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ULTRASONIC CARBURETOR SYSTEM

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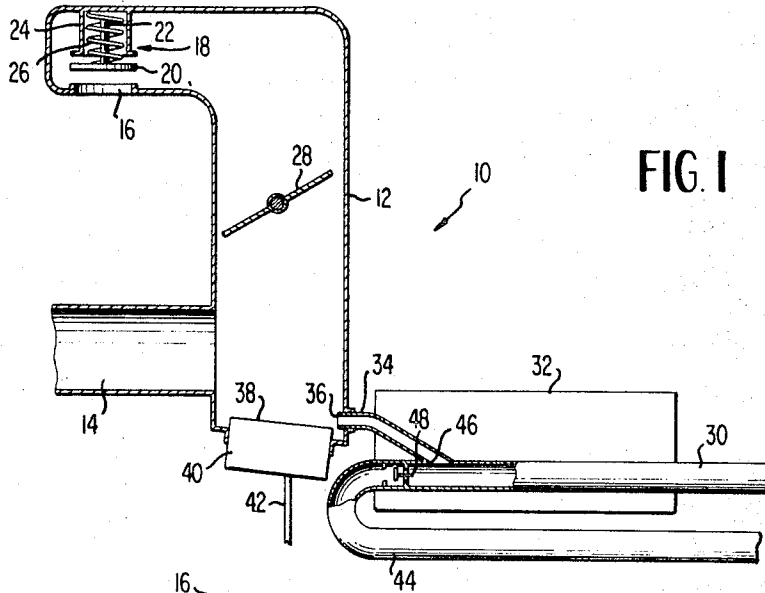


FIG. 1

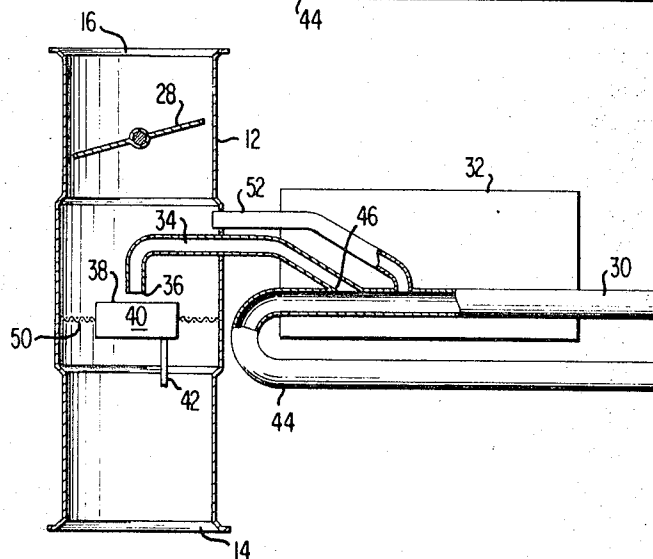


FIG. 2

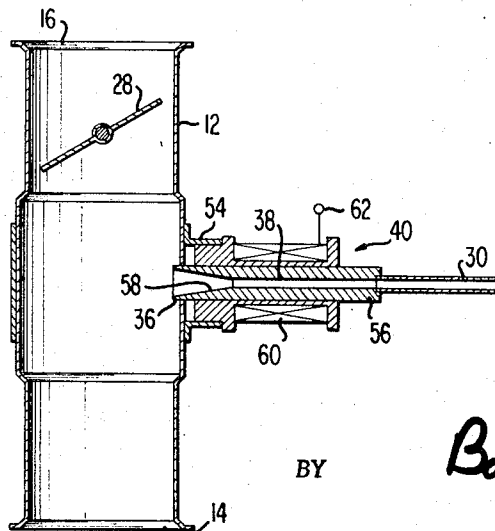


FIG. 3

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ULTRASONIC CARBURETOR SYSTEM

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ABSTRACT OF THE DISCLOSURE

The sonic carburetor system includes a sound wave producing device positioned between an intake manifold opening and a fuel supply inlet in such a manner that fuel is drawn across the active surface of the device by negative pressure from the intake manifold. The carburetor system includes a novel fuel supply control mechanism which employs a vector fluid switching device as a fuel control unit for controlling the fuel supply volume to the sound wave producing device.

The invention relates to carburetors generally, and more particularly to a novel and improved ultrasonic carburetor system for feeding fluid fuel to an internal combustion engine.

In the operation of internal combustion engines, the large amount of unburned and partially burned contaminants produced by such engines remains an unsolved but increasingly important problem. Not only does the production of such contaminants detract tremendously from the over-all efficiency of internal combustion engines as compared to other motive sources, such as electric motors, but these contaminants are discharged to produce noxious compounds which foul the air of metropolitan areas. Generally, most of these contaminants are the result of incomplete combustion of fuel.

In an internal combustion engine, fuel is fed from a fuel tank into a carburetor unit which is in turn connected to the engine intake manifold. During each suction stroke of the engine, air is drawn into the carburetor and fuel is entrained in the air stream and mixed therewith. However, conventional carburetor systems for internal combustion engines are unable to produce consistent molecular suspensions or emulsions of fuel molecules in the air stream, and large droplets of fuel carried by the air stream into the engine cause inefficient and incomplete fuel combustion within the engine.

Attempts to develop carburetor systems which operate more effectively to feed liquid fuel into combustion air at various engine speeds while maintaining a desirable air-fuel ratio have resulted in the development of complex carburetor systems containing mazes of small tubing, passageways, small jets, venturis and pumps. Such complex carburetor systems are expensive, difficult to adjust and repair, and often are merely a compromise between efficiency, physical limitations and cost. These overly complicated systems are plagued by problems caused by small dirt particles and other particles of foreign material commonly found in fuels, and also generally have not increased the fuel combustion or efficiency of internal combustion engines to satisfactory levels.

In recognition of the defects inherent in conventional complex carburetor systems, attempts have been made to develop less complex carburetors employing sonic or ultrasonic vibrators to achieve more intensive atomization of fuel and therefore an even dispersion of liquid fuel in the combustion air stream. However, previous carburetor designs employing sonic or ultrasonic mechanisms have failed to take into account the varying conditions present within the carburetor of an internal combustion engine as the engine operation varies, and therefore such

previous carburetor designs are not effective. For example, common fuels are not completely pure, and because water and other impurities in the fuels are less volatile than the fuel, it is necessary to keep water droplets and other less volatile components of the fuel in contact with the main area of activity of the sound producing device if such less volatile components are to be effectively added to the combustion air within the carburetor. Generally, when fuel is applied to a transducer vibrator or other sound producing device, the fuel will flow to the first area of escape and will not necessarily cross the most active area of the device. Thus means must be provided to hold the less mobile components of the fuel against the active area of the vibrator so that these components can be added to the fuel-air emulsion. This previous carburetor constructions employing sonic or ultrasonic vibrators have failed to do.

More specifically, previously known sonic or ultrasonic carburetor constructions have failed to properly position the sonic or ultrasonic wave producing device with respect to the engine intake manifold and the carburetor air inlet. This has resulted in fuel being diverted away from the active surface of the vibrator by the resultant negative pressure of the intake manifold as the speed of the internal combustion engine increases. The vector forces created by this negative pressure of the intake manifold will overcome the force of gravity on fuel droplets directed toward a vibrator, and also will divert fuel which is directed under pressure from a nozzle toward a vibrator. Thus, the vector forces acting upon the fuel entering the carburetor must be taken into account in positioning a sound wave producing device in or near the carburetor chamber.

It is a primary object of this invention to provide a novel and improved carburetor system which operates with high efficiency but is of simple, inexpensive construction and not hampered by complex components.

Another object of this invention is to provide a novel and improved carburetor system of simple construction which is less susceptible to malfunction due to the introduction therein of foreign particles than conventional carburetor systems.

A further object of this invention is to provide a novel and improved carburetor system which operates to diminish the amount of unburned fuel in the exhaust of an internal combustion engine.

Another object of this invention is to provide a novel and improved sonic carburetor system operative to provide an improved molecular suspension or emulsion of fuel molecules with gas molecules.

A further object of this invention is to provide a novel and improved sonic carburetor system which includes a sound wave producing component located so that the vector force of the negative pressure from the instake manifold of an internal combustion engine maintains fuel in contact with the active surface of the sound wave producing component.

Another object of this invention is to provide a novel and improved sonic carburetor system which includes a vector fuel flow control unit operative to control the flow of input fuel in accordance with the operating condition of an internal combustion engine.

A still further object of this invention is to provide a novel and improved sonic carburetor system which eliminates venturi fuel feed components and employs a relative large fuel input jet means for fuel feeding.

The above and further objects and details of this invention will be readily apparent upon a consideration of the following specification taken with the accompanying drawings in which:

FIG. 1 is a diagrammatic longitudinal section of the carburetor system of the present invention;

FIG. 2 is a diagrammatical longitudinal section of a second embodiment of the carburetor system of the present invention; and

FIG. 3 is a diagrammatical longitudinal section of a third embodiment of the carburetor system of the present invention.

Referring now to the drawings, the carburetor system 10 of FIG. 1 includes a carburetor housing 12 which opens into the intake manifold of an internal combustion engine at 14. The carburetor housing includes an air inlet opening 16 through which combustion air passes to the interior of the carburetor housing, and this opening may be provided with a closure valve assembly 18. The valve assembly 18 may be of any suitable construction so long as this assembly operates effectively to close the opening 16 when the internal combustion engine connected to the carburetor system 10 is not in operation, but to open and permit the flow of combustion air through the carburetor in response to negative pressure from the intake manifold. For purposes of illustration in FIG. 1, the valve assembly 18 includes a valve 20 having a valve stem 22 connected thereto which extends into a support 24 secured to the inner surface of the casing 12. The valve stem is movably mounted within the support 24 to permit movement of the valve 20 toward and away from a closing position across the opening 16. A biasing spring 26 may be provided to bias the valve 20 into a closed position across the opening 16, so that combustion air will operate to open the valve against the bias of the spring 26.

A butterfly control valve 28 of any suitable conventional type is provided within the carburetor housing 12 between the combustion air inlet 16 and the intake manifold opening 14 to control the stream of combustion air passing through the opening 16 into the intake manifold. This butterfly control valve is mounted upon the casing 12 and operates in a manner conventional to carburetors for internal combustion engines.

The fuel for the carburetor system 10 may be provided by pump or gravity flow from a fuel tank (not shown). Fuel so supplied from the fuel tank is passed from an input line 30 through a control mechanism 32 and into an input line 34 which extends to a nozzle 36 within the carburetor housing. The nozzle 36 includes a relatively large fuel orifice which will be less susceptible to clogging by dirt particles and which effectively feeds fuel into the carburetor housing 12 without requiring a high pressure fuel supply source. The novel arrangement of a sound wave producing device within the carburetor chamber in a manner to be subsequently described makes this low pressure fuel feed possible.

The fuel stream from the nozzle 36 is directed against the active surface 38 of a sound wave producing device 40 which, for purposes of description, will hereinafter be designated as a vibrator. This vibrator preferably constitutes an ultrasonic transducer which is excited by an electric connection 42 to a high frequency circuit, not shown. Although an electrically activated ultrasonic transducer is contemplated for use as the vibrator 40, it will be apparent that any suitable vibration device capable of producing sound waves of sufficient power may be employed. Ultrasonic frequency sound waves are preferred, but lower frequency sound waves, although greatly inefficient, would work if enough power is employed.

The positioning of the vibrator 40 within the carburetor housing 12 is critical, for the vector forces created by the negative pressure at 14 from the intake manifold must be taken into account if the vibrator is to achieve an effective air-fuel emulsification. To insure that all of the components of the fuel, including the impurities, are homogenized or emulsified into the combustion air stream, it is necessary to hold the less mobile components of the fuel against the active surface of the vibrator 40. This is accomplished by causing the input fuel stream to flow across the extent of the active surface of the vibrator so that complete emulsification of the fuel and the impurities

therein with the combustion air within the carburetor housing 12 can occur. The fuel must be held against the active surface 38 of the vibrator and cannot be permitted to flow to an area of escape through a low energy side of the vibrator.

In the carburetor system 10 of the present invention, the negative pressure from the intake manifold is employed to draw the input fuel from the nozzle 36 across the extent of the active surface 38 of the vibrator 40 and fuel-air emulsification occurs in a one-step process as this fuel flow progresses. The vibrator is located between the nozzle 36 and the entrance 14 to the intake manifold in such a manner that the negative pressure from the intake manifold draws the fuel stream completely across the active surface of the vibrator. The nozzle 36 is positioned at one extremity of the active surface of the vibrator and the intake manifold opening is positioned at the opposite extremity. Therefore, there is no means by which the fuel is enabled to pass from the nozzle 36 into the opening 14 without first being drawn across the active surface of the vibrator 40. Ideally, the vibrator is positioned at an angle so that the active face thereof intercepts the fuel stream from the nozzle 36. The fuel and the impurities therein are progressively mixed with the air stream as the fuel moves across the vibrator surface.

It is obvious that fuel could be fed into the carburetor housing 12 under the control of conventional fuel control means commonly employed in internal combustion engines, such as for example, a carburetor supply float chamber including a float valve to control the level of fuel within the chamber. When such a chamber is employed, fuel is normally drawn into the carburetor housing by means of the vacuum created by the intake manifold, or alternatively by gravity. However, in the carburetor system of the present invention, a static, fluidics type switching arrangement is used as the fuel feed control unit 32. This fuel feed control unit receives fuel from a conventional fuel pump (not shown) through the line 30 and passes the fuel through the control unit 32 and out through a return line 44 which provides a return circuit for the fuel to the fuel tank. As the fuel passes through the control unit 32, a main fuel line divider 46 is encountered which provides a split in the fuel stream so that some fuel may be diverted from the return circuit to the fuel tank and fed into the input line 34. The amount of fuel which is diverted by the divider 46 into the input line 34 is determined by the speed of the internal combustion engine, for it is the increased vacuum from the intake manifold via the carburetor as the speed of the engine increases which causes additional fuel to be diverted from the return circuit 44. Ideally, the main inlet line 30 and the return line 44 should be greater in diameter of the input line 34 to the carburetor to permit slower fuel flow in the return line and more precise control of fuel to the carburetor. Also, the angle of the divider 46 between the inlet line 30 and the input line 34 should be great enough so as not to permit fuel to enter the carburetor before the engine is turned over. If the angle is great, there is less chance of accidental fuel feed to the carburetor when the engine is not running, but too great an angle can result in a turbulent fuel flow through the input line 34. It has been found that a divider angle within the range of from 45 to 60 degrees is quite effective.

In the operation of the carburetor 10 of FIG. 1, when the internal combustion engine associated with the system is started, negative pressure from the opening 14 into the intake manifold causes fuel to be diverted within the fuel feed control unit 32 so that a small fuel input flows through the inlet line 34. This fuel is projected upon the face of the vibrator 40 which is vibrating within the ultrasonic frequency range. It has been found, for example, that if the vibrator 40 constitutes an electronic transducer, this transducer operates well when the frequency used is approximately 860 kc. and the transducer is powered at or above 2 watts per square centimeter. With the fuel

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flowing in through the input line 34 onto the lowermost extremity of the transducer, the vacuum from the intake manifold draws the fuel across the active surface 38 of the vibrator, maintaining the fuel and impurities therein in contact with the active surface. As the fuel stream moves, the vibration of the vibrator accomplishes a molecular suspension of fuel in air in one step. The air has been drawn in from the inlet opening 16 by the vacuum from the intake manifold, and the influx of air causes the valve 20 to open against the bias of the spring 26. As the speed of the engine increases, the vacuum or negative pressure from the intake manifold increases, and increased air is drawn in through the air inlet opening 16. Also, increased fuel flow is diverted through the fuel inlet 34 from the fuel return circuit 44.

When the internal combustion engine is shut down, the negative pressure from the intake manifold drops and air and fuel are no longer drawn into the carburetor housing 12. However, a vaporized fuel and air mixture may still be present to some extent in the carburetor housing for a short period after the internal combustion engine ceases operation, and it is desirable to provide the valve 20 which will close immediately upon shut down of the engine to prevent this mixture from escaping into the atmosphere.

It is often desirable to provide a one-way check valve 48 in the fuel return line 44 to prevent air from accumulating in the return line when fuel is diverted into the input line 34, and to give maximum full delivery to the engine.

The carburetor system 10 of FIG. 1 may be modified constructionally to adapt the system for a wide variety of uses, the primary constructional limitation being that the vibrator be positioned within the carburetor housing relative to the intake manifold opening and the fuel input so that negative pressure from the intake manifold draws the input fuel across the active surface area of the vibrator. Once such modification of the carburetor system 10 is illustrated in FIG. 2 wherein, for purposes of clarity, like reference numerals are employed to indicate system components common to FIGS. 1 and 2.

Referring now to FIG. 2, it will be noted that the fuel input nozzle 36 is arranged relative to the vibrator 40 so that fuel is directed against the central portion of the active surface 38 of the vibrator rather than against the outer extremity of the active surface as indicated in FIG. 1. In this embodiment, the active surface of the vibrator, instead of merely being slightly inclined relative to the fuel nozzle 36 as indicated in FIG. 1, is positioned substantially perpendicular to the central longitudinal axis of the nozzle. The opening 14 to the intake manifold for the internal combustion engine is positioned beneath the active surface of the vibrator, while the nozzle 36 is positioned above the vibrator. Thus the negative pressure from the intake manifold draws fuel from the nozzle 36 into contact with the central portion of the active surface 38 of the vibrator. Once the fuel is drawn into contact with the vibrator, it then is drawn outwardly from the central portion of the active surface of the vibrator to the outer extremities thereof. It is apparent that the fuel flows across the surface of the vibrator and is held in contact therewith by the negative pressure from the intake manifold, so that an effective fuel-air emulsion occurs with the combustion air being drawn inwardly from air intake 16. This emulsified fuel-air mixture is then drawn through a filter or screening unit 50 which extends between the vibrator 40 and walls of the carburetor housing 12 and into the intake manifold for the internal combustion engine.

For more effective engine idling, it is sometimes desirable to modify the fuel control unit 32 of FIG. 1 to add additional vacuum bleed-off lines extending to the interior of the carburetor housing 12. Although any desirable number of such branch bleed-off lines may be employed, for purposes of illustration, one additional bleed-

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off line 52 is shown in FIG. 2. This additional bleed-off line extends from the full inlet line 30 into the carburetor housing 12 and operates to divert additional fuel from the fuel return system 44. The additional bleed-off line 52 acting on the side of the fuel stream as it flows from the inlet 30 to return line 44 operates to draw additional fuel through the line 34 when the engine is idling. These additional bleed-off lines are sometimes necessary to insure effective engine idling, and it is apparent that a control system 32 containing a plurality of such bleed-off lines may be employed with the carburetor units of either FIGS. 1 or 2.

In the carburetor constructions of both FIGS. 1 and 2, it is important to carefully position the apex point of the divider 46 with respect to the end of the nozzle 36. The apex of the divider should be spaced from the end of the nozzle a distance which is equal to at least five times the diameter of the nozzle. This will insure that proper switching of the fuel stream will occur.

Referring now to FIG. 3, it will be noted that it is possible to position the vibrator 40 externally of the carburetor housing 12 by mounting the vibrator around a modified fuel nozzle 36. Again, as in the embodiments illustrated by FIGS. 1 and 2, the vibrator 40 of FIG. 3 will operate effectively so long as it is positioned in a manner whereby the fuel provided to the vibrator is drawn across the active surface thereof by the negative pressure from the intake manifold.

It will be noted in FIG. 3 that the fuel inlet 30 connects into a tube 56 which forms the nozzle 36. The tube 56 is composed of magnetostrictive material, and the inner bore of the tube forms the active surface 38 for the vibrator 40. Also, it will be noted from FIG. 3 that the outlet end of the inner bore of the tube 56 is flared outwardly, as indicated at 58, to provide an outlet opening of greater diameter than the inlet at the fuel inlet line 30. This flared outlet facilitates the emulsion of fuel with air as the fuel is drawn from the active surface 38 into the carburetor chamber.

A support collar 54 is secured to the outer surface of the carburetor housing 12 and mounts a high frequency electro-magnetic coil 60 on the carburetor housing. The coil 60 surrounds the magnetostrictive tube 56 and combines with the magnetostrictive tube to form the sound wave producing device or vibrator 40. Power for the electromagnetic coil 60 is provided by an input connection 62.

In the operation of the carburetor of FIG. 3, fuel from the fuel tank flows into the inlet line 30 and is drawn across the active surface 38 of the magnetostrictive tube 56 by the negative pressure from the engine manifold. The magnetostrictive tube and the electromagnetic coil 60 combine to provide a sound wave producing device 40, and it will be noted that the input fuel is caused to pass completely across the active surface 38 of this device. Subsequently, the fuel particles mix with the air from the air inlet 16 in the flared portion 58 of the nozzle 36 and also in the carburetor chamber. This fuel-air emulsion is then drawn into the manifold by the negative pressure at the manifold connection 14.

The nozzle 36 of FIG. 3 may be connected to receive fuel from a fuel feed control unit of the types illustrated at 32 in FIGS. 1 and 2 if desired.

It will be readily apparent to those skilled in the art that the carburetor system of the present invention provides a simple, effective carburetor system employing a minimum number of movable parts which operates to achieve an enhanced fuel-air emulsification. The arrangement and types of components employed herein may be subject to numerous modifications well within the purview of this inventor who intends only to be limited to a broad interpretation of the specification and appended claims.

What is claimed is:

1. A carburetor system for connection between a fuel

source and the intake manifold of an internal combustion engine comprising a carburetor housing defining an internal carburetor chamber, said housing including an opening to said intake manifold formed therein, and an air intake opening positioned above said manifold opening, said manifold and air intake openings being relatively positioned to cause air to pass downwardly through said air intake opening into said carburetor chamber and laterally of said chamber into said manifold opening, fuel input means connected from said fuel source to said carburetor housing, said fuel input means including a nozzle opening into said chamber opposite said manifold opening at a level below that of said manifold opening for directing fuel into said carburetor chamber, and a sound wave producing unit having a flat active vibrating surface mounted within said carburetor chamber and extending across said carburetor chamber between said nozzle and the opening to said intake manifold in a manner to cause negative pressure from said intake manifold to draw fuel across the extent of said active surface in contact therewith, said active surface being inclined upwardly relative to the central longitudinal axis of said nozzle and including a first outer extremity positioned to receive fuel from said nozzle and a second outer extremity opposite to and spaced from said first outer extremity, said second outer extremity being positioned toward said intake manifold opening above said first outer extremity.

2. The carburetor system of claim 1 wherein said nozzle is positioned above said first outer extremity of said active surface, said active surface being inclined to an extent whereby said second outer extremity thereof extends upwardly to a point above said nozzle.

3. The carburetor system of claim 1 wherein said fuel input means includes a fuel feed control assembly connected between said fuel source and said nozzle, said fuel feed control assembly including a main fuel line

connected to receive fuel from said fuel source and to return fuel to said fuel source, and a branch line of smaller diameter than said main line extending from said main line to said nozzle, the juncture point between said main and branch lines being spaced from the end of said nozzle a distance equal to at least five times the diameter of said nozzle.

4. The carburetor system of claim 3 wherein said branch line to said nozzle extends above and away from a juncture point with said main line at an angle within the range of from 45° to 60°.

5. The carburetor system of claim 4 wherein at least one vacuum vector control line extends from a juncture point with said main line to said carburetor chamber, said branch line extending from a point on said main line between said nozzle and the juncture point of said vacuum vector control line.

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