FUEL ECONOMY SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

ABSTRACT

A fuel economy system for an internal combustion engine which, when installed in a motor vehicle, overcomes the need for a conventional carburettor, fuel pump and fuel tank. The system operates by using the engine vacuum to draw fuel vapours from a vapour tank through a vapour conduit to a vapour equaliser which is positioned directly over the intake manifold of the engine. The vapour tank is constructed of heavy duty steel, or the like, to withstand the large vacuum pressure and includes an air inlet valve coupled for control to the accelerator pedal. The vapour equaliser ensures distribution of the correct mixture of air and vapour to the cylinders of the engine for combustion, and also includes its own air inlet valve coupled for control to the accelerator pedal. The system utilises vapour-retarding filters in the vapour conduit, vapour tank and vapour equaliser to deliver the correct vapour/air mixture for proper operation. The vapour tank and fuel contained in it, are heated by running the engine coolant through a conduit within the tank. Due to the extremely lean fuel mixtures used by the present invention, gas mileage in excess of one hundred miles per gallon may be achieved.

CLAIMS

1. A fuel vapour system for an internal combustion engine having an intake manifold, which comprises:
   (a) A tank for containing fuel vapour;
   (b) A vapour equaliser mounted on and in fluid communication with the intake manifold of the engine;
   (c) A vapour conduit connecting the tank to the vapour equaliser for delivering fuel vapour from the former to the latter;
   (d) A vapour equaliser having a valve connected to it for controlling the admission of air to the vapour equaliser;
   (e) A tank having a second valve connected to it for controlling the admission of air to the tank;
   (f) A throttle for controlling the first and second valves so that the opening of the first valve precedes and exceeds the opening of the second valve.

2. The fuel vapour system as set forth in claim 1, further comprising a filter positioned in the vapour conduit for retarding the flow of fuel vapour from the tank to the vapour equaliser.

3. The fuel vapour system as set forth in claim 2, where the filter comprises carbon particles.

4. The fuel vapour system as set forth in claim 2, where the filter comprises carbon particles and neoprene fibres.

5. The fuel vapour system as set forth in claim 2, where the filter comprises a substantially tubular housing positioned in series in the vapour conduit, the housing containing a central portion comprising a mixture of carbon and neoprene and end portions comprising carbon positioned on each side of the central portion.

6. The fuel vapour system as set forth in claim 1, further comprising a filter positioned in the vapour equaliser, for retarding the flow of the fuel vapour to the engine intake manifold.

7. The fuel vapour system as set forth in claim 6, where the filter is positioned downstream of the first valve.

8. The fuel vapour system as set forth in claim 7, where the filter comprises carbon particles.

9. The fuel vapour system as set forth in claim 8, where the filter further comprises a porous support member having first and second recessed portions for containing the carbon particles, the first recessed portion being positioned opposite a vapour inlet port in the vapour equaliser to which the vapour conduit is connected, the second recessed portion being positioned opposite the intake manifold of the engine.
10. The fuel vapour system as set forth in claim 9, where the porous support member is comprised of neoprene.

11. The fuel vapour system as set forth in claim 1, with a further filter positioned in the tank for controlling the flow of fuel vapour into the vapour conduit in proportion to the degree of vacuum in the tank.

12. The fuel vapour system as set forth in claim 11, where the filter incorporates a method for reducing the amount of fuel vapour delivered to the vapour conduit when the engine is idling and when the engine has attained a steady speed.

13. The fuel vapour system as set forth in claim 12, where the throttle acts to close the second valve when the engine is idling and when the engine has attained a steady speed to thereby increase the vacuum pressure in the tank.

14. The fuel vapour system as set forth in claim 13, where the filter comprises a frame pivotally mounted within the tank and movable between first and second operating positions, the first operating position corresponding to an open condition of the second valve, said second operating position corresponding to a closed condition of the second valve.

15. The fuel vapour system as set forth in claim 14, where the tank includes a vapour outlet port to which one end of the vapour conduit is connected, and where the second operating position of the frame places the filter in direct fluid communication with the vapour outlet port.

16. The fuel vapour system as set forth in claim 15, where the filter includes carbon particles.

17. The fuel vapour system as set forth in claim 16, where the filter includes neoprene filter material.

18. The fuel vapour system as set forth in claim 17, where the filter comprises a layer of carbon particles sandwiched between two layers of neoprene filter material, and a screen for supporting them within the pivotable frame.

19. The fuel vapour system as set forth in claim 18, further comprising a mechanism positioned on the filter for placing the filter in direct fluid communication with the vapour outlet port when the frame is in the second operating position.

20. A fuel vapour system for an internal combustion engine having an intake manifold, which comprises:
   (a) A tank for containing fuel vapour;
   (b) A vapour equaliser mounted on, and in fluid communication with, the intake manifold of the engine;
   (c) A vapour conduit connecting the tank to the vapour equaliser for delivering fuel vapour from the former to the latter;
   (d) A vapour equaliser having a first valve connected to it, for controlling the admission of air to the vapour equaliser;
   (e) A tank having a second valve connected to it, for controlling the admission of air to the tank;
   (f) A filter positioned in the vapour conduit for retarding the flow of the fuel vapour from the tank to the vapour equaliser means.

21. The fuel vapour system as set forth in claim 20, where the filter comprises a substantially tubular housing positioned in series in the vapour conduit, the housing containing a central portion comprising a mixture of carbon and neoprene and end portions comprising carbon positioned on each side of the central portion.

22. A fuel vapour system for an internal combustion engine having an intake manifold, which comprises:
   (a) A tank for containing fuel vapour;
   (b) A vapour equaliser mounted on and in fluid communication with the intake manifold of the engine;
   (c) A vapour conduit connecting the tank to the vapour equaliser for delivering fuel vapour from the former to the latter;
   (d) The vapour equaliser having a first valve connected to it, for controlling the admission of air to the vapour equaliser;
   (e) The tank having a second valve connected to it, for controlling the admission of air to the tank;
   (f) A filter positioned in the vapour equaliser for retarding the flow of the fuel vapour to the engine intake manifold.

23. The fuel vapour system as set forth in claim 22, where the filter is positioned downstream of the first valve, the filter comprises carbon particles and a porous support member having first and second recessed portions for containing the carbon particles, the first recessed portion being positioned opposite a vapour inlet port in the vapour equaliser to which the vapour conduit is connected, the second recessed portion being positioned opposite the intake manifold of the engine, and where the porous support member is comprised of neoprene.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related to internal combustion engines and, more particularly, is directed towards a fuel economy system for an internal combustion engine which, when applied to a motor vehicle, overcomes the need for conventional carburettors, fuel pumps and fuel tanks, and enables vastly improved fuel consumption to be achieved.

2. Description of the Prior Art
The prior art evidences many different approaches to the problem of increasing the efficiency of an internal combustion engine. Due to the rising price of fuel, and the popularity of motor vehicles as a mode of transportation, much of the effort in this area is generally directed towards improving fuel consumption for motor vehicles. Along with increased mileage, much work has been done with a view towards reducing pollutant emissions from motor vehicles.

I am aware of the following United States patents which are generally directed towards systems for improving the efficiency and/or reducing the pollutant emissions of internal combustion engines:

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor(s)</th>
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<tbody>
<tr>
<td>1,530,882</td>
<td>Chapin</td>
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<tr>
<td>2,312,151</td>
<td>Crabtree et al</td>
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<tr>
<td>3,001,519</td>
<td>Hietrich et al</td>
</tr>
<tr>
<td>3,191,587</td>
<td>Hall</td>
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<tr>
<td>3,221,724</td>
<td>Wentworth</td>
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<tr>
<td>3,395,681</td>
<td>Walker</td>
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<tr>
<td>3,633,533</td>
<td>Holzappfel</td>
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<tr>
<td>3,713,429</td>
<td>Dwyre</td>
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<tr>
<td>3,716,040</td>
<td>Herpin</td>
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<tr>
<td>3,728,092</td>
<td>Gorman, Jr.</td>
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<tr>
<td>3,749,376</td>
<td>Alm et al</td>
</tr>
<tr>
<td>3,752,134</td>
<td>Hollis, Jr.</td>
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<tr>
<td>3,759,234</td>
<td>Buckton et al</td>
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<td>3,817,233</td>
<td>Kihn</td>
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<td>3,851,633</td>
<td>Shih</td>
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<td>3,854,463</td>
<td>Burden, Sr.</td>
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<td>3,874,353</td>
<td>Woolridge</td>
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<td>3,888,223</td>
<td>Mondt</td>
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<tr>
<td>3,907,946</td>
<td>Brown</td>
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<tr>
<td>3,911,881</td>
<td>Lee, Jr.</td>
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<tr>
<td>3,931,801</td>
<td>Rose et al</td>
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<td>3,945,352</td>
<td>Reimuller</td>
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<tr>
<td>3,968,775</td>
<td>Harpman</td>
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<tr>
<td>4,003,356</td>
<td>Naylor</td>
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<tr>
<td>4,011,847</td>
<td>Fortino</td>
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<tr>
<td>4,015,569</td>
<td>Leshner et al</td>
</tr>
<tr>
<td>4,015,570</td>
<td>Sommerville</td>
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The Chapin U.S. Pat. No. 1,530,882 discloses a fuel tank surrounded by a water jacket, the latter of which is included in a circulation system with the radiator of the automobile. The heated water in the circulation system causes the fuel in the fuel tank to readily vaporise. Suction from the inlet manifold causes air to be drawn into the tank to bubble air through the fuel to help form the desired vapour which is then drawn to the manifold for combustion.

The Buckton et al U.S. Pat. No. 3,759,234 advances a fuel system which provides supplementary vapours for an internal combustion engine by means of a canister that contains a bed of charcoal granules. The Wentworth and Hietrich et al U.S. Pat. Nos. 3,221,724 and 3,001,519 also teach vapour recovery systems which utilise filters of charcoal granules or the like.

The Dwyre U.S. Pat. No. 3,713,429 uses, in addition to the normal fuel tank and carburettor, an auxiliary tank having a chamber at the bottom which is designed to receive coolant from the engine cooling system for producing fuel vapours, while the Walker U.S. Pat. No. 3,395,681 discloses a fuel evaporator system which includes a fuel tank intended to replace the normal fuel tank, and which includes a fresh air conduit for drawing air into the tank.

The Fortino U.S. Pat. No. 4,011,847 teaches a fuel supply system wherein the fuel is vaporised primarily by atmospheric air which is released below the level of the fuel, while the Crabtree et al U.S. Pat. No. 2,312,151 teaches a vapourisation system which includes a gas and air inlet port located in a vapourising chamber and which includes a set of baffles for effecting a mixture of the air and vapour within the tank. The Mondt U.S. Pat. No. 3,888,223 also discloses an evaporative control canister for improving cold start operation and emissions, while Sommerville U.S. Pat. No. 4,015,570 teaches a liquid-fuel vapouriser which is intended to replace the conventional fuel pump and carburettor that is designed to mechanically change liquid fuel to a vapour state.

While the foregoing patents evidence a proliferation of attempts to increase the efficiency and/or reduce pollutant emissions from internal combustion engines, no practical system has yet found its way to the marketplace.

OBJECTS AND SUMMARY OF THE INVENTION
It is therefore a primary object of the present invention to provide a new and improved fuel economy system for an internal combustion engine which greatly improves the efficiency of the engine.

Another object of the present invention is to provide a unique fuel economy system for an internal combustion engine which provides a practical, operative and readily realisable means for dramatically increasing the gas mileage of conventional motor vehicles.

A further object of the present invention is to provide an improved fuel economy system for internal combustion engines which also reduces the pollutant emissions.

The foregoing and other objects are attained in accordance with one aspect of the present invention through the provision of a fuel vapour system for an internal combustion engine having an intake manifold, which comprises a tank for containing fuel vapour, a vapour equaliser mounted on and in fluid communication with the intake manifold of the engine, and a vapour conduit which connect the tank to the vapour equaliser for delivering fuel vapour from the former to the latter. The vapour equaliser includes a first valve connected to it for controlling the admission of air to the vapour equaliser, while the tank has a second valve connected to it for controlling the admission of air to the tank. A throttle controls the first and second valves so that the opening of the first valve precedes and exceeds the opening of the second valve during operation.

In accordance with other aspects of the present invention, a filter is positioned in the vapour conduit to retard the flow of fuel vapour from the tank to the vapour equaliser. In a preferred form, the filter comprises carbon particles and may include a sponge-like collection of, for example, neoprene fibres. In a preferred embodiment, the filter comprises a substantially tubular housing positioned in series in the vapour conduit, the housing containing a central portion comprising a mixture of carbon and neoprene, and end portions comprising carbon, positioned on each side of the central portion.

In accordance with another aspect of the present invention, a second filter is positioned in the vapour equaliser for again retarding the flow of the fuel vapour to the engine intake manifold. The second filter is positioned downstream of the first valve and in a preferred form, includes carbon particles mounted in a pair of recesses formed in a porous support member. The porous support member, which may comprise neoprene, includes a first recessed portion positioned opposite a vapour inlet port in the vapour equaliser to which the vapour conduit is connected, while a second recessed portion is positioned opposite the intake manifold of the engine.

In accordance with still other aspects of the present invention, a third filter is positioned in the tank for controlling the flow of fuel vapour into the vapour conduit in proportion to the degree of vacuum in the tank. The filter more particularly comprises a mechanism for reducing the amount of fuel vapour delivered to the vapour conduit when the engine is idling and when the engine has attained a steady speed. The throttle acts to close the second valve when the engine is idling and when the engine has attained a steady speed, to thereby increase the vacuum pressure in the tank. In a preferred form, the third filter comprises a frame pivotally mounted within the tank and movable between first and second operating positions. The first operating position corresponds to an open condition of the second valve, while the second operating position corresponds to a closed condition of the second valve. The tank includes a vapour outlet port to which one end of the vapour conduit is connected, such that the second operating position of the frame places the third filter in communication with the vapour outlet port.

More particularly, the third filter in a preferred form includes carbon particles sandwiched between two layers of a sponge-like filter material, which may comprise neoprene, and screens for supporting the layered composition within the pivotable frame. A conduit is positioned on the third filter for placing it in direct fluid communication with the vapour outlet port when the frame is in its second operating position.

In accordance with yet other aspects of the present invention, a conduit is connected between the valve cover of the engine and the vapour equaliser for directing the oil blow-by to the vapour equaliser in order to minimise valve clatter. The tank also preferably includes a copper conduit positioned in the bottom of it, which is connected in series with the cooling system of the motor vehicle, for heating the tank and generating more vapour. A beneficial by-product of the circulating system reduces the engine operating temperature to further improve operating efficiency.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Various objects, features and attendant advantages of the present invention will be more fully appreciated as the same become better understood from the following detailed description of the present invention when considered in connection with the accompanying drawings, in which:

**Fig.1** is a perspective view illustrating the various components which together comprise a preferred embodiment of the present invention as installed in a motor vehicle;
Fig. 2 is a cross-sectional view of one of the components of the preferred embodiment illustrated in Fig. 1 taken along line 2–2.
Fig. 3 is a sectional view of the vapour tank illustrated in Fig. 2 taken along line 3--3.

Fig. 4 is an enlarged sectional view illustrating in greater detail one component of the vapour tank shown in Fig. 3 taken along line 4--4.

Fig. 5 is a perspective, partially sectional view illustrating a filter component of the vapour tank illustrated in Fig. 2.
Fig. 6 is a cross-sectional view of another component of the preferred embodiment of the present invention illustrated in Fig. 1 taken along line 6--6.

Fig. 7 is a partial side, partial sectional view of the vapour equaliser illustrated in Fig. 6 taken along line 7--7.
Fig. 8 is a side view illustrating the throttle linkage of the vapour equaliser shown in Fig. 7 taken along line 8--8.

Fig. 9 is a longitudinal sectional view of another filter component of the preferred embodiment illustrated in Fig. 1.

Fig. 10 is a view of another component of the present invention.
Fig. 11 is an exploded, perspective view which illustrates the main components of the filter portion of the vapour equaliser of the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring now to the drawings, where parts are numbered the same in each drawing, and more particularly to Fig. 1 which illustrates a preferred embodiment of the present invention as installed in a motor vehicle.

The preferred embodiment includes as its main components a fuel vapour tank 10 in which the fuel vapour is stored and generated for subsequent delivery to the internal combustion engine 20. On the top of fuel vapour tank 10 is mounted an air inlet control valve 12 whose structure and operation will be described in greater detail below.

The internal combustion engine 20 includes a standard intake manifold 18. Mounted upon the intake manifold 18 is a vapour equaliser chamber 16. Connected between the fuel vapour tank 10 and the vapour equaliser chamber 16 is a vapour conduit or hose 14 for conducting the vapours from within tank 10 to the chamber 16.

Reference numeral 22 indicates generally an air inlet control valve which is mounted on the vapour equaliser chamber 16. Thus, the system is provided with two separate air inlet control valves 12 and 22 which are respectively coupled via cables 24 and 26 to the throttle control for the motor vehicle which may take the form of a standard accelerator pedal 28. The air inlet control valves 12 and 22 are synchronised in such a fashion that the opening of the air inlet control valve 22 of the vapour equaliser 16 always precedes and exceeds the opening of the air inlet control valve 12 of the fuel vapour tank 10, for reasons which will become more clear later.

The cooling system of the vehicle conventionally includes a radiator 30 for storing liquid coolant which is circulated through the engine 20 in the well-known fashion. A pair of hoses 32 and 34 are preferably coupled into the normal heater lines from the engine 20 so as to direct heated liquid coolant from the engine 20 to a warming coil 36, preferably constructed of copper, which is positioned within vapour tank 10. I have found that the water circulation system consisting of hoses 32, 34 and 36 serves three distinct functions. Firstly, it prevents the vapour tank from reaching the cold temperatures to which it would otherwise be subjected as a result of high vacuum pressure and air flow through it. Secondly, the heated coolant serves to enhance vaporisation of the fuel stored within tank 10 by raising its temperature. Thirdly, the liquid coolant, after leaving tank 10 via conduit 34, has been cooled to the point where engine 20 may then be run at substantially lower operating temperatures to further increase efficiency and prolong the life of the engine.

Included in series with vapour conduit 14 is a filter unit 38 which is designed to retard the flow of fuel vapour from the tank 10 to the vapour equaliser 16. The precise structure of the filter unit 38 will be described in greater detail below. A thrust adjustment valve 40 is positioned upstream of the filter unit 38 in conduit 14 and acts as a fine adjustment for the idling
speed of the vehicle. Positioned on the other side of filter unit 38 in conduit 14 is a safety shut-off valve 42 which comprises a one-way valve. Starting the engine 20 will open the valve 42 to permit the engine vacuum pressure to be transmitted to tank 10, but, for example, a backfire will close the valve to prevent a possible explosion. The tank 10 may also be provided with a drain 44 positioned at the bottom of the tank.

Positioned on the side of the vapour equaliser chamber 16 is a primer connection 46 which may be controlled by a dash mounted primer control knob 48 connected to tank 10 via conduit 47. A conduit 50 extends from the oil breather cap opening 52 in a valve cover 54 of the engine 20 to the vapour equaliser 16 to feed the oil blow-by to the engine as a means for eliminating valve clatter. This is believed necessary due to the extreme lean mixture of fuel vapour and air fed to the combustion cylinders of the engine 20 in accordance with the present invention.

Referring now to Fig.2 and Fig.3, the fuel vapour tank 10 of the present invention is illustrated in greater detail in orthogonal sectional views and is seen to include a pair of side walls 56 and 58 which are preferably comprised of heavy duty steel plate (e.g. 1/2" thick) in order to withstand the high vacuum pressures developed inside it. Tank 10 further comprises top wall 60 and bottom wall 62, and front and rear walls 64 and 66, respectively.

In the front wall 64 of tank 10 is positioned a coupling 68 for mating the heater hose 32 with the internal copper conduit 36. Tank 10 is also provided with a pair of vertically oriented planar support plates 70 and 72 which are positioned somewhat inside the side walls 56 and 58 and are substantially parallel to them. Support plates 70 and 72 lend structural integrity to the tank 10 and are also provided with a plurality of openings 74 (Fig.2) at the bottom of them to permit fluid communication through it. The bottom of tank 10 is generally filled with from one to five gallons of fuel, and the walls of tank 10 along with plates 70 and 72 define three tank chambers 76, 78 and 80 which are, by virtue of openings 74, in fluid communication with one another.

In the top wall 60 of tank 10 is formed an opening 82 for placing one end of vapour conduit 14 in fluid communication with the interior chamber 76 of tank 10. A second opening 84 is positioned in the top wall 60 of tank 10 over which the air inlet control valve 12 is positioned. The valve assembly 12 comprises a pair of conventional butterfly valves 86 and 88 which are coupled via a control rod 90 to a control arm 92. Control arm 92 is, in turn, pivoted under the control of a cable 24 and is movable between a solid line position indicated in Fig.2 by reference numeral 92' and a dotted line position indicated in Fig.2 by reference numeral 92.

Rod 90 and valves 86 and 88 are journaled in a housing 94 having a base plate 96 which is mounted on a cover 98. As seen in Fig.1, the base plate 96 includes several small air intake ports or apertures 100 formed on both sides of the butterfly valves 86 and 88, which are utilised for a purpose to become more clear later on.

Rod 90 is also journaled in a flange 102 which is mounted to cover 98, while a return spring 104 for control arm 92 is journaled to cover 98 via flange 106.

Extending through the baffle and support plates 70 and 72 from the side chambers 78 and 80 of tank 10 to be in fluid communication with apertures 100 are a pair of air conduits 108 and 110 each having a reed valve 112 and 114 positioned at the ends, for controlling air and vapour flow through it. The reed valves 112 and 114 co-operate with the small apertures 100 formed in the base plate 96 to provide the proper amount of air into the tank 10 while the engine is idling and the butterfly valves 86 and 88 are closed.

Mounted to the front wall 64 of tank 10 is a pivot support member 132 for pivotally receiving a filter element which is indicated generally by reference numeral 134 and is illustrated in a perspective, partially cut away view in Fig.5. The unique, pivotable filter element 134 comprises a frame member 136 having a pin-receiving stub 138 extending along one side member of it. The actual filter material contained within the frame 136 comprises a layer of carbon particles 148 which is sandwiched between a pair of layers of sponge-like filter material which may, for example, be made of neoprene. The neoprene layers 144 and 146 and carbon particles 148 are maintained in place by top and bottom screens 140 and 142 which extend within, and are secured by, frame member 136. A thick-walled rubber hose 150 having a central annulus 151 is secured to the top of screen 140 so as to mate with opening 82 of top wall 60 (see Fig.2) when the filter assembly 134 is in its solid line operative position illustrated in Fig.2. In the latter position, it may be appreciated that the vapour conduit 14 draws vapour fumes directly from the filter element 134, rather than from the interior portion 76 of tank 10. In contradistinction, when the filter element 134 is in its alternate operative position, indicated by dotted lines in Fig.2, the vapour conduit 14 draws fumes mainly from the interior portions 76, 78 and 80 of tank 10.

Fig.4 is an enlarged view of one of the reed valve assemblies 114 which illustrates the manner in which the valve opens and closes in response to the particular vacuum pressure created within the tank 10. Valves 112 and 114 are designed to admit just enough air to the tank 10 from the apertures 100 at engine idle to prevent the engine from stalling.

Referring now to Fig.6, Fig.7 and Fig.8, the vapour equaliser chamber 16 of the present invention is seen to include front and rear walls 152 and 154, respectively, a top wall 156, a side wall 158, and another side wall 160. The vapour equaliser chamber 16 is secured to the manifold 18 as by a plurality of bolts 162 under which may be positioned a conventional gasket 164.
In the top wall 156 of the vapour equaliser 16 is formed an opening 166 for communicating the outlet end of vapour conduit 14 with a mixing and equalising chamber 168. Adjacent to the mixing and equalising chamber 168 in wall 154 is formed another opening 170 which communicates with the outside air via opening 178 formed in the upper portion of housing 176. The amount of air admitted through openings 178 and 170 is controlled by a conventional butterfly valve 172. Butterfly valve 172 is rotated by a control rod 180 which, in turn, is coupled to a control arm 182. Cable 26 is connected to the end of control arm 182 furthest from the centreline and acts against the return bias of spring 184, the latter of which is journalled to side plate 152 of vapour equaliser 16 via an upstanding flange 188. Reference numeral 186 indicates generally a butterfly valve operating linkage, as illustrated more clearly in Fig.8, and which is of conventional design as may be appreciated by a person skilled in the art.

Positioned below mixing and equalising chamber 168 is a filter unit which is indicated generally by reference numeral 188. The filter unit 188, which is illustrated in an exploded view in Fig.11, comprises a top plastic fluted cover 190 and a bottom plastic fluted cover 192. Positioned adjacent to the top and bottom covers 190 and 192 is a pair of screen mesh elements 194 and 196, respectively. Positioned between the screen mesh elements 194 and 196 is a support member 198 which is preferably formed of a sponge-like filter material, such as, for example, neoprene. The support member 199 has formed on its upper and lower surfaces, a pair of receptacles 200 and 202, whose diameters are sized similarly to the opening 166 in top plate 156 and the openings formed in the intake manifold 18 which are respectively indicated by reference numerals 210 and 212 in Fig.6.

Positioned in receptacles 200 and 202 are carbon particles 204 and 206, respectively, for vapour retardation and control purposes.

Referring now to Fig.9, the filter unit 38 mounted in vapour conduit 14 is illustrated in a longitudinal sectional view and is seen to comprise an outer flexible cylindrical hose 214 which is adapted to connect with hose 14 at both ends by a pair of adapter elements 216 and 218. Contained within the outer flexible hose 214 is a cylindrical container 220, preferably of plastic, which houses, in its centre, a mixture of carbon and neoprene filter fibres 222. At both ends of the mixture 222 are deposited carbon particles 224 and 226, while the entire filtering unit is held within the container 220 by end screens 228 and 230 which permit passage of vapours through it while holding the carbon particles 224 and 226 in place.

Fig.10 illustrates one form of the thrust adjustment valve 40 which is placed within line 14. This valve simply controls the amount of fluid which can pass through conduit 14 via a rotating valve member 41.

In operation, the thrust adjustment valve 40 is initially adjusted to achieve as smooth an idle as possible for the particular motor vehicle in which the system is installed. The emergency shut-off valve 42, which is closed when the engine is off, generally traps enough vapour between it and the vapour equaliser to start the engine 20. Initially, the rear intake valves 12 on the tank 10 are fully closed, while the air intake valves 22 on the equaliser 16 are open to admit a charge of air to the vapour equaliser prior to the vapour from the tank, thus forcing the pre-existing vapour in the vapour equaliser into the manifold. The small apertures 100 formed in base plate 96 on tank 10 admit just enough air to actuate the reed valves to permit sufficient vapour and air to be drawn through vapour conduit 14 and equaliser 16 to the engine 20 to provide smooth idling. The front air valves 22 are always set ahead of the rear air valves 12 and the linkages 24 and 26 are coupled to throttle pedal 28 such that the degree of opening of front valves 22 always exceeds the degree of opening of the rear valves 12.

Upon initial starting of the engine 20, due to the closed condition of rear valves 12, a high vacuum pressure is created within tank 10 which causes the filter assembly 134 positioned in tank 10 to rise to its operative position indicated by solid outline in Fig.2. In this manner, a relatively small amount of vapour will be drawn directly from filter 134 through vapour conduit 14 to the engine to permit the latter to run on an extremely lean mixture.

Upon initial acceleration, the front air intake valve 22 will open further, while the rear butterfly assembly 12 will begin to open. The latter action will reduce the vacuum pressure within tank 10 whereby the filter assembly 134 will be lowered to its alternate operating position illustrated in dotted outline in Fig.2. In this position, the lower end of the filter assembly 134 may actually rest in the liquid fuel contained within the tank 10. Accordingly, upon acceleration, the filter assembly 134 is moved out of direct fluid communication with the opening 82 such that the vapour conduit 14 then draws fuel vapour and air from the entire tank 10 to provide a richer combustion mixture to the engine, which is necessary during acceleration.

When the motor vehicle attains a steady speed, and the operator eases off the accelerator pedal 28, the rear butterfly valve assembly 12 closes, but the front air intake 22 remains open to a certain degree. The closing of the rear air intake 12 increases the vacuum pressure within tank 10 to the point where the filter assembly 134 is drawn up to its initial operating position. As illustrated, in this position, the opening 82 is in substantial alignment with the aperture 151 of hose 150 to place the filter unit 134 in direct fluid communication with the vapour conduit 14, thereby lessening the amount of vapour and air mixture fed to the engine. Any vapour fed through conduit 14 while the filter 134 is at this position is believed to be drawn directly off the filter unit itself.

I have been able to obtain extremely high mpg figures with the system of the present invention installed on a V-8 engine of a conventional 1971 American-made car. In fact, mileage rates in excess of one hundred miles per US gallon have been achieved with the present invention. The present invention eliminates the need for conventional fuel pumps,
carburettors, and fuel tanks, thereby more than offsetting whatever the components of the present invention might otherwise add to the cost of a car. The system may be constructed with readily available components and technology, and may be supplied in kit form as well as original equipment.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. For example, although described in connection with the operation of a motor vehicle, the present invention may be universally applied to any four-stroke engine for which its operation depends upon the internal combustion of fossil fuels. Therefore, it is to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described here.