Aug. 26, 1924. 1,506,229

O. H. ENSIGN

CARBURETOR

Filed Sept. 30, 1916 2 Sheets-Sheet 1

Fig. 1.

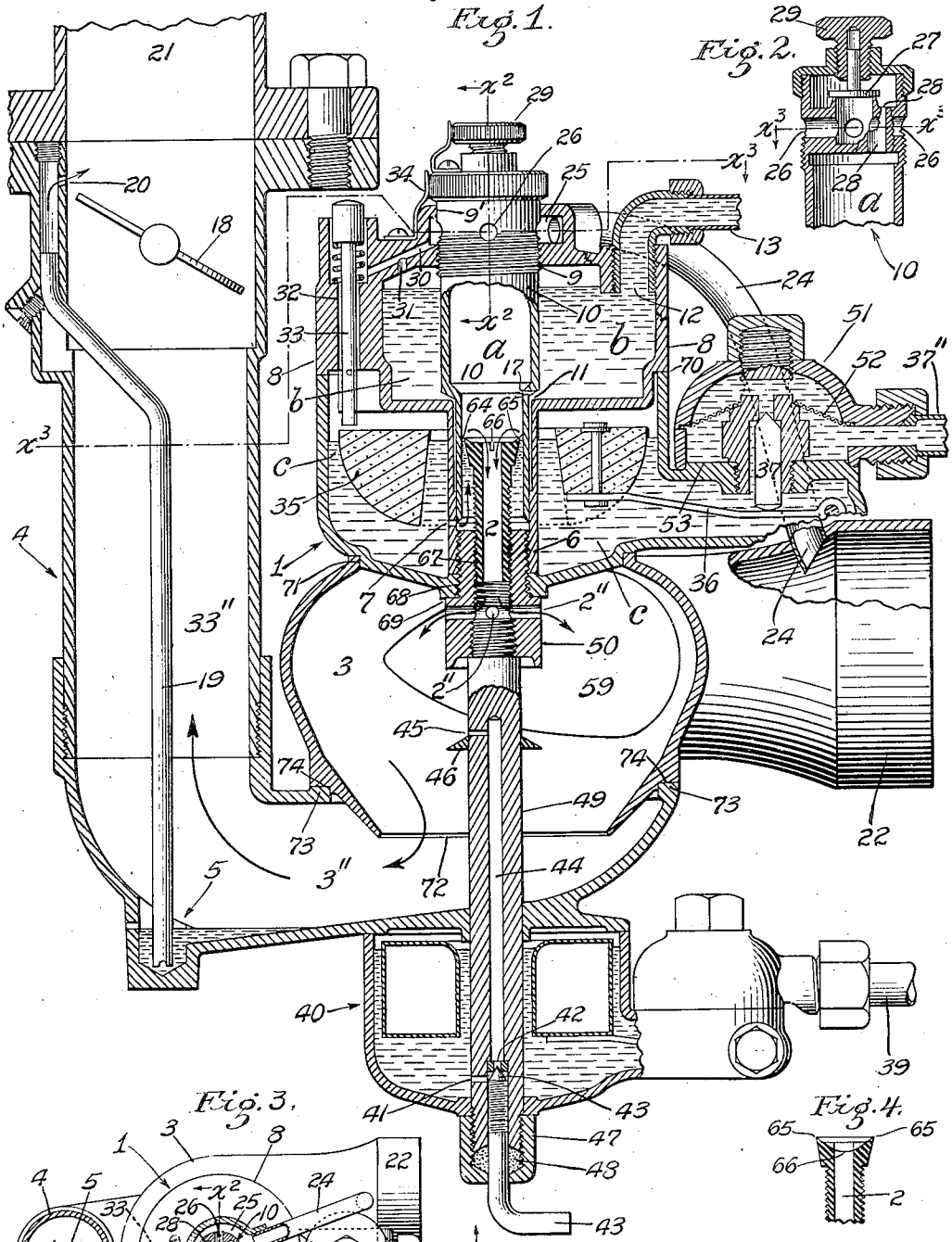


Fig. 2.

Fig. 3.

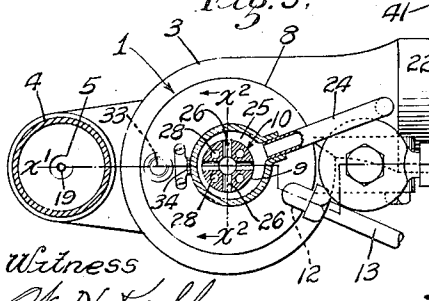


Fig. 4.

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Fig. 5.

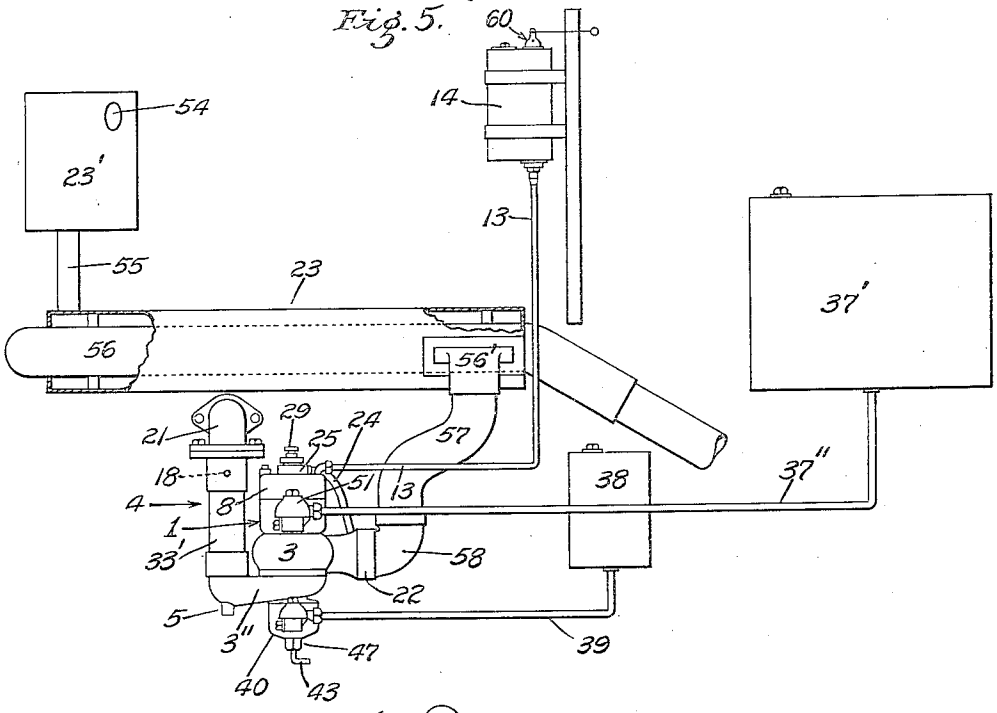
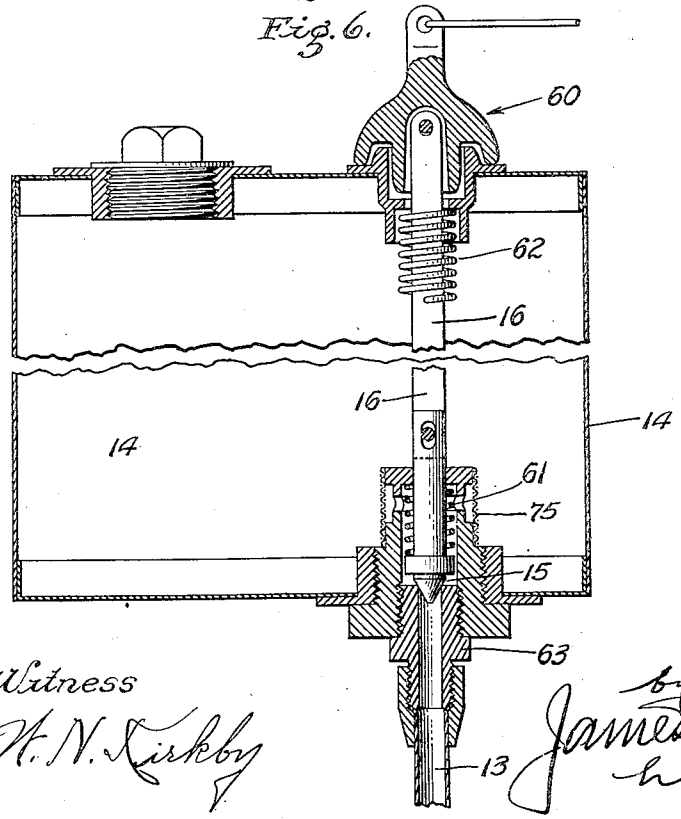


Fig. 6.



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Patented Aug. 26, 1924. 1,506,229

UNITED STATES PATENT OFFICE.

ORVILLE H. ENSIGN, OF PASADENA, CALIFORNIA.

CARBURETOR.

Application filed September 30, 1916. Serial No. 123,180.

To all whom it may concern:

Be it known that I, ORVILLE H. ENSIGN, a citizen of the United States, residing at Pasadena, in the county of Los Angeles and State of California, have discovered and invented a new and useful Carburetor, of which the following is a specification.

This invention relates more particularly to a carburetor using liquid fuels that are difficult to ignite when cold.

An object of the invention is to provide means whereby kerosene and other low gravity fuels as measured by Baumé scale, and also alcohol, may be satisfactorily used as fuel in internal combustion engines that are constructed and adapted for the economic use of gasolene and other high gravity fuels, Baumé scale.

In carrying out this invention I provide a carburetor adapted for the use of heavy liquid fuel, such for instance as kerosene, engine distillates, alcohol and the like.

Such fuels do not vaporize or ignite readily when the engine is cold, but work satisfactorily after the engine becomes hot provided heat therefrom or elsewhere is also applied to the carburetor.

A principle of this invention is the free introduction to the carburetor proportioning and mixing passages, of a limited quantity of freely igniting fuel, without other interference with the regular fuel supplying operations; so that no attention upon the part of the operator is required, after starting with the auxiliary fuel, to maintain the engine under economical operation with the heavy or other regular fuel that is difficult to ignite when cold.

An object is to bring about a convenient economical use of the light fuel employed in starting; and in this regard it is preferred to minimize the quantity of light fuel in the charge so as to meet only the lighter demands, such as prevail in normal or usual atmospheric conditions, and to depend upon repeated chargings where, under more difficult conditions, one charge is insufficient to put the engine into operation on the regular fuel.

The invention includes a carburetor comprising a float controlled main fuel chamber and a freely discharging auxiliary fuel chamber without float open to restricted gravity flow.

For convenience I shall illustrate the invention as applied in a carburetor of the type shown in certain of my patents and applications as follows: Vaporizer, No. 1,064,627, patented June 10, 1913; carburetor, No. 1,064,628, patented June 10, 1913; vaporizer, No. 1,108,727, patented August 25, 1914; carburetor, No. 1,223,159, patented April 17, 1917; and fuel adjusting means for internal combustion motors, No. 1,316,149, patented September 16, 1919.

Another object is to further perfect the operation of producing the mixture for the engine manifold.

It is important that the proportion of fuel to air in the mixture delivered to the engine shall be constant under all conditions of pressure under which air is supplied to the air intake of the carburetor, irrespective of the received air pressure. An object of this invention is to create and maintain such proportion. This type of carburetor is more particularly intended for heavy duty work where air cleaners are used with or without hot air stoves. Such air cleaners and stoves offer such a variable amount of frictional resistance to the flow of the air toward the carburetor under changing load; as to cause a marked variation of pressure in the air which enters the air intake of the carburetor.

A true carburetor is designed to work with its air intake freely open to the air and so that it will correctly proportion the mixture of air and fuel without any variation of air velocity passing through it. Air cleaners or stoves present frictional resistance which creates an irregular depression instead of depression due to air velocity alone, hence there is need to eliminate all such irregular depressions before the air reaches the fuel supply.

With the surface of fuel in the float chamber open to full atmospheric pressure, this variation in air pressure delivered to the carburetor would cause the proportion of fuel to air in the mixture to be very much greater at the heavier, and less at the lighter loads on the engine.

An object of this invention is, therefore, to equalize the pressure of the air upon the surface of the fuel in the float chamber with that of the air supplied to the air intake of the carburetor, by this means it is possible to maintain a constant proportion of fuel to air under all changes of load.

This is accomplished by a balancing system in the form of an air supply means consisting of a tube connecting the air intake with the air space above the fuel surface in the float chamber so that the pressure on the surface of the fuel in the float chamber is always equal to the pressure and velocity head of the air in the air intake.

The open end of the tube is presented to the incoming air in the air intake and picks up whatever air pressure arrives at that point and also receives by impact the pressure which creates the velocity of the flowing air; and these added pressures, viz. the pressure of the moving air in the air intake, and the pressure of the velocity head of such moving air in the intake, are applied to the surface of the fuel.

It is desirable that all of the air used to control the proportions of fuel and air in the mixture shall be under the same depression as that delivered to the air intake irrespective of the depression caused by the air cleaner or stove; therefore the balancing system must connect between the air intake of the carburetor and the surface of the fuel in the float chamber, and to the fuel jet; and such connection to the fuel jet is preferably arranged so that the amount of such air admitted to the fuel jet may be regulated; thereby furnishing means for adjusting the proportions of fuel to air throughout the range of the carburetor operation.

Another object of this invention is to cause this air flow from the balancing system when once properly adjusted to produce an ejecting action upon the fuel, delivering it into the main carburetor air stream at the high velocity of the air flowing from the balancing system into the depression caused by carburetor action; and thus when the mixed proportions are changed by adjusting the fuel orifice it does not effect the fuel velocity into the carburetor proper; or mixture proportion may be changed as desired by adjusting the quantity of air delivered to the fuel jet; adjusted variations in the quantity of air directed to flow with the fuel through the fuel jet will cause inverse variations in the quantity of fuel delivered per unit of time at any given engine load; while the velocity of the fuel delivered to the carburetor main air stream varies directly with the amount and the velocity of air which is adjusted to flow to the fuel jet.

Other objects, advantages and features of the invention may appear from the accompanying drawings, the subjoined detail description and appended claims.

The accompanying drawings illustrate the invention.

Figure 1 is an enlarged sectional elevation of the carburetor in Fig. 5, on irregular line x^1—x^1, Fig. 3.

Fig. 2 is a sectional elevation on line x^2, Figs. 1 and 3, showing construction at upper end of the adjusting tube.

Fig. 3 is a reduced plan partly in section on irregular line x^3—x^3, Fig. 1, also indicated in Fig. 2.

Fig. 4 is an axial section of the suction tube at right angles to Fig. 1.

Fig. 5 is a diagrammatic elevation of an assembly of the apparatus.

Fig. 6 is a fragmental sectional elevation of the gasoline priming tank on a larger scale than Fig. 5.

The main fuel chamber 1 is the usual float chamber for supplying the liquid fuel at a constant level to the suction tube 2 of the carburetor, whence it passes to the circular vortex chamber 3, and thence to the throttle tube 4, past the sump 5 where excessive fuel may accumulate to be sucked up when the throttle is partly closed.

The suction tube 2 is surrounded by orifice tube 6 that is provided with orifice 7 opening from below the liquid level of the float chamber 1. Orifice tube 6 forms a fuel well around the suction tube 2 over the top of which tube 2 the main or usual liquid fuel supply flows from tube 6. Said tube 6 is extended up above the level of the top of the suction tube 2, and is there connected to, and made to communicate with, the interior of a hollow cover 8 for the float chamber 1. In other words the orifice tube 6 is cast integral with, and projects downwardly from said hollow cover 8. Said hollow cover forms an auxiliary chamber to temporarily contain a limited charge of auxiliary liquid fuel, and is provided in its top with a hole having a lower threaded rim 9 and an upper unthreaded rim 9′ through which the adjusting tube 10 is inserted. Said tube 10 fits to turn freely in the upper rim 9′, and is threaded into the lower rim 9 at the top of the auxiliary chamber 8 and is extended into the orifice tube 6 and may screw down onto a seat 11 in the floor of the auxiliary chamber 8, which forms a stop to limit the travel of the adjusting tube. The adjusting tube forms a suction chamber a above the top of suction tube 2.

The auxiliary chamber 8 is provided with an inlet 12 into which an auxiliary supply pipe 13 leads from a priming tank 14. Said pipe is provided with a normally closed valve 15 which may be opened by the operator through the medium of the rod 16, but which closes automatically so that by a pressure of the hand of the operator, a limited charge of liquid fuel will be admitted to chamber 8 from which it immediately flows through the constantly open outlet 17 constituting an auxiliary fuel orifice opening through the wall of the adjusting tube 10 at the bottom of auxiliary chamber 8. Said

chamber 8 is above the upper end of the fuel passage and said orifice is restricted to allow all the liquid fuel charge to flow from chamber 8 into the suction chamber *a* within a predetermined short time which is calculated or assumed to be best adapted to the object in view. In consequence of this construction and arrangement, whenever a charge of gasoline or other easily ignited liquid fuel is supplied to auxiliary chamber 8 it flows freely through the orifice 17 into the suction chamber *a* and finds its way to the mouth of the suction tube 2, and thence it may pass down through lateral outlet 2″ to the vortex mixing chamber 3 and finds its way to the sump 5, so that when the engine is started and the throttle butterfly valve 18 is slightly open, the vacuum formed above the throttle 18 may violently draw such liquid fuel through by-pass tube 19 violently delivering it as a mist through the starting jet-outlet 20 above said throttle into the engine manifold 21 along with the air passing through the carburetor and around the throttle.

The air inlet horn 22 is adapted to receive from a heater 23, heated air which may or may not have been cleansed. The air cleaner 23′ may be of any suitable construction.

To maintain operative air pressure on the liquid in chamber 8, an air balancing Pitot tube 24 leads from the air inlet horn to an air chamber 25 surrounding the adjusting tube and formed in the top of chamber 8 between the plain upper and the threaded lower rims 9, 9′. Said tube 24 communicates through said chamber 25 with air flow adjusting means comprising port 26, valve 27 and vertical passage 28 which opens into the suction chamber *a*.

Holes to form port 26 and holes to form the passage 28 may be employed in singular or in plurality within the judgment of the constructor.

A screw 29 limits the lift of the valve 27 under the suction of vortex chamber 3 thus controlling the suction on orifices 7 and 17.

Chamber 25 communicates air pressure by way of passages 30, 31, to the surface of the auxiliary liquid fuel *b* in the auxiliary chamber 8.

Passage 30 further communicates air pressure through a passage 32 formed around the priming rod 33, to the surface of liquid fuel *c* in the main chamber 1, thus supplying to the suction chamber *a* a heated supply, and to the surfaces of the two liquid fuels, a static pressure corresponding to that of the air entering the mixing chamber through the medium of the air horn 22, thus eliminating the effect of friction on the mixture at various speeds and loads through the heater or the heater and clarifier if both are used as suggested in Fig. 1.

The adjustable tube 10 is provided for adjusting the orifice 7 by screwing said tube down and up in the threaded hole 9, and is kept at any desired position by the contact spring 34.

The adjusting of the mixture through control of the orifice 7 admits of properly determining the mixture proportion without effecting the velocity of the fuel through the fuel jet which is formed by the lateral outlet 2″. This fuel velocity is controlled by the adjustment of air flow which is accomplished by controlling the lift of valve 27.

The level of the liquid fuel *c* in the constant level chamber 1 is maintained by the float 35 through the medium of the lever 36 and the valve 37, which constitute automatic means for delivering for the fuel passage of the carburetor, a regulated supply of liquid fuel for an indeterminate period of time which may be indefinitely prolonged by replenishing the main supply tank 37′ which is connected through main supply pipe 37″ to supply fuel to the float valve.

The auxiliary fuel chamber 8, orifice 17 and suction chamber *a* constituting the means to automatically deliver to the fuel passage a predetermined charge of liquid fuel within a predetermined period of time, may be brought into use at starting or at any other time when it is desired to add fuel to the regular supply from the float valve; but said auxiliary supply invariably stops, automatically, as soon as the charge in chamber 8 can pass through the orifice 17. This definitely limited period of time may be of slight or of greater duration depending upon the more or less forcible action of the suction under different speeds and loads.

The fuel passage of the carburetor comprises the suction tube 2 through which the main and auxiliary liquid fuel passes with some air, and also includes the lateral fuel jet ports 2″, the vortex chamber 3, and the horizontal and vertical limbs 3″ and 33″ of the exit from such chamber.

In the vortex chamber and exit therefrom the liquid fuel and air are intimately brought together and carried onward to supply to the engine, the combustible mixture required for its operation.

When kerosene or other low gravity hydrocarbon fuel is used as the main liquid fuel supply it is desirable to properly mix water to the mixture in definite proportions, to keep down pre-ignition when the engine is under speed or load and to economize fuel and increase the horse power, hours per unit of hydrocarbon fuel used.

For this purpose water may be supplied from the water supply tank 38 through the water pipe 39 to the constant level water chamber 40 and from the constant level water chamber 40 through the passage 41 and through valve seat 42 controlled by

valve 43 to the vertical suction passage 44 and outlet 45 over the cone 46 to the central low pressure zone of the vortex mixing chamber 3 where it is delivered to the spirally whirling air in such chamber.

A gland nut 47 provides means for holding packing 48 around the valve 43. The vertical water suction passage is formed in a hollow bolt 49 and said bolt is threaded into connecting piece 50 by which various fuel supplying elements of the carburetor consisting of main constant level chamber 1, vortex mixing chamber 3, bottom mixture passage 3'' and lower auxiliary constant level chamber 40 are secured together as a whole unit in such a manner that these elements may be placed at various relative angles to each other by relatively revolving them around said bolt 49.

The fuel supplied to the constant level chamber 1 from the supply tank 37' through the supply pipe 37'' passes through a strainer cap 51, and screen 52 before reaching the valve 37, so that impurities in the fuel will be precipitated to the floor 53 beneath the screen.

Air enters the carburetor by way of the opening 54 into the clarifier 23', and, being freed therein from dust, etc., passes by way of the air tube 55 to the heater 23 around the exhaust pipe 56 and thence by way of connection 56', tube 57 and the elbow 58 to the air inlet horn 22, and thence tangentially into the vortex chamber.

The vortex chamber of the fuel passage is so constructed that the vortical action will produce from end to end of the chamber, a substantially uniform drop of pressure, so that the air admitted through the tangential air inlet 59 will whirl around the low pressure zone to which the liquid fuel has passed, and the vortex chamber is contracted as the frustum of a hollow inverted cone which opens unobstructedly and abruptly into the horizontal mixture passage 3''.

The priming tank 14 is provided at the top with a toggle 60 which when pulled in any direction lifts and opens the valve 15 to allow a charge of the light fuel to flow from tank 14 through pipe 13 into the auxiliary chamber 8. The valve 15 is closed by a spring 61 and the toggle 60 is kept tight on its seat by spring 62. A valve seat 63 performs the double purpose of valve seat and part of the union for connecting pipe 13.

In practice the fuel chambers 37' and 14 are supplied with fuel and an indeterminate supply of heavy fuel at once flows to the float chamber to supply liquid fuel indefinitely to keep the float chamber fuel contents at the required level from which it will be sucked by the engine so as to intermittently flow over the top of the suction tube and thence through the low pressure zone to the helical current of air as it is produced in the vortex chamber, and thence on to the engine. The automatically closed valve 15, however, withholds liquid fuel from the auxiliary determinate charge fuel chamber 8 so that when the engine is operating in the regular way no fuel is drawn from tank 14.

In case the fuel in tank 14 is gasoline or other fuel normally easy to ignite when cold, the engine can be started with ease, though the regular fuel in tank 37' be kerosene, alcohol or other fuel normally difficult to ignite when cold, but capable of use when the engine is hot.

The auxiliary fuel chamber 8 is adapted to be substituted for the usual cover of the float chamber of certain previous carburetors and I do not limit its form to that shown in the drawings.

The suction tube 2 is enlarged at its top so that a thin annular orifice 64 is provided around the enlarged top thus to minimize fluctuations of the liquid due to jolts and jars on the carburetor and also to reduce the volume of the vacant space between the top of the suction tube and the top of the liquid in the adjusting tube 10 prior to suction.

The top of the suction tube 2 terminates in a sharp annular edge 65 close to the wall of the adjusting tube 10 so that the capillary attraction of the adjusting tube upon the liquid between it and said sharp edge exceeds that of the top of the suction tube and will maintain a raised rim of liquid around the inner wall of the adjusting tube above the level of the top of the suction tube. By this construction and arrangement great sensitiveness and quick action is secured under suction. A further advantage of this construction and arrangement is that in starting the engine after the automatically closed needle valve 15 has been temporarily opened, a gasoline charge from auxiliary chamber 8 flows at once into the suction tube and on to the sump without materially mixing with the fuel from the main float chamber, and this sump charge will be followed by a mixture of both fuels sucked by the engine until the charge of lighter fuel is exhausted.

The saw kerf 66 in the concave top of tube 2 receives a screw-driver by which said tube may be screwed home into the threaded upper bore 67 of the connection 50 and removed therefrom, in assembling and disassembling the carburetor.

The upper end of connection 50 is reduced and externally threaded to form a threaded stud 68 extending from a shoulder through the bottom of the float bowl or chamber 1. The shoulder 69 at the base of said stud fits against the bottom of said chamber 1.

The orifice tube 6 formed as a downward

extension from the cover 8 is internally threaded at its lower end to screw down upon the externally threaded stud 68 of fitting 50, and on to the bottom of main fuel chamber 1 to clamp it against the shoulder 69 of fitting 50 thus holding the cover in place. The auxiliary fuel chamber has a shoulder 70 to seat on the top of main fuel chamber 1, simultaneously with the seating of tube 6 on the bottom of chamber 1. The top of vortex mixing chamber 3 fits an annular seat 71 provided in the under side of float chamber 1 and said vortex chamber terminates at its lower end in a truncated outlet 72, and has above its discharge end 72, an annular shoulder 73 fitting an annular seat 74 at the inlet to the passage 3″. The horizontal mixture passage member 3″ is provided on its under side with a seat for the top of auxiliary float chamber 40, and the hollow bolt is inserted through chamber 40, passage 3″ and vortex chamber 3 and is screwed into fitting 50. The nut 47 and bolt 49 hold chamber 40, passage 3″, vortex chamber 3 and main fuel chamber 1 in fixed assembly, but by loosening nut 47, the parts may be relatively revolved to fit the carburetor to various structures. The upper end of bolt 49 above the port 45 is solid so that the water is introduced to a mixture of air and fuel.

The needle valve 15 is protected by a screen 75 to prevent impurities from passing from the tank 14 into the auxiliary fuel or high gravity priming chamber 8 so that the orifice 17 will not become clogged.

In practice to start the engine into operation the attendant will first operate the toggle 60, thus opening the needle valve 15, thus causing a charge of easily ignited fuel to flow by gravity into chamber 8 and causing such fuel to flow through the small orifice 17 in the adjusting tube to the suction chamber *a*, through which it drops onto the elevated surface of the heavy gravity fuel around the sharp edge of the suction tube 2 whence it flows down the suction tube and through the fuel jet formed by lateral passages 2″ into the vortex mixing chamber 3 and horizontal passage 3″ of the carburetor to the sump 5 at the bottom of the carburetor. Then with the butterfly throttle nearly closed, the motor is turned over slowly by the operator, fuel is drawn through the by-pass 19 around the throttle 18 and through the idling or starting jet port 20 and is injected above the throttle valve into the manifold in a jet of fine mist or spray. This mist or spray of fine easily ignited fuel fills the cylinders when ignition occurs in the way usual with such fuel and the motor starts immediately. Then fuel from the constant level supply chamber 1 flows into suction tube 2 along with the high gravity fuel, and the two are intimately mixed and such mixture of the two fuels passes through passages 3″, 33″ and enters the cylinders. Because the light fuel is intimately mixed with the heavy fuel, and because both are under the same suction, the two fuels are also accurately proportioned, so that the motor continues to operate while still cold, thus allowing the motor to heat up; giving opportunity for the devices for furnishing hot air to the carburetor from the waste heat of the exhaust gases to get into action to heat the air to 170° F., or more and consequently sufficient heat is soon supplied to the fuel and air to make it possible for the engine or motor to continue operation without the aid of the easily ignited light fuel from the auxiliary fuel chamber. At or about that time the light fuel supply in the auxiliary fuel chamber is exhausted and no further attention in this respect is required. Should the motor be stopped for a short period of time, a slight amount of light fuel delivered to the auxiliary chamber makes easy starting with a warm motor. After a long coast down a hill, using the motor as a brake, a slight touch of the operator on the toggle 62 will cause a small quantity of the light fuel to be delivered to the auxiliary chamber so as to put the motor again into action.

Heavy hydrocarbon fuels have a tendency to crack under the heat of compression in the motor cylinders, and hence to pre-ignite. The conflicting forces ensuing from such pre-ignition are oftentimes powerful enough to loosen bearings, break crank shafts and to otherwise cause damage to the motor. The proper introduction of water is highly desirable to prevent such pre-ignition, and to this end the constant level water chamber 40 at the bottom of the carburetor is provided as shown so that an adjusted mass of water may be introduced with the fuel, but owing to the elevation of the water port 45 above the water level in the float chamber 40 the water will not be introduced to the mixing chamber when starting or at light loads, but only after there is some load applied so as to produce suction on the water to lift it the predetermined distance to cause it to flow into the mixing chamber. After it begins to flow into the mixing chamber it flows under the same suction and is subject to the same mixing action as the hydrocarbon fuel, and therefore the water is evenly distributed throughout the mass of the mixture with the fuel and air, and the requisite water is applied by this method to obtain the desired results, viz, the prevention of pre-ignition and the prevention of carbon deposits, with the use of a minimum amount of water.

The needle valve 15, screen 75 and spring 61 are connected together with valve seat 63 as a single unit screwed into the bottom of

the tank and removable together with the connecting rod 16 by removing the pin that fastens the rod 16 to the tipping toggle 60.

The constant level water supply chamber 40 corresponds in function and operation to that of the float chamber 1 and need not be specifically described. The valve 43 constitutes means to adjust the proportion of water supply and by means of these three supply chambers 1, 8 and 40 in combination with the means set forth for supplying light liquid fuel to the auxiliary fuel chamber, it becomes possible to put the engine into operation with minimized attention and maximized satisfactory results.

The hollow truncated conical outlet form of the circular vortex chamber is an improvement over the form shown in my former applications in that it is a much more exact application of the use of a vortex mixing chamber as a means for correctly metering or measuring out the proper amounts of fuel to correspond to different flows of air.

This result is obtained because this present construction gives to the vortex chamber that is adapted to contain the whirling fluid, a shape more nearly conforming to the ideal vortical gradient of pressure thus allowing the whirling body of air to assume a condition of varying density extending from the center outward, and this gradient of pressure or densities with different velocities of air produces a pressure drop at the center which becomes a direct indication of metering action both of the air and the fuel.

The amount of pressure drop at the center is a measure of the air and also of the fuel flowing through the vortex chamber.

Particular attention is also directed to the orifice restricted gravity flow that occurs through the constantly open outlet 17 whereby the priming liquid is continuously delivered to the suction tube 2 so long as the charge 12 in chamber 8 is unexhausted. The two liquid fuels are therefore supplied in entirely different manners and irrespective of each other, the supply of the lighter fuel being continuous from starting until exhausted, while the heavier fuel is always under the control of the float valve; the lighter fuel being simply an addition to the supply of heavier fuel. By this method I have greatly simplified the apparatus and made its operation positive from the light fuel starting, to the operation upon the heavy fuel only.

I claim:—

1. In a carburetor having a float chamber, a fuel jet, and an air intake, a balancing means to maintain a pressure in the float chamber corresponding to that in the air intake of the carburetor, and means for directing an air supply from the balancing system of the float chamber to the fuel jet, whereby to maintain a proportionate amount of fuel to air without lowering the fuel velocity.

2. In a carburetor having a float chamber, a fuel jet and an air intake; a balancing means to maintain a pressure in the float chamber corresponding to that in the air intake of the carburetor; and automatic valve means adapted and arranged to close such balancing means to the fuel jet and to be lifted against the force of gravity at a predetermined light load for directing adjustable air supply from the balancing system of the float chamber to the fuel jet upon increase of load to thereby proportion the fuel to the air throughout the full range of operation.

3. In a carburetor the combination with a fuel passage of automatic means for delivering to such passage a regulated working supply of liquid fuel for an indeterminate period of time and fixed unobstructed automatic means comprising an auxiliary chamber located above the upper end of said fuel passage and in communication therewith, said means being adapted to deliver from said chamber by gravity and metering suction to said passage, a predetermined charge of liquid fuel within and continuing through a predetermined period of time; the surface of said predetermined charge of fuel being constantly open to atmospheric pressure; both fuels being supplied simultaneously during the predetermined period and the working supply continuing after such period.

4. In a carburetor the combination with a fuel passage, of automatic means for delivering to such passage a regulated working supply of liquid fuel for an indeterminate period of time; and fixed unobstructed automatic means above the upper end of said fuel passage to deliver by gravity and suction to said passage a predetermined charge of liquid within a predetermined period of time, the surface of said fuel being constantly open to atmospheric pressure, the fuel during said predetermined period being supplied simultaneously with that delivered for an indeterminate period.

5. In a carburetor having a float chamber and a cover for said float chamber, a main air intake, and a fuel passage; carburetor adjusting means consisting of an orifice tube projecting downwardly from said cover and provided with an orifice submerged under the liquid fuel in the float chamber and communicating with the fuel passage; adjustment means for said orifice consisting of an adjusting tube threaded in the top part of said cover and adapted to regulate the opening of the orifice; an air

valve for admitting air from said air intake to the center of the adjusting tube for adjusting purposes, and means to limit the lift of said air valve.

6. In a carburetor having a fuel passage, regulated means to supply liquid fuel to said passage for the usual operation of the unobstructed carburetor; a vented chamber above the upper end of said fuel passage open to atmospheric pressure and adapted to contain a limited charge of liquid fuel and provided with a restricted gravity outlet; said chamber communicating through the gravity outlet with said fuel passage so that said limited charge will be, by gravity, emptied into the fuel passage thereby to automatically change the fuel supply from unusual to usual operating conditions.

7. In combination with the mixing chamber of a carburetor; a fuel passage to deliver fuel to said chamber; a vented auxiliary chamber above said passage open to atmospheric pressure and adapted to hold a predetermined charge of fuel for starting an engine into operation, and unobstructed gravity flow means for conducting fuel from said chamber into said fuel passage before delivery to the mixing chamber, said vented chamber being empty during normal engine operation and filled by manually controlled means.

8. A carburetor of the character described consisting of a float chamber, an air intake, a fuel jet in communication with the lower portion of the float chamber, an air supply leading from the air intake to the upper portion of the float chamber and direct to the fuel jet.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 19th day of September, 1916.

ORVILLE H. ENSIGN.

Witness:
JAMES R. TOWNSEND.