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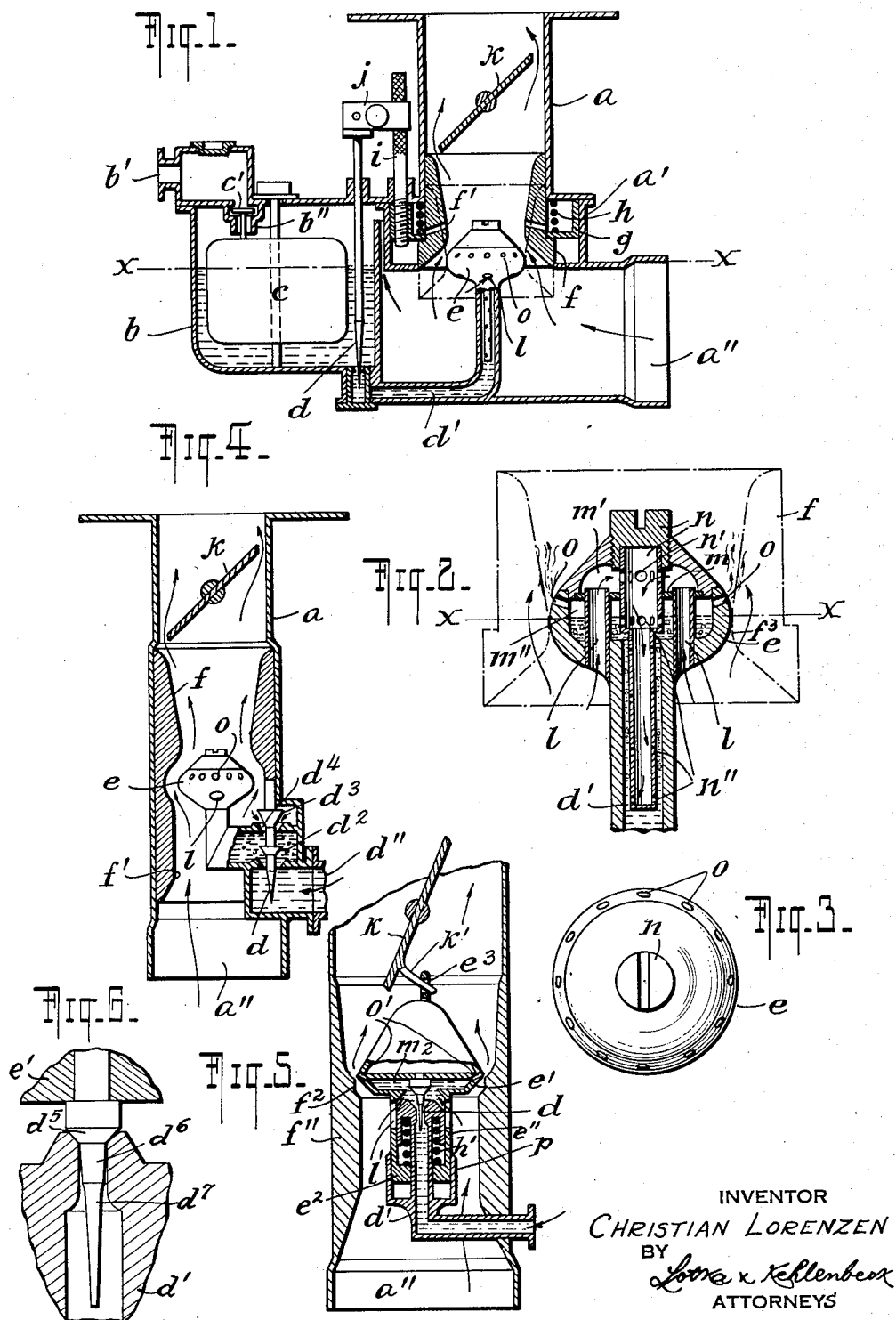
C. LORENZEN

1,972,686

CARBURETOR

Filed Aug. 26, 1931

2 Sheets-Sheet 1



INVENTOR
CHRISTIAN LORENZEN
BY *James K. Kellenberg*
ATTORNEYS

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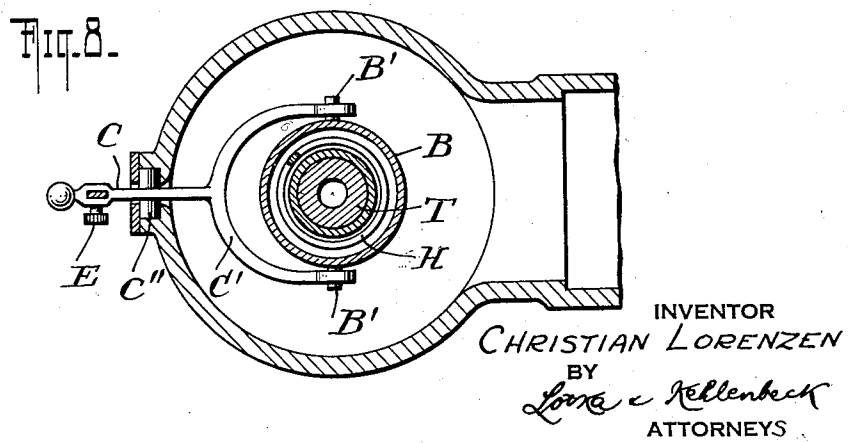
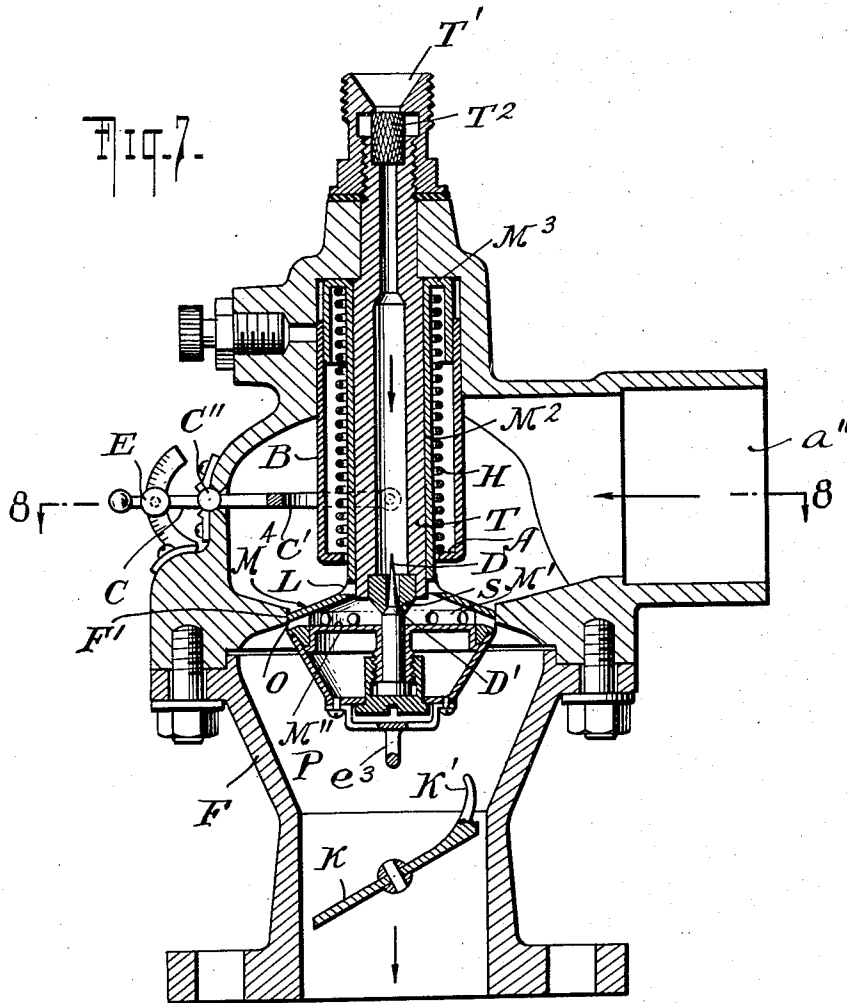
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INVENTOR
CHRISTIAN LORENZEN
BY
Lone & Kellenbeck
ATTORNEYS

UNITED STATES PATENT OFFICE

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CARBURETOR

Christian Lorenzen, Berlin-Treptow, Germany

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In Germany January 9, 1931

8 Claims. (Cl. 261-44)

My invention relates to carburetors for internal combustion engines, and has for its object to provide an arrangement by which the supply of air will always be in proper proportion to the supply of fuel irrespective of the varying conditions. Another object of the invention is to provide a simple construction having a single air supply channel of the Venturi type and two parts connected to move in unison, one of said parts controlling the passage of air, while the other part controls the passage of fuel. It is well-known that the explosive or power-producing effect of a fuel-and-air mixture is the greater, the more thoroughly the fuel has been mixed with the air and the more accurately the correct ratio is maintained between the weights of these two media. Special difficulties are encountered in securing this desirable result when the mixture is fed to the engine with the aid of a compressor or so-called supercharger, since such a device supplies the mixture under a fluctuating pressure, and one of the objects of the present invention is to overcome these difficulties. A carburetor embodying my invention will operate equally well whether the engine is of the customary suction type or whether a supercharger is employed in conjunction with the engine. With my invention, a practically constant suction effect is obtained at the fuel spray nozzle, irrespective of whether the engine is running at no load or at full load and also irrespective of the position assumed by the customary throttle valve interposed between the spray nozzle and the engine proper.

In order to obtain a practically perfect atomizing or spraying of the liquid fuel even when employing alcohol or heavy crude oil, and to insure an intimate mixture of the fuel with the air, I have devised a novel method of operation, according to which the energy of the air flowing to the engine by suction has a duplex action for atomizing or spraying the fuel. This duplex action consists, first, in causing the fuel or the fuel mixture to be discharged, through a series of distributing nozzles, by the application of pressure within the fuel-supply tube; second, in causing the jets issuing from said nozzles to meet a current of air which streams past such nozzles, said current of air exerting a suction effect and breaking up or further atomizing said jets, so that the two atomizing or spraying actions assist and reinforce each other.

It is well-known that difficulties in carburetor action, which become perceptible in irregular operation of the engine, always arise during changes

of speed, and also when the engine is running at low speed or is being accelerated, but do not exist at all, or only to a very slight extent, when the engine is running under full load or at relatively high speed. The reason for this is that in the latter case the fuel issues at a high speed, resulting in efficient spraying or atomizing and consequently in a thorough mixture of the fuel with the air. With my present invention, good atomizing and efficient mixture of fuel with air are obtained even under unfavorable conditions such as hitherto would have caused the engine to falter or even stall.

The novel features of the invention will appear more fully from the description following hereinafter, and will then be specifically pointed out in the appended claims.

Four typical and satisfactory embodiments of my invention are illustrated by the accompanying drawings, in which Fig. 1 is a central vertical section through a float-type carburetor provided with my improvements; Fig. 2 shows upon an enlarged scale, in axial section, the spray nozzle illustrated in Fig. 1; Fig. 3 is a plan view of such spray nozzle; Fig. 4 is a central vertical section through a form of my invention in which no float is employed; Fig. 5 is a similar view of still another floatless form of my invention; Fig. 6 is an enlarged detail view of a portion of Fig. 5; Fig. 7 is a vertical section through another embodiment of my invention; and Fig. 8 is a horizontal section on line 8-8 of Fig. 7.

In Fig. 1 *a* is the mixing chamber and *b* the float chamber which are connected with each other rigidly and may form a unitary casing. At *b'* I have indicated the fuel inlet connected with the float chamber *b* by a passage *b''* controlled by a valve *c'* which is carried by the float *c*. These parts may be of any usual or approved construction. At the bottom of the float chamber *b* is an outlet controlled by the needle valve *d* and leading by way of a tube *d'* to the spray nozzle *e*. This nozzle is stationary relatively to the parts *a*, *b*, and is located axially with respect to the mixing chamber *a*, the latter being tubular. Within said mixing chamber is movable vertically the Venturi tube *f* the contraction or throat of which is but slightly wider than the largest diameter of the spray nozzle *e*. The Venturi tube *f* is connected rigidly with an annular piston *g* movable in a suitable cylindrical portion *a'* of the casing. A spring *h* tends to move the Venturi tube *f* toward the spray nozzle *e*, the corresponding limit position being indicated by dotted lines, while the position indicated by full

lines is the other limit position, which the Venturi tube will take in response to strong suction exerted by the engine. Air enters at a'' and passes around the spray nozzle e , as well as through it as will be described presently, such air mixing with the fuel which issues from the spray nozzle and then passing through the chamber a and beyond the throttle valve k to the engine manifold. I have indicated a throttle valve of the customary pivoted type, but do not wish to restrict myself thereto. The Venturi tube f may be provided with ducts f' to avoid trapping a body of air between the piston g and the upper end of the cylinder a' .

The needle valve d is connected to move in unison with the Venturi tube f . For this purpose, a rod i is secured to the piston g and is connected with the needle valve by a suitable clamp j . Preferably the connection is an adjustable one, which may be accomplished by threading the lower end of the rod i into the piston g , while the upper end of said rod is mounted in the clamp j in such a manner that such rod may rotate in the clamp without moving vertically in relation thereto.

The construction of the spray nozzle is shown in detail in Figs. 2 and 3. Small tubes l extend lengthwise into the spray nozzle at a distance from its axis from the lower surface of said nozzle, said tubes terminating above a partition m located within the spray nozzle. From the chamber m' located above said partition, the air passes through openings n' into a tubular member n located axially within the spray nozzle. This member n is closed at the upper end and preferably also at its lower end. The passage d' communicates with the interior of the member n by openings n'' located below the partition m and below the level $x-x$ of the fuel as maintained by the float c . The upper end of the member n is screwed into the spray nozzle e , a slot being shown in Figs. 2 and 3 for the application of a screw driver to apply or remove said tubular member n . Thus different members n may be substituted in accordance with the character of the fuel and with other conditions varying in individual cases, the members n varying as regards their length, or the arrangement of their openings n' , n'' , or both. Below the partition m is located a chamber m'' provided with an annular series of jet openings o which are located at the upper portion of the spray nozzle, slightly above its greatest diameter.

The suction of the engine will tend to draw the Venturi tube away from the spray nozzle and to enlarge the area of the annular passage between said nozzle and the Venturi tube, while the spring h will tend to move the Venturi tube f in the opposite direction. The amount of engine suction depends upon the position of the throttle valve k . When the Venturi tube is in the lowermost position indicated by the dotted lines, the needle valve d will be almost closed and the fuel supply will be correspondingly cut down. As soon as the engine is running, its suction, depending upon the position of the throttle valve k , will cause the Venturi tube f to shift from the position indicated by dotted lines more or less toward the position shown in full lines. At the same time the needle valve d will be opened wider to supply fuel more abundantly to the spray nozzle e . Air entering at a'' will pass around the spray nozzle, and a portion of such air will enter the tubes l , passing into the chamber m' and through the openings n' into the tubular mem-

ber n , travelling downward in said member to the openings n'' which are located below the level of the fuel. Streams of air will then pass outwardly from the tubular member n through the said openings n'' into the fuel and with particles of said fuel into the chamber m'' from which jets of air mixed with fuel will be projected through the openings o into the Venturi tube f to stream past the throttle valve k to the engine. It will be understood that as the position of the throttle valve or the engine suction varies, there will be corresponding automatic variations in the position of the Venturi tube f and of the needle valve d . The adjustable connection i enables the needle valve d to be given the proper position relatively to the piston g and Venturi tube f . The main object of making the rod i adjustable, however, is to vary or adjust the point at which the downward movement of the Venturi tube f will be stopped. It will be evident from Fig. 1, that the downward movement of the Venturi tube is limited by the engagement of the lower end of the rod i with the bottom flange of the cylinder a' . Therefore, by adjusting the rod i up or down relatively to the piston g , the point at which the Venturi tube f will be stopped in its downward movement, can be adjusted. Preferably, when in its lowermost position, the narrowest portion or throat of the Venturi tube f will be at the level of the widest portion of the spray nozzle e , as indicated by dotted lines in Fig. 1. Instead of having the lower end of the rod i act as a stop for limiting downward motion of the Venturi tube, I might make the throat of said tube of slightly smaller diameter than the widest portion of the spray nozzle e , in which case the downward motion of the Venturi tube would be stopped by the said tube coming to rest on the spray nozzle. The upward motion of the Venturi tube is limited by the engagement of the piston g with the upper end of the cylinder a' , and in said uppermost position, the cross-section of the annular space or passage between the spray nozzle and the Venturi tube is preferably exactly or approximately equal to the cross section of the passage of the Venturi tube at its narrowest portion or throat.

During the operation of an internal combustion engine, there is, except when the engine is running under full load, a considerably lower pressure between the throttle valve and the engine than at the point where the fuel is sprayed or atomized. In my invention, I utilize this difference of pressures for actuating a regulating device which, when the engine is not running, cuts off the supply both of fuel and of air, by the action of a substantial force opposing the effect of such pressure difference. This causes the strong suction effect produced by the said difference of pressures while the engine is running, to extend past the throttle to said regulating device. The pressure difference, except when running under full load, amounts to one-half atmosphere or more, upon an average. In engines of the customary construction, the suction effect is practically destroyed at the throttle valve and does not extend beyond it.

Even without the use of a spring such as h , gravity would tend to bring the Venturi tube f and the needle valve d to their lowermost position, and if the Venturi tube and the parts connected therewith are made of sufficient weight, the spring h might be dispensed with. I prefer, however, to employ such a spring, and preferably such spring is under a substantial tension even when the piston g is in its lowermost position, so

that when said piston moves upward, the tension of the spring will be increased but slightly. With this arrangement, a sufficient suction will be obtained even when the engine is running at low speed without any load, to secure within the spray nozzle the pressure difference required for a thorough spraying or atomizing action even when the amount of fuel fed is relatively small. The fuel is ejected through the openings *o* located below the partition *m*. When a spring is employed, the suction effect on the Venturi tube will not be quite constant, owing to the slight increase in spring tension which occurs when the Venturi tube moves upward. If a perfectly constant suction effect is desired, I employ the construction referred to above, in which the spring *h* is dispensed with, so that the suction effect is counteracted by a constant force, viz. the weight of the Venturi tube and the parts connected therewith. When using a Venturi tube without a spring such as *h*, the weight of said tube and the parts connected therewith will be made to just counterbalance the suction effect on the surface of the Venturi tube when the engine is running at full load. The distance to which the Venturi tube will rise from its lowermost position, and therefore the amount of fuel-and-air mixture passing through said tube will depend on the position of the throttle valve *k* at any particular moment. The speed with which such mixture travels will therefore remain constant, and the amount of fuel passing through the spray nozzle will be in direct ratio to the cross-section of the fuel passage controlled by the needle valve *d*. The device therefore will produce an efficient regulation without the aid of any additional nozzles, pumps, or other auxiliaries, and the construction is not only simplified, but will work positively under all conditions.

When crude oil is employed as the fuel, in which case a relatively high pressure difference is required to produce the necessary spraying of the fuel, I employ a spring *h* of higher tension, or, if no spring is employed, a Venturi tube of greater weight than when employing more volatile fuel.

It is well understood that, as in usual practice, the throttle valve *k* will, even in its so-called closed position, leave a sufficient clearance for air to pass from the inlet *a''* through the interior air channels of the spray nozzle, thus supplying a sufficient amount of fuel even under these special conditions (no load).

The ducts *f'* not only prevent a trapping of air in the cylinder *a'*, but also permit the suction existing within the air tube to extend to the interior of the cylinder *a'* whereby the effect will be increased since the upward suction will be exerted not only on the Venturi tube *f*, but on the piston *g* as well. The piston furthermore serves as a dash pot to prevent fluttering of the Venturi tube in accordance with the pulsations in the suction effect exerted by the engine.

The air which enters the spray nozzle *e* through the (preferably tapered or conical) tubes *l* is first conducted to the chamber *m'* which is situated above the fuel level *x-x*. Such air then passes down into the fuel through the tubular member *n* and its openings *n''*, which latter are located below the fuel level. This insures a thorough mixture of air and fuel which mixture passes out of the chamber *m''* through the openings *o* which form an annular series of jets. These openings are located in such a manner that even with the Venturi tube *f* in its lowermost position, the outlets of the jet openings *o* will be unobstructed.

The aggregate cross section of the inlets of the tubes or channels *l* is greater than the aggregate cross section of the outlets *n''* through which the air passes from said channels to the fuel, so as to increase the pressure of the air within said channels. The outlets *n''* are preferably in the same axial planes with the respective jet openings *o*. The tubular member *n* is removable not only for the purpose of substituting different members of different character according to different circumstances, but also to enable the level of the fuel within the spray nozzle *e* to be observed so as to properly set the float controlled valve *c'*.

While in Fig. 1 the float chamber *b* is shown as located to one side of the mixing chamber *a*, it will be understood that any other suitable arrangement may be employed.

Figs. 4 and 5 illustrate two constructions in which the carburetor operates without a float. In Fig. 4 the construction of the vertically movable Venturi tube is substantially the same as described above, except that such tube is not connected with a separate piston working in a dash pot. The needle valve *d* is secured directly to the Venturi tube and controls the passage of fuel from a supply pipe *d''* to the spray nozzle *e* which latter may be of exactly the same construction as shown in Figs. 1, 2 and 3. In this particular construction there is no spring tending to bring the Venturi tube to its lowermost position, but only the weight of said tube and the parts connected therewith is relied to oppose the suction effect of the engine. The needle valve is in this case shown as provided with a head *d²* which in the lowermost position of the Venturi tube will rest upon a seat and form a valve to shut off the passage of fuel to the spray nozzle. In addition to the needle valve *d* the Venturi tube in this case also carries a tapering (initially closed) valve *d³* which controls an air inlet opening *d⁴*. The suction will cause the Venturi tube *f* to rise more or less and such movement will effect a corresponding setting both of the fuel valve *d* and of the air valve *d³* so that in all cases the proper relation is maintained between the supply of air and the supply of fuel.

In Fig. 5, the Venturi tube *f''* is stationary and is formed with a valve seat adapted to be engaged by the spray nozzle *e'* when the latter is in its lowermost position, the spray nozzle in this case being movable vertically upon the axial end of the fuel supply pipe *d'*. This construction has certain advantages over those described above, in that there are no surfaces in frictional engagement with each other during the vertical movement. The needle valve *d* is in this case secured to the spray nozzle *e'*, to extend into the upper end of the fuel supply pipe *d'*. Preferably the needle valve is removable, as by screwing it into the spray nozzle, so that different kinds of needle valves may be substituted in accordance with the particular type of fuel or engine employed. The spray nozzle has an annular series of jet openings *o'* so located that even in the lowermost position of the spray nozzle, the outlets of said openings will be unobstructed. Fuel passes from the supply tube *d'* to said openings *o'* through an auxiliary mixing chamber *m²* in the spray nozzle *e'*, while whenever said nozzle is raised from its lowermost position, a supplementary air supply is admitted to said chamber through openings *l'* in the vertical stem or cylinder *e''* of the spray nozzle. The spray nozzle may be held in its lowermost position (in which the openings *l'* are closed) either simply by gravity, or with the aid of a

spring h' and preferably, as in the form first described, said spring is under tension even when the spray nozzle is in its lowermost position. In order to prevent fluttering of the spray nozzle in this form of my invention, I prefer to provide a dash pot p surrounding the fuel supply pipe d' , said dash pot working in conjunction with an annular piston e^2 located at the lower end of the stem e'' and moving in unison therewith, the spring h' being in engagement with said piston and with a corresponding abutment surface near the upper end of the fuel supply pipe d' .

In order to prevent fluttering, I found that a spring h' of relatively considerable stiffness is required, or, if no spring is employed, a relatively considerable weight must be given to the spray nozzle and the parts connected therewith. The resistance opposed by these parts would, however, be an objectionable feature at such times as the engine is working under full load, and it is therefore desirable that when the engine is working at full load, the resistance opposed by the spray nozzle and the parts connected therewith should be eliminated. For this purpose, I have shown the throttle valve k as provided with a projection k' adapted to enter an opening e^3 in a lug at the top of the spray nozzle, said projection being inclined so that when it enters the said opening e^3 with the throttle valve in its fully open position, the said throttle valve will lift the spray nozzle to a higher position than the suction of the engine will do.

The needle valve illustrated in Fig. 5 is of a special novel and useful shape shown more clearly in the enlarged view Fig. 6. This valve has an enlarged, preferably conical portion d^5 which, when the engine is not running, rests on a valve seat at the upper end of the fuel supply pipe d^1 and closes the fuel outlet. When the valve rises off its seat, the fuel issuing at a considerable speed is finely distributed radially in all directions by the flaring surface of the valve portion d^5 . The air passing through the openings l' and forming, owing to its higher speed, an annular jet surrounding the fuel jet, likewise strikes said inclined or flaring surface and becomes intimately mixed with the fuel; this preliminary mixture, occurring in the chamber m^2 , is then perfected when the mixture, issuing from the openings o' , meets the additional stream of air which surrounds the nozzle e' within the tube f'' .

Preferably the nozzle e' and the Venturi tube f'' are so constructed that at the beginning of the upward (opening) movement of the nozzle, when the engine is running idle, no air will be allowed to pass around the nozzle, but the only air admitted will be that flowing through the openings l' . For this purpose, the Venturi tube f'' will be made with a short cylindrical portion f^2 , immediately above the seat of the nozzle head, and of a diameter almost equal to that of said head. Thus, while the engine is idling, the entire amount of air will pass through the nozzle head.

Preferably, in this case, the tapering end of the valve d , below the enlargement d^5 , is made in two portions d^6 , d^7 , of which the upper one tapers less than the lower one. The height of this upper portion d^6 should be equal to the height of the cylindrical portion f^2 , so that the lower edge of the portion d^6 will reach the level of the valve seat at the upper end of the supply pipe d' , at the same time that the widest portion of the nozzle head rises above the upper end of the cylindrical portion f^2 . Thus the fuel supply

will be increased (owing to the narrow end portion d^7 rising to the level of the valve seat, as in Fig. 5) at the same time that the air supply is increased by allowing air to pass around the nozzle head.

By a proper formation of the Venturi tube, I may prevent the passage of air around the nozzle head, at the beginning of the operation, even in constructions of the type shown in Figs. 1, 2 and 3. Thus, in Fig. 2, I have indicated a short cylindrical portion f^3 on the Venturi tube f , which portion will have the same function as the portion f^2 of Fig. 5; that is to say, the air passage around the nozzle head e will not be opened until the widest portion of such head has risen above the cylindrical portion f^3 , and until that time air will pass exclusively through the interior of the nozzle.

Floatless carburetors such as shown in Figs. 4, 5, and 6 may be used in any position, and not only in the upright position illustrated. More particularly, they may be used in an inverted position, so that both air and fuel will stream downwardly to the carburetor, which will increase the speed of their flow and enhance the atomizing or spraying action, especially when employing a needle valve with a flaring surface such as shown at d^5 in Fig. 6.

In Figs. 7 and 8, I have shown a form of my invention which is particularly adapted for use in an inverted position, both the air and the liquid fuel (gasoline) being fed downwardly to the throttle valve k and to the engine, and no float being necessary. The Venturi tube F forms part of the carburetor body, the latter also having a cylindrical portion F' , similar in function to the portion f^2 of Fig. 5, the outer edge of the nozzle head M being adapted to slide, like a piston, along said portion F' when the needle valve D , carried by said head, is adjacent to its closed position, or in other words adjacent to the stationary valve seat S provided at the discharge end of the fuel supply pipe T . The fuel may be conveyed to this pipe in any suitable manner, for instance at the top, as indicated at T' , a screen or strainer T^2 being preferably located at the fuel inlet of the carburetor. Air entering the carburetor body at a'' has access, through openings L on the nozzle head, to an interior chamber M' formed in the said head above a horizontal or approximately horizontal wall or partition M'' , said chamber extending to the edge or peripheral portion of the head M . The latter is made integral, or connected rigidly, with a tubular member M^2 arranged to slide up and down along the outer surface of the fuel supply pipe T . The chamber M' is provided, adjacent to the outer edge of the wall M'' , with openings O through which fuel and air will be discharged in jets into the main mixing chamber P . The upper end of the tubular member M^2 is made with a flange M^3 against which bears one end of a coiled spring H , the other end of said spring engaging an abutment A . This abutment might be stationary, and in any event is stationary during the ordinary operation of the engine, but may be adjustable in the manner and for the purpose explained below. The spring H tends to keep the needle valve D on its seat S . When said valve is seated, the edge of the nozzle head M is in registry with the cylindrical portion F' , so that no air can pass from the inlet a'' to the mixing chamber P by the direct path around the nozzle head, adjacent to said portion F' . When the needle valve is seated, the openings L will be closed entirely by the adjacent portions of

the supply pipe T. As soon as the needle valve opens, as it will when the nozzle head M moves downward in response to engine suction, the openings L and O will be uncovered partly or fully, thus providing a path for the passage of air from the inlet a'' through the openings L to the chamber M', and from the latter through the openings O into the mixing chamber P. As soon as the needle valve D opens, liquid fuel will drop by gravity from the supply pipe T and spread in a thin film on the horizontal partition M'', such liquid flowing outwardly and its upper surface being exposed to the stream of air passing over it from the openings L to the openings O. During this initial stage (at the time of starting the engine) the carburetor will therefore act as a surface carburetor. When the needle valve opens to a greater extent, the film of liquid fuel will be of sufficient depth to cover the outlet openings O, and at that time air entering through the openings L will pass through the liquid, and not simply over it. This will result in a spraying action. As long as the outer edge of the nozzle head M is in registry with the cylindrical portion F', air from the inlet a'' passes to the chamber P exclusively through the interior chamber M' of the nozzle head. When however the nozzle head moves down sufficiently to clear said cylindrical portion F', an additional, wider path, externally of the nozzle head and around its entire edge, is opened for the passage of air from the inlet a'' directly to the mixing chamber P. The air flowing through this additional path will strike the jets of fuel, or fuel and air, issuing from the openings O, and thus a very thorough mixing of air and fuel will be insured. It will be understood that the tapering needle valve D, and particularly the conical seating portion D' thereof, will cause the fuel issuing from the pipe T to be deflected and distributed radially or outwardly toward all portions of the periphery of the interior chamber M'. The fuel thus thrown outwardly will impinge against the opposing wall M⁴ of said chamber and will thus be broken up into a spray which will be the finer, the greater the diameter of the nozzle head. The inlets L form an annular series of openings, or virtually an annular opening through which air enters the chamber M'. Since air has a smaller specific gravity than the fuel, the current of air will travel at a much greater velocity than the fuel, and striking the finely-divided film of fuel at this high velocity, will atomize or spray the same. The air, which at first travels inwardly at the openings L, then takes an outward course, in substantially radial directions, in response to the suction exerted outwardly at the openings O. The impact of the air on the inner wall of the head M and on the fuel will cause a considerable whirling action, which in turn produces heat, the carbureting or vaporizing action being thereby assisted materially. A very efficient mixture of air and fuel is the result.

The upward or closing movement of the nozzle head M is limited solely by the engagement of the needle valve portion D' with its seat S. Therefore, when the engine is not running, the spring H will positively insure shutting off the fuel supply at the valve seat S. When the engine is idling, the edge of the nozzle head will be in registry with the cylindrical portion F', and air will pass only through the inner path L, M', O as described above. During normal running under load, the nozzle head will be in a position low enough to allow air to stream externally of the said head, through the opening formed by

said portion F', so that during normal running, air will pass both externally of the nozzle head and through it, whereby there is secured carburetion resulting from surface action combined with a spraying effect.

Another advantage of this form of my invention is that it greatly facilitates the starting of the engine, for instance in cold weather or when the ignition is not functioning efficiently. When the engine is cranked over, but fails to start, the liquid fuel which has spread over the partition M'' will evaporate, at least in part, during the interval between the first cranking of the engine and the next, so that when the next cranking causes a further amount of fuel to be fed from the supply pipe T, a richer mixture will be obtained, it being well-known that a richer mixture makes the engine start more easily.

Practical experience with this improved carburetor has shown that, without any change in the size of the passages for air and fuel, a richer mixture will be obtained if the tension of the spring H is increased. It is well-known that in carburetors of usual construction, seasonal or other temperature changes in the surrounding air will cause the mixture to become leaner (in cold weather) or richer (in warm weather), and to counteract this, resort has been had to the substitution of different nozzles for summer and winter use respectively. I have found that with my improved carburetor, an adjustment to meet different seasonal conditions can be made readily, without any exchange of nozzles, but simply by varying the tension of the spring H, thereby obtaining a uniform mixture under all temperature conditions. This adjustment of the spring tension may also be employed to meet different conditions resulting from the manner of feeding the fuel to the carburetor. When for instance a gravity feed is employed, the spring tension should be somewhat less than when a suction or vacuum feed is used. Furthermore, practical trials have shown that the vaporizing action is increased materially when the initial tension of the spring is relatively high, and quicker acceleration and response is thus obtained. I have therefore found it desirable to give the spring an initial tension high enough to cause the air velocity both within and around the nozzle head, to be greater at low engine speeds than when running under full load. In order that this high spring tension may not oppose an undue resistance when running at full load, I may employ an arrangement such as described above with reference to Fig. 5, where the throttle valve in its full open position compresses the spring to a greater extent than the mere suction effect of the engine would do and holds the needle valve open against such increased spring tension; or instead of this, I might provide means for releasing the spring fastening and thereby reducing or suppressing the spring tension.

Any appropriate means may be provided for varying the tension of the spring to meet seasonal changes, or for other purposes. Figs. 7 and 8 show the following simple arrangement: The abutment A is constituted by a flange at the bottom of a sleeve B surrounding the spring H and suitably guided for vertical movement in the carburetor body. At diametrically opposite points, said sleeve has two pins B' projecting into slots in the fork members C' of a lever C swinging on a stationary fulcrum C''. The outer end of the lever is exposed and thus readily accessible

for manipulation. A set screw E or other suitable means serves for locking the lever and the abutment against accidental movement. It will be obvious that moving the free end of the lever C upward will reduce the initial tension of the spring H, while a downward movement of said lever end will produce the opposite result.

It will be seen that in Figs. 7 and 8 the carburetor is used as a down-draft carburetor, differing however from other carburetors of the down-draft type in that not only the air but the fuel as well travels in a downward direction, and also in other respects.

While the carburetor shown in Figs. 7 and 8 will generally be employed as a floatless carburetor, it may, if preferred, be used in conjunction with a float-controlled fuel supply, particularly if the fuel is fed from above and it is desired to avoid the slight fluctuations due to changes of the fuel level in the main fuel tank.

Practical trial of my improved carburetor on a motor car having a maximum speed of over 60 miles per hour has shown that while driving in high gear, the speed could be throttled down to two miles per hour and again increased without causing the engine to miss or stall.

Various modifications may be made without departing from the nature of my invention as set forth in the appended claims.

I claim:

1. A carburetor provided with two members movable relatively to each other, one of said members being an air tube of the Venturi type, and the other a fuel spray nozzle located within said tube, in combination with a throttle valve controlling the passage of the air-and-fuel mixture to the engine, one of said members being movable in response to the engine suction and means on said throttle valve to engage the said movable member in the full-open position of said throttle and move said member beyond the position which it will be given by suction alone.

2. In a carburetor, a movable spray nozzle, an air-supply channel leading through said nozzle, and a member surrounding the nozzle and forming therewith an external air-supply channel surrounding the nozzle, the nozzle constituting a valve for closing said external channel, and said surrounding member being so formed that the external channel will not be opened for the passage of air until the nozzle has moved a predetermined distance from its extreme closing position, said spray nozzle having a fuel-supply channel with a valve seat at its discharge end, and said nozzle being provided with a needle valve having an enlarged portion fitted to said valve seat, and a smaller end portion extending from said enlarged portion into the fuel-supply channel, said end portion being tapered lightly adjacent to said enlarged portion, and more strongly toward its free extremity, the length of said lightly-tapered portion corresponding to the length of that portion in the movement of the nozzle dur-

ing which the external air-channel remains closed.

3. In a carburetor, a fuel supply conduit having a valve seat at its discharge end, a movable spray nozzle provided with a valve co-operating with said seat, said nozzle having an internal chamber arranged to receive fuel when said valve is open, and provided with outlets for the discharge of air and fuel, said internal chamber having a wall on which the fuel is adapted to spread into a film, said chamber also having air inlets so located that upon a slight opening of the valve a surface carburetion will take place and that upon the valve opening more fully, a spraying of the fuel will be obtained.

4. A carburetor according to claim 3, in which the internal chamber extends substantially throughout the width of the nozzle, and in which the outlets are located at the periphery of the nozzle.

5. A carburetor according to claim 3, in which the valve seat and the valve fitting it are tapered in such a direction as to spread the fuel from the discharge end of the fuel supply conduit radially within the chamber of the nozzle.

6. A carburetor according to claim 3, in which the air inlet surrounds the discharge end of the fuel supply conduit, the supply of air varying automatically in response to the suction exerted at the outlet of the carburetor.

7. A carburetor according to claim 3, in which the discharge end of the fuel supply conduit is directed downwardly to the internal chamber of the spray nozzle.

8. In a carburetor, a movable spray nozzle provided with an internal chamber having peripheral outlets and air inlets located nearer to the axis of said nozzle than said outlets, a stationary member surrounding said nozzle and having a portion adjacent to the periphery of said nozzle when the latter is in its initial position, a stationary fuel supply channel having its outlet within said chamber and provided with a valve seat at such outlet, the internal chamber of the spray nozzle having a transverse wall along which the fuel entering at the central portion of the chamber will spread outwardly and become vaporized by the currents of air which flow radially from the air inlets to the peripheral outlets, to produce vaporization of the fuel and carbureted said air by surface action and a valve carried by said nozzle and co-operating with said seat to allow fuel to enter said chamber and to be vaporized therein by the air entering said inlets and to pass out with such air through said peripheral outlets during the initial movement of the spray nozzle, while upon further movement of said nozzle the peripheral portion thereof will come away from the adjacent portion of the stationary member and open an external channel for the passage of air around said nozzle.

CHRISTIAN LORENZEN.