, the intermediate top plate **131** has a vacuum bore **175** drilled therethrough for selective communication between the collector port **154** and the tank **121**. The top end of the bore **175** is normally sealed by the diaphragm **145** which is formed with a port **177** offset from the bore **175**.

The bottom wall **181** of the tank **121** is formed with a plurality of circularly arranged drain ports **183** which are confronted on their bottom ends by a flexible gasket **187** having a central opening **189** which opens into a drain fitting **191** that is connected with the automobile fuel tank **193** by means of a drain tube **195**.

Operation of the evaporation control apparatus shown in FIGS. 7 through 12 is substantially similar to that of the apparatus shown in FIGS. 1 through 6. When the automobile is started the manifold vacuum will be communicated to the respective vacuum cavities **143** to create a vacuum above the diaphragm **145** and pull the valve stems **147** upwardly to seal the O-rings **151** against the walls of the ports **139** thereby discontinuing communication between the tank **121** and the respective carburetors **123** and **125**.

The vacuum in the collector port **154** will lift the diaphragm **145** off the upper end of the bore **175** to enable communication of vacuum through such bore **175** into the interior of the tank **121**. At any time when the vacuum from the engine manifold is lowered below that in the tank **121**, the gasket **145** will seal on the upper end of the bore **175** thereby discontinuing communication from the manifold and maintaining the high vacuum in the tank **121**.

When the engine is turned off and the intake manifold pressure rises, the gasket **145** will be pulled into sealing arrangement over the port upper end of the bore **175** to prevent communication between such manifold and the interior of the tank **121**. Loss of the vacuum in the valve vacuum cavities **143** will enable the valve stem **147** to drop downwardly thereby providing for communication between the respective carburetors **123** and **125** and the interior of the vacuum tank **121** to draw the residual fuel from such carburetors. During drainage of the respective carburetors **123** and **125** the fuel drawn therefrom will pass through the passages **163** in the respective inserts **161** to be directed downwardly and outwardly to clear the floats **171** to prevent interference therewith. The floats **171** will be buoyed upwardly to raise the conical portions **173** off the bores **157** to pass the drained fuel into the tank **121**.

When drainage of either of the carburetor **123** or **125**, which ever is the first to drain, is completed the associated bore **159** will empty to enable the corresponding float **171** to lower to seat the conical portion **173** on the upper extremity of the respective passage **157** to restrict admission of air and prevent the vacuum tank **121** from rapidly rising to atmospheric pressure to thereby discontinue drainage from the carburetor which is last to drain. When such last-to-drain carburetor is emptied, the respective float **171** will drop to seal the associated bore **157** but seepage of air will continue until the vacuum tank 121 rises to atmospheric pressure to thereby enable the weight of the fuel on the gasket 187 below the drain ports 183 to bend such gasket downwardly and enable drainage through the central aperture 189 to the fuel tank 193.

Obviously, the drainage time of the carburetors could be determined and a capillary tube inserted in the fuel line of the first-to-drain to decrease its drain rate so both would finish draining at the same time thereby eliminating the requirement for the floats 171.

From the foregoing, it will be apparent that the evaporative loss control apparatus of present invention provides an economical and convenient means for drawing residual gasoline from the carburetor of an internal combustion engine to thereby prevent evaporation of such gasoline by the residual heat in such engine. Further, the drainage is accomplished automatically by the vacuum readily available from the intake manifold of the engine.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention.

I claim:

1. In an evaporative loss control apparatus for drawing fuel from an engine fuel bowl and of the type having a first fuel port connected with said fuel bowl, a vacuum port connected with a vacuum source, a dump port connected with a fuel tank and control means responsive to operation of an engine to close said fuel port and dump port and render said vacuum port communicative with said vacuum source and to said engine being rendered inoperative to close said vacuum port, open said fuel port and after a selected time open said dump port, the improvement comprising:
   a vacuum tank including a valved fuel port connected with said fuel bowl, a valved vacuum port connected with said vacuum source, and a valved dump port disposed below said fuel port for having fuel entering through said fuel port drawn directly thereto by gravitational attraction whereby in response to operation of said control means when said engine is operative said dump and fuel ports will be closed and said vacuum port rendered communicative with said vacuum source to draw a vacuum in said tank and when said engine is rendered inoperative said fuel port will be opened to enable the residual fuel from said bowl to be drawn into said vacuum tank and after said selected time said dump port will be opened to enable said residual fuel to be dumped into said fuel tank.

2. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said dump control means is means including a dump port normally covered by a movable element and arranged to be held closed by a pressure differential thereacross resulting from a vacuum in said tank and to be opened by the weight of said fuel in said tank when said tank resumes atmospheric pressure.

3. An evaporative loss control apparatus as set forth in claim 1 wherein:
   said valved dump port includes a sealing member responsive to a predetermined head of fuel action thereon and a predetermined pressure drop thereacross to open and dump fuel into said fuel tank.

4. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said dump port is formed in the bottom wall of said vacuum tank.

5. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said vacuum tank is vertically elongated and is open throughout its length to maintain said vacuum port and fuel port in direct communication with said dump port.

6. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said vacuum tank is disposed above the elevation of said fuel tank whereby when said dump port is open said residual fuel will be drawn from said vacuum tank by gravitational force.

7. Evaporative loss control apparatus as set forth in claim 1 wherein said engine includes an afterburner device having an auxiliary carburetor and wherein:
   said vacuum tank includes a second fuel port for connection with said auxiliary carburetor; and
   said fuel control means includes first and second float valves connected with said respective first and second fuel port valves and each including a poppet element having a specific gravity which will cause it to float off its seat as long as fuel is draining from the respective carburetors and will seat as soon as said drainage is complete.

8. Evaporative loss control apparatus as set forth in claim 7 wherein:
   said first and second valves are electric and are in circuit with the ignition system of said engine to be held closed while said ignition system is energized and to be opened when said ignition system is deenergized.

9. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said fuel control means includes a normally open electric valve in series with the ignition switch of said engine for controlling flow in said fuel port whereby said valve will be held closed while said switch is closed and will be opened when said switch is opened.

10. Evaporative loss control apparatus as set forth in claim 7 wherein:
   said control means includes a movable element arranged to be held closed over said dump port by the pressure differential thereacross resulting from the vacuum in said vacuum tank and to be opened by the weight of the fuel in said vacuum tank when said vacuum tank resumes atmospheric pressure.

11. Evaporative loss control apparatus as set forth in claim 7 wherein:
   said dump control means is connected with the engine fuel tank and is responsive to the subatmospheric pressure in said vacuum tank approaching atmospheric pressure to dump the fuel in said vacuum tank into said fuel tank; and
   at least one of said poppet elements is shaped to provide restricted seepage of air thereby when it is seated on its seat to cause the subatmospheric pressure in said vacuum tank to approach atmospheric pressure when said one of said poppet elements is seated to thereby actuate said dump control means.

12. Evaporative loss control apparatus as set forth in claim 1 wherein:
   said fuel control means includes a poppet for seating in said fuel port, a pressure-responsive member controlling said poppet and a vacuum cavity on one side of said pressure-responsive member for connection with said intake manifold whereby the intake manifold pressure applied to said cavity will flex said pressure-responsive member to seat said poppet on said fuel port.

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