Jan. 20, 1931. C. L. RAYFIELD 1,789,564

CARBURETOR

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Fig. 1

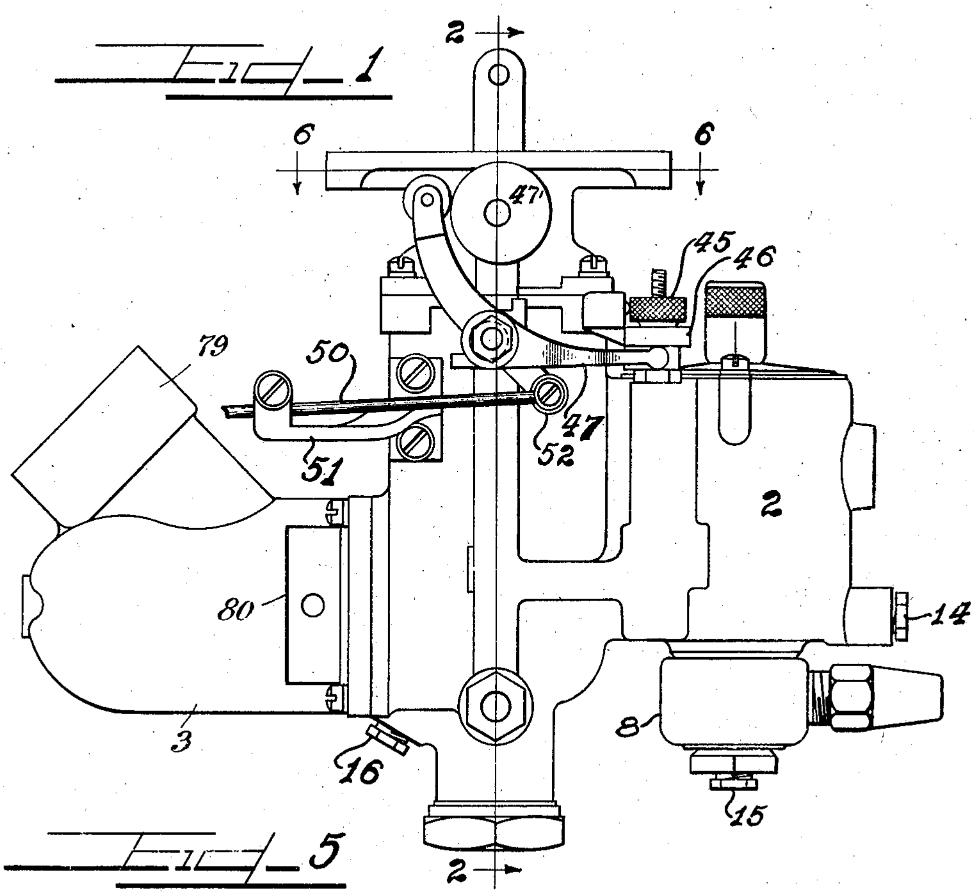
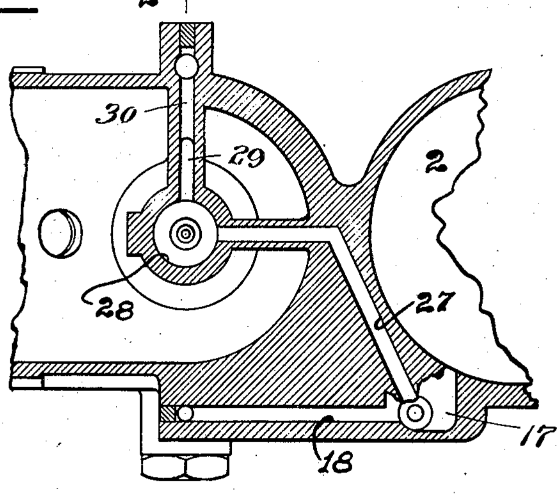


Fig. 5



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CARBURETOR

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Fig. 2

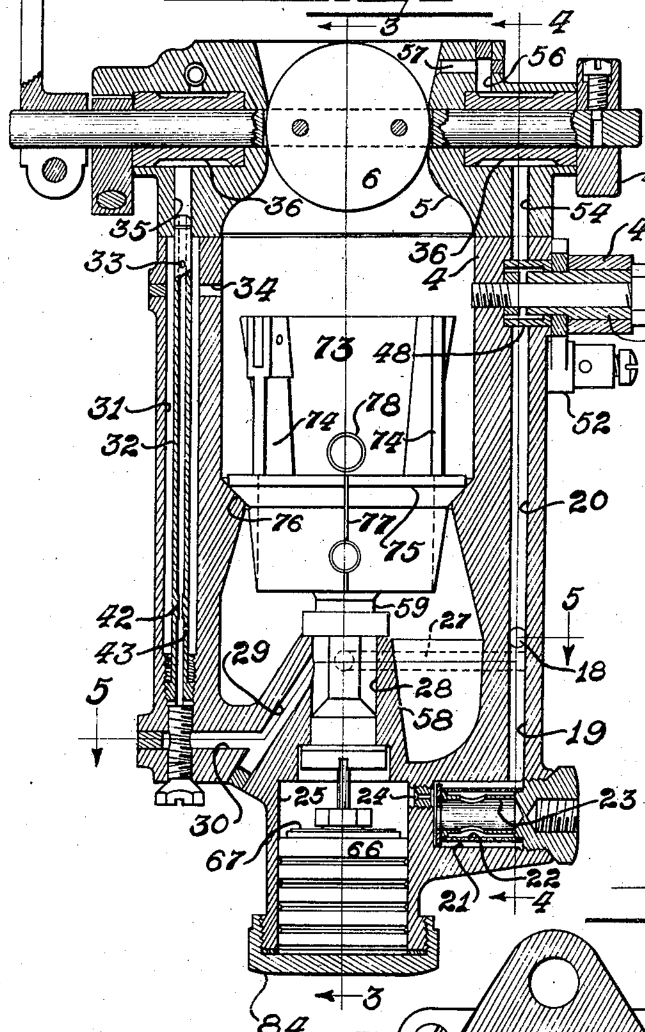


Fig. 8

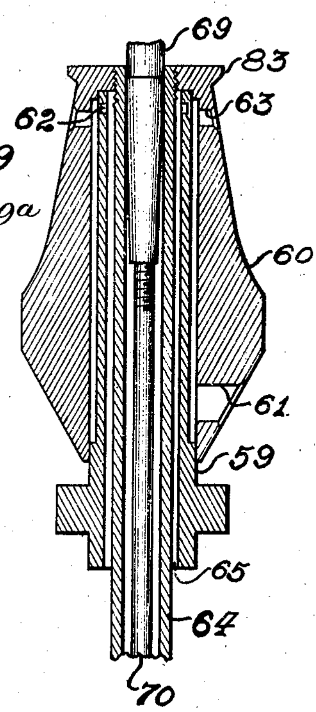
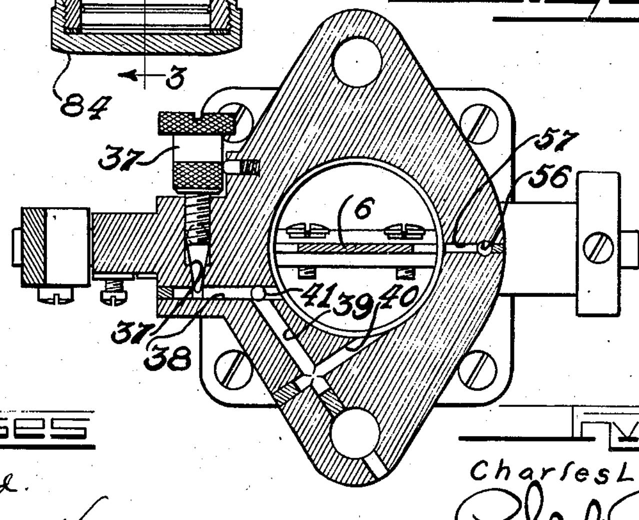


Fig. 6



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CARBURETOR

Filed April 2, 1923

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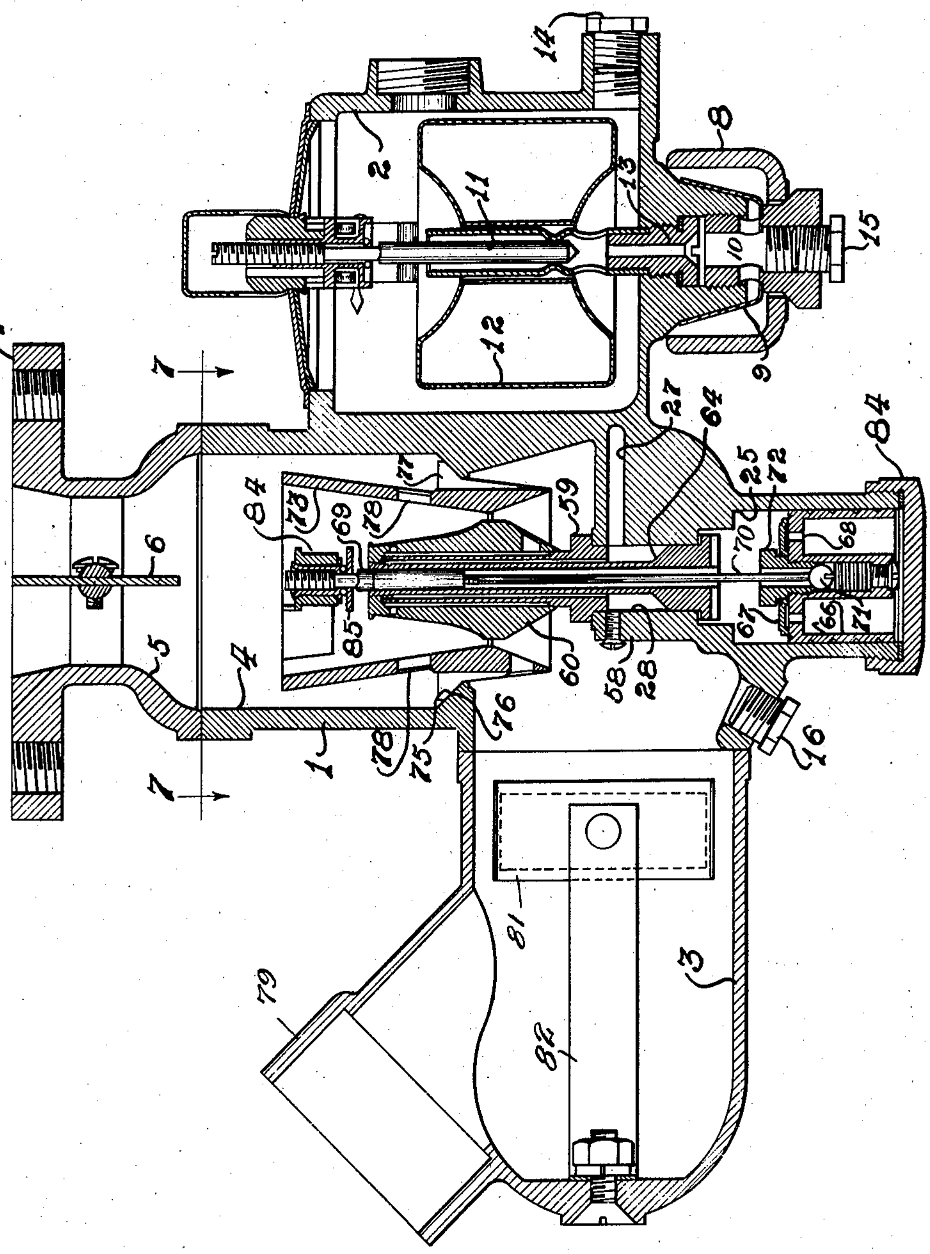
Fig. 3



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CARBURETOR

Filed April 2, 1923 4 Sheets-Sheet 4

Fig. 4

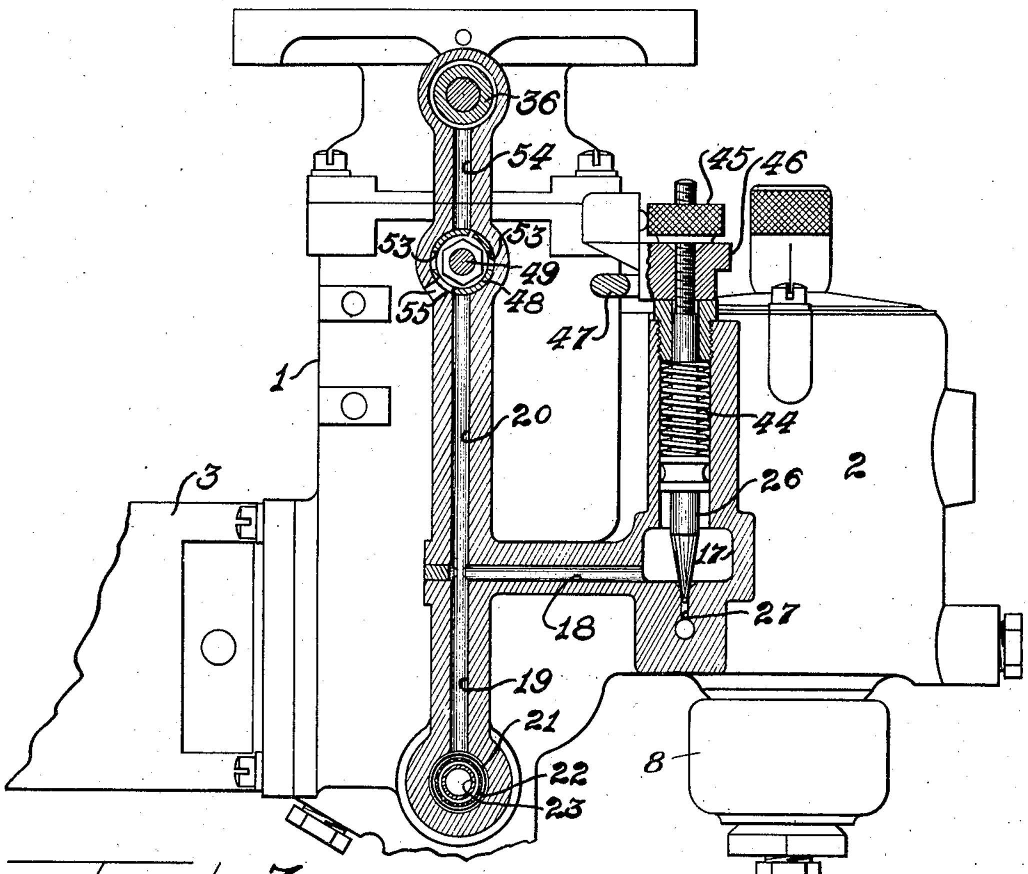
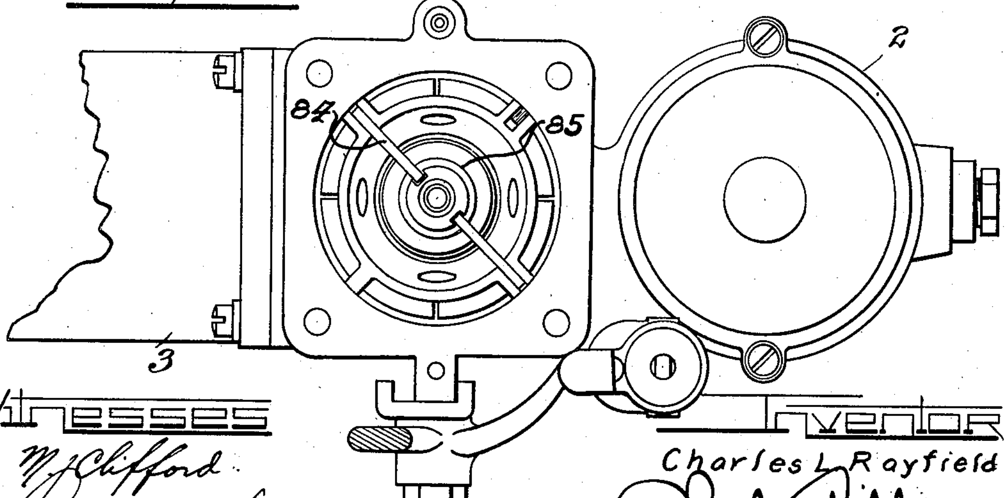


Fig. 7



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UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed April 2, 1923. Serial No. 629,335.

This invention relates to improvements in carburetors for internal combustion engines with special reference to proper metering of the fuel supply relative to the air supply to afford correct variation of the richness of the fuel mixture according to the requirements of a wide range of operating conditions, especially those conditions found in automotive installations.

It is an object of this invention to provide a carburetor having a plurality of separately adjustable fuel nozzles for various speed ranges wherein on one or more of the nozzles, particularly those for average operating conditions, a preliminary admixture of air is provided with the fuel prior to spraying into the main air streams passing through the carburetor. Such an admixture of air insures more complete atomization of the fuel particles and therefore permits a leaner mixture, thus resulting in increased fuel economy with an actual increase in flexibility of performance in the internal combustion engine to which this carburetor is attached.

It is another object of this invention to provide in a carburetor of the class described a movable Venturi casing resiliently connected to a dash pot piston so that the Venturi casing can seat properly due to its own weight even when the piston strikes the bottom of the dash pot chamber.

It is still a further object of this invention to provide a form of spray nozzle adapted to coact with the Venturi casing to properly regulate the rate of increase in air flow for increments in the movement of the venturi by so generating the body of the nozzle as to form a conoid of revolution above the point of greatest restriction in the Venturi casing when at its lowest point.

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

The invention (in a preferred form) is illustrated on the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a front elevation of a carburetor embodying the features of this invention.

Figure 2 is a vertical cross section on the line 2—2 of Figure 1, showing various fuel passages as well as the Venturi and dashpot piston in elevation.

Figure 3 is a vertical longitudinal section on the line 3—3 of Figure 2, showing the Venturi, nozzles and dashpot piston in section.

Figure 4 is a vertical cross section on the line 4—4 of Figure 2 showing the fuel passages from the float chamber.

Figure 5 is an irregular horizontal section along the line 5—5 of Figure 2 showing various fuel passages from the float chamber.

Figure 6 is a horizontal section on the line 6—6 of Figure 1.

Figure 7 is a horizontal section on the line 7—7 of Figure 3; in other words, a top plan view of the carburetor with the head carrying the throttle removed.

Figure 8 is an enlarged detail vertical sectional view of the upper end of the double nozzle and metering pin.

As shown on the drawings:

The carburetor of this invention comprises a casing 1 in which is formed a float chamber 2, an air inlet passage 3, a mixing chamber 4 and having a throttling head 5 attached in which is a butterfly throttle 6, a suitable flange 7 being formed on the head for attachment to an intake manifold or the cylinder block of an internal combustion engine.

Liquid fuel enters the float chamber 2 by means of the member 8 forming a strainer trap having a fuel pipe connected thereto, through a screen 9 and a passage 10 leading upwardly in the center of the chamber. A needle valve 11 controlled by a float 12 governs the flow through a valve seat member 13 in the passage 10 to maintain a constant fuel level within the float chamber. A drain plug 14 for the float chamber and a similar drain plug 15 for the fuel connection and strainer are provided, as well as a third drain plug 16 located at the bottom of the air inlet passage 2.

Two fuel outlets are provided from the float chamber, one unrestricted outlet from a recess 17 in the wall of the chamber communicating through a horizontal passage 18 to a vertical passage 19 leading downwardly and a similar passage 20 leading upwardly to form a priming fuel supply for starting purposes. The passage 19 leads to a chamber 21 containing a cylindrical strainer 22 into which the fuel passes and out through an apertured tube 23 to a high speed jet 24 discharging into a dash pot chamber 25 closely adjacent the upper end thereof. This high speed jet is made in various sizes, the proper size for a given installation being determined largely by trial.

An intermediate nozzle fuel supply is controlled by a needle valve 26 in a passage 27 leading from the bottom of the recess 17 to an intermediate nozzle well 28. Passages 29 and 30 lead from this well 28 to a vertical passage 31 forming an accelerating fuel well in which is mounted an idling tube 32 of smaller diameter. Holes 33 are drilled in this tube near its upper end to form air bleeds into the idling tube, and a hole 34 just below the holes 33 communicates from the well 31 to the interior of the mixing chamber 4 below the throttle, forming an air bleed into the fuel well. Above the hole 34 the well 31 is restricted to the diameter of the idling tube and continues upward as the passage 35 and around the spool 36 on the throttle shaft to a needle valve 37 and thence through passages 38, 39 and 40 to the interior of the manifold above the throttle. The passage 41, the end of which is visible at the junction of passages 38 and 39, in Figure 6, forms an additional air bleed from below the throttle. The idling tube 32 is open at both ends and restricted in inside diameter to form a fuel jet 42, and in conjunction with the various passages provides a fuel line from the float chamber to above the throttle, the amount of fuel being controlled by the size of the fuel jet 42 as well as the needle valves 26 and 37. A small hole 43 is drilled in the tube below the fuel jet 42 so that when the motor is idling an excess of fuel will flow from the tube into the acceleration well 31. When the engine is idling with the throttle closed a high vacuum exists in the carburetor above the throttle, which draws fuel out of the idling tube into the manifold, at the same time mixing it with air drawn through the air bleeds 33 and 34 into the idling tube and additional air drawn from the mixing chamber through the passage 41.

The needle valve 26 heretofore mentioned is pressed downwardly by a spring 44, the upper end of the needle valve stem being threaded for an adjusting nut 45 and passing through a shouldered washer 46 which is engaged by the forked end of a needle lifter bell-crank lever 47. The other end of the crank carries a roller engaging a cam 47′ on the throttle shaft whereby the needle valve is lifted as the throttle is closed. The needle valve 26 is never completely closed; the supply of fuel is intended to be increased by lifting the needle under idling conditions for the purpose of filling the passages and accelerating well 31 more rapidly so that more fuel will be available for acceleration after idling.

The priming fuel supply passage 20 previously mentioned leads upwardly to a valve 48 rotatable about a stud 49 on which is rotatably mounted an eccentric 49^a on which the needle lifter bell crank 47 is pivoted. The eccentric 49^a and valve 48 are turned by means of a Bowden wire dash adjustment 50 supported in a tubing holder 51 and connected to an eccentric arm 52, having limiting stops, whereby pulling out the dash adjustment rotates the eccentric 49, lifting the bell crank 47 and needle valve 26, to increase the fuel supply to the intermediate and idling nozzles. Pulling the dash adjustment out to the limit of its movement brings ports 53 in the valve 48 into register with the passage 20 below the valve and a passage 54 above the valve. An air vent 55 is provided in the casing surrounding the valve so that when the dash adjustment is closed the primer will be inoperative. The passage 54 leads up to a spool 36 on the throttle shaft and thence through passages 56 and 57 into the carburetor above the throttle.

Centrally disposed at the bottom of the mixing chamber is a boss 58 on which rests a tubular standpipe 59. Slidably engaged thereover and spaced therefrom is a double frustro-conical member 60 having an air inlet 61 to the space between the two members. Slightly below the top, the standpipe 59 has a plurality of small fuel orifices 62 forming the intermediate nozzles, and the member 60 has corresponding orifices 63 of a larger size, air entering the inlet 61 mixing with the fuel from the orifices 62 and discharging as a rich fog from the orifices 63, where it is diluted by air passing outside the member 60 on its way to the engine. The standpipe and conical member are secured in place by a tubular member 64 inserted from below the boss 58 and threaded into the conical member 60 above the standpipe. This tubular member is of smaller diameter than the standpipe, forming an annular passage 65 from the interior of the boss 58 heretofore referred to as the intermediate nozzle well 28.

The dash pot chamber 25 previously mentioned is disposed below and concentric with the boss 58 and contains a piston 66 with a check valve 67 and ports 68 thereon adapted to pass fuel as the piston moves downwardly. For closing the outlet of the tubular member 64 a tapered metering pin 69 is provided having a flexible stem 70 extending down through the member and having a ball end 71 resiliently secured in the piston 66 by a member 72 which also secures the plate forming the check valve 67. A threaded upward extension of the tapered metering pin is adapted to be adjustably secured in a bridge 84 in a movable venturi 73 surrounding the upper end of the standpipe and conical member and slidable in the mixing chamber of the carburetor. Fins 74 are provided to guide the venturi and to provide air passageways outside as well as through the venturi. A baffle 85 is provided on the Venturi bridge to properly break up the fuel stream issuing from the nozzle about the metering pin. An annular boss 75 is formed on the outside of the venturi and is adapted to seat on an annular ring 76 formed within the body of the carburetor when the venturi is in its lowest position. Small slots 77 are cut through the annular boss 75 to provide escape for excess liquid fuel flowing down the carburetor walls, and apertures 78 are provided through the wall of the venturi in line with these slots to equalize the air pressure on the outside and inside of the venturi when in its lowest position, as well as to cause reatomization of as much of the fuel as possible rather than to deposit it at the bottom of the carburetor.

The air inlet chamber 3 is preferably provided with a hot air connection 79 leading to a hot air stove in connection with the exhaust manifold of the motor. Such a hot air supply may reduce the charge taken into the motor if the temperature rises too high, so that a pair of cold air ports 80 are provided, normally closed by shutters 81 thermostatically controlled by a strip of thermostatic metal 82 which will open the shutters when a certain temperature is reached.

The operation is as follows:

The float chamber 2 is filled with liquid fuel maintained at a constant predetermined level by means of the float 12 and needle valve 11 controlled thereby. When it is desired to start an engine equipped with a carburetor embodying the features of this invention, the priming connection, mounted along with the usual control instruments adjacent the driver, is pulled out all the way rotating the primer valve 48 by means of the lever 52 so that the ports 53 therein register with the passages 20 and 54 to deliver fuel from the float chamber to the outlet 57 above the throttle. It is to be noted that, unlike the usual choke dash adustments for starting which operate by reducing the air supply to the carburetor, the priming device described herein does not restrict the air supply and thus does not impair the performance. The dash adjustment also provides a means of increasing the supply of fuel to the idling and intermediate nozzles while warming up the motor; the increased fuel supply is effective throughout the operating range, while the priming valve is only operative in the fully extended position of the dash adjustment.

The idling range for the engine, i. e., when the engine is running with an almost entirely closed throttle, produces a high vacuum above the throttle but relatively very slight vacuum below the throttle so that the intermediate or spray and high or metering nozzles do not supply fuel under such conditions. The idling passages, terminating in the outlet passages 38 and 40 above the throttle, serve to supply fuel mixed with air through the air bleeds 33 and 34 in the idling tube 32 and carburetor wall as well as the passage 41. This gives a rich air and fuel mixture which is diluted to the proper extent after entering the manifold and the fuel supplied thereto is adustable both by the valve 26 which can be temporarily moved further towards open position by the dash adjustment, and the idling adjustment valve 37 which is usually set with a slightly rich adjustment when the engine is warm.

The valve 26 forms the intermediate or spray nozzle adjustment and normally delivers more fuel than the idling conditions require, the excess flowing out of the hole 43 in the idling tube 32 to fill the accelerating well 31. The instant the throttle is opened wide for acceleration, a high vacuum is created at the main nozzles, causing a high velocity of air past the spray orifices and thus drawing the fuel in the well back into the tube 32 and thence back through the passages to the spray nozzle. On a slightly opened throttle however this fuel will not discharge from the well because a partial vacuum is maintained in the mixing chamber which is communicated to the well through the air vent 34 and thus prevents discharging of the well.

The spray or intermediate nozzles 59 and 60 will evidently supply fuel in proportion to the suction on the orifices up to the capacity of the passage at the valve 26 and thereafter deliver a fixed quantity of fuel. This fuel is mixed with air entering the space between the members 59 and 60 through the port 61 and is sprayed out through the enlarged orifices 63, the rim or baffle 83 shown on the member 60 forming a means of breaking up any unatomized liquid fuel dragged up the sides of the member 60 from the orifices 63.

The high speed or metering nozzle 64 is controlled by the tapered metering pin 69 which is attached to the movable or floating venturi 73 surrounding the nozzles. At low engine speeds this venturi rests on its seat 76 in the body of the carburetor, and the abutting bases of the conoids forming the member 60 then occupy most of the space within the venturi restriction. As the venturi is drawn up by the increased suction at higher speeds, the metering pin is lifted in the nozzle and allows an increased flow of fuel therefrom. At the same time upward movement of the venturi brings its locus of greatest restriction above the base of the upper cone which is a conoid of revolution such as a paraboloid or hyperboloid, thus giving a greatly increased air space with the initial upward movement. Further, as the venturi lifts air is permitted to pass upwardly around the outside of the venturi in gradually increasing quantities.

The movement of the venturi relative to the nozzle structures results in that at low speeds the restricted portion of the venturi is below the fuel discharge orifices, and that at high speed it moves nearer to said orifices whereby the cross-sectional area of the passage between the nozzle and the venturi at the level of the fuel orifices is reduced at high speeds, although the least cross sectional area of the venturi is increased. Thus the greater flow of fuel under such circumstances is met by an increased rate of flow adjacent the nozzle orifices.

The amount of increased fuel supply, for a given air supply as determined by the movement of the venturi, can be altered by a change in the taper of the metering pin, and the time of the opening controlled by the adjustable mounting of the metering pin in the venturi bridge. The extreme total fuel supply at wide open position is limited to the size of the high speed opening 24 in the wall of the dash pot chamber 25.

The dash pot piston 66 connected to the metering pin serves to retard the rising of the venturi, to prevent fluttering thereof and in a measure to pump fuel up the nozzle upon a sudden opening movement of the throttle. The check afforded by the dash pot piston also serves to create a high suction temporarily at the spray nozzle, which assists in providing the increased supply of fuel from the accelerating well. The ball 71 on the end of the stem 70 is resiliently held against the member or bushing 72 so that the venturi may seat at low suctions even though the metering pin has been adjusted so low that the dash pot piston strikes the pot closure member 84. To adjust the metering pin the closure is removed and a small set screw removed from the piston boss when a narrow screwdriver can be inserted to engage with a slot provided in the ball end 71 to turn the stem and metering pin, the venturi being held from rotation by a pin allowing only vertical movement.

It will thus be apparent that I have provided herein a carburetor which is adapted to operate efficiently throughout a wide range of operating conditions.

I am aware that numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. In a carburetor, a fuel nozzle member in the form of a converging taper and having discharge orifices adjacent its upper smaller end, and a movable venturi cooperating therewith, the restricted portion of which venturi at low speeds is located below the discharge orifices and at high speed moves nearer to said orifices whereby the cross-sectional area of the passage between the nozzle and the venturi, at the level at which said orifices are located, is reduced at high speeds.

2. In a carburetor, a fuel chamber, a mixing chamber, a nozzle receiving fuel from said fuel chamber and discharging said fuel into said mixing chamber, said nozzle having an outer surface forming a concave conoid of revolution having fuel discharge passages in said surface near its upper edge, and a venturi member movably mounted in the mixing chamber and surrounding said nozzle, the restricted portion of the venturi being so located that at low speed it is below the said fuel discharge passages, and at high speed it moves nearer to said passages, whereby the cross-sectional area of the air passage between the nozzle and the venturi, at the level at which said passages are located, is reduced at high speed.

In testimony whereof I have hereunto subscribed my name.

CHARLES L. RAYFIELD.