

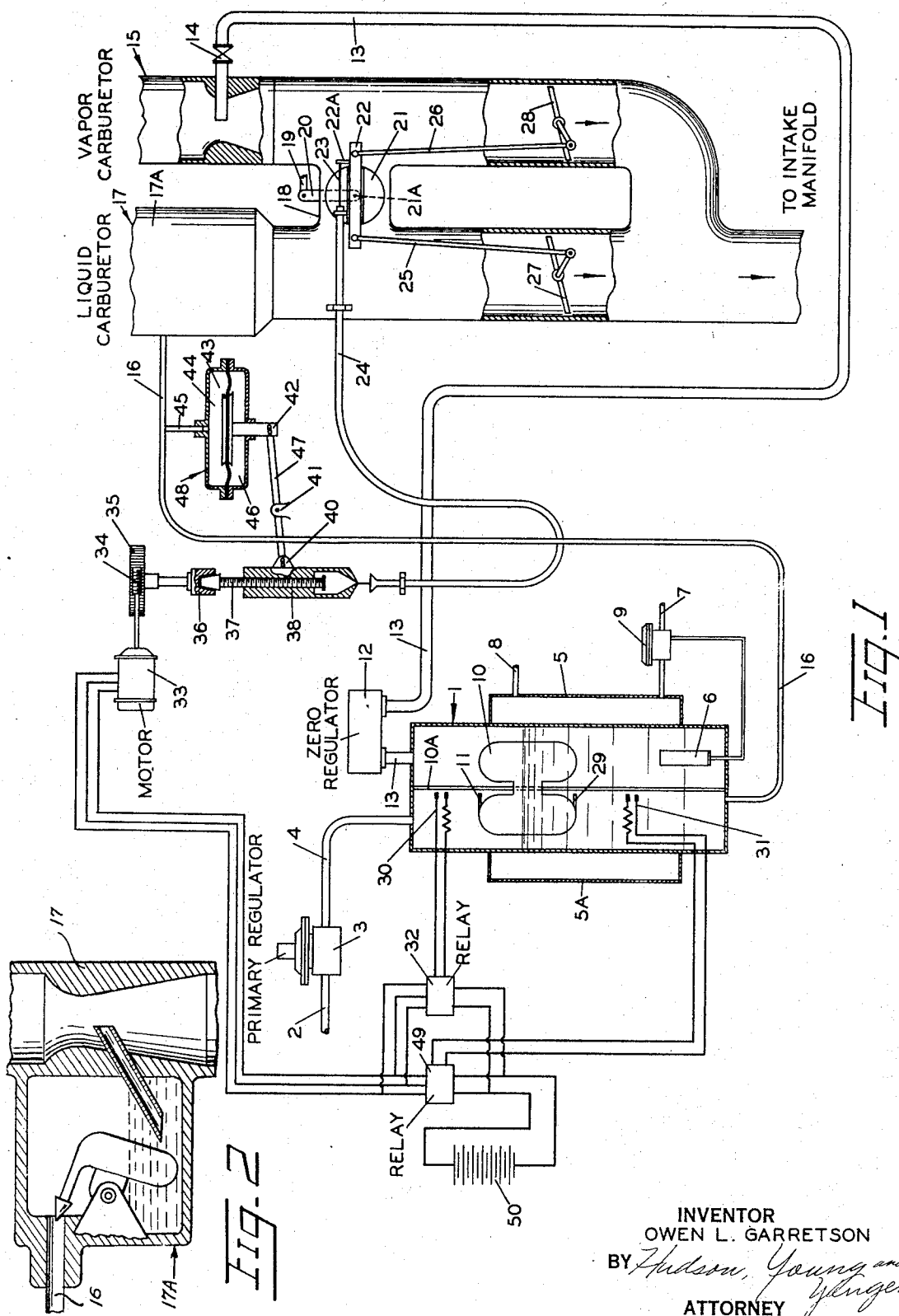
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CARBURETOR FOR HIGH PRESSURE FUELS

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CARBURETOR FOR HIGH-PRESSURE FUELS

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This invention relates to carburetors and more particularly it relates to a type of carburetor especially adapted for use of gasoline having vapor pressure higher than normal, in which the normally gaseous hydrocarbons are separated from the normally liquid hydrocarbons, and the two phases carbureted separately but in the same overall ratio as the ratio in which they separate from the high vapor pressure fuel, and the regulation of the relative liquid and gaseous phase flow to the engine being electrically controlled and operated.

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. The latter engines are equipped with special type carburetors for mixing the gas with air to form the combustible fuel mixture.

For each of these above-mentioned types of fuel, carburetors need operate only on one physical phase, that is all liquid or all gas.

I have devised a carbureting system which is designed to carburet a two phase fuel, that is, a fuel which is composed of liquid and normally gaseous hydrocarbons under pressure. Fuels of this class may be such as high vapor pressure natural gasoline or even liquefied petroleum gases or mixtures thereof. In my system the hydrocarbon fuel is separated into liquid fuel and gaseous fuel, and each is carbureted separately or together in various ratios, the overall carburetion of the gas and liquid however being in the same ratio. These fuel components, which separate at a given temperature and pressure, exist in the original fuel. The changes in carburetion from all gas to all liquid, or vice versa, or largely gas to largely liquid, say 75% gas-25% liquid to 75% liquid to 25% gas, or the reverse, are electrically controlled and operated.

An object of my invention is to devise a carburetion system and carbureting device for use with high vapor pressure hydrocarbon fuels.

A further object of my invention is to furnish a carburetion system in which the high vapor pressure fuel is separated into liquid fuel and gaseous fuel and each carbureted separately or simultaneously.

A still further object of my invention is to furnish a carburetion system for use with fuel con-

taining liquid hydrocarbons and gaseous hydrocarbons, the change in carburetion from liquid fuel to gaseous fuel, or from gaseous fuel to liquid fuel, or from predominantly liquid fuel to predominantly gaseous fuel, or the reverse, being controlled according to liquid levels in a phase separating chamber and electrically operated.

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

Figure 1 illustrates diagrammatically one embodiment of my invention showing the electrically controlled and operated carburetion system.

Figure 2 is a fragmentary section of the liquid carburetor 17 of Figure 1.

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 which may have a relatively high pressure is conducted from the fuel pressure tank, not shown, through line 2, a primary pressure regulator 3 whereby the fuel pressure may be reduced, for example from 20 lbs. per sq. in. to 0.5 lb. per sq. in. Reid vapor pressure, and line 4 into the vaporizing chamber 1. The vaporizing chamber 1 is equipped with a heating jacket 5 and thermoregulator 6. Heating fluid from the cooling system of an internal combustion engine enters jacket 5 through line 7 and exits through line 8, the flow being controlled by the control valve 9. The thermostatic valve 9 and regulator 6 are of a conventional type and control the temperature of the vaporization chamber. Float 10 is of a double kidney type and is guided during vertical movement by an oval guide bar 10A which passes through an oval slot in the connection between the two float sections. The float is provided with upper and lower contact members 11 and 29, respectively. The fuel vapor from the vaporizing chamber passes through a zero regulator 12, gas line 13, control valve 14 and into the gas carburetor 15. The zero pressure regulator is of a conventional type and is adjusted to close at atmospheric pressure thereby preventing loss of vapor fractions at standstill. Slight vacuum, however, induced in the gas carburetor venturi causes gas to flow through the zero regulator reducing the pressure from 0.5 lb. per sq. in. to substantially atmospheric. The liquid fuel from said vaporizing chamber passes through the liquid fuel line 16 to the float

chamber 17A of a conventional liquid type carburetor shown generally at 17.

A solid connection 18 is formed between the gaseous and liquid intake tubes to provide a support for the throttle linkage to be hereinafter described. Rod 19 from foot throttle, not shown, is attached by means of arm 20 to disc 21 which is pivoted at 21A to the side of connection 18. Control link 22, bevelled longitudinally, is adapted to slide in a correspondingly shaped channel in the disk 21. To either end of slide link 22 is attached throttle valve rods 25 and 26, the valve rod 25 operating butterfly throttle valve 27 and valve rod 26 operating the butterfly throttle valve 28.

Electrical switch 30, positioned in the vapor or gas accumulation portion of vaporizing chamber 1 in any suitable manner operates through relay 32 to cause the armature of the reversible electric motor 33 to rotate. To this armature is attached a worm gear 34 which in turn meshes with gear wheel 35 which upon rotation turns clutch arrangement 36. Supports for said gear wheel 35, clutch assembly 36 and turn screw 37 are obviously necessary mechanical parts but since they form no part of my invention, are omitted in the interest of clarity. Member 38 is provided with a threaded longitudinal passage which loosely receives the turn screw 37. The lower portion of member 38 is hollow and of sufficient cross section and length to permit some longitudinal travel of the head on the bottom of the turn screw 37. To the bottom of said member 38 is attached control wire 23. The other end of control wire 23 is attached to an arm 22A on slide link 22. The control wire slides through a Bowden sheath 24, held stationary relative to the disc 21. It is obvious that vertical movement of member 38 is communicated to control link 22, moving the same longitudinally in the aforementioned channel in disc 21. Thus the upper ends of rods 25, 26 are moved nearer to or farther from pivot point 21A, as the case may be, and the relative degree of opening of throttles 27, 28 for a given amount of rotation of disc 21 is varied in accordance with the displacement of member 22 from a central or symmetrical disposition relative to center 21A. When this displacement is to the left, for example, the movement of butterfly 27 for a given amount of disc rotation will be increased and that of butterfly 28 will be decreased proportionally.

A rod 41 is attached at one end to member 38 by pivot 40, supported by fulcrum 41, and the other end attached by a pivot to diaphragm pin 42 of a volume displacer 48. Volume displacer 48 is composed essentially of open air chamber 46, diaphragm 43, gasoline containing space 44 and line 45 connecting said space 44 to the liquid fuel line 16. Obviously the volume displacer could be located at any convenient point and connected directly to the vaporizer rather than to the liquid fuel line.

When float 10 is in the lower part of vaporizing chamber 1, the lower float contactor 29 causes the switch 31 to close and by means of relay switch 49 the armature of motor 33 rotates in the reverse direction from that when switch 30 is closed. Storage battery 50 furnishes electricity for the operation of the relays 32 and 49 as well as for the operation of the motor 33. The electrical circuit shown in the drawing is

purely diagrammatical, of course, and any suitable arrangement may be employed.

In the operation of my carburetion system, hydrocarbon fuel comprising natural gasoline, high vapor pressure natural gasoline containing substantial quantities of normally gaseous hydrocarbons dissolved therein, for example, 20 or 40 lb. Reid vapor pressure natural gasoline, flows from the fuel storage tank, not shown, under storage pressure through line 2, pressure reducer 3 and line 4 into the vaporizing chamber 1. The fuel at reduced pressure in vaporizer 1, e. g. 0.5 to 2 lbs. per sq. in., 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 from 100° to 120° F. at essentially atmospheric pressure or slightly above, excellent gas-liquid separation is obtained when using natural gasoline of from 20 to 40 pounds Reid vapor pressure. The pressure in the vaporization chamber remains substantially constant under normal conditions. Provision for warming of the liquid fuel in the vaporizing chamber to accelerate the gas evolution is made in the form of the water jacket 5. Hot water from the engine cooling system, not shown, enters the jacket through tube 7 and leaves through tube 8, the flow being controlled by the temperature bulb or thermoregulator 6 and control valve 9 in said incoming hot water line 7.

The separated vapor accumulates in the upper portion of the vaporizing chamber 1 and said vapor or gas passes therefrom by way of tube 13 to the vapor or gas section 15 of the dual carburetor. The zero regulator 12 controls or maintains the desired pressure in the vaporizing chamber while at all times permitting gas to flow from said chamber to the vapor carburetor 15. Control valve 14 is inserted in the gas line 13 at a point near said vapor carburetor to prevent vacuum or suction from the carburetor jet, not shown, from backing up said vapor line, and to adjust the flow of vapor to correspond to the air flow that will pass through the vapor carburetor venturi.

The liquid hydrocarbon fuel from the bottom of vaporizing chamber 1 passes through tube or pipe 16 into the float chamber 17A of the liquid carburetor 17.

When liquid fuel from the pressure storage tank, not shown, passes by way of pressure reducer 3 and line 4 into the vaporizing chamber 1, the liquid level in said vaporizing chamber rises in case the separated vapor is being withdrawn and carbureted more rapidly than the residual gas-free liquid. Upon the continued rise in liquid level, the float 10 rises to such a point that the upper contactor 11 closes the upper switch 30 completing an electrical circuit to the relay 32. This said relay operates to cause the armature of the electric motor to rotate in a clockwise direction causing internally threaded member 38 of the cable assembly to rise communicating movement to cable 23 and moving slide link 22 from right to left, i. e., from the gas carburetor 15 toward the liquid carburetor 17. Assuming that previous to this slide link movement, said slide link was in an intermediate position, the above mentioned movement then causes the slide link to move toward liquid

carburetor side, then upon operation of the manual foot throttle, not shown, through the throttle rod 19 and associated parts, the butterfly valve 27 opens permitting air and liquid gasoline vapors from the liquid carburetor to pass into the intake manifold and thence into the engine. As long as the said float 10 and upper contactor 11 cause switch 30 to remain closed, the motor 33 operates to cause prolonged travel of said slide link 22 from its previously assumed center position toward the liquid carburetor side, thereby causing butterfly valve 27 to open wider for a definite position of the foot throttle (not shown)—throttle rod 19, arm 20, and disc 21 assembly. At idling speed the link may travel to its extreme position until the pivot point for arm 26 coincides with the disc pivot 21A. When this occurs the gas throttle remains fully closed. To prevent prolonged operation of the motor 33 in either direction, with the resultant full use of liquid fuel to the exclusion of all gaseous fuel and vice versa, the volume displacer apparatus 48 is attached to the liquid fuel line 16 somewhere along its length or connected directly to the vaporizer. This volume displacer is composed of a diaphragm 43, atmospheric air space 46 and liquid fuel space 44. To the diaphragm 43 is attached diaphragm pin 42, as shown, and this pin is pivoted to one end of rod 47, the other end of said rod being pivoted to the internally threaded member 38, at pivot 40. Said rod is pivoted to fulcrum 41 to permit unobstructed movement.

During periods of idling or low speed when fuel is not being consumed at a rapid rate, the liquid level in the vaporizing chamber will very slowly fall or very slowly rise, dependent upon the given position of the slide link 22. Assuming that the said slide link is on the gas carburetor side and the liquid level slowly rises until the float connector 11 closes switch 30 to start the motor 33. The closing of this upper switch 30 starts the said motor in a clockwise direction rotating the clutch 36 and turn screw 37, the internally threaded member 38 rises thereby pulling cable 23, causing the slide link to move from the gas carburetor side toward the liquid carburetor side. This movement tends to diminish the rate of carburetion of gas and to increase the rate of carburetion of liquid fuel, thereby decreasing the rate of liquid fuel rise in the vaporizing chamber. But during periods of slow speed or idling, the liquid level change is very slow resulting in relatively long periods of electric motor 33 operation. A long period of electric motor operation in the above direction will cause the slide link to travel its limit toward the liquid carbureting side with the result that gas or vapor carburetion will cease in favor of all liquid carburetion. When this change becomes effective, then the liquid level in the vaporizing chamber begins to drop and the drop continues until the lower float connector 29 causes switch 31 to complete the electrical circuit through relay 49 resulting in the operation of the electric motor 33 in the reverse direction from that caused by throwing off the upper switch 30 and relay 32. The electric motor then causes the slide link to move from left to right or from the liquid side to the vapor side of the dual carburetor, resulting then in the carburetion of proportionally more gas than liquid. In case the liquid level remains at a sufficiently low mark in said vaporizer for an extended period

of time, the electric motor 33 continues to operate resulting in the movement of the slide link 22 all the way over to the right on the gas side so that only vapor or gas is carbureted. This condition then removes vapor alone from the vaporizing chamber 1 allowing the liquid to remain therein, causing therefore the liquid level to rise until the upper contactor closes switch 30 causing slide link 22 to move to the liquid side, as above described.

Summing these above described steps, one may conclude that if switch 30 and switch 31 remain closed for relatively long periods of time the slide link 22 will always travel its limit and either all gas or all liquid will be carbureted. The liquid level will alternately rise and fall. While this condition permits satisfactory operation it is not especially desirable because of the different octane characteristics of the liquid and gaseous phases which result in inconsistent operation. The ideal condition, therefore, is where the fractions of the fuel are carbureted simultaneously and in the ratio of their separation. This latter condition is realized by use of the volume displacer assembly 48, as follows:

During light load on idling operation, as above described, when the upper float contactor 11 closes and holds closed switch 30 for an extended period of time causing the slide link to change over to all liquid carburetion the electric motor 33 in addition to operating said slide link 22, also moves rod 47. When slide link 22 is moving toward the liquid side the rod 47 moves in such a manner as to pull diaphragm 43 downward thereby causing liquid fuel from line 16 to accumulate in volume space 44. When liquid fuel flows into this space or chamber 44, the liquid level in the vaporizing chamber is caused to drop more rapidly than if the volume displacer assembly were not functioning. As soon as space 44 contains sufficient volume of liquid in relation to the liquid level in vaporizer 1, the level in said vaporizer drops sufficiently to open switch 30 thereby stopping the electric motor 33 before the slide link 22 has travelled its limit toward 100% liquid carburetion. This step may take place rather rapidly, in fact so rapidly that the slide link 22 may not have moved a sufficient distance to give simultaneous and stable liquid and gas carburetion, in which case as soon as the diaphragm 43 stops its downward movement, the liquid level in vaporizer 1 begins to rise again until switch 30 closes to operate motor 33 in the same direction as before and to move slide link 22 further toward the liquid side. When this movement begins, the diaphragm 43 also moves further downward taking in liquid fuel and causing the liquid level in vaporizer 1 to drop again to open the switch 30. This intermittent automatic operation continues until a balance is obtained and the liquid and gas fractions are carbureted at approximately equivalent rates and the liquid level in vaporizer 1 then remains essentially fixed.

In case fuel consumption is more rapid than in the above example, the periods of operation of motor 33 will be shortened as well as the number of operating periods and adjustments of slide link 22 until equilibrium conditions are reached and the two fractions of fuel are carbureted in the ratio of their separation.

In case of full load or nearly full engine operation, the periods in which switch 30 is closed

are such that the electric motor will be energized only a few seconds at a time.

When the liquid level in the vaporizing chamber 1 is low and the lower float contactor closes switch 31, steps the reverse to those above described, take place. The electric motor turns in the opposite or counterclockwise direction causing slide link 22 to move from the liquid side to the gas side. At the same time diaphragm 43 moves upward to displace liquid fuel from the space 44 into the liquid fuel line 16. This displaced liquid causes a rise in liquid level in the vaporizing chamber which rise is sufficient to cause float 10 to rise and permit opening of the electric switch 31. In case the liquid level still is being lowered, switch 31 again closes causing slide link 22 to move farther toward the gas side of the dual carburetor, and this operation so continues until the control link 22 has reached an intermediate position permitting liquid and gas to be carbureted in the ratio in which they separate. Then following this adjustment the liquid level in the separating or vaporizing chamber remains essentially constant until operating conditions change in such a manner as to necessitate a recharge to establish new equilibrium conditions.

When the liquid level is low in chamber 1 and the engine is operating under full load with a high rate of fuel consumption, the periods of operation of the electric motor for changing from mostly liquid to mostly gas carburetion are very short and ordinarily fewer in number than during periods of idling to reach an equilibrium condition in which liquid and gas fractions are carbureted in approximately the same ratio in which they separate.

There are then two conditions of equilibrium within the vaporizing chamber 1, that is two conditions in which vapor and liquid fractions are carbureted in the same ratio in which they are separated from the original fuel. The first condition results when the vaporizing chamber 1 is essentially full of liquid and the float 10 operating through the upper contactor 11, switch 30 and motor 33 positions the control link that the separated gas and residual liquid hydrocarbons are carbureted in such relative amounts that the liquid level in the chamber 1 remains essentially constant. The second equilibrium condition results when the liquid level is low in the chamber 1 and the float 10 operates in conjunction with lower contactor 29, switch 31, motor 33, slide link 22 and connecting parts to cause the separated gas and residual liquid hydrocarbons to be carbureted in the ratio of their separation. Thus essentially these two conditions are similar, the only practical difference being that in one case the liquid level in the vaporizing chamber 1 is high and in the other case the liquid level is low. Which of these two conditions is present and in operation is dependent upon previous conditions, that is, when the slide link 22 permits mostly gas to be carbureted, the liquid level in vaporizing chamber will be rising and the resultant condition of equilibrium will occur at the high level. Whereas if the slide link 22 has been permitting mostly liquid hydrocarbons to be carbureted, then the equilibrium following will occur at a low liquid level in the said vaporizing chamber.

In my carburetion system, as above fully described, one may use as fuel natural gasoline, high vapor pressure natural gasoline, high vapor pressure refinery gasoline, liquefied petroleum gases, mixtures of natural gasoline and/or re-

finery gasoline with normally gaseous hydrocarbons under pressure.

The electric switches 30 and 31 may be of conventional design, the essential prerequisite being that they operate easily and in a hydrocarbon gas or liquid atmosphere. However, these switching arrangements may be such that mechanical devices within the vaporizing chamber 1 actuated by float 10 and the corresponding connectors 11 and 29, extend through the chamber walls and actuate switches mounted on the exterior of said vaporizing chamber. The switches, too, must be explosion proof.

The rod member 47 connecting threaded member 38 and diaphragm pin 42 is shown in its simplest form, and may be used as shown or may be modified or replaced by another apparatus as long as the vertical movements of member 38 are transmitted to the diaphragm pin 42, so that both members may move freely and unobstructed. One simple method of accomplishing this result is that the pivot holes in members 38 and 42 may be horizontal slots in place of circular holes, so that the movement of the rod 47 around the fulcrum 41 as a center will not cause horizontal movement in members 38 and 42 allowing these members free, unobstructed vertical movements in normal operation.

The clutch 36 is shown in my apparatus for the protection of the diaphragm 43 and slide link 22. In case of prolonged periods of operation of electric motor 33, when slide link 22 reaches either end of its travel, the clutch 36 slips thereby protecting slide link 22 and diaphragm 43 from forced movements, beyond normal limits as well as avoiding undue strain on the motor. Other means of accomplishing the same results may be used since this feature of the apparatus is not a part of my invention.

In addition, to simplify the figure, supports for the electric motor-clutch-volume displacer assembly, are not shown. Supports for these and other members of my apparatus may be of conventional design and should be such that they may be adaptable for use with any or all engines, stationary or automotive.

The liquid fuel and gaseous fuel carburetors for use with my control apparatus, can be of conventional design, and it is not necessary to use carburetors of special or uncommon manufacture.

While one embodiment of my control system has been described in detail, it will be obvious to those skilled in the art that many changes and alterations of the component parts as to specific design and selection of materials of construction may be made and yet remain within the intended scope of my invention.

I claim:

1. In a charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components including a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, a valve in each of the intake tubes to control the air flow and thereby the fuel flow therethrough, said valves being so connected that when one valve is moved toward closed position, the other valve is moved toward open position to thus vary the relative proportion of fuel flow induced by air flow through the respective

carbureting means, the improvement comprising electrical motive power means operably connected with said valves, said electrical motive power means being reversible to vary the relative valve position and thereby the relative proportion of liquid to gaseous fuel flow induced by said carbureting means, an electrical circuit for said motive power means, and means connected in said circuit and associated with the vaporizing chamber for controlling the energization of the electrical motive power means, said means being actuated by an increase in the accumulated volume of liquid fuel in the vaporizing chamber to energize the electrical motive power means to move the valve controlling the induction of liquid fuel toward open position and the valve controlling the induction of gaseous fuel toward closed position and by a decrease in the accumulated volume of liquid fuel to energize the electrical motive power means to move said valves in the reverse direction.

2. In a charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components including a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, a valve in each of the intake tubes to control the air flow and thereby the fuel flow therethrough, said valves being so connected that when one valve is moved toward closed position, the other valve is moved toward open position to thus vary the relative proportion of fuel flow induced by air flow through the respective carbureting means, the improvement comprising electrical motive power means operably connected with said valves, said electrical motive power means being reversible to vary the relative valve position and thereby the relative proportion of liquid to gaseous fuel flow induced by said carbureting means, means controlling the temperature of vaporization, an electrical circuit for said motive power means, and means connected in said circuit and associated with the vaporizing chamber for controlling the energization of the electrical motive power means, said means being actuated by an increase in the accumulated volume of liquid fuel in the vaporizing chamber to energize the electrical motive power means to move the valve controlling the induction of liquid fuel toward open position and the valve controlling the induction of gaseous fuel toward closed position and by a decrease in the accumulated volume of liquid fuel to energize the electrical motive power means to move said valves in the reverse direction.

3. In a charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components including a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, a valve in each of the intake tubes to control the air flow and thereby the fuel flow therethrough, said valves being so connected that when one valve is moved toward closed position, the other valve is moved toward open position to thus vary the relative proportion of fuel flow induced by air flow through the respective car-

5 carbureting means, the improvement comprising electrical motive power means operably connected with said valves, said electrical motive power means being reversible to vary the relative valve position and thereby the relative proportion of liquid to gaseous fuel flow induced by said carbureting means, means controlling the temperature of vaporization, an electrical circuit for said motive power means, a float in said vaporization chamber having contact means thereon, an electrical switch in the vaporization chamber above the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on an increase in the accumulated volume of liquid fuel to energize the electrical motive power means to move the valve controlling the induction of liquid fuel toward open position and the valve controlling the induction of gaseous fuel toward closed position, and an electrical switch in the vaporization chamber below the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on a decrease in the accumulated volume of liquid fuel to energize the electrical motive power means to move said valves in the reverse direction.

4. In a charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components including a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, a valve in each of the intake tubes to control the air flow and thereby the fuel flow therethrough, said valves being so connected that when one valve is moved toward closed position, the other valve is moved toward open position to thus vary the relative proportion of fuel flow induced by air flow through the respective carbureting means, the improvement comprising electrical motive power means operably connected with said valves, said electrical motive power means being reversible to vary the relative valve position and thereby the relative proportion of liquid to gaseous fuel flow induced by said carbureting means, means controlling the temperature of vaporization, an electrical circuit for said motive power means, a relay connected into the electrical circuit, means maintaining a constant pressure in the vaporization chamber, a float in said vaporization chamber having contact means thereon, an electrical switch in the vaporization chamber above the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on an increase in the accumulated volume of liquid fuel to energize the electrical motive power means to move the valve controlling the induction of liquid fuel toward open position and the valve controlling the induction of gaseous fuel toward closed position, and an electrical switch in the vaporization chamber below the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on a decrease in the accumulated volume of liquid fuel to energize the electrical motive power means to move said valves in the reverse direction.

5. In a charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components including a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for

the liquid fuel and carbureting means for the gaseous fuel, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, a valve in each of the intake tubes to control the air flow and thereby the fuel flow therethrough, said valves being so connected that when one valve is moved toward closed position, the other valve is moved toward open position to thus vary the relative proportion of fuel flow induced by air flow through the respective carbureting means, the improvement comprising electrical motive power means operably connected with said valves, said electrical motive power means being reversible to vary the relative valve position and thereby the relative proportion of liquid to gaseous fuel flow induced by said carbureting means, means controlling the temperature of vaporization, an electrical circuit for said motive power means, a float in said vaporization chamber having contact means thereon, an electrical switch in the vaporization chamber above the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on an increase in the accumulated volume of liquid fuel to energize the electrical motive power means to move the valve controlling the induction of liquid fuel toward open position and the valve controlling the induction of gaseous fuel toward closed position, an electrical switch in the vaporization chamber below the level of accumulated liquid fuel connected in the electrical circuit and actuated by said contact means on a decrease in the accumulated volume of liquid fuel to energize the electrical motive power means to move said valves in the reverse direction and a volume displacer associated with said electrical motive power means and actuated thereby to vary the volume of accumulated liquid fuel in the vaporizing chamber and tend to maintain a substantially constant liquid level therein.

6. A charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components comprising a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel connected with the vaporizing chamber, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting

means, means in said fuel-air intake tubes for proportioning the relative air-flow therethrough and hence the relative proportions of liquid and gaseous fuel flow induced to said carbureting means, electrical motive power means operably connected with the proportioning means, said electrical motive power means being reversible to vary said proportioning means and thereby the relative quantities of liquid to gaseous fuel induced in said carbureting means, an electrical circuit for said motive power means and means connected in said circuit and associated with the vaporizing chamber for controlling the energization of the electrical motive power means to vary said proportioning means and hence the relative induction of said liquid and gaseous fuels in accordance with the volume of liquid fuel accumulated in the vaporizing chamber.

7. A charge-forming device for vaporizing and carbureting fuels containing superatmospheric vapor pressure components comprising a vaporizing chamber for separating the fuel into liquid and gaseous fuels, carbureting means for the liquid fuel and carbureting means for the gaseous fuel connected with the vaporizing chamber, a fuel-air intake tube connected with the liquid carbureting means and a fuel-air intake tube connected with the gaseous carbureting means, means in said fuel-air intake tubes for proportioning the relative air-flow therethrough and hence the relative proportions of liquid and gaseous fuel flow induced to said carbureting means, electrical motive power means operably connected with the proportioning means, said electrical motive power means being reversible to vary said proportioning means and thereby the relative quantities of liquid to gaseous fuel induced in said carbureting means, an electrical circuit for said motive power means, means connected in said circuit and associated with the vaporizing chamber for controlling the energization of the electrical motive power means to vary said proportioning means and hence the relative induction of said liquid and gaseous fuels in accordance with the volume of liquid fuel accumulated in the vaporizing chamber, and a volume displacer associated with said electrical motive power means and actuated thereby to vary the volume of accumulated liquid fuel in the vaporizing chamber and tend to maintain a substantially constant liquid level therein.

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