G. A. F. AHLBERG.

INTERNAL COMBUSTION ENGINE.

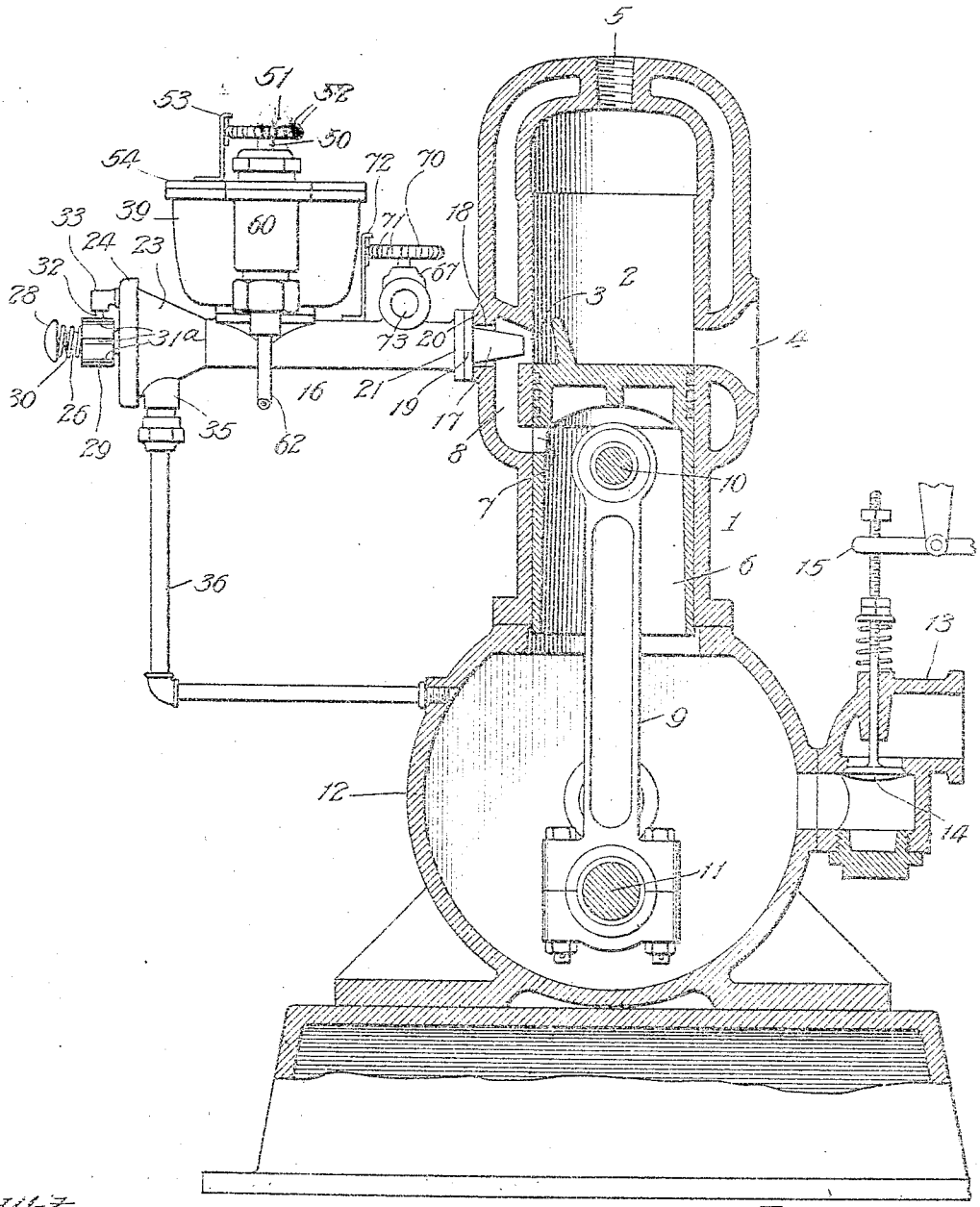
APPLICATION FILED JAN. 9, 1913.

1,096,819.

Patented May 19, 1914.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

E. E. Seybold.

Chas. H. Burr.

Inventor:

Gustav A. F. Ahlberg,

By David H. Fletcher,

Atty.

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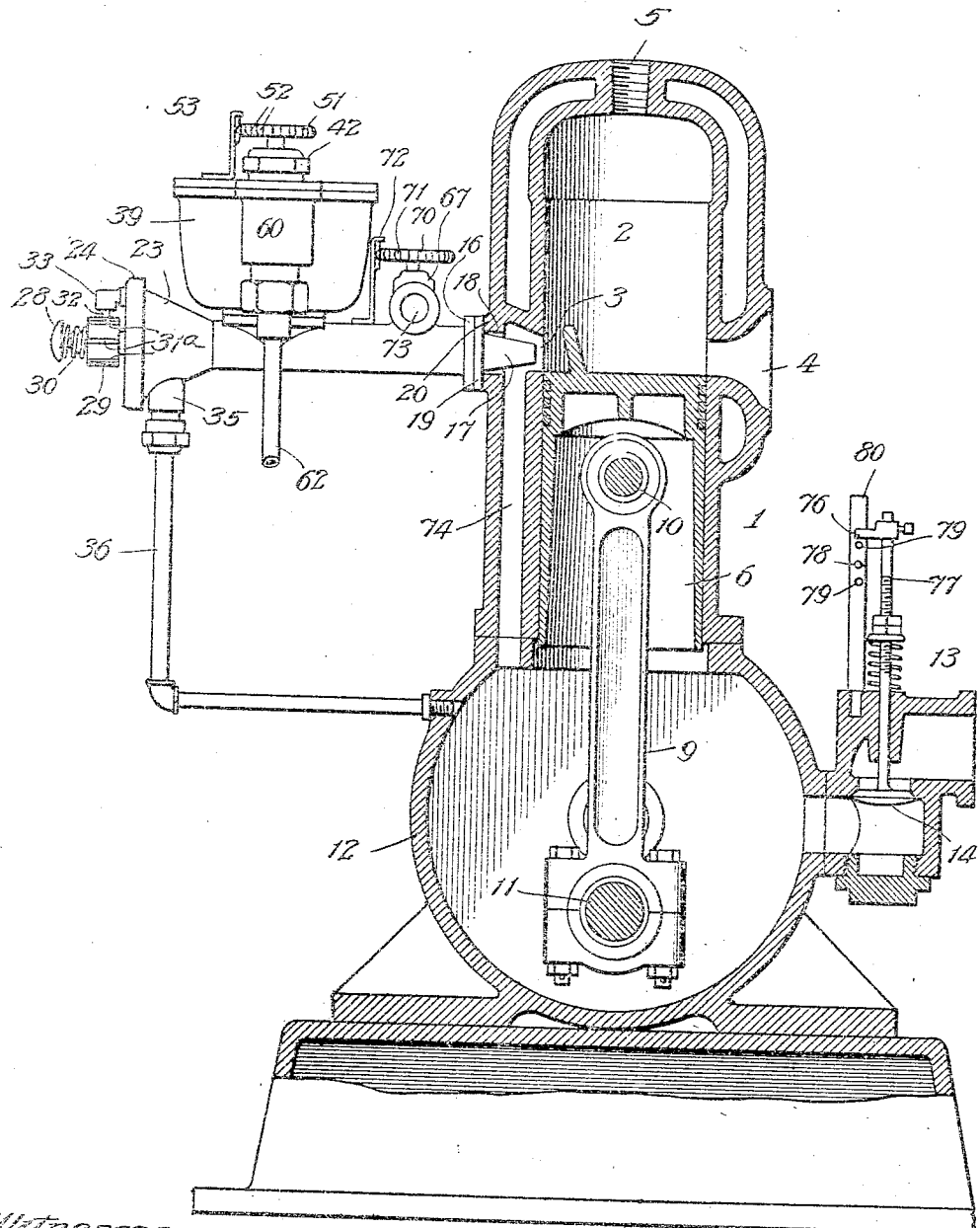
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4 SHEETS—SHEET 2.

Fig. 2.



Witnesses:

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4 SHEETS—SHEET 3.

Fig. 3

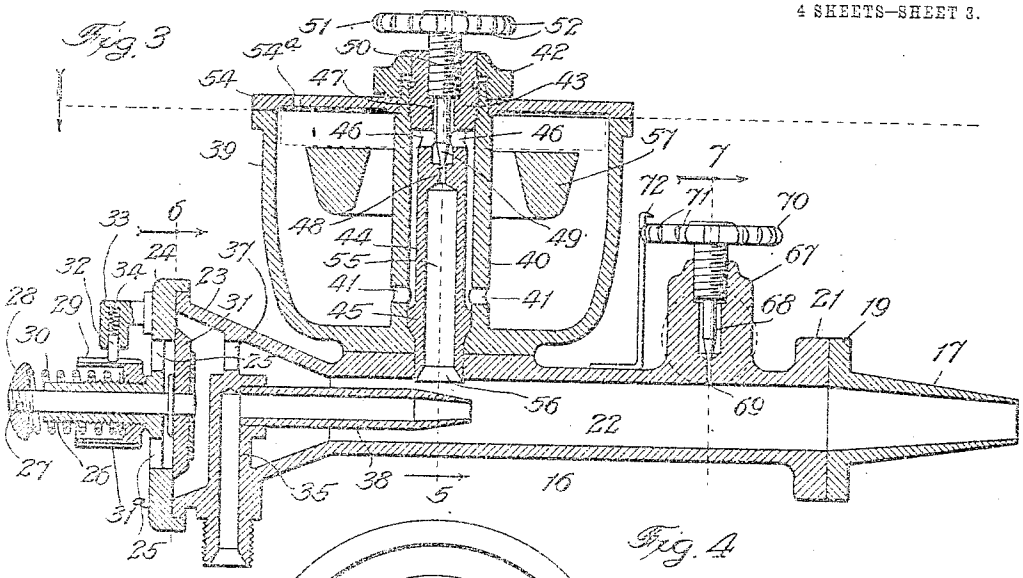


Fig. 4

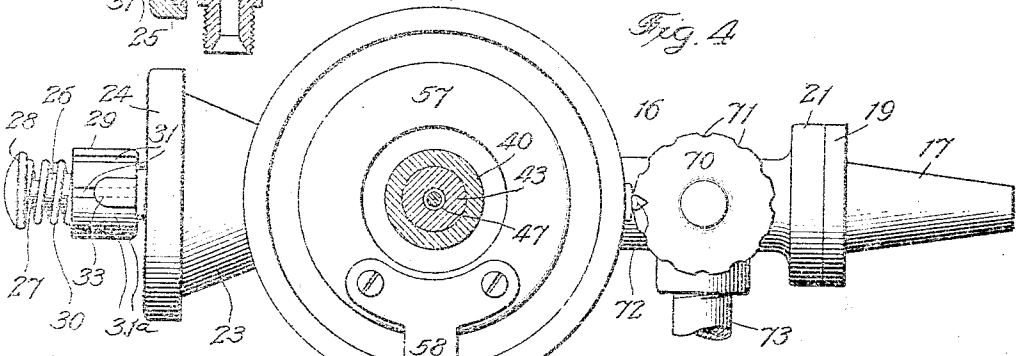
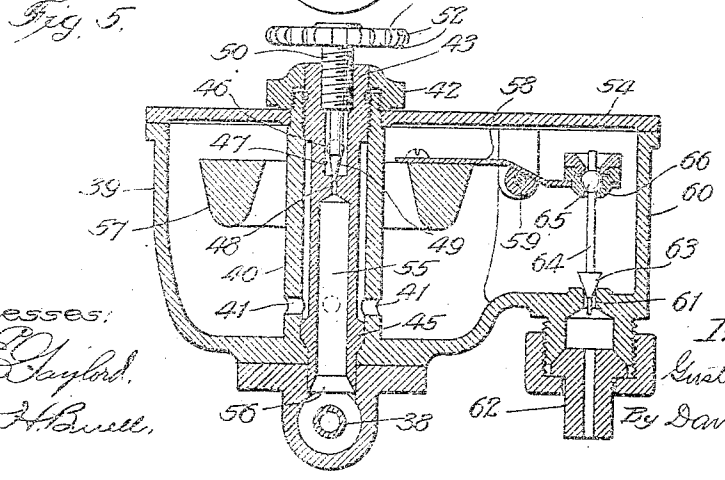


Fig. 5.



Witnesses:

E. P. Gaylord.

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1,096,819.

Patented May 19, 1914.

4 SHEETS—SHEET 4.

Fig. 6.

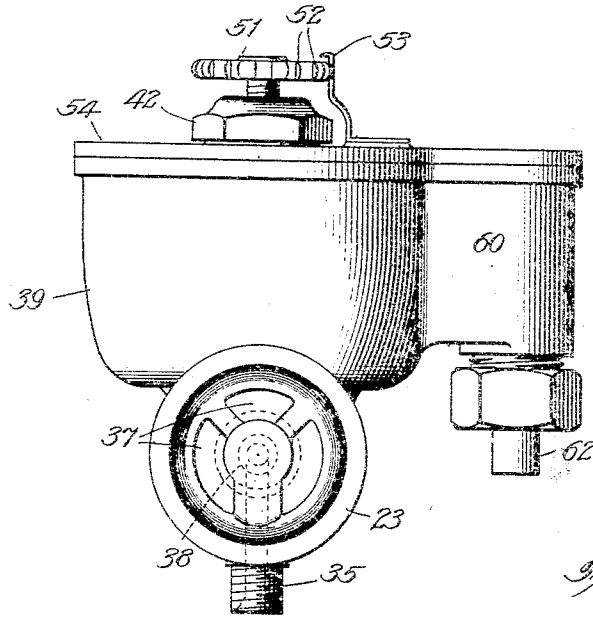


Fig. 7.

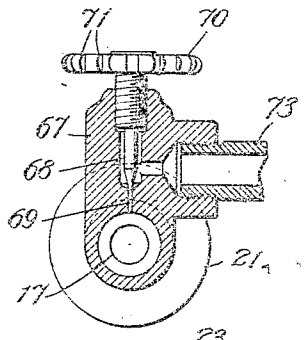


Fig. 9.

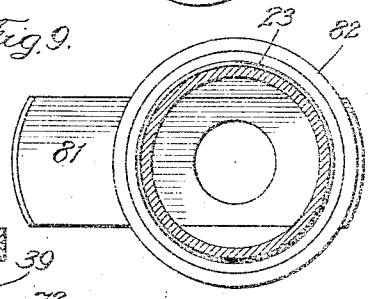


Fig. 8.

Witnesses:

Chas. H. Bull.

Inventor:

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UNITED STATES PATENT OFFICE.

GUSTAV A. F. AHLBERG, OF RACINE, WISCONSIN.

INTERNAL-COMBUSTION ENGINE.

1,096,819. Specification of Letters Patent. Patented May 19, 1914.

Application filed January 9, 1913. Serial No. 741,014.

To all whom it may concern:

Be it known that I, GUSTAV A. F. AHLBERG, residing at Racine, in the county of Racine and State of Wisconsin, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a description, reference being had to the accompanying drawings, forming a part of this specification, in which corresponding letters of reference in the different figures indicate like parts.

My invention relates to two-cycle internal combustion engines and my object, generally stated, is to provide simple and efficient means for feeding the same, so that the delivery of the fuel charge, may be insured when the engine is running at low speed or minimum "throttle", and that, even though the liquid fuel may be relatively heavy.

It is well known that internal combustion engines when operated at high speed and maximum load, require a relatively "lean" fuel mixture and a proportionately "rich" one when running at low speed or minimum load. This is particularly true of two-cycle engines which have heretofore failed to satisfactorily respond to attempts to run them at "low throttle."

One important purpose of my invention is to utilize fuel having a heavier specific gravity than gasolene, and, with a two-cycle engine to obtain therefrom the desired "flexibility", which, so far as I am aware, has not heretofore been accomplished.

To these and other subsidiary ends, my invention consists in the combination of elements hereinafter more particularly described and definitely pointed out in the claims.

In the drawings, Figure 1, is a view of an engine and carbureter embodying the features of my invention, the former being shown in central vertical section and the latter in elevation, Fig. 2, is a like view showing a modified construction, Fig. 3, is an enlarged central, vertical, longitudinal sectional view of the carbureter, Fig. 4, is a plan view thereof with the bowl cover removed, the view being partly in section upon the line 4, Fig. 3, Fig. 5, is a transverse vertical sectional view taken upon the line 5, Fig. 3, Fig. 6, is a transverse, vertical sectional view taken upon the line 6, Fig. 3, viewed in the direction of the arrow there shown, Fig. 7, is a transverse vertical sectional view taken upon the line 7, Fig. 3, viewed in the direction of the arrow there shown, Fig. 8, is a central, longitudinal vertical sectional view of a carbureter showing a modified feature adapted for use in connection with the form of by-pass shown in Fig. 2, and Fig. 9, is an end view of a portion of Fig. 8, showing a modified means for admitting air to the mixing-chamber.

Referring to the drawings, 1, Fig. 1, indicates generally the engine casing, 2 the cylinder, having an inlet-port 3, an exhaust-port 4, and a spark-plug opening 5. A piston 6 is provided with a port 7, adapted, when at the end of the compression stroke, to communicate with a by-pass 8 in communication with the inlet-port. A pitman 9, has one end connected to the piston at 10 and the other to a crank 11, upon a crank shaft, said crank shaft being inclosed within a crank-case 12. Communicating with the crank-case is an air-inlet casing 13, having a normally closed air-valve 14, the extent of opening of which is limited by a lever 15, in operative connection with the valve-stem and with the engine governor. The construction so far described, is that embodied in Letters-Patent No. 1,035,513, issued to me August 13th, 1912.

Connected with the engine is a carbureter generally designated by 16, having a tapered nozzle 17, adapted to extend into an opening 18, opposite to the inlet-port 3. Said nozzle is provided with a circular flange 19, adapted to abut against a shoulder 20, formed upon the cylinder and to be secured to a like flange 21, upon the end of the carbureter body. The body of said carbureter is provided with a mixing-chamber 22, preferably cylindrical, one end of which is in communication with said nozzle and the other with an outwardly flaring or enlarged end portion 23, which is provided with a cap 24, having one or more openings 25, therein, Fig. 3, for the admission of air. A central tubular stud 26, is extended outwardly from said cap, through which is loosely extended a valve-stem 27, having a head 28, upon its outer end. A hollow sleeve 29, is tapped upon the stud 26, which is of sufficient diameter to provide for the reception of a coiled spring 30, which is located in the annular space between it and the stud and tends to exert an outward pressure upon the head 28. A valve 31, is secured to the inner end of the stem 27, which is held normally closed by the spring 30, the tension of

which may be regulated by turning the sleeve 29, in or out upon the stud 26. A series of indentations 31ª, are formed upon the periphery of the sleeve 29, which are adapted to receive the rounded end of a locking-pin 32, extending downwardly from a bore in an arm 33, in which is inserted a spring 34. This construction enables the tension of the valve-closing spring 30, to be adjusted to the utmost nicety.

Extending upwardly into the casing 23, is a tubular member 35, the lower end of which is connected by means of a pipe 36, Fig. 1, with the crank-case 12. Openings 37, Figs. 3 and 6, are arranged around the part 35 for the admission of air. A tapered injector nozzle 38, is tapped into the upper end of the part 35, and extended coaxially into the mixing chamber 22. Located above said mixing-chamber is a bowl 39, having therein a central tube 40, extending upwardly to a level above that of the top. Said tube, which is provided with openings 41, near its base, is externally and internally screw-threaded at its upper end as shown, the one screw-thread being for the reception of an annular nut 42, and the other for the reception of a screw-threaded plug 43, which is passed through said nut and into said tube. Extending downwardly from said plug into the mixing-chamber 22, is a tubular member 44, the diameter of the greater portion of which is less than that of the interior of the tube 40, so as to form an annular space between the two. An enlarged portion 45, is provided near the lower end of said tube which is adapted to form a tight joint with the opening in the casing. Openings 46, are formed in the part 44 in communication with a central bore 47, which leads to a needle-valve-opening 48, adapted to be closed by a needle-valve 49, the enlarged stem 50, of which is provided with a fine screw-thread and is tapped into the plug 43. A hand-wheel 51 having peripheral notches 52, is secured to the part 50. A spring-catch 53, Figs. 1 and 6, is attached to the bowl cover 54 and arranged to engage with the notches 52 to yieldingly lock the hand-wheel in any desired position. This arrangement enables the needle-valve to be adjusted with the closest accuracy. One or more small openings 54ª, Fig. 3, should be provided in the cover for the admission of atmospheric air. The bore 55, of the tube 44, below the needle-valve opening, is made quite large and is flared outwardly at the lower end as shown at 56 in order to cause the liquid fuel to spread in a thin sheet for the purpose hereinafter stated. The discharge end of said tube is located in immediate proximity to and preferably slightly back of the tapered end of the nozzle 38.

An annular shaped float 57, of cork or suitable material, is located in the fuel-bowl 39, to surround the tube 40. A lever arm 58, Figs. 4 and 5, is rigidly attached to said float and is pivoted at 59, to a pivot-pin secured in the bowl. A lateral offset 60, is formed in the bowl, in the bottom of which is provided a valve-opening 61, in communication with a tube 62, leading to a gravity or other liquid fuel supply not shown, of any well-known form. A needle-valve 63, adapted to close the valve-opening 61, is provided with a stem 64, having a ball 65, near its upper end, fitted in a socket 66, which, in turn, is attached to one end of the lever 58, said ball and socket forming a universal joint for imparting the requisite freedom of movement to said valve. As the valve 63, is lifted, by the lowering of the fuel level in the bowl, oil from the source of supply is permitted to flow in until the rising of the float causes the valve to close in the usual well known way.

Formed upon the carbureter, between the bowl and discharge nozzle, is an upwardly extended boss 67, having a vertical bore for the reception of the screw-threaded stem of a needle-valve 68, adapted to close a valve-opening 69, leading to the mixing-chamber. A hand-wheel 70 having notches 71, in its periphery, adapted to be engaged by a spring 72, enables the valve to be adjusted. A tube 73, Figs. 1, 4 and 7, leading to a source of water supply not shown, is in communication with the valve opening 69.

The operation of my improved device is as follows: Upon the up-stroke of the piston, air is drawn into the crank-case, the quantity thereof being proportionate to the piston speed and the relative extent to which the governor-controlled valve 14, is caused to open. Upon the return stroke, the indrawn air is compressed in the crank-case until the port 7, is brought into registration with the by-pass 8, when the compressed air rushes through the port 3, into the combustion-chamber, thereby causing a partial vacuum to be formed in the mixing-chamber 22, which, in proportion to its extent, tends to open the valve 31, and cause atmospheric air to be drawn into the mixing-chamber. At the same time the partial vacuum in the mixing-chamber causes a downward suction in the tube 44. Fuel from the bowl 39 in which it is maintained at a constant level by the float 57 is drawn through the openings 41, into the annular space around the tube 44, in which it stands normally at a like level. The downward suction in the tube causes said oil to rise sufficiently in said annular space to flow through the openings 46, and needle-valve 48, into said tube and thence into the mixing-chamber from whence it, with its complement of air, is transferred in vaporous form to the combustion-chamber ready to

be compressed upon the upward stroke of the piston. During the operation described, air from the crank-case is forced through the pipe 36, and air-injector 35, into the mixing-chamber where it is delivered in advance of and in close proximity to, the discharge end of the tube 44, thereby accentuating the vacuum in that zone of the mixing-chamber and insuring a proper feed.

When the engine is running at high speed with a relatively "wide throttle," a proportionately large quantity of air, at a correspondingly high pressure is received into the crank-case. When upon the descent of the piston, air is admitted through the port 7, to the by-pass, it enters the inlet-port 8, at a maximum velocity, thus causing a corresponding vacuum in the mixing-chamber. The valve 31 is then opened to its maximum, thereby drawing in the full complement of atmospheric air which, in turn, tends to lessen the vacuum in the mixing-chamber and hence the quantity of fuel drawn from the bowl is lessened in proportion. When, on the other hand, the engine is caused to run at "low throttle" or slow speed, the conditions are changed. The air velocity around the inlet nozzle 17, is decreased, as is the vacuum in the mixing-chamber. At the same time the opening of the valve 31, is lessened which, in turn, reacts upon the mixing-chamber to relatively increase its vacuum and cause proportionately more fuel to be drawn into it through the needle-valve. The action of the air-injector serves to insure a fuel delivery from the needle-valve under all working conditions and is especially responsive when the engine is running at low speed. Said injector forms, therefore, a very important factor in the successful operation of two-cycle engines.

The water delivery through the valve opening 69, is controlled by the same principles as those governing the oil delivery and may be regulated to the utmost nicety by the hand-wheel 70.

In Figs. 2, 8 and 9, I have shown a modified construction adapted to be used in conjunction with the air injector feature. In said modification a by-pass 74, is carried from the crank-face directly to the intake-port 3, which obviates the necessity for a port in the piston. This form of by-pass requires a modified construction in connection with the bowl. An equalizing pipe 75, Fig. 8, is tapped through the bottom of the bowl and through an opening in the mixing-chamber, the upper end of said pipe being extended above the level of the float. The effect of this feature is to equalize the pressure or vacuum in the bowl and mixing-chamber so that the constant-fuel level in the bowl cannot be disturbed by a pressure in the crank-case; nor would a vacuum therein tend to draw fuel into the mixing-chamber or into said case when no function is to be performed by the carbureter. In this construction the air vent in the bowl cover is dispensed with.

The carbureter action to supply fuel is needed from the time the upper end of the piston begins to open the intake-port and continues during the descent and return of the piston, during which period the balancing effect described does not occur. This result is due to the fact that the air when released, rushes into the combustion-chamber, and further to the action of the exhaust.

I do not wish to be limited to the exact construction shown inasmuch as it may be varied without departing from the spirit of the invention. For example, while I prefer to use, and recommend the use of, automatic means for controlling the air intake to both the crank-case and to the mixing-chamber of the carbureter, I wish to have it understood, that the air injector may be utilized with manually controlled means for regulating the admission of air to either of those features.

In Fig. 3, in lieu of the governor-controlled lever 16, I have shown an arm 76 on the valve-stem 77, which is adapted to be limited in its downward movement by a stop-pin 78, adjustably secured in any one of a series of holes 79, in a vertical standard or member 80.

In lieu of the automatic valve shown in Fig. 3, for controlling the admission of air to the mixing-chamber, I have shown in Figs. 8 and 9 a manually controlled slide 81, adapted to slide in suitable grooves in an end-piece 82. The nipple 83 of the part 35, of the air-injector may also be connected with any desired source of compressed air, not shown.

The modifications described enables the compressed air-jet to be utilized at the time most needed, viz: when the engine is running at minimum speed, thereby insuring a fuel-feed regardless of the means employed for controlling the admission of air. The primary action of the air-jet in the mixing-chamber in immediate proximity to the fuel-inlet makes a fuel delivery certain even though the gravity of the material may greatly exceed that ordinarily used.

Having thus described my invention, I claim:

1. An internal combustion engine comprising a crank-chamber, a combustion-chamber, piston in operative relation thereto, means for admitting air to said crank-chamber, means for transferring the same therefrom to said combustion-chamber at a predetermined period in each cycle of operation, said air serving to cause a suction and to induce a flow of fuel-mixture from the discharge nozzle of a carbureter, a carbureter having a mixing-chamber, means for

admitting air thereto, a source of fuel supply, a fuel inlet leading thereto from said source of fuel supply, said mixing chamber being provided with a discharge-nozzle in communication with said combustion-chamber, and means for positively producing a jet of compressed air in said mixing chamber in addition to the atmospheric air induced by the suction around said discharge nozzle.

2. An internal combustion-engine comprising a crank-chamber, a combustion-chamber, a piston in operative relation thereto, means for admitting air to said crank-chamber, means for transferring the same therefrom to said combustion-chamber at a predetermined period in each cycle of operation, said air serving to induce a flow of fuel mixture from a carbureter, a source of fuel supply a carbureter having a fuel inlet leading from said source of fuel-supply to the mixing-chamber, a mixing chamber provided with the discharge-nozzle in communication with said combustion chamber, means for admitting atmospheric air to said mixing chamber, a source of compressed air and an air-injector in communication with said source of compressed air and having its delivery within said mixing-chamber in operative proximity to said fuel inlet whereby, in addition to a volume of atmospheric air sucked through said mixing chamber, a jet of compressed air is injected.

3. An internal combustion engine having a crank-chamber, a combustion-chamber, a piston in operative relation thereto, means for admitting air to said crank-chamber, means for admitting the same to said combustion-chamber at a predetermined period in each cycle of operation, said air serving in its passage to induce a flow of fuel-mixture from a carbureter, a source of fuel supply, a carbureter having a fuel inlet leading from said source of supply to a mixing chamber, a mixing chamber provided with a discharge outlet in communication with said combustion chamber, means for admitting atmospheric air to said mixing chamber, a source of compressed air and an air-injector in communication with said source of compressed air and having its delivery end in said mixing chamber directed toward the discharge opening of the latter.

4. An internal combustion engine comprising a crank-chamber, a combustion-chamber, a piston in operative relation thereto, means for admitting air to said crank-chamber to be expanded into said combustion chamber at a predetermined period in each cycle of operation, while serving to induce a flow of fuel-mixture from a carbureter, a source of fuel supply, a carbureter having a mixing-chamber, a fuel inlet leading thereto from said source of fuel supply, said mixing-chamber being provided with a discharge outlet in communication with said combustion-chamber, means for admitting atmospheric air to said mixing-chamber and an air injector in communication with said crank-case, said injector being extended into said mixing-chamber with its nozzle directed toward the outlet of the latter.

5. An internal combustion engine having a combustion chamber, a piston, an air-compression chamber, means for regulating the volume of successive charges of air to be admitted to the latter to conform to variations in load, means for admitting air from said compression-chamber to the combustion-chamber at a predetermined period in each cycle of operation, said air serving to induce a fuel mixture flow from a carbureter, a carbureter having a fuel inlet, a discharge outlet leading into said combustion chamber, a mixing-chamber, an air inlet thereto, the effective area of which is adapted to be varied by the relative degree of air-pressure in said compression-chamber and means for admitting a jet of compressed air to said mixing chamber with each mixture delivery to said combustion chamber.

6. A two-cycle internal combustion engine having an air-compression chamber, a combustion-chamber, a piston, means for controlling the volume of air to be admitted to the compression-chamber upon each compression stroke of the piston to be compressed by each expansion stroke thereof, means for permitting said air at a predetermined interval to expand into said combustion chamber, a carbureter having a mixing-chamber, with a mixture outlet leading to said combustion chamber, a liquid-fuel inlet, the feed of which is controlled by a vacuum in the mixing-chamber induced by the flow of said compressed air into said combustion-chamber, an air-inlet, means for varying its area, and means in communication with said compression-chamber for admitting a jet of air into said mixing chamber in proximity to said liquid fuel inlet.

7. A two-cycle internal combustion engine having a combustion-chamber provided with an inlet-port, a piston, a compression-chamber, a carbureter having a mixing-chamber, a discharge-nozzle leading therefrom to said inlet-port, the latter being in direct communication with said compression chamber, a constant-level fuel reservoir in communication with said mixing-chamber, means for maintaining an equilibrium of pressure between said fuel reservoir and said mixing-chamber and means for introducing compressed-air into said mixing chamber directed toward the discharge opening of the latter.

8. A two-cycle internal combustion engine having a combustion chamber provided

with an inlet-port, a piston, a compression-chamber, a carbureter having a mixing-chamber, a discharge-nozzle leading therefrom to said inlet-port, the latter being in direct communication with said compression-chamber, a constant-level fuel reservoir in communication with said mixing-chamber, means for admitting air to said mixing-chamber and means for maintaining an equilibrium of pressure between said fuel reservoir and said mixing-chamber.

9. An internal combustion engine comprising a piston, a combustion chamber, an air compression chamber, means for admitting air thereto with each compression stroke of the engine piston, means for admitting air from said compression chamber to the combustion chamber at a predetermined period in each cycle of operation, a carbureter having a mixing-chamber, a liquid fuel supply, a fuel inlet in communication with said source of liquid-fuel supply maintained at a constant level, a mixture outlet leading to the combustion chamber of the engine, an air inlet, an inwardly opening valve for controlling the admission of air thereto, yielding means for normally closing said valve, a source of compressed air and an air injector arranged axially within said mixing chamber and in communication with said source of compressed air.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses, this fourth day of January 1913.

GUSTAV A. F. AHLBERG.

Witnesses:

DAVID H. FLETCHER,

LESLIE W. FRICKE.