

[54] AIR AND FUEL MIXING AND FEED SYSTEM

[75] Inventor: Bobby M. Wooldridge, College Park, Ga.

[73] Assignee: Lynwood A. Maddox, Decatur, Ga.

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Primary Examiner—Charles J. Myhre

Assistant Examiner—R. H. Lazarus

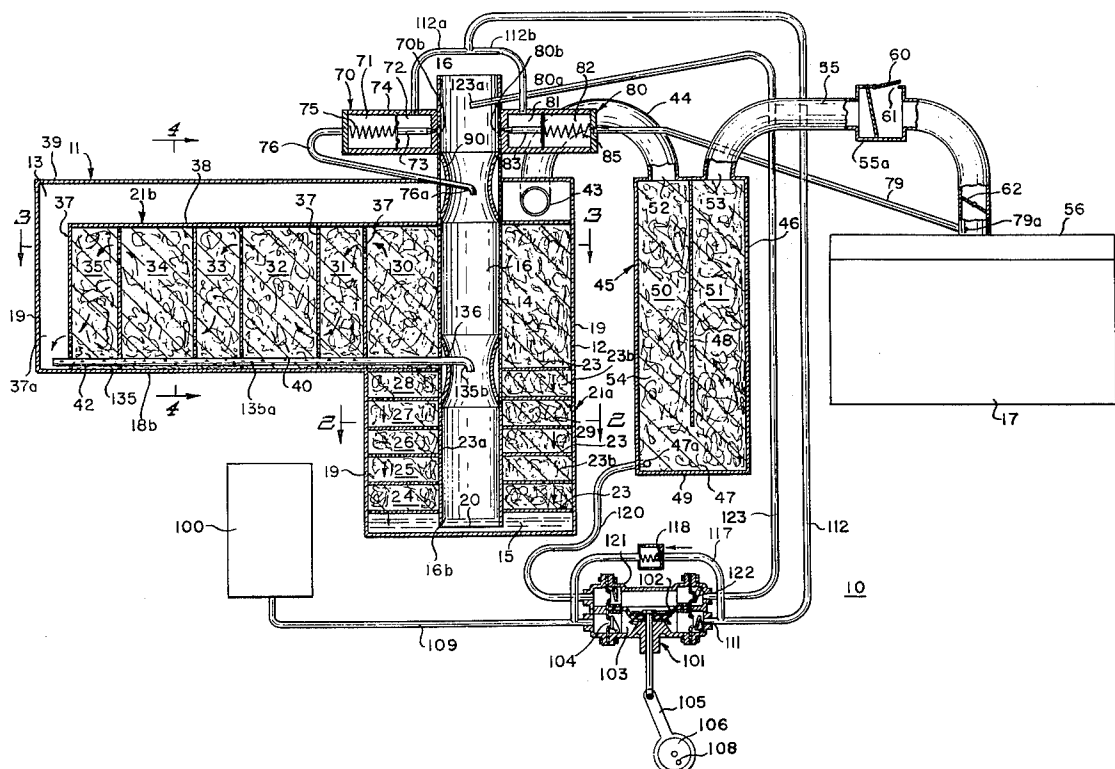
Attorney, Agent, or Firm—John B. Armentrout

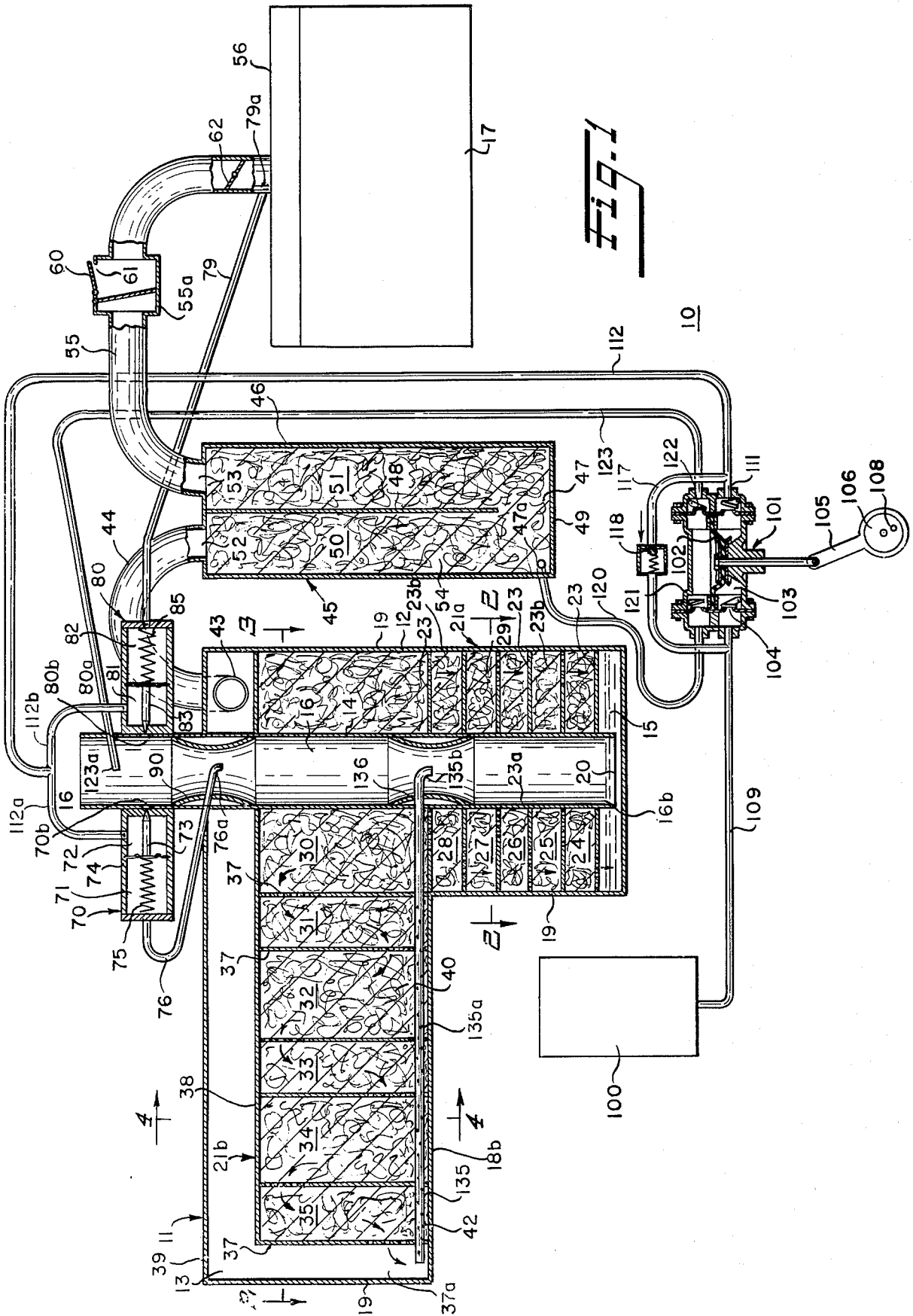
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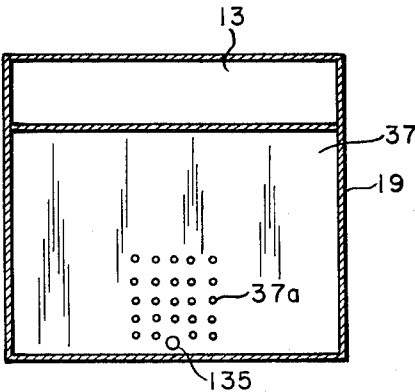
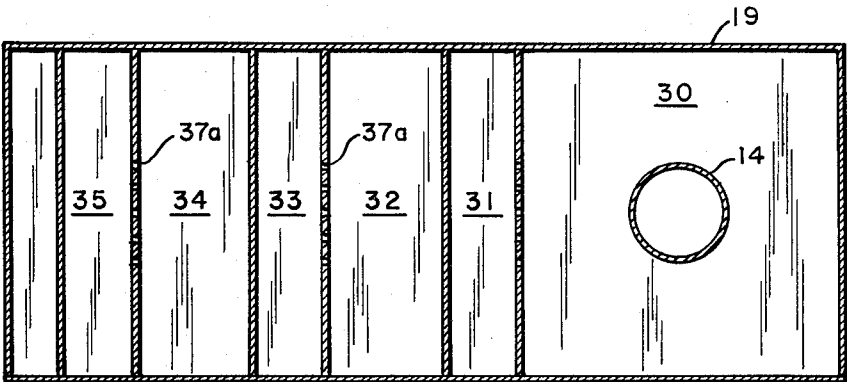
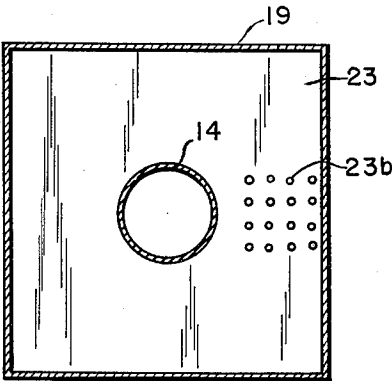
ABSTRACT

An air and fuel mixing and feed system for an internal combustion engine equipped with throttle valve means and an induction manifold includes: venturi and duct means communicating with ambient air, with a bath of liquid fuel in reservoir means, and with said throttle valve means, and comprising venturi means for developing static pressure in a region therein varying inversely in intensity with velocity of engine intake air flow; and means for pumping liquid fuel and regulating liquid fuel flow and pressure, comprising, pump means operated at a rate increasing and decreasing with engine operating speed, and fuel flow regulator means including pressure responsive flow control valve means having an excess pressure-alleviated pressure chamber communicating with said region and with a liquid fuel pressurizing chamber in said pump means, for said pressure responsive flow control valve means to open in response to decreased static pressure in said region for supplying said reservoir means with liquid fuel received from said pressurizing chamber of said pump means, and for said pressure responsive flow control valve means substantially to close to relatively high static pressure in said pressure chamber.

15 Claims, 4 Drawing Figures







AIR AND FUEL MIXING AND FEED SYSTEM

This invention relates to gas and fuel mixing and feeding apparatus wherein a both of liquid fuel is utilized for contributing fuel to the gas, and the invention is particularly directed to improvements in a system for supplying a mixture of fuel and air to an internal combustion engine.

An object of the present invention is to provide new and useful improvements in an air and fuel mixing and feed system for an internal combustion engine using a bath of liquid fuel for contributing liquid fuel to the air.

Another object herein is to provide a fuel and air mixing and feed system for an internal combustion engine, having air induced to flow through a bath of liquid fuel in response to intake of the engine, and to achieve feed of liquid fuel in replenishment of the bath through use of pressure responsive flow control valve means supplied from fuel pump means and by controlling the pressure responsive flow control valve means in accordance with static pressure developed within an open region inside a venturi means and varying in proportion to operating speed of the engine, to have fuel delivered from the pump means pass through the pressure responsive flow control valve means and to the bath when the pressure responsive flow control valve means is open in response to low static pressure in the open region inside the venturi means, and to have the pressure responsive flow control valve means substantially close to fuel from the pump means when static pressure in the open region inside the venturi means has sufficiently increased.

Another object herein is the provision of a system of the character indicated wherein replenishment of the bath of liquid fuel further is had through pressure responsive flow control second valve means supplied from the fuel pump means and by controlling the pressure responsive flow control second valve means to open for fuel delivered from the pump means to pass through the pressure responsive flow control second valve means in response to low pressure developed between the throttle valve means and the engine when the throttle valve means is in a relatively closed position, and which pressure responsive flow control second valve means substantially closes in response to relatively high pressure developed between the throttle valve means and the engine corresponding to when the throttle valve means is in a relatively open position.

A further object herein is the provision of a system of the character indicated, introducing features relating to extracting liquid fuel from an air and fuel mixture en route to an internal combustion engine from a bath of liquid fuel.

Other objects in part will be obvious and in part pointed out more fully hereinafter.

The present invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIG. 1 is a schematic representation of an air and fuel mixing and feed system, partially in vertical sectional view, for an internal combustion engine;

FIG. 2 is a horizontal sectional view taken through a liquid fuel extracting first stage at 2—2 in FIG. 1;

FIG. 3 is a horizontal sectional view taken at 3—3 through a liquid fuel extracting second stage in FIG. 1; and

FIG. 4 is a vertical sectional view taken at 4—4 in FIG. 1 through the liquid fuel extracting second stage.

Referring now more particularly to the embodiment of the invention represented in the accompanying drawings, an air and fuel mixing and feed system, designated in general by the reference numeral 10 in FIG. 1, is provided and includes an air and fuel mixing and liquid fuel extracting unit 11 in which a housing 12 forms inside at a lower bottom portion 18a thereof and at adjacent portions of the sidewall structure 19 thereof a reservoir means 15 normally containing a bath of liquid fuel 20, such as gasoline. A normally vertical air inlet duct 14 has a passageway 16 therein which communicates at upper air intake end 16a with air ambient to the air and fuel mixing and feed system 10. The lower discharge end 16b of the passageway 16 is immersed in the bath of liquid fuel 20 for air in the passageway 16 to move having ingress into the bath below the surface of the bath and in order to rise in and carry off fuel from the bath.

Housing 12 further introduces first and second stage extractor means 21a and 21b for liquid fuel to be extracted from a mixture of air and fuel passing from the bath of liquid fuel 20 in the reservoir means 15 en route to an outlet duct 13, which latter duct is an integral component of the housing 12. Further, in this regard, a first labyrinthic stage 21a of the extractor means includes a plurality of similar generally horizontal partitions 23 each having a central opening 23a therein receiving the air inlet duct 14, and each of the partitions 23 further is characterized by having a set of apertures 23b therein for the latter to conduct a mixture of air and fuel. The partitions 23 are spaced vertically apart from one another, thus subdividing a space within the housing 12 into liquid fuel extracting chambers 24, 25, 26, 27 and 28 extending above the reservoir means 15 and are walled in by the housing sidewall structure 19. Chambers 24, 25, 26, 27 and 28 are substantially closed off at the inside surface of the housing sidewall structure 19 and at the outside surface of the air inlet duct 14 and are packed with filter material 29 suitable for extracting liquid fuel from a mixture of air and fuel while tolerating flow of the mixture. Further, the sets of apertures 23b are horizontally removed one with reference to the next for placing the chambers 24, 25, 26, 27 and 28 labyrinthically in series with one another and flow through the labyrinth to be mainly generally horizontal though vertically stepped and reversing from chamber to chamber. The lowermost one of the partitions 23 has its set of apertures 23b open directly into space immediately above the reservoir means 15 for air entering the bath of liquid fuel 20 from the discharge end 16b of the passageway 16 in the air inlet duct and carrying fuel from the bath to enter the chamber 24 through that set of apertures 23b, and the uppermost one of the partitions 23 has its set of apertures 23b open from the chamber 28 and directly into a compartment 30 in the housing 12 immediately above the latter partition. 18b

A second labyrinthic stage 21b of the extractor means is formed in an upper lateral extension of the housing 12 and introduces generally vertical liquid fuel extracting chambers 32, 33, 34 and 35 between a plurality of substantially upright similar partitions 37

spaced horizontally apart from one another and alternately having upper and lower sets of apertures 37a therein to introduce a predominantly generally vertical flow through each of the chambers 32, 33, 34 and 35 in labyrinthic series in the order named, having those chambers closed off at the top by a generally horizontal wall 38 inside the housing 12 and at the bottom by an upper portion 18b of the bottom of the housing 12 and further having those same chambers closed off at opposite sides by upper portions of the housing sidewall structure 19. The inner one of the partitions 37 and the corresponding set of apertures 37a therein are in common to the compartment 30 and the extracting chamber 31, and the outer one of the partitions 37 and its set of apertures 37a are in common to the extracting chamber 35 and an inner end of the air and fuel outlet duct 13 which is a duct having a generally rectangular lateral cross section substantially throughout within the housing 12. Outlet duct 13 furthermore communicates with the housing outlet port 43. A top wall 39 of the housing 12 constitutes a portion of the wall of the outlet 13 as does the generally horizontal wall 38 inside the housing and as does a portion of the sidewall structure 19 of the housing while the bottom wall portion 18b closes off the inner end of the duct 13 for that end to communicate with the fuel extracting chamber 35 directly through the apertures 37a in the outermost one of the partitions 37.

Further in the present embodiment the housing 12 comprises sump means 42 open to the lower end of each of the fuel extracting chambers 31, 32, 33, 34 and 35 and having for bottom the bottom wall portion 18b of the housing and for sides the inner one of the partitions 37 next to the compartment 30 and portions of the housing sidewall structure 19 on a remaining three sides. Each one of the liquid fuel extracting chambers 31, 32, 33, 34 and 35 is packed with filter material 40 which is suitable for extracting liquid fuel from a mixture of air and fuel labyrinthically flowing through the second labyrinthic stage 21b of the extractor means, and the liquid fuel extracted in the chambers 31, 32, 33, 34 and 35, such as that by the filter material 40, is fed into the sump means 42 for being returned to the reservoir means 15 in a manner to be described more fully hereinafter.

Third stage extractor means 45 also is provided in the present embodiment and includes a housing or casing 46 which at the bottom inside comprises sump means 47. A wall 48 within the casing 46 and leading from the top and opposite sidewalls of the casing forms a partition between a pair of labyrinthically interrelated extracting chambers 50 and 51 which intercommunicate with one another through a passage 49 above the sump means 47 and below the lower end of the wall 48. Adjacent to the top thereof the casing 46 has an inlet port 52 leading into the extracting chamber 50 and an outlet port 53 leading from the extracting chamber 51, both of the latter two chambers being packed with a suitable filter material 54 for this filter material to extract liquid fuel from an air and fuel mixture passing from the inlet port 52 en route to the outlet port 53, and the chambers 50 and 51 are arranged for liquid fuel thus extracted in those chambers to pass into the sump means 47.

The fuel and air outlet duct 13 has output from the housing outlet 43 through an air and fuel outlet extension duct 44 which communicates with the inlet port 52

in the casing 46 and through the chambers 50 and 51 with the outlet port 53, the latter having output through to an air and fuel extension duct 55 and an induction manifold 56 leading into the internal combustion engine 17. An opening 47a from the bottom of the sump means 47 communicates for liquid fuel from the sump means 47 to be returned to the reservoir means 15 in a manner hereinafter to be more fully described. A portion 55a of the air and fuel extension duct 55 is being a in cross section, and the one-way check valve 59, being rectangular flapper valve hinged at upper end and inclined leading downstream from the hinge in the duct extension 55, has a normally gravity-closed position and is adapted to open in response to flow past the one-way check valve 59 being induced in the air and fuel mixing and feed system 10 due to operation of the engine 17. A backfire pressure relief valve 60 suitably biased to close a port 61 in the portion 55a of the air and fuel extension duct 55 is provided having the port 61 communicating with the passageway in the duct extension 55 downstream of the one-way check valve 59 and is responsive to backfire pressure from the engine 17 to open the port 61 to air ambient to the engine, thereby relieving backfire pressure with the one-way check valve 59 meanwhile being closed.

Throttle valve means 62, in the passageway formed by the air and fuel extension duct 55 and the induction manifold 56 downstream of the one-way check valve 59 and the backfire pressure relief valve 60, is used to control operating speed of the engine 17 in accordance with being given increasing open positions to increase the engine operating speed and reduced open positions to reduce the engine operating speed down to engine idling speeds. Under all of these conditions of engine operation, air ambient to the air and fuel mixing and feed system 10, in view of negative pressure transmitted into the induction manifold 56 from the engine 17, is induced to enter the upper air intake end 16a of the passageway 16 in the air intake duct 14 and be conducted through the passageway 16 and thence through a bath of liquid fuel 20 normally in the reservoir means 15, thus carrying off fuel from the bath, and to pass through the first liquid fuel extracting stage means 21a and into the second liquid fuel extracting stage means 21b, the air and fuel outlet duct 13, and through air and fuel outlet duct extension 44 into the third liquid fuel extracting stage means 45, and thence through the air and fuel outlet duct extension 55 and the induction manifold 56 into the engine 17. During the flow thus induced, liquid fuel is extracted in the first liquid fuel extracting stage means 21a and returns through the apertures 23b in the labyrinth partitions 23 to the reservoir means 15 by gravity, and further amounts of liquid fuel are extracted from the relatively dry mixture of air and fuel flowing in the second and third liquid fuel extracting stage means 21b and 45 respectively, and liquid fuel extracted passes into the sump means 42 and 47 respectively, thus for the engine 17 to receive a dry mixture of air and fuel through the induction manifold 56 under the control of the throttle valve means 62.

For regulating the admission of liquid fuel to replenish the liquid fuel in bath 20, the air and fuel mixing and feed system 10 includes pressure responsive flow control first and second valve means 70 and 80, the first valve 70 having an inlet opening 70a into a liquid fuel chamber 71 from which an outlet opening 70b of the first valve means leads into the passageway 16 in the air

inlet duct means 14. A pressure chamber 72 within the first valve means 70 has a wall in the form of a diaphragm 74 in common with the liquid fuel chamber 71, and a valve needle 73 having one end secured to the center of the diaphragm 74 projects within the liquid fuel chamber 71 so as normally to close the valve outlet opening 70b under the bias of a helical spring 75 housed in the pressure chamber 72. Spring 75 is located compressed having its opposite ends respectively secured to the center of the diaphragm 74 and to the opposite outside end wall of the pressure chamber 72.

A first venturi 90 in the air and fuel mixing and feed system 10 forms a component of the air inlet duct means 14 and introduces a constricted open region in the passageway 16 downstream from the fuel outlet port 70b in the flow control first valve means 70. A bleed line 76 having its inner end 76a open within the open region inside the first venturi 90 in the passageway 16 communicates with the pressure chamber 72 of the flow control first valve means 70 for the latter means to open the outlet port 70b to an increasing degree in response to static pressure being decreased and transmitted from the region inside the first venturi 90 through bleed line 76 into the pressure chamber 72 and be closed by spring 75 in response to relatively high pressure transmitted from the region inside the first venturi means through bleed line 76 to the pressure chamber 72.

The pressure responsive flow control second valve means 80 is similar to the flow control first valve means 70 and comprises an inlet opening 80a into a liquid fuel chamber 81 from which an outlet opening 80b of the second valve means communicates with the passageway 16 in the air inlet duct means 14 upstream of the first venturi 90. The flow control second valve means 80 further has a wall forming a diaphragm 84 which is in common to the liquid fuel chamber 81 and a pressure chamber 81, and there is a valve needle 83 secured to the center of the diaphragm 84 in the liquid fuel chamber 81 and projecting to control the outlet port 80b. A helical spring 85 in the pressure chamber 82 is secured at a first of its opposite ends to the center of diaphragm 84 and at the second of its opposite ends to the outside end wall of the pressure chamber 82 opposite the diaphragm 84, the spring 85 normally being compressed holding the valve needle 83 in closing position with reference to the valve outlet port 80b. A bleed line 79 having an end 79a open into the air and fuel mixture flow path inside the induction manifold 56 downstream of the throttle valve means 62 is open at opposite end 79b into the pressure chamber 82 of the pressure responsive flow control second valve means 80 for the valve needle 85 to open the outlet port 80b in response to low pressure developed between the throttle valve means 62 and the engine 17 having the throttle valve means in a relatively closed position and for the second valve means 80 to close in response to relatively high pressure developed between the throttle valve means and the engine when the throttle valve means is in a relatively open position.

Pump means in the air and fuel mixing and feed system 10 is characterized by including a plural chamber diaphragm pump 101 wherein a diaphragm 102 in common to first and second pumping chambers 103 and 104 is connected through actuating linkage 105 with a rotary cam 106, the latter being fixed and driven to rotate with a shaft 108 at a speed which is directly

proportional to the operating speed of the engine 17, and the actuating linkage 105 being adapted to drive the diaphragm 102 at a rate which is directly proportional to the engine operating speed in response to rotation of the cam 106. A fuel tank 100, such as for gasoline, has a gravity feed line 109 communicating with the first pumping chamber 103 through a one-way inlet valve 110 of the pump means, and there is a fuel outlet line 112 from the first pumping chamber in communication with a one-way outlet valve 111 of the pump 101 and leading into the liquid fuel chambers 71 and 81 of the pressure responsive flow control first and second valve means 70 and 80 respectively through the line branches 112a and 112b, for the pump 101 in response to operation of the diaphragm 102 thereof to pump liquid fuel from the tank 100 through the one-way inlet valve 110, the first pumping chamber 103 and the one-way outlet valve 111, and through the outlet line 112 and its branches 112a and 112b and maintain pressure in the fuel chambers 71 and 81 in the first and second flow control valve means 70 and 80. A liquid fuel bleed-off line 117, by-passing the pumping chamber 103 and communicating with the liquid fuel outlet line 112 and with the liquid fuel inlet line 109, is equipped with a pressure responsive regulating valve 118 which opens in response to a predetermined maximum pressure in the liquid fuel outlet line 112 for the bleed-off line 117 to return liquid fuel received in the liquid fuel outlet line 112 from the first pumping chamber 103 back to the liquid fuel inlet line 109 and thus alleviate pressure of liquid fuel in the liquid fuel chambers 71 and 81 in the first and second flow control valve means 70 and 80 to be at a predetermined maximum pressure which assures having the valve outlets 70b and 80b normally closed by the valve needles 73 and 83. Further, the needle valve 73 as carried on the diaphragm 74 and biased by the spring 75 is adapted to open the valve outlet port 70b in response to a decrease in static pressure brought about in the pressure chamber 72 by flow of air induced by the engine 17 through the region of the passageway 16 which is inside the venturi 90 for relatively open positions of the throttle valve means 62 thus allowing liquid fuel in amounts increasing with the engine operating speed above idling speed to issue from the valve outlet port 70b until static pressure communicated from the region inside the venturi 90 to the pressure chamber 72 once more increases for the valve outlet port 70b to be closed. Liquid fuel issued from the flow control first valve means 70 through the outlet port 70b when the latter is open passes through the passageway 16 into the reservoir means 15. When the throttle valve means 62 is relatively closed, the operation of engine 17 causes a negative pressure to develop in the induction manifold 56 downstream of the throttle valve means 62 as well as in the pressure chamber 82 of the flow control second valve means 80 and this promotes movement of the valve needle 83 from a closed position to an open position with reference to the valve outlet port 80b so as to have liquid fuel on supply from the pump 101 flow through the outlet port 80b and into the passageway for replenishing the bath 20. Under the latter conditions, static pressure in the region inside the venturi 90 and in the pressure chamber 72 is increased due to reduced rate of intake of the engine 17 on lower operating speeds, having the throttle valve means relatively closed, and thus the outlet port 70b remains substantially closed by the valve nee-

dle 73 until the throttle valve means 62 once again is brought to a relatively open position for static pressure to develop in the pressure chamber 72 to promote opening of the outlet port 70b while the outlet port 80b in the flow control second valve means 80 remains substantially closed.

The second pumping chamber 104 in pump 101 is connected through a one-way inlet valve 121 with a liquid fuel inlet line 120 communicating with the opening 47a from the sump means 47 in the third liquid fuel extracting state means 45 and is connected through a one-way outlet valve 122 with a liquid fuel outlet line 123 which has an end 123a inside the passageway upstream of the venturi 90 for liquid fuel to be returned through the latter passageway from the sump means 47 to the bath of liquid fuel 20 inside the reservoir means 15 on operation of the pump diaphragm 102 at a rate varying in direct proportion to the speed of operation of the engine 17. In order to return liquid fuel from the sump means 42 in the second fuel extracting stage means 21b, a liquid fuel feed line 135 is introduced leading in the sump means 42 through an opening in the bottom portion of each of the partitions 37, and the feed line 135 has liquid fuel intake apertures 135a for communicating with liquid fuel in the sump means 42 at the bottom of each of the extracting chambers 31, 32, 33, 34 and 35 and at the adjacent inner end of the air and fuel outlet duct means 13. A second venturi 136 formed as a component of the air inlet duct means 14 introduces a reduced open region of the passageway 16 inside the second venturi 136 downstream toward the reservoir means 15 from the first venturi 90, and the feed line 135 has an open end 135b disposed in the open region inside the second venturi 136, for air induced to flow through the passageway 16 on operation of the engine 17 to develop a static pressure varying inversely in intensity with velocity of air flow through the passageway 16 in the environs of end 135a and induce liquid to flow from the sump means 42 through the feed line 135 from the apertures 135a and out the open end 135b and have fuel so issuing be returned through the passageway 16 back into the reservoir means 15.

As the invention lends itself to many possible embodiments and as many possible changes may be made in the embodiment hereinbefore set forth, it will be distinctly understood that all matter described herein is to be interpreted as illustrative and not as a limitation.

I claim:

1. In an air and fuel mixing and feed system wherein an internal combustion engine is equipped with throttle valve means and an induction manifold with said induction manifold intercommunicating downstream of said throttle valve means with said throttle valve means and said engine for said engine on negative pressure therein to take in a mixture of air and fuel from said induction manifold and be controlled by said throttle valve means, the combination which includes; venturi and duct means comprising, air inlet duct means having a passageway therein and said passageway communicating with air ambient to said engine, and with said throttle valve means and said induction manifold through a bath of liquid fuel normally contained in reservoir means of said system for a mixture of air and fuel to be supplied to said engine in response to negative pressure in said engine through said induction manifold and under control of said throttle valve means, and venturi means having an inside open region for developing

static pressure in said region varying inversely in intensity with velocity of engine intake air flow induced in said region by said engine; and means for pumping liquid fuel and regulating liquid fuel flow and pressure, the latter said means comprising, pump means for being operated with said engine at a rate increasing and decreasing with operating speed of said engine for pumping liquid fuel, fuel flow regulator means including pressure responsive flow control valve means having a pressure chamber communicating with said region inside said venturi means and said pressure responsive flow control valve means communicating with a liquid fuel pressurizing chamber in said pump means and with said reservoir means, for said pressure responsive flow control valve means to open in response to static pressure being decreased in said region inside said venturi means and transmitted to said pressure chamber of said pressure responsive flow control valve means for supplying said reservoir means with liquid fuel received from said pressurizing chamber of said pump means, and for said pressure responsive flow control valve means substantially to close when static pressure in said pressure chamber of said pressure responsive flow control valve means is relatively high, and excess pressure alleviating means responsive to fluid pressure beyond a predetermined maximum pressure and communicating for responding to alleviate liquid fuel pressure in said pressurizing chamber of said pump means.

2. In an air and fuel mixing and feed system as set forth in claim 1 wherein housing and duct means includes, a housing containing said reservoir means with said air inlet duct means being in communication with air ambient to said engine and with said reservoir means in said housing, and air and fuel outlet duct means communicating with said throttle valve means and with said reservoir means, for air in response to negative pressure in said engine to enter and flow through said passageway in said air inlet duct means into and through a bath of liquid fuel in said reservoir means and pass carrying fuel through said air and fuel outlet duct means in response to negative pressure in said engine and under control of said throttle valve means.

3. In an air and fuel mixing and feed system as set forth in claim 2 wherein said air and fuel outlet means is controlled to be opened and closed by one-way check valve means opening said air and fuel outlet means in response to flow of air carrying fuel being induced from said induction manifold on operation of said engine and closing said air and fuel outlet means in response to pressure of backfire of said engine, and backfire pressure relief valve means is provided communicating with said air and fuel outlet means downstream of said one-way check valve means for relieving pressure of backfire of said engine having said one-way check valve means closed.

4. In an air and fuel mixing and feed system as set forth in claim 2 wherein said system is characterized by including filter means disposed for extracting liquid fuel from an air and fuel mixture passing en route to said engine from said reservoir means.

5. In an air and fuel mixing and feed system as set forth in claim 2 wherein said system is characterized by including extractor means comprising filter means and sump means disposed between said reservoir means and said induction manifold for said filter means to ex-

tract liquid fuel from an air and fuel mixture passing en route to said engine from a bath of liquid fuel normally in said reservoir means and said sump means to collect liquid fuel from said filter means, and said pump means communicates with said sump means and with said reservoir means for fuel from said sump means to be returned to said reservoir means on operation of said pump means.

6. In an air and fuel mixing and feed system as set forth in claim 2 wherein said system is characterized by including filter means disposed in said housing between said reservoir means and said induction manifold for extracting liquid fuel from an air and fuel mixture passing en route to said induction manifold from a bath of liquid fuel normally contained in said reservoir means.

7. In an air and fuel mixing and feed system as set forth in claim 2 wherein said system is characterized by including labyrinthic passage means disposed in said housing between said reservoir means and said induction manifold, and said labyrinthic passage means contains filter means for extracting liquid fuel from an air and fuel mixture passing through said labyrinthic passage means en route to said induction manifold from a bath of liquid fuel normally contained in said reservoir means.

8. In an air and fuel mixing and feed system as set forth in claim 2 wherein said system is characterized by including extractor means comprising filter means and sump means disposed in said housing between said reservoir means and said induction manifold for said filter means to extract liquid fuel from a fuel and air mixture passing en route to said induction manifold from a bath of liquid fuel normally contained in said reservoir means, and said sump means communicates with said reservoir means for liquid fuel in said sump means to be returned to said reservoir means.

9. In an air and fuel mixing and feed system as set forth in claim 8 wherein said venturi and duct means includes said venturi means intercommunicating with second venturi means through an intermediate portion of said passageway in said duct means, and there being a feed line having feed line inlet means communicating with said sump means and having feed line outlet means in an open region inside said second venturi means for static pressure varying inversely with velocity of air flowing through said region inside said second venturi means to develop in said region inside said second venturi means and induce fuel from said sump means to flow in said feed line from said feed line inlet means to said feed line outlet means.

10. In an air and fuel mixing and feed system as set forth in claim 9 wherein said system is characterized by said extractor means including supplemental filter means and supplemental sump means interposed between said housing and said induction manifold for said supplemental filter means to extract liquid fuel from a fuel and air mixture passing en route to said engine from a bath of liquid fuel normally in said reservoir means and said supplemental sump means to collect liquid fuel from said supplemental filter means, and said pump means communicates with said reservoir means for inducing fuel to flow from said supplemental sump means and be returned to said reservoir means.

11. In an air and fuel mixing and feed system as set forth in claim 1 wherein said system is characterized by including filter means and sump means, said filter means for extracting liquid fuel from an air and fuel

mixture passing en route to said induction manifold from a bath of liquid fuel normally contained in said reservoir means and said sump means to collect liquid fuel from said filter means, and said pump means communicating with said sump means and with said reservoir means for inducing fuel to flow from said sump means and be returned to said reservoir means.

12. In an air and fuel mixing and feed system as set forth in claim 1 wherein said venturi and duct means includes said venturi means intercommunicating with second venturi means through an intermediate portion of said passageway in said air inlet duct means, and said system is further characterized by including filter means and sump means, said filter means for extracting liquid fuel from an air and fuel mixture passing en route to said induction manifold from a bath of liquid fuel normally contained in said reservoir means and said sump means to collect liquid fuel from said filter means, and there being a feed line having feed line inlet means communicating with said sump means and having feed line outlet means in an open region inside said second venturi means for static pressure varying inversely with velocity of air flowing through said region inside said second venturi means to develop in said region inside said second venturi means and induce fuel from said sump means to flow in said feed line from said feed line inlet means to said feed line outlet means.

13. In an air and fuel mixing and feed system wherein an internal combustion engine is equipped with throttle valve means and an induction manifold with said induction manifold intercommunicating downstream of said throttle valve means with said throttle valve means and said engine for said engine on negative pressure therein to take in a mixture of air and fuel from said induction manifold and be controlled by said throttle valve means, the combination which includes; venturi and duct means comprising, air inlet duct means having a passageway therein and said passageway communicating with air ambient to said engine, and with said throttle valve means and said induction manifold through a bath of liquid fuel normally contained in reservoir means of said system for a mixture of air and fuel to be supplied to said engine in response to negative pressure in said engine through said induction manifold under control of said throttle valve means, and venturi means having an inside open region for developing static pressure in said region varying inversely in intensity with velocity of engine intake air flow induced in said region by said engine; and means for pumping liquid fuel and regulating liquid fuel flow and pressure, the latter said means comprising, pump means for being operated with said engine at a rate increasing and decreasing with operating speed of said engine for pumping liquid fuel, fuel flow regulator means including pressure responsive flow control first valve means having a first pressure chamber communicating with said region inside said venturi means and said flow control first valve means communicating with said pump means and with said reservoir means, for said flow control first valve means to open to an increasing degree in response to static pressure being decreased and transmitted from said region inside said venturi means to said first pressure chamber for supplying said reservoir means with liquid fuel received from said pump means as said throttle valve means is progressively opened and substantially closed in response to relatively high static pressure transmitted from said region inside said ven-

turi means to said first pressure chamber when said throttle valve means is in a relatively closed position and pressure responsive flow control second valve means having a second pressure chamber communicating with said induction manifold downstream of said throttle valve means and pressure responsive flow control second valve means communicating with said pump means and said reservoir means for said pressure responsive flow control second valve means to open for supplying said reservoir means with liquid fuel from said pump means in response to low pressure developed between said throttle valve and said engine having said throttle valve means in said relatively closed position and for said pressure responsive flow control second valve means substantially to close in response to relatively high pressure developed between said throttle valve means and said engine as said throttle valve means is opened, and excess pressure alleviating means responsive to fluid pressure beyond a predetermined maximum pressure and communicating for responding to alleviate liquid fuel output pressure of said pump means.

14. In an air and fuel mixing and feed system as set forth in claim 13 wherein said system is characterized by including extractor means comprising filter means and sump means, said filter means for extracting liquid fuel from an air and fuel mixture passing en route to said induction manifold from a bath of liquid fuel normally in said reservoir means and said sump means to collect liquid fuel from said filter means, and said pump means including first and second pressurizing chambers for pumping liquid fuel, said first pressurizing chamber

communicating with said pressure responsive flow control first and second valve means for liquid fuel pressurized in said first pressurizing chamber to be supplied through said pressure responsive flow control first and second valve means as controlled and thence to said reservoir means, and said second pressurizing chamber communicating with said sump means and with said reservoir means for fuel from said sump means to be returned to said reservoir means.

15. In an air and fuel mixing and feed system as set forth in claim 13 wherein said venturi and duct means includes said venturi means intercommunicating with second venturi means through an intermediate portion of said passageway in said air inlet duct means, and said system is further characterized by including extractor means comprising filter means and sump means, said filter means for extracting liquid fuel from a fuel and air mixture passing en route to said induction manifold from a bath of liquid fuel normally in said reservoir means and said sump means to collect liquid fuel from said filter means, and there being a feed line having feed line inlet means communicating with said sump means and having feed line outlet means in an open region inside said second venturi means for static pressure varying inversely in intensity with velocity of air flowing through said region inside said second venturi means to develop in said region inside said second venturi means and induce fuel from said sump means to flow in said feed line from said feed line inlet means to said feed line outlet means.

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