Feb. 27, 1934. R. F. ENSIGN ET AL 1,948,702

CARBURETOR AND FUEL CONVERTER

Original Filed Feb. 23, 1927 3 Sheets-Sheet 1

Fig. 2.

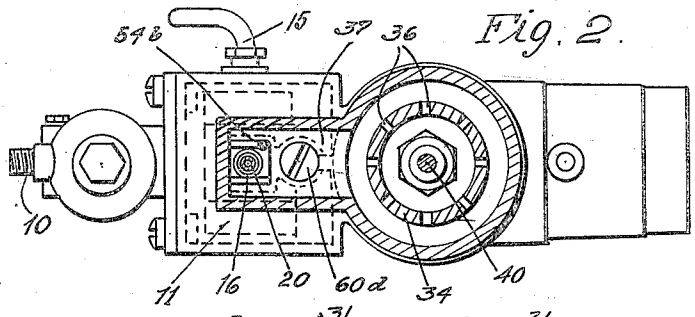


Fig. 1.

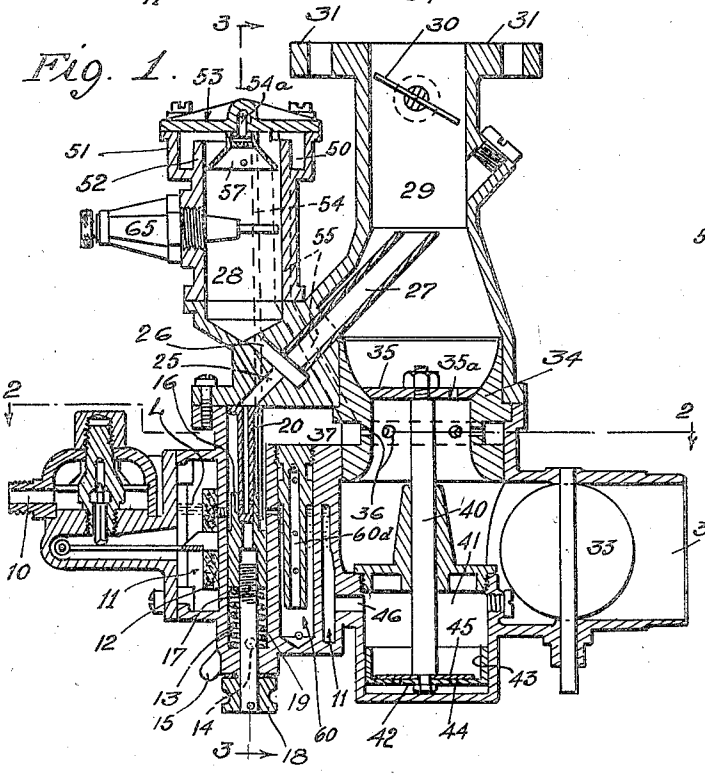


Fig. 3.

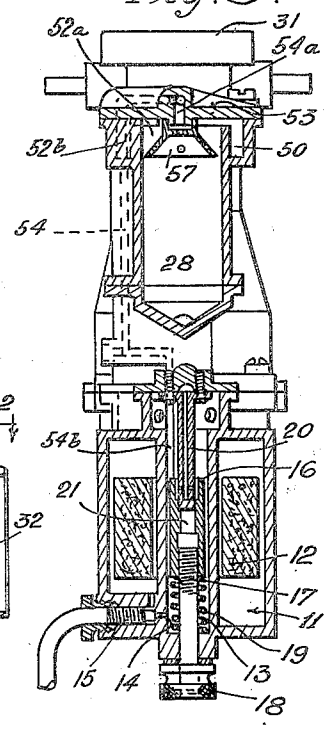
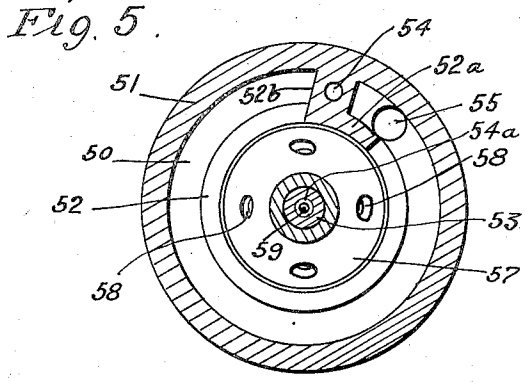


Fig. 5.



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CARBURETOR AND FUEL CONVERTER

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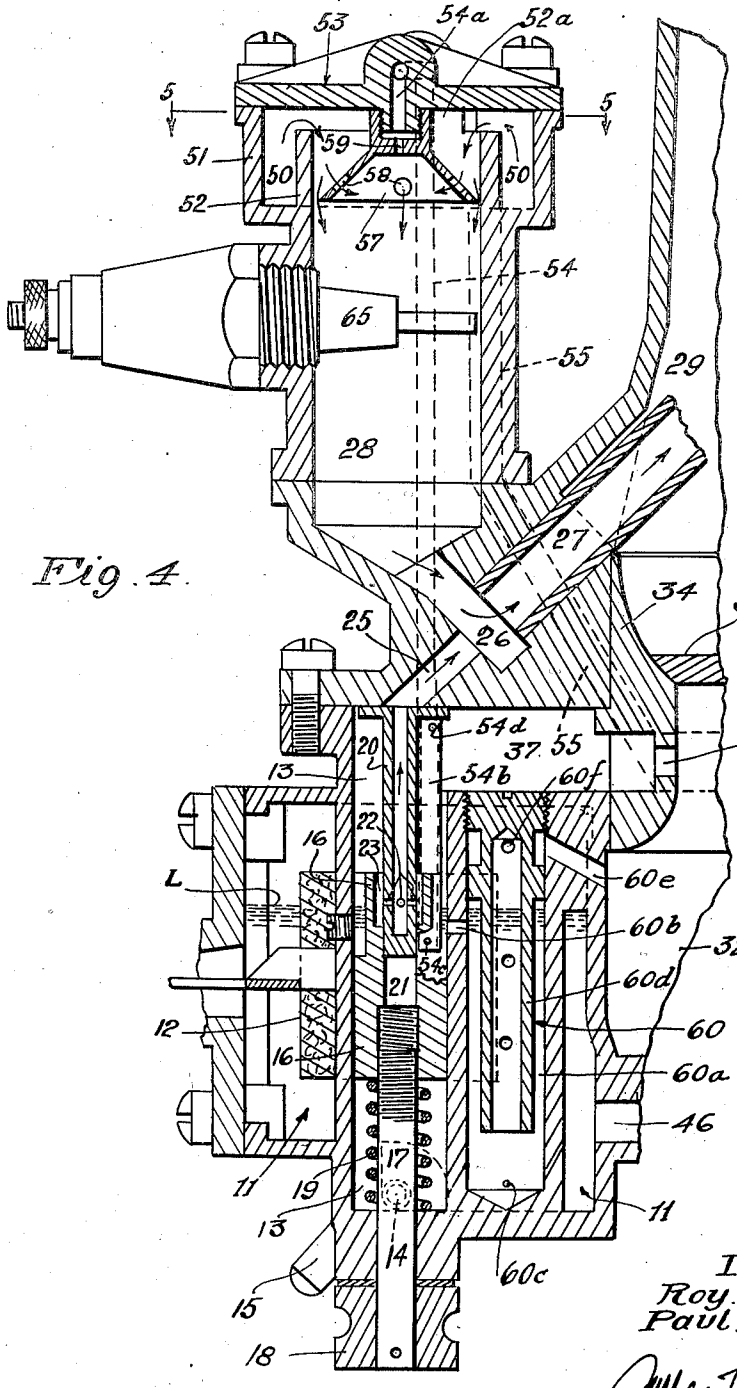


Fig. 4.

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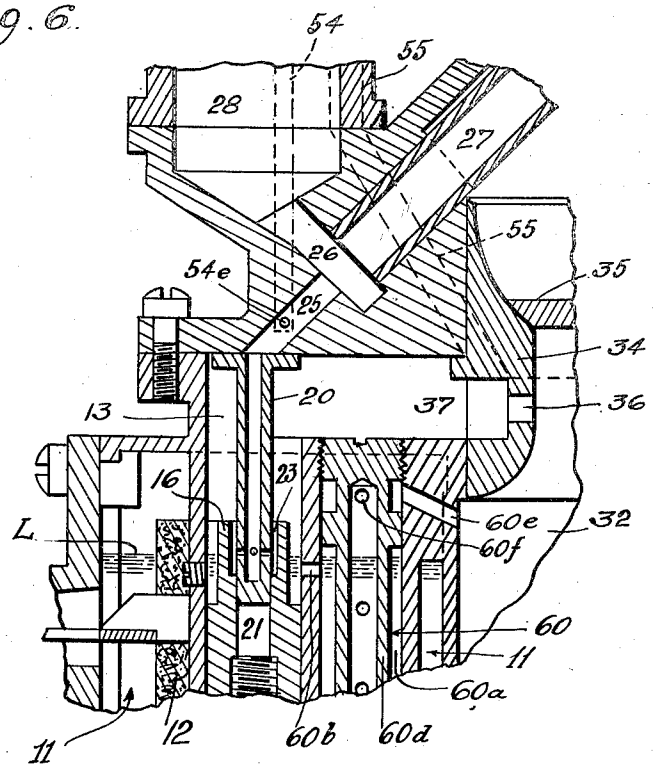
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CARBURETOR AND FUEL CONVERTER

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Fig. 6.



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UNITED STATES PATENT OFFICE

1,948,702

CARBURETOR AND FUEL CONVERTER

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Continuation of application Serial No. 170,182, February 23, 1927. This application December 18, 1931, Serial No. 581,816. In Germany September 18, 1931

23 Claims. (Cl. 123—122)

This invention has to do broadly with carburetors and converters for reducing a combustible air mixture with the use of liquid fuels; and the following described illustrative embodiment of the invention has particularly to do with the carburetion and conversion of liquid fuels to form a combustible mixture for operating internal combustion engines. And, although the particular embodiment herein described may be used, with the slight proportioning changes necessary for the purpose, for handling such heavy hydrocarbon fuels as kerosenes and distillates, the device illustrated has been specifically developed for gasoline as a fuel. Present day gasoline is of such a nature that its use as motor fuel in cold climates entails difficulties comparable with those attending the use of heavier fuels in more temperate climates; both being attended by difficult evaporation of the fuel. The specific purpose of the converter hereinafter described is to produce and supply an internal combustion engine, such as an automobile engine, with a combustible mixture on which the engine quickly starts and warms up to full power and can operate at high efficiency and with all the flexibility desired in the coldest of weather; but it will be understood that the invention itself, of which the following mechanism is but a typical illustration, is not necessarily limited to the production of fuel or mixture for such a specific use, nor limited to using gasoline.

This application is a continuation of our prior application Ser. No. 170,182, filed February 23, 1927, entitled Fuel converter.

The present invention embodies functionally both a carburetor and a fuel converter. Considered as a carburetor, the invention may be regarded in certain aspects as an improvement upon the carburetor upon which Patent No. 1,684,055 was granted to Roy F. Ensign on September 11th, 1928. In its aspects as a carburetor without the conversion of fuel, or as a combined carburetor and fuel converter, the present invention includes provisions for forming, and maintaining throughout operating range, the desired air to fuel proportions, by providing initial fuel metering means substantially independent of the final fuel delivery to the main air stream. This present device forms an initial pressure differential for first metering the fuel in desired proportion to the air stream volume; maintaining said initial pressure differential substantially independent of the second pressure differential which finally delivers the fuel into the main air stream for admixture therewith. The improvement in this direction, over and above the carburetor shown in said Roy F. Ensign patent, centers largely around the use of a movable valve obstruction in the main air stream, whereby to create and maintain the pressure differentials here spoken of. And, in such aspects of improvement, the invention has to do both with carburetors in general and fuel converting carburetors.

As a combined carburetor and fuel converter, or in its fuel converting functions, our present invention may be regarded in certain aspects as an improvement upon the devices and method set out in the Letters Patents of Orville H. Ensign, Nos. 1,408,277 and 1,408,278, dated February 28, 1922. The fuel converters set out in said issued patents embody a system in which a body of proportionate air and fuel, more or less mixed, is divided into two parts, one part being more or less completely burnt to supply heat for vaporization of the fuel of the other part, the products of combustion from the burnt part being mixed with the air and fuel of the other part in one homogeneous heated mixture which is then conducted to the engine for final combustion. Certain minor difficulties have been encountered in the operation of such fuel converters, among which may be mentioned the occasional tendency of the combustion to fire back into the main initial stream of air and fuel mixture, or to fire forward to the point of final admixture, with an attendant liability of firing the whole body of mixture within the device itself and before it can reach the place of final combustion. Our present invention is designed to overcome these difficulties completely as well as to provide other and further improvements in matters of construction and operation, and particularly in the matter of automatic regulation of the final mixture, and the heat supplied by the combustion. Also it is an object to give more perfect control of the mixture to the combustion chamber so that mixture shall not change its composition with change of composition of the main mixture—so that the main mixture can be enriched without correspondingly enriching the combustion mixture and consequent fouling of the combustion chamber with carbon. The invention also makes it possible to operate an engine at full power and low speed and still sustain a proper fire in the combustion chamber; and also facilitates the obtaining of a correct mixture for the relatively small amount of combustion mixture by using only a small fraction of the total depression (suction) used to form the whole mixture and by taking the fuel for combustion from a point of constant operating level even more

constant than the float maintained level, which fluctuates somewhat with the load. All of these things, and improvements with respect to various other matters, will be best understood from a consideration of the following detailed specification wherein a typical and specific form of the invention adapted specifically for supplying a combustible mixture to an internal combustion engine is set forth in detail.

It will be understood that in giving a detailed description of a specific form we do so not for the purpose of limiting the invention to such specific details, but so that those skilled in the art may have a complete understanding of the invention itself by way of a thorough understanding of one form of it, and also may have a complete understanding of the specific apparatus which we now deem best adapted to the particular purposes set forth. We refer to the accompanying drawings, in which:

Fig. 1 is a vertical central longitudinal section of a fuel converter embodying our invention and adapted particularly for use in connection with an internal combustion engine;

Fig. 2 is a horizontal section taken as indicated by line 2—2 on Fig. 1;

Fig. 3 is a vertical cross-section taken as indicated by line 3—3 on Fig. 1;

Fig. 4 is a fragmentary enlargement of parts of the section of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary section similar to parts of Fig. 4 but showing a slight modification.

Fuel is initially admitted from fuel feed 10 into a constant level chamber 11 governed by a float 12, the normal fuel level standing at such a line as indicated at L in Figs. 1 and 4. Arranged within the constant level chamber is a fuel well 13 communicating with the constant level chamber through a fuel feed orifice 14 controlled by a manually adjustable valve 15. Within the fuel well 13 there is an adjustable standpipe 16 whose upper overflow edge stands, adjustably, a little above the normal fuel level L. This standpipe 16 may be adjusted up and down in the well by means of a screw 17 having a thumb nut 18 on its lower end, the screw acting to pull the standpipe down and a spring 19 acting to elevate it. The screw 17 fits screw-threadedly into the lower end of the standpipe tightly enough that fuel leakage past it is of no material consequence. A fuel suction tube 20 depends from above into bore 21 of the standpipe, making a fairly tight fit with the bore; this arrangement is merely to allow considerable vertical adjustment of the standpipe if desired. And the upper end of the standpipe has an enlarged bore to form an annular fuel receiving space 23 around the lower end of the suction tube, fuel and air being drawn from this space through ports 22 in the lower part of suction tube 20. The upper end of fuel suction tube 20 communicates with a suction passage 25 which in turn communicates with combustion passage 26 and mixing tube 27. Combustion passage 26 communicates with combustion chamber 28, and mixing tube 27 discharges into main mixture passage 29. This main mixture passage is controlled in the usual way by a throttle 30 and is formed at 31 at its upper end for attachment to the intake manifold of an engine. Air is initially taken into the device through the air intake passage 32, past the choke valve 33, and thence upwardly and through the Venturi tube 34 and through or around the vertically opening valve 35 into the mixture passage 29. Air ports 36 communicate with the interior of the Venturi tube at its throat while valve 35 seats above ports 36. Air ports 36 communicate with an air passage 37 to which the upper end of fuel well 13 is open, so that the varying depression present in the throat of the venturi, slightly modified by the depression communicated from the passage 29 above valve 35, through tubes 27 and 20 and through passage 55, acts upon well 13 to raise the fuel level therein to a point where the fuel will overflow the upper edge of standpipe 16 and thus flow into the annular space 23. Due to the functions here described the passage 37 and the well 13 act as, and may be called, a depression chamber or passage. The constant action of valve 35, obstructing the flow of air to passage 29, is to make the depression in 29 somewhat greater than at the Venturi throat; with a tendency to increase the relative difference in depressions at low operating speeds when valve 35 is closed or nearly closed. This difference in depressions constitutes the force that lifts the fuel through tube 20; and the greater depression in 29 is to a certain extent transmitted through the fuel lift tube 20 to passage 37 to modify the depression therein that lifts fuel in well 13. The modifying effect of depression in 29 on the depression in 37 is relatively small, due to the fact that passage 37 and ports 36 are much larger than tube 20 and ports 22. Consequently, although the lift of fuel in well 13 is dependent primarily upon the depression at the Venturi throat (and therefore on the velocity and volume of air through the venturi) to a certain small extent the fuel lift in the well is dependent on the greater depression present in passage 29, and the fuel delivered to and lifted through tube 20 increases slightly, proportionately to the total air, at low speeds. It should be borne in mind however that the lift of fuel through tube 20 is dependent entirely upon the depression in 29 over that in 37; and this matter will be referred to later.

Valve 35 is mounted upon the upper end of a stem 40, the lower end of which passes into a dash pot cylinder 41, and carries a check valve 42 at its lower end. This check valve is conveniently formed of a piston 43 loosely fitting the cylinder, the piston having openings 44 controlled by a downwardly closing flap 45. Dash pot cylinder 41 is kept full of liquid (fuel in this case) by having a communication 46 with constant level chamber 11. The construction and arrangement are such that the downward closing movement of valve 35 under influence of gravity is comparatively unchecked. The effect is thus that, at any constant or decreasing air flow, the obstruction of valve 35 is due to gravity only and is constant, while the obstruction is momentarily increased when the throttle is opened, causing more proportionate fuel to be lifted in well 13 and tube 20 during acceleration. This is due to the increased depression above the valve acting, in its modifying function, to momentarily increase the depression in the fuel well; and also acting, directly, to lift more fuel from the well through tube 20. Valve 35 has a hole or holes 35*a* through it to pass a minimum quantity of air when the valve is closed and thus to limit the proportionate amount of fuel lifted at slow operating speeds. It will be understood that a small amount of air is drawn up through tube 20 along with fuel; and that although the proportion of fuel, through

tube 20, to the total air passing through the device to form the final mixture varies as above stated, the mixture in tube 20 itself thins down at lower operating speeds.

Further to vary the fuel level in well 13 and thereby vary the proportionate fuel fed to tube 20, we may provide an accelerating well device 60. This may comprise a well 60*a* having a port 60*b* near its top, communicating with fuel well 13, and having a fuel orifice 60*c* near its bottom leading from constant level chamber 11. An open bottomed tube 60*d* depends in well 60*a* and has air connection to air intake passage 32 by way of air ports 60*e* and 60*f*. Upon any sudden opening of the throttle and consequent momentary abnormal increase of depression in passage 37 and well 13 fuel is drawn into well 13 from well 60*a*, the level in tube 60*d* falling under the approximately atmospheric pressure applied to it, and the fuel level in well 13 being thus temporarily raised to deliver more fuel over the upper edge of standpipe 16 to fuel tube 20. Upon decrease of depression at the Venturi throat and passage 37, the accelerating well tends to fill again by feed from port 60*c*.

The action of valve 35 also assists in acceleration. Upon increase of air flow the valve does not instantaneously move up to its new equilibrium position but is retarded not only by its own inertia but also by the action of the dash pot during the acceleration period the depression difference, above and below the valve, is thus increased, and the relatively increased depression transmitted through suction tube 20 has, for the time being, a greater than normal modifying effect on the depression in well 13; thus acting temporarily not only to lift more than normal fuel from the well, but also to somewhat increase the well depression to lift more fuel in the well and meter more fuel over into space 23.

Combustion chamber 28 is preferably constructed as is best shown in Figs. 4 and 5, being generally cylindric in form and having the combustion outlet passage 26 leading from its lower end into communication with passage 25 and mixing tube 27, passage 25 being substantially coaxial with mixing tube 27 and passage 26 extending transversely of 25 and 27. At its upper end the combustion chamber 28 has an annular chamber 50 formed between an outer wall 51 and an inner wall 52, which inner wall is in effect an upward continuation of the cylindric wall of the combustion chamber proper. This inner wall 52 ends somewhat below the chamber cover 53, so that a space is left over the upper edge of wall 52 for the purpose to be described; except that at one point the wall 52 extends on up, as shown at 52*a*, to the level of the under side of the cover. Adjacent this upward extension 52*a* the annular space 50 is completely blocked off by a block 52*b* (see Fig. 5) and the fuel supply passage 54 extends up through block 52*b*. The air supply passage 55 for the combustion chamber extends up from passage 37 to the bottom of annular chamber 50 and delivers its air into the annular chamber adjacent the block 52*b* and at a point behind the wall extension 52*a*, so that the air delivered at that point cannot flow immediately upwardly and over the upper edge of wall 52, but is set into a circular motion around annular space 50 and thus flows both around and up and over the upper edge of wall 52 in a spiral path as indicated by the arrows in Fig. 4. Thus the air for the combustion chamber is delivered equally around its upper periphery to maintain combustion evenly in the chamber. The air that is thus delivered into the upper end of the chamber comes into contact with a distributor or spreader 57 preferably conical in shape and whose outer edge is spaced slightly from the inner wall of the combustion chamber to allow air to be distributed in an even annular flow downwardly next the wall of the chamber. The distributor also has air openings 58 through which air may flow inwardly and downwardly to mingle directly with the fuel which is being delivered downwardly through the central fuel port 59 of the distributor. Fuel reaches this central fuel port of the distributor from the passage 54*a* which communicates with the vertical passage 54 before mentioned. The lower end of this vertical passage 54 is formed by a tube 54*b* (see particularly Fig. 4) which extends down into well 13 to a point below the fuel level L. The lower end of this tube is closed but near this lower end the tube has a small fuel orifice 54*c* of determined size and through which fuel is drawn into the tube. Also the tube has a small calibrated air bleed 54*d* which bleeds in air from passage 37 to modify the fuel elevating depression in the tube. To prevent passage 55 from taking any fuel mist that may at times be present in well 13 over the fuel therein, the passage is made to communicate with passage 37 at a point removed from the well, as shown in the drawings.

The above description has dealt only with the essentials of the converter as it has now been developed; various features that are present in a commercial device, such as an economizer bypass and such as a pressure equalizing communication between intake 32 and constant level chamber 11, will not be described as their constructions and functions are well known.

In operation it will be understood from what we have previously said how the device acts to lift fuel and air through tube 20 and how the amounts and proportions are varied to suit different operating conditions. The cooperation of this action with that of supplying fuel and air to the combustion chamber will be noted later.

The depression applied to mixing tube 27 is applied through combustion outlet 26 to the combustion chamber. The depression in the combustion chamber is applied through fuel passages 54*a* and 54 to the fuel suction tube 54*b*, modified by the bleed 54*d*, to draw fuel up into the combustion chamber. Also the depression present in combustion chamber 28 is applied through air passage 55 to draw air into the combustion chamber from air passage 37. Thus, on the whole, the combustion in chamber 28 is heavier as the device acts at higher operating speed—as the throttle is opened. But the proportionate amount of air and fuel which is thus drawn into the combustion chamber, compared with the amount of air and fuel that goes directly to mixing chamber 29, is controlled fundamentally by the relative sizes of the passages, by the depression action at the throat of the Venturi tube, and by the relative depression in passage 29 caused by the action of valve 35. On opening the throttle the action of valve 35 in controlling the relative depressions not only causes more fuel to be drawn through the fuel suction tube 54*b* but also momentarily causes a larger proportion of air to be drawn through passage 55 into the combustion chamber. And speaking in a general way, the normal action of valve 35, in combination with the design and proportion of the other parts, causes the proportion of fuel

and air to the chamber somewhat to increase, relative to the whole amount of fuel and air going through the device, upon decrease of the total amount of fuel and air flowing through the device. In a typical installation the temperature of the final mixture in passage 29 at idling operation is about 160° to 170° F., and about 140° F. at full load. The opening 35*a* in valve 35 limits the proportionate amount of fuel and air going to the combustion chamber at low speeds and therefore limits the temperatures at such speeds. But, throughout all such changes of total amounts of air and fuel going to the combustion chamber, the fuel to air proportion remains substantially unchanged. This proportion is designed to be a little richer than would make complete combustion, but not so rich as to cause deposition of soot. It is to be noted that, although changes of fuel level in well 13 vary considerably the amount of fuel flowing into space 23 and into tube 20, the actual variation of level above the upper edge of stand pipe 16 is very small—so small that the hydrostatic head over the opening 54*c* to fuel tube 54*b* varies very little. Consequently, the fuel level variation that materially changes the composition of the main mixture (fuel through tube 20 and air through the venturi) has substantially no effect on the mixture proportions delivered to the combustion chamber.

The fuel and air in the combustion chamber are mixed at the distributor 57 and are ignited by the spark plug 65, the spark plug being operated continuously enough to insure continuity of combustion. The air delivered into the combustion chamber passes through that chamber in a more or less swirling path, due to its method of introduction above described, and the fuel which is introduced is sprayed through the small fuel port 59 in admixture with air which has entered the fuel suction passage through bleeder 54*d*. The fuel therefore is quickly atomized and vaporized in the heat of the combustion chamber and being thus finely divided and intimately mixed with the air, uniform and efficient combustion takes place. The hot products of combustion are drawn out through discharge passage 26 across the path of the fuel and air moving up through the fuel passage 25 and then into mixing tube 27, coming into turbulent contact with the fuel and air that are being drawn up through passage 25; and that fuel is immediately vaporized and the flame is smothered at that point, if it extends that far, due to a deficiency of air. The air requisite for forming a combustible mixture with the fuel that is being drawn through passage 25 is being drawn up through mixing chamber 29 and does not come into contact with this fuel until the fuel reaches that mixing chamber. Consequently, at the point where fuel passage 25 and combustion outlet passage 26 meet the flame is smothered and there is then constantly present in mixing tube 27 a mixture of some products of combustion (more or less complete), products of incomplete combustion, vaporized fuel, a small amount of uncombusted air which may be drawn through tube 20 along with the fuel, and perhaps some products of cracking of the hydrocarbon fuel due to heat action taking place in the flame or where the main fuel meets the flame or hot products of combustion. In mixing tube 27 all these various gases and vapors are thoroughly admixed and heated to a temperature sufficient to vaporize substantially all of the unburnt fuel present. If any of the heavier parts of the fuel are not vaporized, they are so small in quantity that, in their atomized or finely divided state, they are carried on in suspension in the gases. Investigation shows that the final mixture from passage 29 is quite dry.

At the outlet end of mixing tube 27 these mixed gases and vapors come into contact with the major air stream passing through mixing tube 29 and in that mixing tube and in the engine intake manifold they are mixed thoroughly with air and give up their heat to the air; so that the final admixture passing to the cylinders of the engine is a somewhat warmed combustible mixture of air with fuel vapor (and perhaps in some cases a little mist) gaseous products of cracking and of incomplete combustion, all in proper proportion for perfect combustion or most effective combustion considering the instant conditions of engine operation. When we here refer to a mixture properly proportioned for perfect combustion it will be understood that we do not necessarily mean theoretic perfect combustion, because in various phases of engine operation it is desired at times to feed the engine a slightly lean mixture (the well known economizer effect) and at other times such as during starting, idling or accelerating, to feed the engine a somewhat rich mixture.

It is a feature of the present converter that the major air does not come into contact with fuel until the fuel has been heated and vaporized by the hot products of combustion. There are several advantageous characteristics flowing from that fact. Admixture of the fuel and air is most easily and uniformly accomplished because the fuel is then largely in vapor form; and there is practically no possibility of the final mixture becoming ignited from the flame, the point of final admixture with air being removed from the point of quenching of the flame by the length of mixing tube 27. Also in this design there is practically no possibility of the flame firing back through the fuel passages to well 13 and air passage 37, as the only possible means of communication of that flame to well 13 is through the fuel passage 25 and fuel suction tube 20. And in passage 25 and tube 20 there is never present a mixture that is capable of supporting combustion. The flame, if it has not burned itself out by the time it reaches passage 26, is definitely and positively smothered at the point of juncture of passage 25, passage 28 and mixing tube 27, with no possibility of firing either back into the fuel well or forward into the mixing chamber 29.

It is also a feature of the form described above that the mixture proportions going to combustion chamber 28 are comparatively unchanged throughout the range of operation; due to the fact that the air and fuel feeding means to that chamber are actuated by the same forces (differential depressions) and that the forces and condition (for instance, the fuel level changes in well 13) which cause proportionate changes in the composition of the main mixture, do not affect, or materially affect, the fuel feed to the combustion chamber.

In the modification shown in Fig. 6, wherein the fuel drawn up through passage 54 to the combustion chamber is fed to that passage through an orifice 54*e* from passage 25, the final combustion mixture in chamber 28 may again be maintained approximately uniform; although this arrangement has not, as yet, given as good results as the form first described. As the speed of operation lowers, the mixture in 25 becomes some-

what thinner; but by proper proportioning of the parts enough fuel may be drawn into 54 to keep up combustion at low speed and at the same time prevent the combustion mixture from being non-combustibly rich at high speed.

There is also another characteristic feature of which we wish to speak particularly. It will be noted, as we have said, that the lift of fuel initially from the float chamber into well 13, and the consequent initial isolation of a metered or measured amount of fuel in that well and in the space 23, is an operation performed primarily by the depression present at the throat of the Venturi tube—by the difference in pressure at the Venturi throat and that in the float chamber, which latter, in this case, is atmospheric. Then the final lift and delivery of fuel, from that measured and isolated body of fuel in the well, is a function that depends upon the difference between the depression in mixing chamber 29 and the depression at the Venturi throat and in air passage 37. At average operating conditions this last mentioned differential depression that finally lifts the fuel, and causes the metering of both the main and combustion fuel in proportion to their respective air volumes, is but a fraction of the total depression operative in the device. By thus utilizing a controlled fractional depression the proportional metering of the fuel, and particularly of the relatively small amount of fuel going to the combustion chamber, is greatly facilitated, as far greater delicacy of control is thereby obtained than could be had by using the total depression for raising and metering such a small amount of fuel. The initial metering and isolation of the whole body of fuel in proportion to the whole body of air also facilitates such accurate final fuel metering. In this last mentioned feature, as well as in several other features, similarities of function will be recognized between our present improved device and that of the O. H. Ensign patents hereinbefore mentioned, wherein also the whole body of fuel is initially metered and then a part of it taken off for combustion, and also, the R. F. Ensign patent wherein the fuel is initially metered by a first depression and then finally delivered to the main air stream by another depression.

Finally, we wish to call particular attention again to the device of this invention functioning as a carburetor. In its function as a fuel converting carburetor, its functions are mainly those of a carburetor; most of the fuel and air being admixed without combustion taking place. Only a small proportion of the total fuel and air is put through the combustion chamber for warming and thus helping to vaporize the remaining body of fuel. In operating upon lighter fuels, or upon the same fuels at higher temperatures, the preburning of fuel may be dispensed with—the conversion function of the device is not necessary to the carburetor function, although the latter is necessary to the former.

It is therefore our desire to claim the invention both as a carburetor and as a combined carburetor and converter. The converting function may be dispensed with by omitting from the device the fuel burning elements; or, in the complete device, may be dispensed merely by preventing fuel from reaching the burner, as by stopping fuel passage 54, or by cutting off suction from the combustion chamber, as by stopping passage 26 above its point of communication with passages 25 and 27.

We claim:

1. Apparatus of the character described, embodying, a combustion chamber, an air and mixture passage having a throttle controlled suction outlet and an air inlet, a Venturi tube in the passage between the inlet and outlet, a flow obstructing valve in the passage at the outlet side of the Venturi tube and opening toward the outlet, a constant level liquid fuel chamber, a fuel well fed from said chamber, an air passage leading from the Venturi throat to the well above the fuel level therein, a suction passage leading from the air and mixture passage between the outlet and the valve to the fuel well to draw fuel therefrom, a combustion outlet passage leading from the combustion chamber to a medial point in said suction passage, a fuel feed passage leading from the well to the combustion chamber, and an air inlet leading from the air passage to the combustion chamber.

2. Apparatus of the character described, embodying, a combustion chamber, an air and mixture passage having a throttle controlled suction outlet and an air inlet, a Venturi tube in the passage between the inlet and outlet, a flow obstructing valve in the passage at the outlet side of the Venturi tube and opening toward the outlet, a constant level liquid fuel chamber, a fuel well fed from said chamber, and air passage leading from the Venturi throat to the well above the fuel level therein, a suction passage leading from the air and mixture passage between the outlet and the valve to the fuel well to draw fuel therefrom, means in association with the fuel well and suction passage whereby slight fuel level variations in the well vary the feed of fuel to the suction passage, a combustion outlet passage leading from the combustion chamber to a medial point in said suction passage, a fuel feed passage leading from the well to the combustion chamber, the inlet to said fuel feed passage being below the normal fuel level in the well so that fuel feed to said tube is substantially unaffected by the fuel level variations, and an air inlet leading from the air passage to the combustion chamber.

3. The method of forming a combustible mixture for internal combustion engine operation, which includes first metering and isolating the proper proportionate amount of fuel for any given and proportionately measured amount of air for the final mixture; then taking from said isolated fuel a small proportion of fuel and burning it with a measured and proper amount of said proportional air to maintain combustion, delivering to the products of said combustion the remainder of the isolated fuel, thereby quenching any remaining flame and heating and vaporizing said fuel, and thereafter bringing together a portion of said proportional air not utilized in maintaining said combustion, and the combustion products and vaporized fuel to form the final mixture.

4. The method of forming a combustible mixture for internal combustion engine operation, which includes first metering and isolating the proper proportionate amount of fuel for any given and proportionately measured amount of air for the final mixture; then taking from said isolated fuel a small proportion of fuel and burning it with a measured and proper amount of said proportional air to maintain combustion, delivering to the products of said combustion the remainder of the isolated fuel with a small amount of air insufficient to sustain combustion, thereby quenching any remaining flame and heating

and vaporizing said fuel and thereafter bringing together the remainder of said proportional air and the combustion products and vaporized fuel to form the final mixture.

5. The method of forming a combustible mixture for internal combustion engine operation, that includes first isolating measured and proportionate amounts of air and fuel in proper proportion for the final mixture, then forming a substantially uniform combustible mixture of a small portion of said isolated fuel with a corresponding small portion of said isolated air and burning that mixture, simultaneously forming a combustible mixture of the remainder of the isolated fuel and air in proportions varying in accordance with the requirements of engine being operated, and mixing the last mentioned mixture with, and heating it by, the products of said combustion.

6. The method of forming a combustible mixture for internal combustion engine operation, which includes first metering and isolating the proper proportionate amount of fuel for any given and proportionately measured amount of air for the final mixture; then taking from said isolated fuel a small proportion of fuel and burning it with a measured and proper amount of said proportional air to maintain combustion, delivering to the products of said combustion the remainder of the isolated fuel, thereby quenching any remaining flame and heating and vaporizing said fuel, and thereafter bringing together a portion of said proportional air not utilized in maintaining said combustion, and the combustion products and vaporized fuel to form the final mixture, the fuel and air proportions of said combustion mixture being maintained substantially constant, and the fuel and air proportions of the remaining mixture being varied in accordance with the requirements of the engine being operated.

7. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases.

8. In a carburetor, a main air passage with a Venturi constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the Venturi constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases.

9. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases, and a control throttle in the main air passage beyond the fuel nozzle.

10. In a carburetor, a main air passage with a Venturi constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the Venturi constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases, and a control throttle in the main air passage beyond the fuel nozzle.

11. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, a flow obstructing valve in the main air passage between the constriction and the fuel nozzle and movable to open the passage as air flow therein increases, and a control throttle in the main air passage beyond the fuel nozzle.

12. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the main air passage between the constriction and the fuel nozzle and movable by the air current toward the outlet and away from the constriction to open the passage as air flow increases.

13. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air ve-

locity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the main air passage between the constriction and the fuel nozzle and provided with means to retard its movement toward the outlet with the air stream.

14. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the main air passage between the constriction and the fuel nozzle and provided with means to retard its movement toward the outlet with the air stream, but allowing free movement of the valve in the opposite direction.

15. In a carburetor, a main air passage with a Venturi constriction therein, a fuel chamber, a depression chamber in open fuel communication with the fuel chamber, an air communication between the depression chamber and the Venturi constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction to lift fuel into the depression chamber consonantly with the variation of such depression, a fuel nozzle communicating with the depression chamber to take fuel therefrom and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the Venturi constriction and adapted to be moved by the air current from a position substantially closing the Venturi throat to a position further along the constriction in the direction of air flow.

16. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases, and an accelerating well taking fuel from the fuel chamber and from which fuel is taken to the depression chamber by the action of the depression applied thereto.

17. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, a flow obstructing valve in the main air passage between the constriction and the fuel nozzle and movable to open the passage as air flow therein increases, and a control throttle in the main air passage beyond the fuel nozzle, and an accelerating well taking fuel from the fuel chamber and from which fuel is taken to the depression chamber by the action of the depression applied thereto.

18. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the main air passage between the constriction and the fuel nozzle and provided with means to retard its movement toward the outlet with the air stream, and an accelerating well taking fuel from the fuel chamber and from which fuel is taken to the depression chamber by the action of the depression applied thereto.

19. In a carburetor, a main air passage with a Venturi constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the Venturi constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve floating on the air current in the Venturi constriction and adapted to be moved by the air current from a position substantially closing the Venturi throat to a position further along the constriction in the direction of air flow, and an accelerating well taking fuel from the fuel chamber and from which fuel is taken to the depression chamber by the action of the depression applied thereto.

20. A carburetor comprising a fuel supply chamber, a depression chamber, an air passage having therein two restrictions which cause two spaced depression areas in the air stream flowing through the air passage, the depression further along the air stream being the greater and the two depressions increasing as the air velocity rises and decreasing as the air velocity falls, a control throttle in the air passage beyond the further depression area, a fuel passage connecting the fuel supply chamber with the depression chamber, an air passage connecting the first depression area with the depression chamber, an air communication placing on the fuel supply chamber a pressure unaffected by the depression communicated to the depression chamber, and a fuel passage leading from the depression chamber to the further depression area, said last mentioned passage being restricted relative to air passage communicating with the depression chamber, so that the depression at the first depression area controls the depression obtaining in the depression chamber; the air passage restriction which causes the first depression area comprising a Venturi constriction, and the air passage restriction which causes the further de-

pression area comprising a valve movable to open the passage as air flow increases.

21. A carburetor comprising a fuel supply chamber, a depression chamber, an air passage having therein two restrictions which cause two spaced depression areas in the air stream flowing through the air passage, the depression further along the air stream being the greater and the two depressions increasing as the air velocity rises and decreasing as the air velocity falls, a control throttle in the air passage beyond the further depression area, a fuel passage connecting the fuel supply chamber with the depression chamber, an air passage connecting the first depression area with the depression chamber, an air communication placing on the fuel supply chamber a pressure unaffected by the depression communicated to the depression chamber, and a fuel passage leading from the depression chamber to the further depression area, said last mentioned passage being restricted relative to air passage communicating with the depression chamber, so that the depression at the first depression area controls the depression obtaining in the depression chamber, and an accelerating well taking fuel from the fuel chamber and from which fuel is taken to the depression chamber by the action of the depression applied thereto.

22. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, and a flow obstructing valve in the air passage between the constriction and the fuel nozzle and movable by virtue of air flow to open the passage wider as air flow increases, and means in association with the depression chamber and fuel nozzle whereby slight changes in fuel level in said chamber vary the fuel feed to the nozzle.

23. In a carburetor, a main air passage with a constriction therein, a fuel chamber, a depression chamber in fuel communication with the fuel chamber, an air communication between the depression chamber and the constriction in the air passage to apply to the depression chamber the depression caused by air velocity at the constriction, a fuel nozzle communicating with the depression chamber and discharging into the main air passage at a point beyond the constriction, a flow obstructing valve in the main air passage between the constriction and the fuel nozzle and movable to open the passage as air flow therein increases, and a control throttle in the main air passage beyond the fuel nozzle, and means in association with the depression chamber and fuel nozzle whereby slight changes in fuel level in said chamber vary the fuel feed to the nozzle.

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