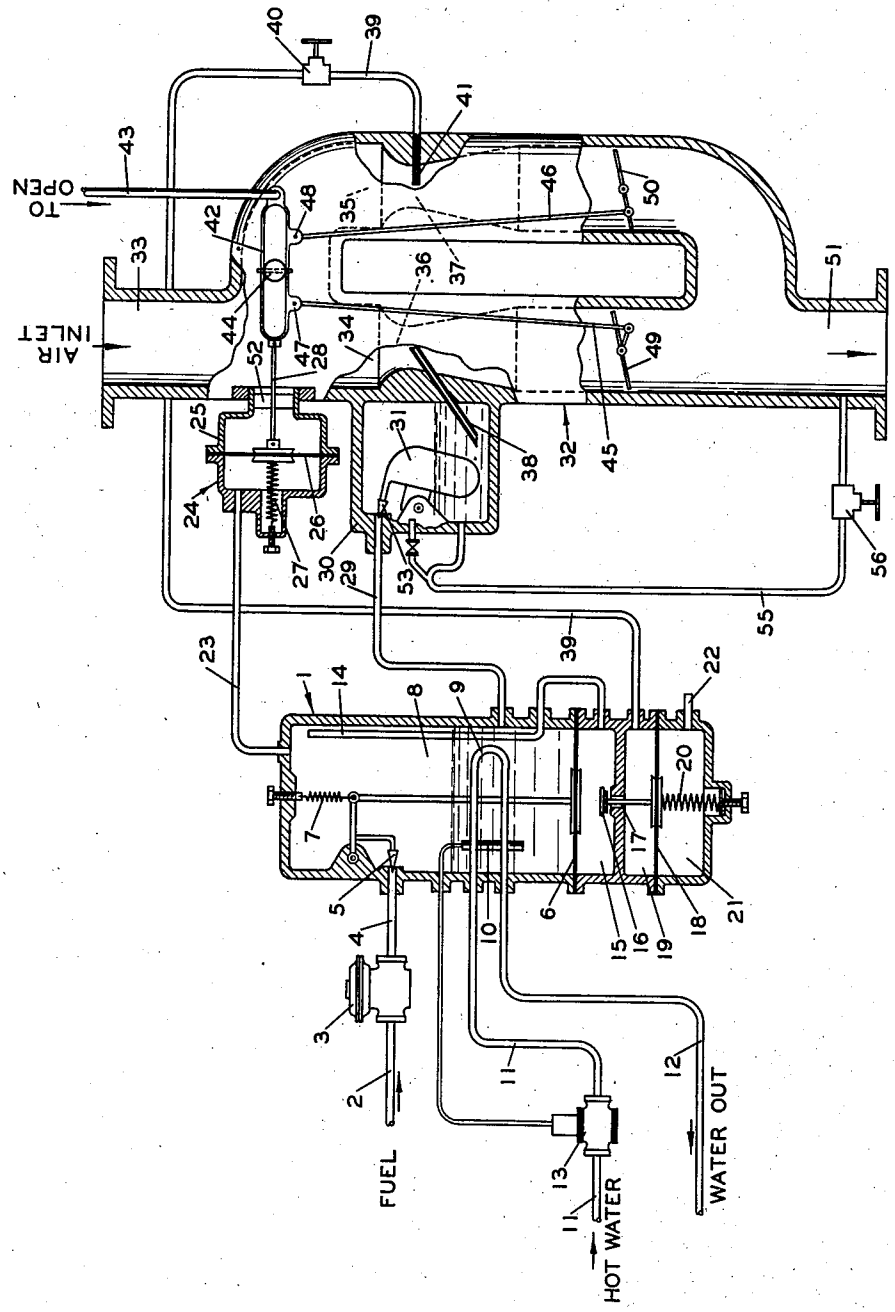
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HIGH VAPOR PRESSURE FUEL VAPORIZER-CARBURETOR COMBINATION

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HIGH VAPOR PRESSURE FUEL VAPORIZER-CARBURETOR COMBINATION

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This invention relates to carburetors and more particularly it relates to a type of carburetor especially adapted for use with higher than normal vapor pressure gasoline, in which the normally gaseous hydrocarbons are separated from the normally liquid hydrocarbons, and the two phases carbureted separately but in the same ratio as they occur in the original high vapor pressure fuel.

For automotive uses, the conventional carburetor is one in which liquid gasoline of from approximately 9 to 12 pounds Reid vapor pressure is used as fuel. Some stationary internal combustion engines operate on natural or artificial gases, and in some regions trucks, busses and even motor-cars are propelled by internal combustion engines which are fueled by compressed gases. These latter engines are equipped with special types of carburetors for mixing the gas with air to form the combustible fuel mixture.

In each of the above mentioned types of carburetors, the apparatus is used to carburet fuel from one phase, that is, from an all liquid phase, or from an all gaseous phase.

I have devised a carburetor which is designed to carburet a two phase fuel, that is, a fuel which is composed of liquid and vapor under pressure. Fuels of this class may be such as high vapor pressure natural gasoline or even liquefied petroleum gases or mixtures thereof.

An object of this invention is to devise a carburetor for carbureting high vapor pressure fuels.

A further object is the control of fuel flow to the separating means in accordance with the mass of liquid phase therein.

Another object is the provision of gas responsive means for regulating relative feed of liquid and gaseous phases.

A still further object of this invention is to devise a carbureting device for use with a high vapor pressure fuel, which upon reduction to slightly above atmospheric pressure, i. e., from 1 to 4 pounds per square inch gauge, is separated into a liquid phase and a vapor phase, and carbureting these two phases in the ratio in which they are present in the original fuel.

Still other objects and advantages will be realized by those skilled in the art by a careful study of the following disclosure.

The figure illustrates one modification of my invention showing my carburetor for use with high vapor pressure fuel.

Referring to the figure, numeral 1 represents a vaporizing chamber in which the normally gaseous components of the fuel are separated from the normally liquid components. Liquid fuel is conducted from the fuel pressure tank, not shown, through line 2 through pressure regulator 3 and line 4 into vaporizing chamber 1. Valve 5 operated by diaphragm 6 and tension spring 7 controls the flow of fuel from line 4 into the vaporizing chamber. The vaporizing chamber 1 is equipped with a heating coil 9 and thermoregulator 10. Heating fluid enters heating coil through tube 11 and leaves the coil through tube 12, the flow being controlled by control valve 13. Vapor tube 14 connects vaporizing chamber 1 with vapor compartment 15, the bottom wall of which is equipped with a zero pressure regulator valve 16. This latter passes through passage 17, the valve stem being attached to diaphragm 18. Gas feed chamber 19 receives gas through the the passage 17. A spring 20 slightly compressed when valve 16 is closed and adjusted to open slightly below atmospheric pressure controls the operation of said diaphragm 18, air chamber 21 being open to the atmosphere through opening 22 or connected to air inlet 33 to balance air cleaner friction. Tube 23 connects vaporizing chamber 1 to the throttle regulating apparatus 24. The said throttle regulating apparatus is essentially a diaphragm regulator composed of a housing 25, diaphragm 26, tension spring 27 and push pin 28.

Tube 29 connects the liquid containing portion of vaporizing chamber 1 with the float chamber 30, the flow of liquid fuel being controlled by the float mechanism 31 and valve 53.

The throttle valve portion 32 of the carburetor comprises the air-fuel mixing apparatus. Air enters this apparatus through air inlet tube 33, the stream of air being divided into two portions, one passing through the liquid carbureting side 34 of the device and the remainder passing through the gas carbureting portion 35. These carbureting parts are equipped with Venturi sections 36 and 37. Liquid carbureting jet 38 connects the liquid containing portion of float chamber 30 with the point of essentially maximum suction in the liquid carbureting venturi 36, while tube 39 connects the gas feed chamber 19 with the gas carbureting jet or tube 41 in the gas carbureting section of the dual carburetor. Flow of gas through tube 39 is adjustably restricted or controlled by valve 40.

Throttle valve operation is adjustably controlled by a slotted lever 42 which in turn is connected to and controlled by diaphragm 26 through push pin 28 pivoted to lever 42 at one end and pivoted to diaphragm 26 at the opposite end.

The push pin 28 has vertical movement in a slot 52. Any suitable means responsive to gas pressure in the vaporizing chamber may be used in place of the diaphragm and push pin arrangement shown to impart relative movement to lever 42. For example, a piston and cylinder arrangement may be utilized connected to lever 42 by suitable means. The said lever is supported by fulcrum pin 44 and manually operated by the manual throttle control 43. Butterfly throttle valve 49 is connected by arm 45 through pivot 47 to the lower side of lever 42 near one end thereof. Similarly, butterfly throttle valve 50 is connected near the opposite end of lever 42 by pivot 48 and arm 46. The liquid carbureting tube or side 34 and the gas carbureting tube or side 35 join into a common tube at the outlet end 51 of the carburetor.

Tube 55 connects the float chamber 30 to the carbureting side of the carburetor on the downstream side of the throttle valves 49 and 50 and carries the control valve 56. A branch tube connects tube 55 with the vapor space in the float bowl to prevent liquid from draining into the manifold when the engine stops. The float chamber is vented to the air inlet tube by a passage, not shown.

In the operation of my carburetor, hydrocarbon fuel comprising natural gasoline, high vapor pressure natural gasoline containing substantial quantities of normally gaseous hydrocarbons under pressure, flows from the fuel storage tank, not shown, through line 2, pressure regulator 3 and line 4 into the vaporizing chamber 1. Pressure regulator 3 reduces the pressure of the incoming fuel from that of the storage tank to approximately from 1 to 4 pounds per square inch. Fuel at this lower pressure enters vaporizing chamber 1 through valve 5, which valve is operated by diaphragm 6 and tension spring 7. The liquid fuel upon entrance into vaporizing chamber 1 evolves as vapor some of the normally gaseous hydrocarbons, and the amount of vapor formed is dependent upon the specific hydrocarbons present in the fuel and upon the pressure and temperature maintained within said chamber. I have found that by maintaining a temperature of approximately 120° F. at between 1 to 4 pounds pressure, excellent gas-liquid separation is obtained when using natural gasoline of from 26 to 40 pounds Reid vapor pressure. Provision for warming of the liquid fuel in the vaporizing chamber is made in the form of the hot water coil 9. Hot water from the motor cooling system, not shown, passes through line 11, into the above-mentioned coil 9, through tube 12 and reenters the cooling system. The rate of flow of the heating water through the coil is thermostatically controlled by the action of the temperature bulb or thermoregulator 10 and control valve 13 in said hot water line.

The separated vapor from the vaporizing chamber 1 passes downwardly through tube 14 into vapor compartment 15, the pressure being essentially the same in these two compartments. The diaphragm 6 serves as the bottom of the vaporizing chamber 1 and the top of the vapor compartment 15, and since the gas pressures in these two chambers are essentially equal, the operating force on said diaphragm is the mass of the accumulated liquid fuel as modified by the active tension in the tension spring 7. Thus when the weight of the residual liquid reaches a certain predetermined value, the said diaphragm closes valve 5 which in turn closes off the flow of liquid fuel into the carburetor. The spring 7 is so adjusted that the valve 5 remains closed during the presence of a preponderance of liquid fuel in the vaporizing chamber and until at least a small portion of the residual liquid fuel has passed through tube 29 to float chamber 30, thereby lessening the weight of liquid upon the diaphragm and causing valve 5 to open admitting more fuel to the vaporizing chamber. In ordinary operation due to the normal sensitivity of the diaphragm and adjusting spring, the level of liquid remains essentially constant or varies only within very narrow limits while valve 5 remains partially open depending on the rate of fuel consumption. When the gas pressure in gas feed chamber 19 becomes less than atmospheric as occasioned by the suction of gas from chamber 19 through tube 39 and gas carbureting jet 41 into venturi 37, the diaphragm 18 rises thereby opening the gas metering valve 16 allowing gas to pass through valve opening 17 into gas feed chamber 19 in accordance with the demand. In gas feed tubing 39 is inserted a valve 40 for the restriction or control of gas flow. When valve 16 is open, the gas pressure in chamber 19 and in tube 39 tends to build up due to the presence of the restricting valve 40 and when the pressure becomes greater than atmospheric the diaphragm 18 acts to close valve 16, thereby shutting off the gas flow. In actual operation when the amount of gas issuing from gas carbureting jet 41 is constant, a pressure equilibrium results which holds the metering valve 16 open an amount necessary to furnish the proper flow of gas.

The vapor-free residual liquid fuel from the bottom of the vaporizing chamber 1 passes through gasoline feed line 29 to the float chamber 30 under the 1 to 4 pounds pressure heretofore mentioned. When this liquid reaches a certain predetermined level in the float chamber, the float 31 rises and the attached valve 53 closes off the flow of liquid from fuel line 29. A liquid carbureting jet 38 extends from the bottom of the said float chamber 30 through the wall of the venturi 36 on the liquid side of the dual carburetor.

The diaphragm throttle regulating device 24 being connected to the top of vaporizing chamber 1 proportions the amount of residual liquid and separated gas entering the throttle valve portion 32 of the dual carburetor so that these two fractions of fuel may be used in the same ratio in which they are present in the original fuel. This regulating device operates by pressure variations communicated from the vaporizing chamber 1 through tube 23. When the pressure in chamber 1 increases, diaphragm 26 within housing 25, moves from left to right according to the drawing, and this movement increases the tension on tension spring 27, and is transmitted through push pin 28 to move lever 42 from left to right. Slotted lever 42 may move in the above given direction until pivot 47 is directly under fulcrum pin 44, then upon downward movement of the manual throttle control 43, pivot 48 and arm 46 move downward, thereby opening butterfly throttle valve 50. When this gas-side throttle valve is open, air from inlet 33 passes through the gas side 35 and the corresponding venturi 37 and the vacuum set up at the gas jet 41 communicates backward through tube 39, valve 40 and through tube 39 extended and tends to evacuate the gas feed chamber 19 in the lower part of the vapor-liquid separator 1. This pressure drop causes

diaphragm 18 to open the gase metering valve 16 which permits the separated gas to flow from the vapor containing portion of the vaporizing chamber 1 into the vapor compartment 15, through valve 16 and into vapor feed chamber 19, thence through tube 39, valve 40, jet 41 and into the air stream. This operation continues until the gas pressure in vaporizing chamber 1 drops to a predetermined value during which time metering valve 16 remains open permitting continued gas flow, and at the time of said pressure drop, regulator 24 functions to move diaphragm 26 from right to left, which movement is communicated by push pin 28 to slotted lever 42 causing the latter to move from right to left until pivot 48 is directly under fulcrum pin 44 or at some intermediate point. All during this operation, the manual throttle control 43 remains open, that is control 43 is held depressed. When slotted lever 42 moves from right to left, pivot 47 and arm 45 move upward while pivot 48 and arm 46 likewise move upward, thereby opening butterfly throttle valve 49 and permitting more inlet air to pass through the liquid side 34 of the dual carburetor and closing valve 50. As inlet air passes through this section of the carburetor, and thrugh venturi 36, vacuum or suction is communicated through jet 38 which action draws residual vapor-free liquid fuel through said jet 38 into contact with the flowing air for mixing and passage through the outlet end of the dual carburetor 51 and into the intake manifold, not shown. Upon continued consumption of residual liquid fuel the liquid level in float chamber 30 drops until float 31 causes valve 53 to open, thereby permitting vapor-free residual liquid to flow from the vaporizing chamber 1 into the float chamber 30. This liquid continues to flow in this direction as long as float valve 53 remains open. If during this flow the liquid in vaporizing chamber 1 becomes lowered to a predetermined level or what amounts to the same thing, the weight of the residual liquid is lessened to a predetermined amount, diaphragm 6 opens the fuel valve 5, thus permitting raw fuel to flow from the pressure storage tank, not shown, through the pressure regulator 3 into the vaporizing chamber 1, thereby increasing the weight of liquid on the said diaphragm and valve 5 closes. Upon the addition of this raw fuel to the vaporizing chamber, vaporization occurs thereby increasing the gas pressure within said chamber. This pressure increase acts through tube 23 on the throttle regulating apparatus 24 to move the push link from left to right to open the gas side butterfly valve 50 for consumption of the vapors evolved in said vaporizing chamber. The gas side of the carburetor functions as long as the gas pressure in the vaporizing chamber remains within a certain pressure range, say from 1 to 4 pounds per square inch, then when this pressure drops to less than 1 pound the tension spring 27 contracts pulling the diaphragm 26 and connected parts from right to left and feeding more liquid fuel to the carburetor. Thus when the mass of the residual liquid on diaphragm 6 is lessened to a predetermined value, valve 5 opens wider permitting more raw fuel to enter the vaporizing chamber at which time the pressure in said chamber increases to open up the gas side of the carburetor as heretofore explained.

When the motor is operating at a constant load and at constant speed, the operation of the carburetor reaches a state of equilibrium in which raw liquid fuel enters the vaporizing chamber 1 in a small but essentially continuous flow through valve 5, the slight gas pressure increase in said chamber 1 holds diaphragm 26 in such a position that the push link 42 is held at an intermediate position allowing both throttle valves 49 and 50 to be partially opened, thereby permitting consumption of residual gas-free liquid and separated gas in the same proportion in which they occur in the original high vapor pressure fuel. The tension spring 20 is so adjusted that the diaphragm 18 plays its part in maintaining the operating equilibrium under the above mentioned conditions.

During periods of acceleration when the manually controlled throttle is opened, the separated gas may be consumed more rapidly in proportion than the residual liquid fuel and the valve 5 is so arranged, as explained heretofore, that the flow of original fuel through line 4 into the vaporizing chamber is controlled solely by the mass of residual gasoline on the diaphragm 6 and not by the pressure of the liberated vapor or gas in the upper portion of the said vaporizing chamber.

The pressure of the liberated gas or vapor in the vaporizing chamber controls the relative position of link 42 so that under certain conditions only separated gas will be carbureted, while under other conditions only residual gas-free liquid fuel will be carbureted, and under still other conditions both the separated gas and the residual liquid are carbureted simultaneously, the overall separate and individual carburetion of said gas and said liquid being in the ratio in which these components are present in the original liquid fuel.

For idling of the motor, there may be sufficient air leakage through the butterfly valves to draw sufficient fuel or definite provision may be made. In this latter case, tube 55 connects the carbureting portion of the carburetor at a point on the downstream side of the throttle valves 49 and 50 to the float chamber 30 for liquid fuel idling and to the top of the vaporizing chamber 1 for gaseous fuel idling. In either case an adjustment valve 56 is provided in tube 55.

The thermoregulator 10 and valve 13 which control the flow of warm water from the engine's cooling system are set to maintain the temperature of the liquid fuel in the vaporizing chamber such that the proper amount of high vapor pressure hydrocarbons will be vaporized therefrom. Such an amount of said high vapor pressure hydrocarbons should be removed from the liquid so that there will not be a tendency of the residual liquid to form vapor in tubes and chambers in which there should only be liquid fuel, or in other words the vapor pressure of the liquid fuel should be so reduced that there will be no tendency to form vapor lock. While the temperature of the liquid fuel in this vaporizing chamber may be varied within not too wide limits, some variation is permissible. I have found that under normal operating conditions a vaporizing chamber temperature of 120° F. gives excellent operation when using a natural gasoline of 26 to 40 pounds Reid vapor pressure. When using fuel of higher vapor pressure, the vaporizing chamber temperature may be lower than 120° F. and for lower vapor pressures the temperature should be somewhat higher. By controlling the pressure and temperature in the vaporizer, I can obtain the volatility characteristic desired in the residual liquid fuel.

The gas metering valve 18 is so constructed that there will be essentially no gas leakage therethrough when the valve is in a seated or closed position. To assist in preventing gas leakage, the valve may be faced with such hydrocarbon insoluble material as synthetic rubber, fiber or other swellproof material, the face being identified by numeral 54 in the drawing.

While one embodiment of my dual carburetor has been described in detail, it is obvious to those skilled in the art that many changes and alterations of the component parts may be made and yet remain within the intended scope of my invention.

I claim:

1. In a carburetion system for internal combustion engines adapted for handling higher than normal vapor pressure fuel, including a vaporization chamber normally containing a body of liquid and a volume of gaseous fuel, a dual branched carburetor, each branch including a Venturi tube and fuel nozzle, a passage for liquid fuel leading from the vaporization chamber connected with one nozzle and a passage for gaseous fuel leading from the vaporization chamber connected with the other nozzle, to induce liquid and gaseous fuel flow in accordance with air flow through said Venturi tubes, the improvement comprising a valve in each branch of the dual carburetor to control the air flow and thereby the relative fuel flow thereto, a fulcrum, a manually operable lever adjustable with respect to said fulcrum, arms pivoted to said lever on opposite sides of the fulcrum and operably connected with said valves and pressure responsive means for shifting the pivots toward and from the fulcrum to vary the position of the valves and thereby the relative proportions of liquid and gaseous fuel induced in the branches by air flow through the Venturi tubes.

2. In a carburetion system for internal combustion engines adapted for handling higher than normal vapor pressure fuel, including a vaporization chamber normally containing a body of liquid and a volume of gaseous fuel, a dual branched carburetor, each branch including a Venturi tube and fuel nozzle, a passage for liquid fuel leading from the vaporization chamber connected with one nozzle and a passage for gaseous fuel leading from the vaporization chamber connected with the other nozzle, to induce liquid and gaseous fuel flow in accordance with air flow through said Venturi tubes, the improvement comprising a valve in each branch of the dual carburetor to control the air flow and thereby the relative fuel flow thereto, a fulcrum, a manually operable member adjustable with respect to said fulcrum, means pivoted to said member on opposite sides of the fulcrum operably connected with said valves and means for shifting the pivots toward and from the fulcrum to vary the position of the valves and thereby the relative proportions of liquid and gaseous fuel induced in the branches by air flow through the Venturi tubes.

3. In a carburetion system for internal combustion engines adapted for handling higher than normal vapor pressure fuel, including a vaporization chamber normally containing a body of liquid and a volume of gaseous fuel, a dual branched carburetor, each branch including a Venturi tube and fuel nozzle, a passage for liquid fuel leading from the vaporization chamber connected with one nozzle and a passage for gaseous fuel leading from the vaporization chamber connected with the other nozzle, to induce liquid and gaseous fuel flow in accordance with air flow through said Venturi tubes, the improvement comprising a valve in each branch of the dual carburetor to control the air flow and thereby the relative fuel flow thereto, a fulcrum, a manually operable lever adjustable with respect to said fulcrum, arms pivoted to said lever on opposite sides of the fulcrum and operably connected with said valves and means responsive to pressure of the gaseous phase in the vaporization chamber for shifting the pivots toward and from the fulcrum to vary the position of the valves and thereby the relative proportions of liquid and gaseous fuel induced in the branches by air flow through the Venturi tubes.

4. In a throttling arrangement for an internal combustion engine carburetion system adapted for handling higher than normal vapor pressure fuel including means separating said fuel into liquid and gaseous phases, a dual branched carburetor, each branch including a Venturi tube and a fuel nozzle, a passage for liquid fuel leading from the separating means connected with one nozzle and a passage for gaseous fuel leading from the separating means connected with the other nozzle, to induce liquid and gaseous fuel flow in accordance with air flow through said Venturi tubes, the improvement comprising a valve in each branch of the dual carburetor to control the air flow and thereby the relative fuel flow thereto, a fulcrum, a manually operable lever adjustable with respect to said fulcrum, arms pivoted to said lever on opposite sides of the fulcrum and operably connected with said valves and means for shifting the pivots toward and from the fulcrum to vary the position of the valves and thereby the relative proportions of liquid and gaseous fuel induced in the branches by air flow through the Venturi tubes.

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