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ART OF CARBURATION

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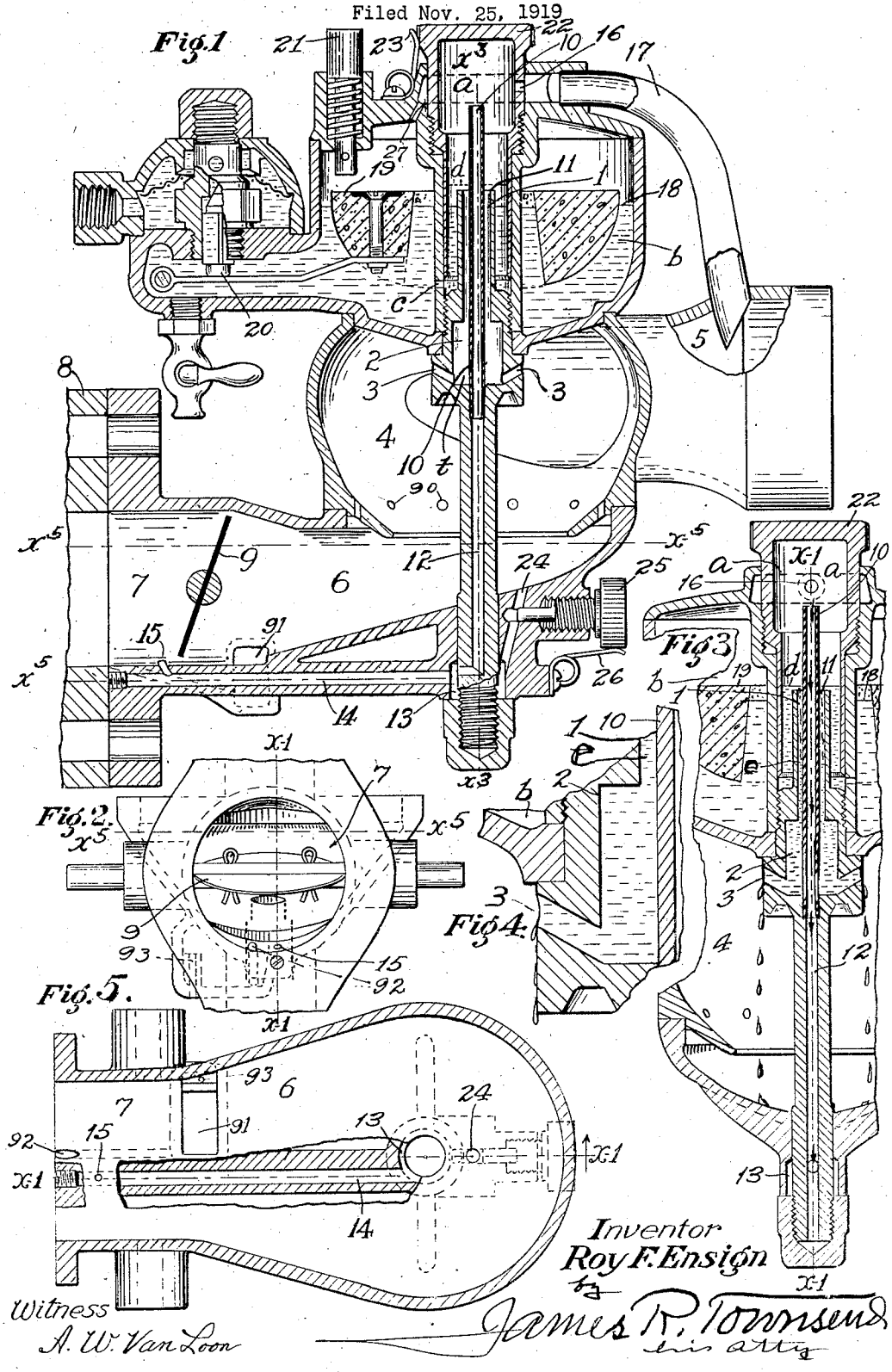

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UNITED STATES PATENT OFFICE.

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ART OF CARBURATION.

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An object of this discovery and invention is to control in a novel and effective manner, the idling mixture in that class of carburetor in which all the liquid fuel in the fuel passage flows downward during all phases of carburetor operation, and at the same time provide for acceleration upon opening of the throttle; and in carrying out this invention, I make provision in that type of carburetor using a down flow fuel passage between the float chamber and the mixing chamber, whereby I cause the fuel flowing in such passage during idling, to form a seal at the lower end of such passage, and thereby provide means to cause an accumulation of fuel in such passage, and I make use of the sealing of the lower end of such fuel passage by checking the liquid fuel at the lower end of its path to make it possible to apply the modified high depression of the engine intake to enrich the mixture during idling and to use the accumulated fuel thus obtained for acceleration as above stated.

An object of the invention is to increase the proportion of fuel to air in the mixture during idling action of the engine so as to permit the motor to function well during the lower speeds.

In carrying out this invention I use only one passage and cause operation by applying both the force of gravity and of suction to deliver fuel under all conditions of operation in a continuously downward path, to the mixing chamber, and I make provision whereby the effective air pressure or suction upon the fuel to cause it to flow through this passage into the mixing chamber is increased during idling, above the pressure or depression imposed by the air flowing in such chamber.

I use only one passage and apply to the liquid fuel therein, the combined forces of gravity and suction to deliver fuel to the mixing chamber; and I apply the effective air pressure or suction upon the fuel in the direction of gravity to cause the fuel to flow down through a passage into the mixing chamber, and increase such suction during idling above that imposed by the air flowing in such chamber.

In the type of carburetors which I have employed in carrying out this invention, there is produced by vortical action of air in the mixing chamber, a depression which is applied to maintain a constant ratio between the liquid fuel and the quantity of air flowing through the mixing chamber, and in this invention I increase the flow of liquid fuel under low speed idling conditions as compared with the flow which occurs in carburetors of this type as heretofore constructed.

I provide an internal combustion engine carburetor comprising, in combination with a by-pass whereby suction of the engine on the engine side of the throttle is applied, during the idling period to increase the suction on a restricted fuel orifice through which all the fuel supply passes to the air supply throughout the entire range of operation, a downwardly extending fuel passage through which all the fuel passes during all conditions and phases of such operation.

An object of the invention is to furnish additional fuel during rapid acceleration of the engine, and I provide at the lower end of said downwardly extending fuel passage, a pocket adapted to accumulate such additional fuel for such purpose and arranged to be sealed by such accumulation to make it possible to increase the richness of the mixture during idling.

The discovery and invention is an improvement in the art in that I increase the depression in the suction chamber over that imposed by the normal operation of the air flow through the proportioning element of the carburetor to such an extent as to reverse the effective pressure of the air in the suction chamber, through the fuel passage to the mixing chamber, thus causing momentary cessation of fuel delivery to the main air stream, and an accumulation within said fuel passage, of a seal or column of fuel, the height of which seal determines the richness of the low speed mixture; and in this invention I provide means for controlling the height of said column of suspended fuel, and thereby controlling the richness of the mixture.

Another object is to provide an adjustment whereby the depression applied as above mentioned can be practically regulated.

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

In order to more particularly set forth the discovery and invention, reference will now be had to the accompanying drawing which

illustrates the application of said discovery and invention with relation to carburetors of the vortex type.

Figure 1 is a view showing apparatus adapted to carry out the operations involved in my new discovery. The parts are shown in idling position and the liquid levels are shown in position occupied when the engine is at rest. Lines x^1, Figs. 2, 3, and 5 indicate the plane of section.

Fig. 2 is a detached fragmental elevation of the delivery end of the carburetor shown in Fig. 1, looking into the suction passage.

Fig. 3 is a fragmental axial section of the carburetor shown in Fig. 1 at that period of operation during which low idling speed is maintained and a charge of liquid fuel is held suspended by regulating the application of depression in the suction chamber *a* preparatory to an increased fuel flow for accelerating the engine when the throttle is opened.

Fig. 4 is an enlarged fragmental section of the suction fuel outlet with liquid fuel charge suspended as shown in Fig. 3.

Fig. 5 is a section on lines x^5, Figs. 1 and 2, omitting the center stem that forms a part of the suction conduit. Parts are broken away to more clearly show the conduit.

It is understood that different forms and arrangements of means may be provided whereby my newly discovered method may be performed; but the foregoing drawing is deemed sufficient to fully explain the operations and to illustrate the best form in which I have embodied the means I employ in carrying out my invention.

The suction chamber *a* is connected with the constant level fuel supply chamber *b* through the fuel orifice *c*, and extends above, and is open to, the fuel passage 1 which is shown in the drawing as having an enlargement or chamber 2 at its lower end, and communicates through a trap *t*, and the fuel jet 3, with the mixing chamber 4 that has an air inlet 5 and a mixture outlet 6, the latter opening into the suction passage 7 which is connected to the intake manifold 8, of an internal combustion engine. 9 is the throttle between the suction passage 7 and the mixture outlet 6.

A by-pass for controlling the depression on the fuel orifice during idling is provided, leading from the suction chamber *a* above the fuel level to the suction passage 7; and said by-pass is shown as comprising a suction tube 10, leading from above the overflow inlet 11 of the fuel passage to a duct 12 that opens into an annular chamber 13 which communicates with the suction passage 7 through a bore 14 and by-pass port 15.

Said suction chamber *a* also has a restricted communication with the atmosphere, and in Fig. 1, such communication is shown as being effected through an air port 16 and an equalizing tube 17 that communicates with the air inlet 5 and is arranged to insure that pressure conditions in the float chamber are the same as those at the air intake 5 of the vortex chamber. The restricted fuel orifice *c* opens from the constant level chamber *b* into the suction chamber *a* below the constant liquid level 18 of such chamber, and the parts are so constructed and arranged that the overflow inlet 11 is somewhat above the constant liquid level 18. The intake of suction tube 10 is at such a height above the liquid level 18 as to prevent any liquid fuel from being sucked into the suction tube 10 at any time by the operation of the engine.

The cork float 19 is of the usual type to close the fuel valve 20 against the pressure of the fuel supply. 21 is a priming plunger adapted to depress the float 19 to open valve 20 when desired.

The adjusting sleeve 22 is provided at the top with a milled head to make it convenient to rotate the same to adjust the opening of the orifice *c*. Said sleeve is retained in fixed position by means of the retainer spring 23.

The adjusting passage 24 connects the by-pass and the mixture outlet 6, of the mixing chamber 4.

The adjusting passage 24 is controlled by a screw operated valve 25 retained in adjusted position by the retainer spring 26. Said valve 25 is adapted to regulate the adjusting passage 24 and thereby control the amount of extra suction applied to the suction chamber *a* through the suction tube 10 when the engine is throttled and is operating under very light load.

The height of the fuel in suction chamber *a* when operating under load is indicated by the line *d* in Figs. 1 and 3.

Vent 27 supplied the requisite air pressure from the balance tube 17 to the surface of the fuel in the constant level fuel chamber.

During engine operation at any speed, the usual vortex is formed in the mixing chamber by air sucked through from the inlet 5, but with the former carburetor of this type the suction produced on the fuel jet port at 3 by vortical action, is insufficient to maintain the operation of the engine at low idling speed; but by my improvement the fuel feed during idling, is made positive, and fuel is accumulated in the fuel passage and held therein until the throttle is opened, and is thereupon released or discharged into the mixing chamber and then serves to accelerate the engine.

Starting with the engine running under load and the proportioning and mixing chamber operating normally, closing the throttle past the port 15, will immediately increase the depression beyond the throttle and in the suction passage 7, which depression, acting through the port 15 and through

the idling by-pass creates in the suction chamber *a*, a depression greater than that at the fuel jet 3 imposed by the vortical action in the mixing chamber 4, at the low speeds of the motor when idling, in spite of the fact that the suction chamber *a* is open to the atmosphere at the upper end through the port 16 and is normally freely open downward through the fuel passage 1 and its enlargement 2, and communicates through the jet port 3 with the air in the mixing chamber 4.

This excess depression in *a* above that in the mixing chamber when idling, will cause, an increase in fuel flow through the orifice *c*, an increase in air flow through the restricted port 16, a momentary flow of air through the jet port at 3 from the mixing chamber, and an accumulation of fuel in the chamber 2 and the fuel passage 1 against the force of gravity, thus forming a seal as shown in Fig. 4, and filling the fuel passage until these forces come to equilibrium; that is, until the height of this column of fuel becomes sufficient to balance the suction that is applied through the by-pass during idling; and operates against the restricted air port 16 and against the depression in the vortex chamber; fuel continuing to flow through *c* under this depression, will fall down to the surface of the upper end *e*, of this column and will drop out of the jet 3 as shown in Fig. 3, and will flow down along the bottom of the mixture outlet 6; some of it flowing through the adjusting passage 24, and on past the throttle into the engine. The height of this column of fuel is regulated by means of valve 25, opening or closing this passage, adjusting the amount of air and fuel which will flow through orifice *c*.

In practice the port 15 being operated on by the high vacuum beyond the throttle, can be relatively small and may not be larger than $\frac{1}{16}$th of an inch depending upon the design of the carburetor while the port 16 is somewhat larger and would be at least fifty per cent greater in area than the port 15 in this particular type of carburetor.

Adjustment of the valve 25 will control the height, as at *e*, of the column of accumulated fuel in the fuel passage 1 and the fuel flow for the idling mixture. It will be readily seen that the height of this column of fuel is a measure of the pressure operating to increase the flow of fuel through the orifice *c* under idling conditions as compared to the pressure which could be produced by the vortical depression occurring at 3. This increased pressure to force the fuel is necessery because the pressure necessary to raise the fuel to the point of overflow at 11 is too large a percentage of the total depression existing in chamber *a* during idling. An idling or low speed operating mixture must be slightly richer than a full load mixture to obtain smooth operation at such low speeds. The over-flow inlet 11 is necessarily some distance above the normal fuel level in oredr to prevent leakage, therefore, a correspondingly higher depression in low speed range must be maintained in the suction chamber *a*.

This accumulation of fuel between the jet 3 and some point in the mixture passage 1 becomes available for rapid acceleration of the motor or engine when changing from idling to higher speed, or load; for, upon opening the throttle 9, the excess depression applied through the by-pass is instantly diminished, and the accumulated fuel will immediately be discharged and carried in with the rush of new air to supply the engine at the first instant of acceleration, until normal flow is established for the new speed. At no time during all of these operations is there any fuel passing through the upper end of the tube 10, and nothing but air is carried by this idling by-pass until it is supplied with fuel through some vent, such as the adjusting passage 24, which may pick up fuel; so that in general operation this idling adjustment has no effect upon the mixture until the throttle is nearly closed; and all the fuel, all the time, whether under load or idling, flows through the same path and in the same direction toward the engine, and invariably meets the air stream at the same point; that is, at the jet 3, throughout all phases of the operation of this carburetor.

This is important since this carburetor inherently produces a correct mixture throughout its whole range of load operation; the depression at 3 which is caused by the action of the vortex mixing chamber 4, being correct at all speeds when fuel orifice *c* is adjusted at any speed; and the difficulty of obtaining correct mixture at idling is overcome by having a predetermined fuel orifice *c* and varying the pressure on that orifice to cover the idling speed. If independent means were introduced to produce the idling mixture, it would supply more or less fuel throughout the whole range and would supplement and interfere with the correct mixture produced in the mixing chamber 4. With this improvement a small movement of the throttle from the idling position removes any special pressure on the fuel orifice, leaving the carburetor to the normal action and this is especially helped by using the air and fuel flowing within the carburetor for supplying the adjusting passage 24.

One important reason for supplying this vent from the inside of the carburetor is that if atmospheric air is taken in at this point during idling, it disturbs the proportion throughout the whole range of the carburetor on account of the vent 24 being constantly open to new air; and a second important reason is, that carburetors may be either connected to a hot air stove or air washer and there should be only one con-

nection to such stove or washer; therefore all vents and controls should be supplied from the one air inlet 5.

Such stove or air washer will cause a variable depression at the intake 5, which is compensated for by means of air supplied through equalizing tube 17 to air port 16, and to the surface 18 of the fuel through the hole 27. If air from outside the carburetor were admitted to 24 these variable pressures would upset the proportioning.

The heavy fractions of the fuel that are thrown on the walls of the mixing chamber 4 finally escape thoroughly atomized and under considerable pressure through the ports 90 into the mixture outlet 6. The pressure at which the heavy fractions of fuel are discharged into the mixture passage may amount to one-half pound per square inch at full load and at such pressures air flowing with the fuel in the mixing chamber causes violent atomization of the fuel passing through the ports 90.

Auxiliary accelerating means are provided comprising a sump 91 adapted to accumulate fuel from the mixture outlet and a passage 92 leading from the bottom of said sump to a point beyond the throttle. An overflow is provided for the sump to prevent flooding of the engine to which the carburetor is attached and consists of an outlet 93 drilled in the boss 94 the top of which is slightly below the bottom of the mixture outlet as shown in Fig. 2.

I claim:—

1. A carburetor comprising a suction passage; a mixing chamber provided with an air inlet and having a mixture outlet open to the suction passage; a throttle to control the mixture outlet; a constant level fuel chamber; a suction chamber; a restricted fuel orifice to deliver liquid from the fuel chamber to the suction chamber; a fuel passage leading downwardly from the suction chamber and opening into the mixing chamber below the level of the restricted fuel orifice; a conduit open beyond the throttle and forming a constantly open communication between the suction passage and the suction chamber, and a restricted air port constantly open to the suction chamber.

2. A carburetor comprising a suction passage; a mixing chamber provided with an air inlet and having a mixture outlet open to the suction passage; a throttle to control the mixture outlet; a constant level fuel chamber; a suction chamber; a restricted fuel orifice to deliver liquid from the fuel chamber to the suction chamber; a fuel passage leading downwardly from the suction chamber and provided at the lower end with a trap opening into the mixing chamber below the level of the restricted fuel orifice; a conduit open beyond the throttle and forming a constantly open communication between the suction passage and the suction chamber, to utilize the depression of the suction passage to cause the formation of a seal at the trap in the fuel passage, thus making possible a richer mixture during idle operating; and a restricted air port constantly open to the suction chamber.

3. A carburetor provided with a constant level fuel chamber; a suction passage; a suction chamber supplied with fuel from the constant level chamber through a restricted orifice, and with air from a restricted air port; a mixing chamber; an air inlet and a mixture outlet; a throttle controlling the mixture outlet; a fuel passage leading downward from the suction chamber to the mixing chamber to supply fuel from said suction chamber to said mixing chamber; a by-pass leading from the suction chamber at a point well above the fuel level, to the suction passage to apply in the suction chamber at a closed position of the throttle a depression from beyond the throttle to sustain a column of fuel in the fuel passage against the force of gravity; and means for controlling the suction applied in said chamber through said by-pass.

4. A carburetor provided with a constant level fuel chamber; a suction passage; a suction chamber supplied with fuel from the constant level chamber through a restricted orifice, and with air from a restricted air port; a mixing chamber; an air inlet and a mixture outlet; a throttle controlling the mixture outlet; a fuel passage leading downward from the suction chamber to the mixing chamber to supply fuel from said suction chamber to said mixing chamber; a by-pass leading from the suction chamber at a point well above the fuel level, to the suction passage to apply in the suction chamber at a closed position of the throttle a depression from beyond the throttle to sustain a column of fuel in the fuel passage against the force of gravity; and a valve controlled passage to admit a controlled amount of mixture to the by-pass to control the suction in the by-pass and adjust the depression in the suction chamber.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 19th day of November, 1919.

ROY F. ENSIGN.