July 19, 1932. C. G. HAWLEY 1,867,742

CARBURETOR

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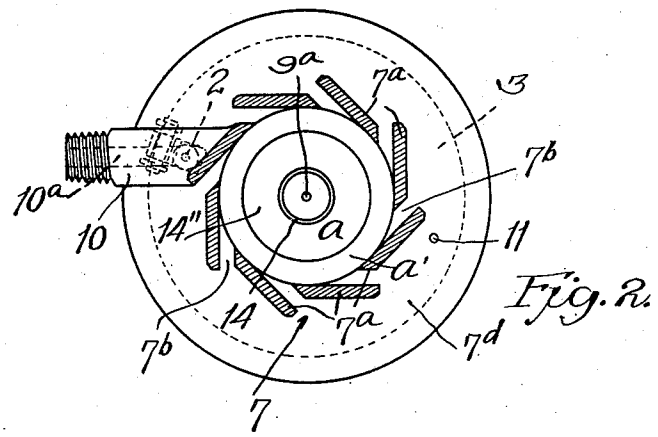


Fig. 2.

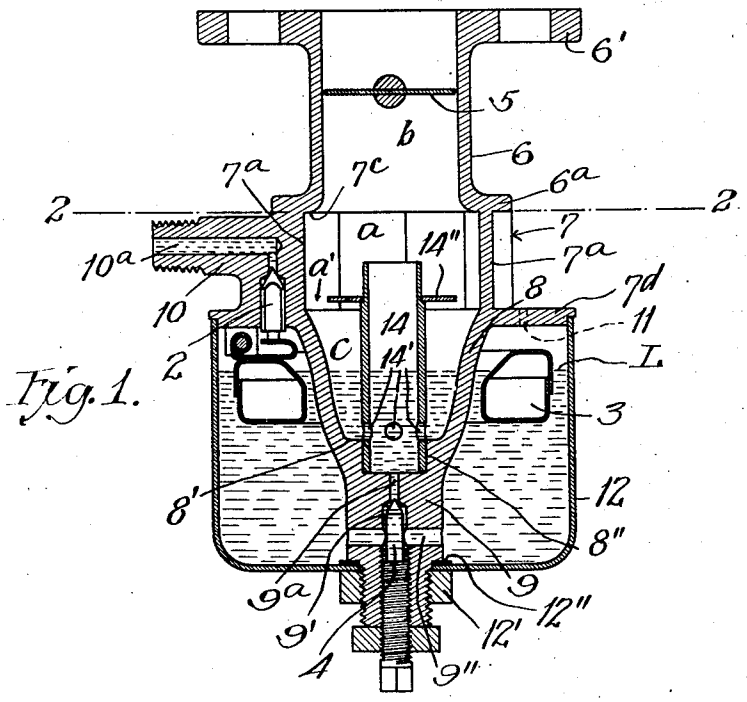


Fig. 1.

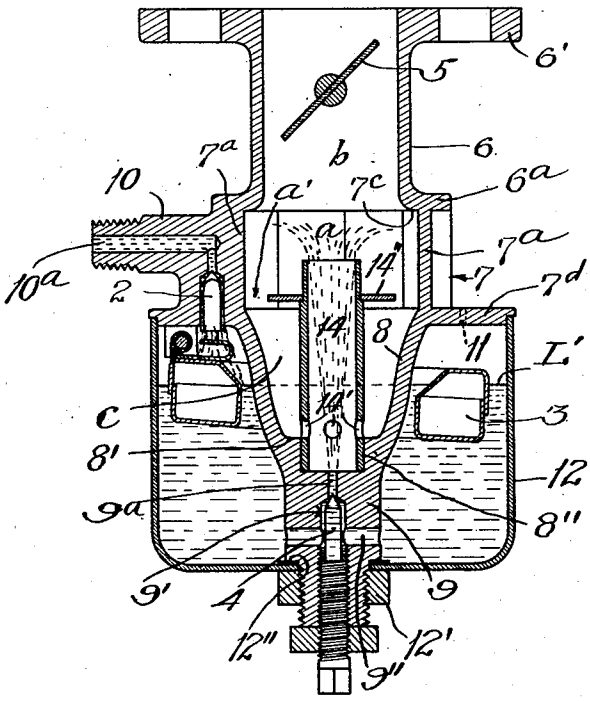
Charles G. Hawley.
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Fig. 3.



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Fig. 5.

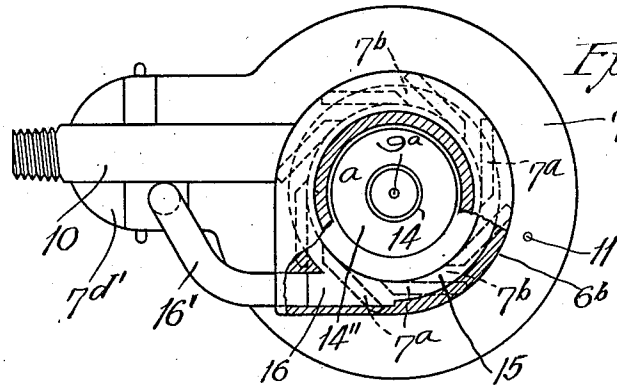
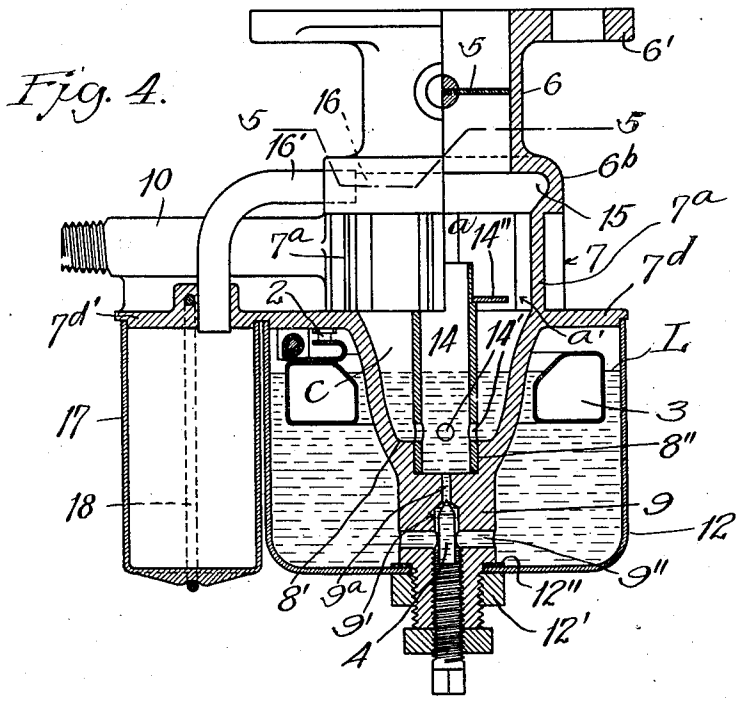


Fig. 4.



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Fig. 7.

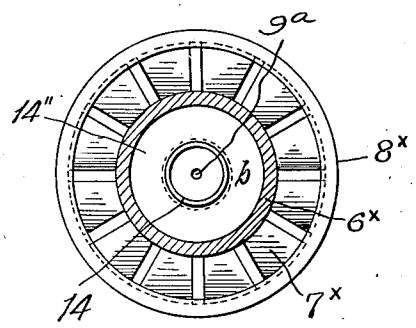
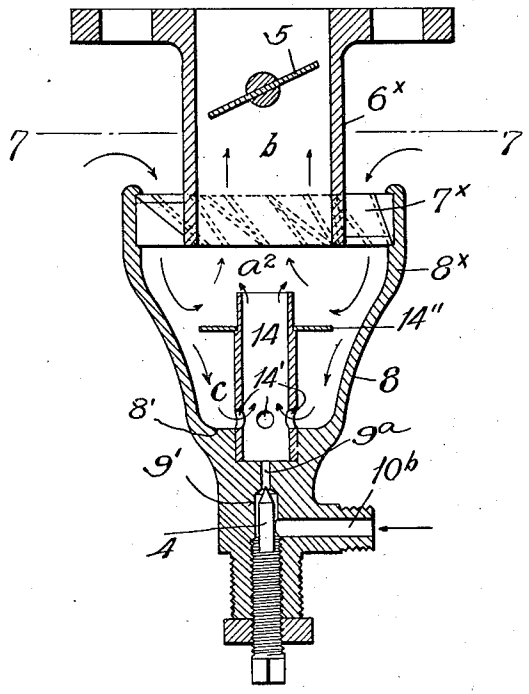


Fig. 6.



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Patented July 19, 1932 1,867,742

UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed June 5, 1926. Serial No. 283,089.

The invention relates to improvements in carburetors; that is, in fuel and air mixing intakes for internal combustion engines. The object of the invention is to simplify the carburetor or intake means and to improve the operation thereof. A special purpose is to eliminate many of the auxiliary means and adjusting devices now employed in and upon carburetors, particularly those used upon the engines of automotive vehicles.

The prerequisites in this art are that a given ratio of air and liquid fuel shall be admitted to an internal combustion engine. That the fuel shall be thoroughly atomized, vaporized and admixed with the air. Coupled with these requisites is the necessity for promptly furnishing the engine with a rich mixture at times of starting, and to this is to be added the ability to automatically enrich the mixture at times when the speed of the engine is lowered because of an excessive load thereon. Therefore the present invention is designed to provide a carburetor which shall conform to and meet all such requirements; and further to in large measure offset or overcome the difficulties presented by the varying density and temperature of atmospheric air.

The invention will be comprehended at once upon reference to the accompanying drawings. It comprises and operates as a simple carburetor or may comprise a combined carburetor and air cleaner.

In the drawings, Fig. 1 is a vertical section of a carburetor embodying the invention in its most compact and simple form; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is identical with Fig. 1 except that the movable parts of the carburetor are shown in positions which illustrate the action of the carburetor; Fig. 4 is a side view of the combined carburetor and air cleaner, with some parts broken away, to show the interior; Fig. 5 is a plan view thereof, partly in section, as upon the irregular line 5—5 of Fig. 4; Fig. 6 illustrates a modified construction of the carburetor which may be regarded as a simplified form thereof; and Fig. 7 is a horizontal section on the line 7—7 of Fig. 6.

In its preferred form this carburetor is of extremely simple construction, possessing few small passages and having only four moving parts; to wit, the fuel inlet valve 2, the hinged float 3 for actuating that valve, the flow adjusting needle valve 4, and the butterfly valve 5. The body of the carburetor is made of metal and comprises the flanged neck portion 6, which contains the butterfly valve, in combination with the centrifugal or tangential tuyère portion 7, and the inner sink or pocket portion 8, which latter terminates in the central stud or stem 9. If desired these portions may be formed in and by a single casting, and they are additionally identified by the following constituent parts and portions. The portion 6 has a flange 6′ by which the device is attached to the intake port or intake manifold (not shown) of the engine (not shown) to be served. Further, the part 6 has an annular bottom flange or enlarged part 6^a, partly comprising the tuyère 7. That portion is completed by the circumferential series of tangential blade portions 7^a all having the same direction, and separated by the narrow slot-like passages 7^b, which are called tangential tuyères, being the openings through which air tangentially enters the carburetor in its passage to the neck 6 and the engine. The internal chamber *a*, defined by the many blades 7^a, is preferably always of larger diameter than the interior *b* of the neck portion 6 and thus an annular portion or abutment ring 7^c is formed or interposed between the tuyère and the outlet or neck 6. The lower end of the tuyère comprises the wider ring-like portion 7^d whereon the blades are rooted or fixed; and erected on this ring is the angular portion 10 which, as shown, contains the fuel supply duct 10^a and the before mentioned float valve 2. The portion 7^d contains a vent hole, 11, and also serves as the cover for the fuel bowl 12, as shown. That bowl contains the float 3 and is secured to the central stem 9, as by means of a threaded nut 12′. The joint is made tight by a gasket 12″. The stem 9 contains a central bore 9′ which is placed in communication with the interior of the liquid bowl by a cross bore or duct 9″. The diameter of the bore 9′ is

reduced at the top to form the fuel feeding nozzle or orifice 9^a upward through which the fuel is drawn into the inner chambers of the carburetor. By means of the needle valve 4 the effective size of the orifice 9^a may be regulated to suit the different conditions encountered. The sink *c*, within the portion 8 is of peculiar importance and it is to be observed that the bottom floor 8′ of that sink is much below the "rest" level L of the liquid which occupies the bowl 12. Being freely connected with the interior of the bowl by the passage 9′, 9″ and 9^a, it is clear that when the carburetor is at rest, the lower part of the sink *c* will likewise be occupied by liquid fuel, to the same height or level as the level L in the bowl 12. This is clearly shown in Fig. 1. The contrasting condition is shown in Fig. 3. The part or member 14 now remains to be described. It comprises a tube which stands centrally within the cavity *c* and the tuyère chamber *a*, and which rising from the sink floor 8′ projects about midway into the chamber *a*. The upper end of the tube 14 is freely open. Its lower end is fixed in the large bore 8″ in the part 8 and is in free communication with the fuel orifice 9^a. At the floor level (8′) the tube is in free communication with the outer portions of the sink *c*, through the medium of capacious holes 14′. Near its top and best at a level which is above the lower ends of the tuyère openings 7^b, the tube 14 is provided with a flange or ring 14″ having a diameter which is less than the internal diameter of the tuyère chamber *a*. In practice this flange 14″ may nearly equal the diameter of the passage in the neck portion 6. A relatively wide annular opening *a*′ is thus provided between the outer periphery of the flange 14″ and the blades 7^a, or in other words between the flange and the inner periphery of the tangential tuyère. The annular opening *a*′ places the sink *c* in open communication with the chamber *a* at the top.

A carburetor of this construction exerts a definite lifting force upon the liquid fuel standing in the open fuel orifice 9^a. Hitherto it has been the practice in carburetors to admit the air below the level of the top of the fuel nozzle in order that the air might exert an aspirating and atomizing effect. This invention is directly contrasted therewith, for herein the air is admitted to the carburetor at a point relatively far above the liquid level as defined by the upper end of the nozzle 9^a and the actual level in the float chamber. It may at first appear that the liquid will be short circuited and but little affected by the inrush of air above the same, but that condition is obviated by a vortexial or whirling action of the air within the chamber *a* (occasioned by the tangential introduction of the air through the tuyères 7^b) and by the communication of the suction from the engine to the closely related passages *b*, *a* and 9^a. Preferably also the combined areas of the tuyère openings 7^b are in aggregate somewhat less than the area of the passage or carburetor outlet *b*, the better to communicate the suction of the engine to both fuel and air. Obviously the construction of the tuyères 7^b results in a higher entrance velocity of the air flow therethrough and in an increased whirling action within the chamber *a*.

The whirling action results in establishing and maintaining a vortex of air within the carburetor, the vortex rotating about the common vertical axis, and creating a state of lesser pressure in the axial portions of the chambers *a*, *c* and *b*. Thereby the suction of the engine is supplemented by an added pressure difference which is brought about through the manner in which the air is admitted to the carburetor. Thus the fuel is caused to jet upward from the orifice and quickly partaking of the whirling action, the fuel leaves the upper end of the tube 14 centrifugally; and in the form of an attenuated mist. The level L′ and the positions of float and butterfly valve at such times are clearly depicted in Fig. 3. An obvious result of the centrifugal projection of the fuel mist is that it is dispersed laterally or radially within the vortex of air which constantly occupies the chamber *a*, including the chamber *b*. In consequence an admirable admixture of air and fuel is accomplished.

Some of the liquid fuel from the tube 14 impacts the inner sides of the blades 7^a and the first function of the annular abutment 7^c is to hold such liquid upon the inner periphery of the tuyère against the whirling upward rush of the air and until such accumulations are normally taken up by the air. A second important function of the abutment 7^c is to aid in maintaining a condition of highest pressure in the outer portion of the whirling body of air; and by such pressure condition, plus gravity, any actual excess of liquid from the blades is discharged downward through the opening *a*′ and into the sink *c*. Arriving at the bottom of the latter and because of the lower pressure at the center of the sink, the excess liquid immediately enters the base of the tube 14 through the openings 14′ and is again drawn upward within the vortex. The flange 14″ on the tube greatly aids in this performance by tending to increase (relatively) the pressure in that portion of the sink *c* which surrounds the lower part of the tube 14.

With the foregoing well understood the action of the carburetor at the starting of the engine may now be described. When the engine is at rest the liquid stands at the level L. In other words, the lower part of the sink *c* at such times is flooded with fuel after the manner illustrated in Figs. 1 and 4. Im-

mediately upon the starting or "turning over" of the engine the air inrushing at the tangential tuyère, forms the described vortex and establishes within the carburetor pressure relations which result in exhausting the flood of liquid from the bottom of the sink, the same rising through the dispersion or vaporizing tube 14, quite as above described in relation to the orifice 9^a but momentarily in larger volume. Thereby the engine is at once furnished with a necessary rich starting mixture which ensures the prompt starting of the engine. A similar performance takes place when the rotative speed of the engine is checked by an excessive load, and when, in consequence, its suction upon the carburetor is lessened. At such times the fact that the maintained level of the liquid in the bowl 12 is higher than the nozzle 9^a results in a positive gravity flooding of the lower part of the tube 14 and thereby the mixture is conveniently increased to the extent required to take up the load upon the engine.

It will now be understood that during the ordinary operation of the carburetor at different engine speeds and at different butterfly valve positions the exhaustion of liquid from the orifice 9^a occurs directly within the tube 14 and thence into the upper body of the carburetor as shown in Fig. 3. In this connection the invention has a further practical application to engine operation as follows: It will be perceived that the lower pressure condition maintained at the axis of the carburetor is so nearly a direct function of the whirling action within the carburetor as to be responsive to every change in the velocity of whirling motion and every change in the density of the entering air. Thus the liquid drawing capacity of the vortex is seen to increase as the intensity of the vortex increases. Further, as the velocity of rotation increases, and tends to draw a disproportionate quantity of liquid from the orifice 9^a, the efficiency of the orifice 9^a as a liquid delivery duct decreases and defeats that tendency; by reason of the effort to increase the velocity of the liquid delivery through the orifice 9^a. By opposing the forces and resistances in this manner it now becomes possible to deliver fuel to the incoming air in a substantially fixed ratio of fuel, to air; and thereby the best performance of an engine is ensured throughout its load and speed ranges.

The vent opening 11, admitting atmospheric pressure to the interior of the bowl 12, may be closed; and, the strong suction within this carburetor is such that it may then be depended upon to lift fuel from a distant tank or reservoir at a lower level. This is made possible by great increase in suction secured at the orifice of this carburetor, as compared with the performance of other carburetors. Obviously, the adjustment of the needle valve belonging to the orifice 9^a, places such a fuel lifting carburetor within exact control in relation to the desired ratio of fuel and air. In this ability to perform the functions of the common "vacuum tank," this carburetor comprises a distinct forward step in the art.

In further explanation of the foregoing paragraph attention is called to Figs. 6 and 7 in which such a self-supplying carburetor is depicted. In that case the common carburetor bowl, float and float valve are entirely omitted and the fuel supply line or connection 10^b is directly connected to the passages 9′ and 9^a. Obviously the bowl and float valve could be restored to the device in Figs. 6 and 7, and that device is not limited to this direct connection with the fuel supply pipe.

In the structure of Figs. 6 and 7 the characteristic parts 8^c and 14 remain the same. The upper portion may be as shown in the preceding views, that is, a whirl-promoting element of a barrel-like form may be retained. Or the whirl-promoting portion may be modified and become a tangential tuyère of the radially bladed type shown in Figs. 6 and 7. Conveniently the annular wall 8 is extended upward to form the mixing bowl or chamber a^2 and the top of that chamber is occupied by this radially bladed tuyère; the latter comprising the circumferential series of inclined blades 7^x, which also serve to unite the neck portion 6^x and the top 8^x of the bowl a^2. Given the construction of Fig. 6, an indraft of air through the inclined tuyères or openings between the blades 7^x results in the whirling action within the internal chamber, quite as before described and with like effects.

As before mentioned, this novel carburetor may be constructed to combine its functions with those of an air cleaner, and such a combination is typified in Figs. 4 and 5. It will at once be recognized that the carburetor proper is identical with that shown in Figs. 1 and 3, except that the portion 6^b, between the blades 7 and the neck 6, is increased in height or thickness and is made to include a circumferential groove or race 15. Dust which enters with the air is centrifugally separated by the described vortexial action within the chamber a, and being virtually confined to the outer periphery of the vortex is whirled upward into the groove 15. Continuing to whirl therein, the dust is ejected through the tangential nozzle 16 and descends into the pocket 17 by way of the duct 16′. Conveniently, the pocket is detachable and may be emptied from time to time. It is supported by an extension $7^{d'}$ of the portion 7^d, assisted by a spring bail 18. Practically all non-vaporizing heavy substances admitted with the fuel are centrifugally separated and deposited in the pocket in this manner, and by the removal of such substances together with the dust the "car-

bonizing" of the engine is much reduced. Such readily vaporizable fuel as chances to reach the pocket through the medium of the separating race 15 is ultimately vaporized in the pocket and thus returns to the body of the carburetor. Therefore it is not wasted.

Many other advantages of this invention will be obvious to those skilled in the art; for example, its structural simplicity and sturdiness; the absence of moving parts likely to get out of order; the ease with which the carburetor may be opened and inspected or cleaned; the ease with which it may be produced; and, its low cost.

The invention comprehends the connection of this carburetor with both air preheating means and a source of pressure air, the latter following the practice of so-called superchargers. The connection comprises a mere hooding of the air admission tuyère of the carburetor and is so obvious that it does not require special illustration. Either heated air or hot pressure air may be so introduced without modifying the operation of the invention as above described.

I claim:

1. The herein described process of making combustible mixtures of substantially constant ratios for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn into the engine and localizing a rapidly whirling vortex thereof coaxially in advance of the engine mixture intake, and admitting fuel to the entrance end or base of said vortex and through an orifice of fixed size.

2. The herein described process of making combustible mixtures of substantially constant ratios for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn into the engine and then localizing a rapidly whirling vortex thereof of larger diameter than and coaxially in advance of the engine intake, and admitting fuel to the entrance end or base of said vortex through a fixed orifice and in response to the varying suction of said vortex.

3. The herein described process of making combustible mixtures of substantially constant ratios for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn into the engine and thus maintaining a rapidly whirling vortex thereof in immediate axial advance of the engine intake, closely localizing the intensity of such rotation in advance of said intake, thus magnifying the low pressure at the distant end or base of said vortex, and admitting fuel axially to said vortex base, with reluctance that inversely responds to that variation of the pressure at the base of the vortex which is caused by changes in the velocity and density of the entering combustion supporting air.

4. The herein described process of simultaneously making and conditioning combustible mixtures for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn ino the engine and localizing a vortex thereof axially in the presence of the engine mixture intake, admitting fuel to the end or base of said vortex distant from said intake, coincidently separating centrifugally the dust that enters with the air and discharging the separated substances in advance of said intake.

5. A carburetor for internal combustion engines, comprising a body portion containing a mixing chamber composed of tangentially positioned blades and having at one end a coaxial mixture outlet, in combination with a fuel feeding means including a fuel inlet orifice positioned at the opposite end of said chamber.

6. A carburetor for internal combustion engines, comprising a body portion containing a mixing chamber composed of tangentially positioned blades and having at one end a mixture outlet and the openings between said blades being of less area than said outlet, in combination with a fuel feeding means including a fuel supply orifice positioned at the opposite or intake end of said chamber.

7. A carburetor for internal combustion engines, comprising a body portion containing a mixing chamber having at one end a mixture outlet of less diameter than itself, in combination with whirl-promoting means that set the entering air into vortical rotation in said chamber while moving toward said outlet, a fuel feeding member and fuel inlet orifice in the opposite or intake end of said chamber, and dust separating means in axial advance of said outlet.

8. A carburetor for internal combustion engines, comprising a body portion containing a substantially cylindrical mixing chamber having at one end a mixture outlet of less diameter than itself, in combination with whirl-promoting means that set the entering air into vortical rotation in said chamber while moving toward said outlet, a fuel feeding member and fuel inlet orifice in the opposite or intake end of said chamber, a race positioned at the outlet end of said member to receive the foreign substances that are centrifugally separated within said chamber, and a pocket which in turn receives such substances from said race.

9. For the purposes herein described, a tangentially bladed mixing chamber having an outlet in its top and thereby adapted for attachment to the intake of an internal combustion engine, in combination with fuel feeding orifice means entering the bottom of said bladed chamber, and means axially distant from said outlet and centrally posi-

tioned within said chamber to direct excess fuel away from said outlet and toward said outlet.

10. For the purposes herein described, a liquid fuel chamber and means for maintaining a liquid level therein, in combination with a mixing chamber extending downward within and to a point below said level in the fuel chamber, said chambers being connected by a fuel orifice also below said level and which opens into the bottom of said mixing chamber, said mixing chamber having a mixture outlet of less diameter than itself, and presenting an annular abutment adjacent said outlet for directing air toward said orifice, to exhaust liquid from the lower part of said mixing chamber.

11. A carburetor having a fuel chamber and superposed mixing chamber, the latter provided with a mixture outlet in its top and, at the bottom, being extended downward to a point below the liquid level in said fuel chamber, a fuel orifice joining said chambers at the bottom, and means for admitting air into the upper part of said mixing chamber and causing it to whirl therein above said orifice, thence to depart through said outlet.

12. A carburetor comprising a mixing chamber and means for setting the inrushing air into rotation therein, in combination with means for supplying fuel to the bottom of said chamber, an atomizing tube rising therefrom and at the top terminating within the mixing chamber, the base of said tube being in open communication with the lower part of said chamber, and said chamber having a mixture outlet centrally above said tube.

13. The hereindescribed process of making combustible mixtures for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn into the engine, forming a vortex thereof coaxially in advance of the engine intake and maintaining a pool of fuel at the base of said vortex.

14. The hereindescribed process of making combustible mixtures for internal combustion engines that consists in setting the combustion supporting air into rotation as it is drawn into the engine, forming a vortex thereof coaxially in advance of the engine intake, maintaining a supply of fuel at the base of said vortex and coincidentally depositing therein the impurities centrifugally separated from the air.

In testimony whereof I have hereunto set my hand this 2nd day of June, A. D. 1928.

CHARLES GILBERT HAWLEY.