May 17, 1932. G. M. BICKNELL 1,858,615

CARBURETOR

Filed Nov. 18, 1930 5 Sheets-Sheet 1

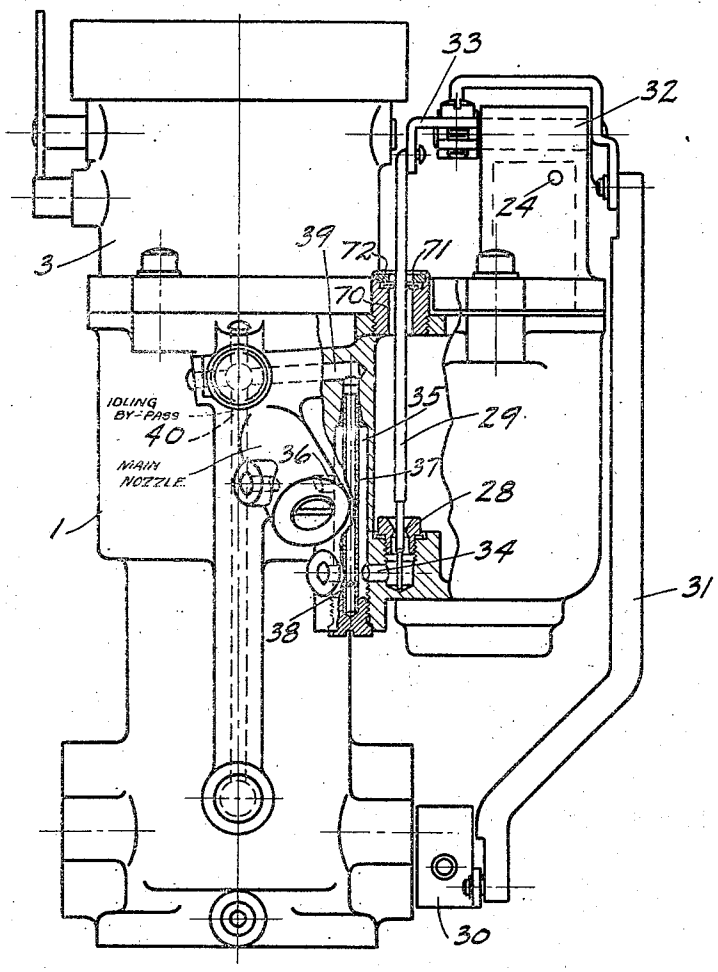


FIG. 1

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CARBURETOR

Filed Nov. 18, 1930 5 Sheets-Sheet 2

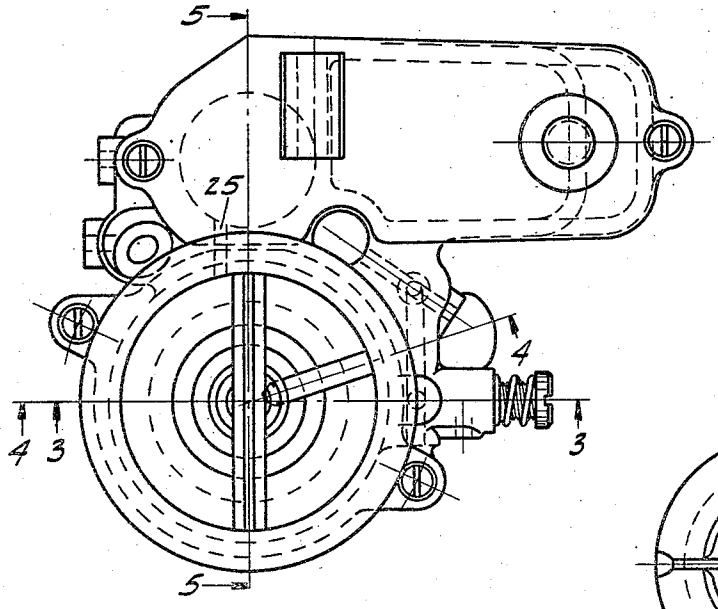


FIG. 2

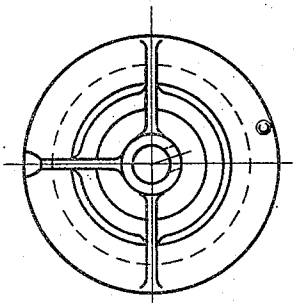


FIG. 6

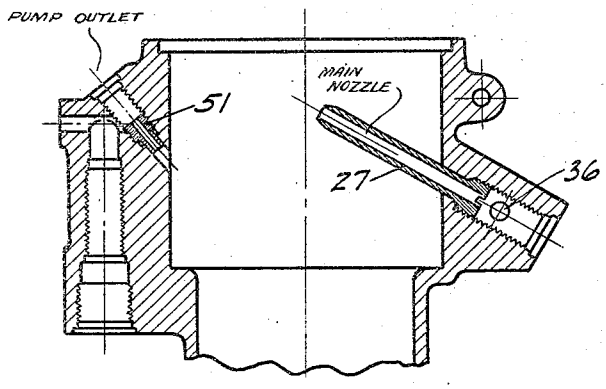


FIG. 8

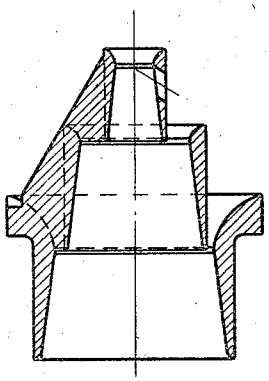


FIG. 7

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May 17, 1932. G. M. BICKNELL 1,858,615

CARBURETOR

Filed Nov. 18, 1930 5 Sheets-Sheet 3

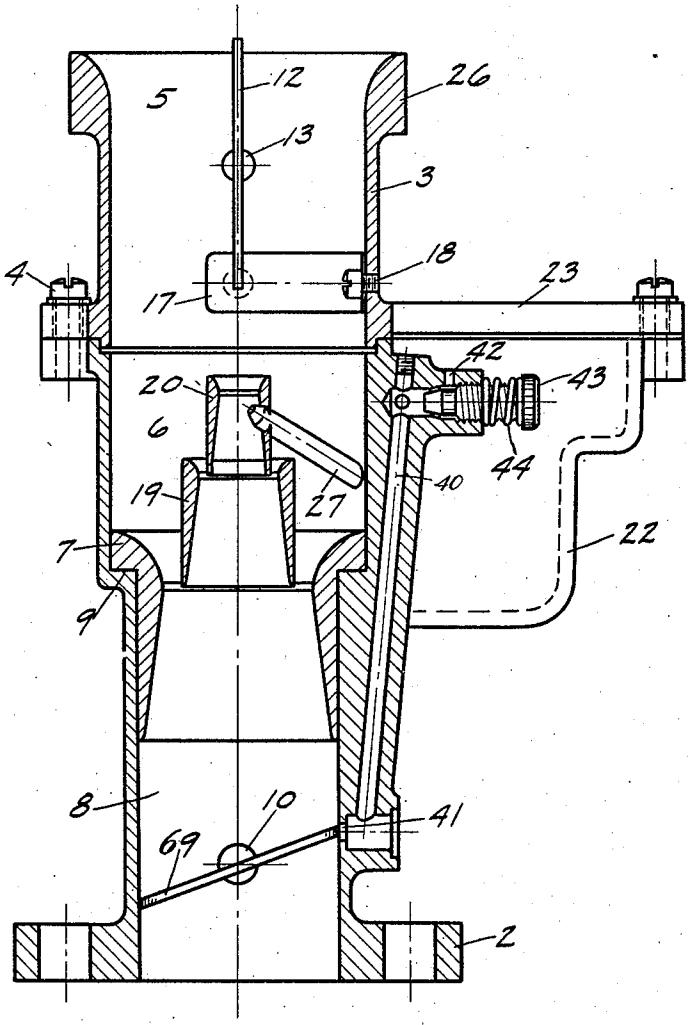


FIG. 3

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May 17, 1932. G. M. BICKNELL 1,858,615

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Filed Nov. 18, 1930 5 Sheets-Sheet 4

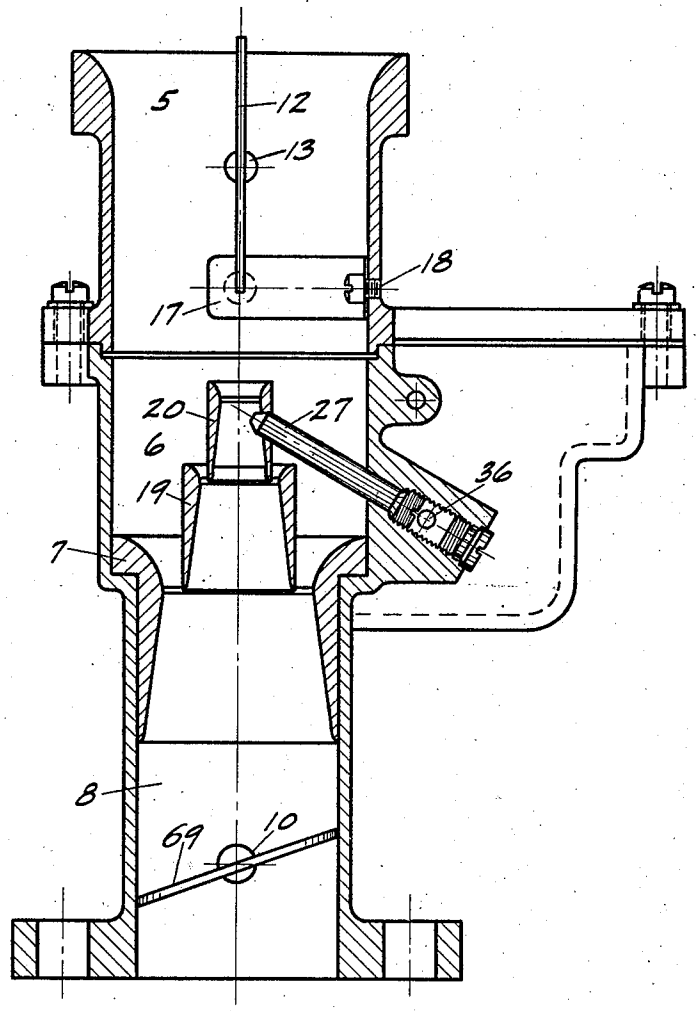


FIG. 4

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May 17, 1932. G. M. BICKNELL 1,858,615

CARBURETOR

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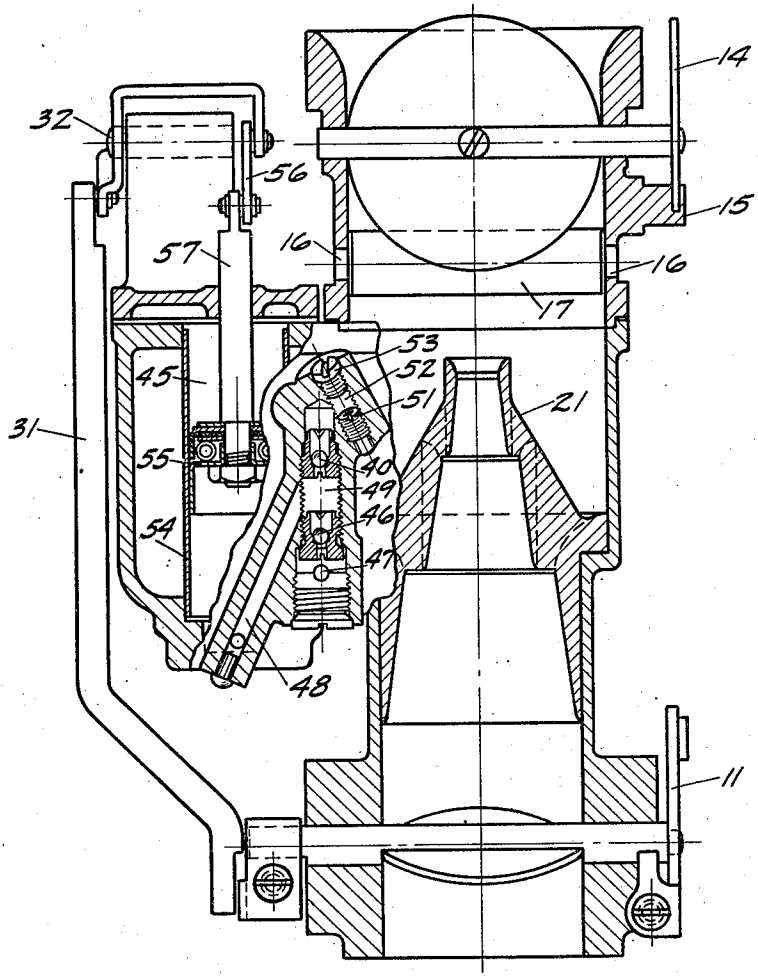


FIG. 5

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Patented May 17, 1932 1,858,615

UNITED STATES PATENT OFFICE

GEORGE M. BICKNELL, OF ST. LOUIS, MISSOURI, ASSIGNOR TO CARTER CARBURETOR CORPORATION, OF ST. LOUIS, MISSOURI, A CORPORATION OF DELAWARE

CARBURETOR

Application filed November 18, 1930. Serial No. 496,396.

It will be understood that the invention is susceptible of many modifications, and, accordingly, I do not wish to be limited in my protection, except as set forth in the accompanying claims.

This invention relates to carburetors for internal combustion engines. In previous devices of this type considerable difficulty has been experienced in providing a carburetor having sufficient capacity for operation of the engines under maximum power conditions and having, at the same time, the ability to efficiently vaporize the fuel for low and intermediate power requirements.

It is an object of this invention to provide a carburetor for internal combustion engines capable of efficiently vaporizing fuel at widely varying rates of flow, and which will not present any great resistance to the flow of air and fuel mixture to the engine.

It is a further object of this invention to provide a carburetor of the above described type capable of maintaining a substantially constant fuel mixture ratio at different rates of operation.

A further object of the invention is to provide a carburetor having means for cooling the fuel in the float chamber thereof.

Other objects will appear from the following specification and accompanying drawings, referring to which:

Figure 1 shows a side elevation of a carburetor constructed according to one embodiment of my invention, with parts broken away for better illustration of others.

Figure 2 is a plan view of the carburetor shown in Figure 1.

Figure 3 shows a longitudinal sectional view of the carburetor shown in Figures 1 and 2, the section being taken along the line 3—3 of Figure 2.

Figure 4 is a longitudinal sectional view of the carburetor shown in Figures 1 to 3, the section being taken along the broken line 4—4 of Figure 2.

Figure 5 is a longitudinal sectional view of the carburetor shown in Figures 1 to 4 taken along the line 5—5 of Figure 2, parts being shown in section and parts being broken away for better illustration of others.

Figure 6 is a detail plan view showing the nest of venturis.

Figure 7 is a longitudinal sectional view of the parts shown in Figure 6.

Figure 8 is a fragmentary sectional view showing the upper part of the lower body member and the relation of the nozzle thereto.

The reference numeral 1 indicates a casting forming the main body member of the carburetor. This casting has a flange 2 formed on its lower end for attachment to the intake manifold of an internal combustion engine. An upper body member 3 is attached to the member 1 by any suitable means, such as screws 4. An air inlet 5 is formed in the upper body member and registers with an air chamber 6 which forms the upper end of the main air passageway through the lower body member 1.

A venturi 7 is fitted into the air chamber 6 and extends downwardly into a bore 8 which forms the mixing chamber of the carburetor. It will be understood that the bore 6 is slightly larger in diameter than the bore 8, and that the two portions are joined by a shoulder or tapered portion 9 to provide means for locating the venturi 7 with respect to the length of the carburetor.

The lower end of the bore 8 is controlled by a throttle valve 69 mounted on a shaft 10 which is journaled in the casting 1 as shown. A suitable operating lever 11 is attached to the shaft 10 for operation by any suitable means.

An air inlet valve 12 is mounted on a shaft 13 in the upper body member 3, and a suitable operating lever 14 is attached in a conventional manner. A stop 15 is formed integral with the casting 3 and may be provided with an adjustment, if desired.

One or more openings 16 are formed in the upper body member 3 to communicate with the atmosphere, and these openings are controlled by a spring member 17 which is attached to the inner wall of the air inlet 5 by any suitable means, such as a screw or rivet 18. It will be understood that the member 17 acts as a valve which may be opened by suction to permit the admission of air through the port 16.

The tension of the spring 17 is calibrated with respect to the size of the port 16 and the leakage which may occur past the valve 12, in such a way that the valve 17 will remain in closed position when the valve 12 is closed during cranking speeds of the engine, but when the suction of the engine is increased by its beginning to run under its own power, the valve 17 will be unseated and air may flow in through the port 16. Obviously, the tension required in the spring 17 will vary with different installations, but, as an illustration, the valve 17 should ordinarily remain closed at speeds below one hundred revolutions per minute of the motor, and it should begin to open at speeds in excess of that figure.

In this installation, three venturis are provided, the largest venturi 7 fitting the outer wall of the carburetor as shown. The second venturi 19 terminates at the throat or at the most restricted portion of the venturi 7, and the third venturi 20 terminates at the throat of the most restricted portion of the venturi 19.

To prevent eddy currents being formed in the venturis, I provide one or more vanes or straighteners 21 which extend parallel to the lines of flow and which are preferably made thicker at the inlet end than at the end adjacent the outlet of the carburetor. These vanes are mainly for the purpose of preventing the rotation of the air currents in the carburetor, or checking any rotation which may have been set up in the inlet, but they are also highly useful as devices for locating the venturis with respect to each other. It will be understood that where many thousands of carburetors are to be produced, it is essential that the air flow characteristics in each be substantially the same. By forming the venturis and the vanes as a single die casting, I am able to secure absolute uniformity so that there is no need of separately adjusting the venturis in each carburetor.

A fuel bowl 22 is cast integrally with the lower body member 1 and a conventional float mechanism is located in this bowl for maintaining the fuel at a constant level substantially as indicated by the line A—A. The fuel is supplied to the bowl by any suitable means which, being entirely conventional, is not shown.

A cover 23 is provided for the bowl, and this cover forms an air tight seal so that the pressure conditions in the bowl may be controlled by a pair of vents 24 and 25. The vent 25 is connected to the inside of the air chamber, and the vent 24 is connected to the atmosphere, thereby giving a flow of air in through the vent 24 and out through the vent 25. This flow of air through the fuel bowl cools the fuel by carrying off vapors into the mixing conduit.

An economizing action is also obtained in this construction by reason of the fact that the pressure in the fuel bowl is caused to vary inversely with the rate of flow through the air chamber. It will be understood that provision of the vent 25 also helps to correct difficulties caused by the variation in the resistance to flow through the air cleaner which is normally attached to the flange 26 at the air inlet of the carburetor.

A main fuel nozzle 27 is mounted at an angle so that it will discharge against the direction of air flow, thereby serving as a correction to assist in obtaining a substantially constant fuel mixture ratio. The fuel is supplied to the nozzle 27 through a metering jet 28 mounted in the lower part of the float chamber, as indicated, and the constriction of the jet is controlled by a stepped metering rod 29 operated by the throttle through crank 30, link 31, rock shaft 32, and crank 33. It will be understood that a smaller step of the metering rod is brought in juxtaposition to the restricted orifice when the throttle is in wide open position.

The metering rod 29 enters the float chamber through an opening 70 which provides a substantial amount of clearance, so that the rocking motion of the arm 33 may be provided for. In order to keep dust from entering the carburetor bowl, a flat disk 71 is located in a counterbore at the upper end of the opening 70. The flat disk is larger in diameter than opening 70 and is slidably mounted on the shaft 29. The disk 71 is held in place by a washer 72 or other suitable means.

The fuel is conveyed from the restricted orifice in the jet member 28 through a cross bore 34 into a vertical bore 35 and from this bore the fuel flows through a cross bore 36 into the nozzle chamber and on up through the nozzle 27 through which it is discharged into the venturi 20. The fuel comes out of this nozzle with some velocity and is discharged into the most rapidly moving portion of the air stream as it passes through the venturi 20.

The walls of this venturi serve as baffles to straighten out the flow of the fuel, thereby preventing it from striking the walls of the air chamber or the conduit 8 until after it has been vaporized by additional air entering the venturis 19 and 7. I consider this an important feature of the invention, for tests have shown that when liquid fuel is permitted to strike the outer wall of the mixing conduit, it is likely to be carried along in liquid form by the air stream in such a way that vaporization and distribution are not efficiently accomplished.

By the above arrangement, I am enabled to avoid the necessity for mixing air with the fuel in the fuel passageways and nozzles which would cause the delivery of the fuel in slugs and generally inefficient operation of the carburetor, particularly at low speeds.

Low speed operation of the carburetor is provided for as follows:

The conduit 37 is concentrically mounted in the bore 35 and is closed at its lower end, except for a metering orifice 38. A cross bore 39 leads transversely to the upper end of a vertical bore 40. This vertical bore extends downwardly to the port 41 which is formed adjacent the edge of the throttle 9 on the side which opens toward the inlet of the carburetor. The construction and operation of this idle port are well known, being previously covered in Patent No. 1,207,134 to W. C. Carter.

The port 41 being below the fuel level in the chamber 22, an air bleed 42 is provided at a point above the fuel level for admitting air to the cross bore 39 to break the siphon and prevent the drainage of the carburetor when it is not in operation. An adjusting screw 43 frictionally held in position by a spring 44 is provided for controlling the admission of air at 42, so that the richness or leanness of the idle may be adjusted.

An accelerating pump 45 is provided for delivering an increased charge of fuel to the carburetor upon acceleration. The pump is provided with an inlet check valve 46 receiving fuel from the float bowl through the bore 47, and the outlet side of the check valve is connected to the pump through the passage 48. The check valve 46 is threaded into a bore 49, and the outlet check valve 40 of the accelerating pump is also threaded into the same bore, the connection 48 being located between the two valves.

The pump discharges into the mixing conduit through nozzle 51 which is fitted to a bore 52 which intersects the bore 49 on the outlet side of the check valve 50. The bore 52 is plugged at 53, as indicated. The passage 48 connects with the lower end of the cylinder 54 in which a piston 55 is reciprocally mounted. This piston is operated from the throttle through link 31, rock shaft 32, crank 56, and connecting rod 57. The nozzle 51 discharges between the venturis 19 and 7, so that the stream from the pump will be vaporized by the rapidly flowing air stream.

The operation of the device is as follows:

The carburetor is attached to the intake manifold of an engine, and fuel is supplied to the float chamber 22 by any suitable means. Assuming that the engine is to be started cold, the choke valve 12 is closed for starting purposes and the throttle valve 69 is preferably slightly open. It will be understood that linkage may be provided for causing the throttle to be slightly open when the choke valve is closed, but said linkage is not a part of this invention and need not be further described.

Upon operation of the engine at cranking speeds, say, fifty revolutions per minute, a strong suction acts on the nozzle 27, causing a very rich fuel mixture to be supplied to the engine. When the engine begins to fire, and run under its own power, its speed will substantially increase, and the increased suction will cause the opening of the valve 17 to permit the admission of sufficient air through the port 16 to supply the requirements of the engine and to prevent the engine being stalled by too rich a mixture, which would probably occur if all the suction caused by the engine operating under its own power were permitted to act on the nozzle 27. After the engine is started, the valve 12 is gradually opened, and the free admission of air to the air inlet 5 is permitted.

Assuming that the throttle 69 is in open position, air flows through the venturis 20, 19, and 7, and the most rapidly moving part of the air stream flows through the venturi 20. The speed of this rapidly moving air being increased by the restriction at the throat of the venturi 20, a strong suction on the end of the nozzle 27 is caused, serving to draw fuel out of that nozzle in proportion to the speed of the air stream at low speeds, and at high speeds the normal tendency of the fuel nozzle to over richness is overcome in two ways. First, the increasing impact of the air against the fuel issuing from the nozzle and the partial reversal of the flow of fuel which is caused to occur in the venturi 20 partially corrects the normal tendency of this nozzle to increase the richness of the mixture as a whole at high speeds. The tendency to increase richness at high speeds is further counteracted by the fact that the flow ratios between the venturis 20 and 19 and 7 tend to change, as the speed increases, in favor of the larger venturis.

In modern carburetors, the high capacity which is so greatly desired necessarily involves comparatively large venturis and air passageways and correspondingly low suctions available to draw fuel from the nozzle during low speed operation with wide open throttle. With this construction, the difficulty of getting enough fuel at low speeds when the throttle is open is overcome, to a great extent, by the fact that the impact of air against the outlet of the nozzle 27 at low speeds is very much less than at high speeds and, accordingly, I am able to use a comparatively large metering jet 28 which permits the free flow of fuel at the low speeds and yet does not give too much fuel at high speeds on account of the economizing action of the impact of the air stream against the fuel which is discharged from the nozzle 27. It will be understood that it is not only the impact of the air striking against the fuel which retards it, but also the suction is lowered by the fact that the velocity of the air is slightly reduced by the inertia of the fuel which it must overcome.

During low speed closed throttle opera-

tion, the carburetor obtains its fuel through the port 41 in the manner described in the above mentioned Carter patent, and as the throttle is gradually opened, the nozzle 27 is kept from coming into operation until the port 41 begins to go out of operation by reason of the fact that the suction from the port 41 is communicated to the nozzle 27 through passages 38, 35, and 36. By this arrangement, the nozzle 27 is permitted to come in only gradually as the idling supply goes out gradually.

I claim:

1. In a carburetor, means forming a mixing conduit, a venturi in said conduit, a second venturi discharging substantially at the throat of said first named venturi, a constant level fuel chamber, a nozzle receiving fuel from said constant level chamber, said nozzle discharging at an angle against the air stream at an acute angle to the path of flow of air in the said second venturi.

2. In a carburetor, means forming a mixing conduit, a venturi in said conduit, an air inlet for said venturi, a fuel nozzle discharging into said venturi at an angle against the flow of air entering said inlet, a throttle valve in said mixing conduit, a low speed conduit discharging adjacent the edge of said throttle valve, and means for reducing the flow of fuel through said nozzle according to the degree of suction applied to said low speed conduit.

3. In a carburetor, means forming a mixing conduit, a throttle valve controlling said conduit, a high speed fuel nozzle discharging into said conduit anterior to the throttle and at an angle against the air stream flowing through said conduit, a low speed nozzle connected to discharge fuel to said mixing conduit posterior to said throttle, and means for reducing the flow through each of said fuel conduits in accordance with the amount of fuel being discharged through the other of said fuel conduits.

4. In a carburetor, means forming a mixing conduit, a fuel supply chamber, a calibrated passageway receiving fuel from said supply chamber, a high speed fuel conduit and a low speed fuel conduit connected to each other and both connected to receive fuel through said calibrated passageway, said high speed conduit discharging at an angle against the air stream in said mixing conduit, and said low speed conduit discharging into said mixing conduit posterior to said high speed conduit.

5. In a carburetor, means forming a mixing conduit, a throttling valve controlling said conduit; a low speed port in the wall of said conduit, said low speed port opening into said mixing chamber, both above and below the throttle valve when it is in closed position, a fuel supply chamber, a restricted and calibrated passageway leading from said fuel supply chamber, a low speed conduit conveying fuel from said restricted passageway to said low speed port, a high speed conduit discharging at an angle against the air stream in said mixing conduit, said high speed conduit and said low speed conduit being connected at a point between said low speed port and said restricted passageway.

6. In a downdraft carburetor, means forming a downwardly extending mixing conduit, means forming a constant level fuel chamber, a plurality of concentric venturis in said downwardly extending conduit, each except the last of said venturis being smaller than the next lower venturi and discharging near the most restricted portion thereof, and a fuel conduit leading from said constant level fuel chamber and discharging at an angle upwardly against the air stream at an acute angle to the path of flow of air in the uppermost and smallest of said venturis.

7. In a carburetor, means forming a mixing conduit, a fuel nozzle discharging at an acute angle in opposite direction the air stream flow in said mixing conduit, said conduit comprising at least a pair of concentric walls, and said nozzle discharging toward the inner of said walls, whereby the direct direct discharge of fuel against the outer wall of said conduit will be prevented.

8. In a down draft carburetor, means forming a downwardly conducting mixing conduit, a fuel chamber, means for maintaining a substantially constant fuel level therein, and a fuel nozzle discharging into said conduit, said fuel nozzle being directed upwardly against said air stream at an angle to the vertical and discharging above said level in opposition to the path of flow of air, whereby the fuel issuing from said nozzle will be caused to meet the air stream flowing past the outlet of said nozzle at a higher velocity than the absolute velocity of the air.

9. In a down draft carburetor, walls forming a downwardly conducting mixing conduit, a suction operated nozzle discharging upwardly against said air stream at an angle acute to the path of flow thereof, and baffle means mounted in the line of discharge of said nozzle between the outlet of the nozzle and the opposite wall of the mixing conduit, whereby unvaporized fuel discharged from said nozzle will be prevented from directly impinging on the outer wall of said conduit.

10. In a down draft carburetor, means forming a downwardly conducting mixing conduit, a main venturi in said conduit, means forming a constant level fuel supply chamber, a suction operated nozzle for conveying fuel from said supply chamber to said mixing conduit, said nozzle being directed upwardly at an angle acute to the path of flow of air through said mixing conduit, and a primary venturi encircling the outlet of said nozzle to prevent the squirting of fuel

from said nozzle directly against the outer wall of said conduit.

11. In a down draft carburetor, means forming a mixing conduit, said mixing conduit having an air inlet of comparatively large area, and a mixture discharge outlet of smaller area, a venturi between said inlet and said outlet, a fuel nozzle discharging upwardly at an angle acute to the path of flow of air in said mixing conduit, a throttle for controlling said outlet, an accelerating pump connected to and operated by said throttle, said pump having a discharge nozzle mounted in a wall of said conduit and having its outlet anterior to said venturi and in a point of comparatively low restriction and low velocity in said mixing conduit, the flow from said fuel nozzle being reduced at high velocities by the impact of air striking the fuel as it issues therefrom.

12. In a carburetor, means forming a constant level fuel chamber, a vent in said chamber above the fuel level therein, means forming a downwardly conducting mixing conduit having an air inlet above the fuel level in said chamber and a mixture outlet below said fuel level, a venturi in said conduit, an upwardly conducting fuel nozzle leading from a point near the bottom of said fuel chamber and discharging at a point above the said fuel level and into the restricted part of said venturi, the outlet of said fuel conduit comprising a straight line passageway extending from a point substantially below the fuel level, whereby air flowing downwardly through the mixing conduit will be caused to impact directly against the fuel in said nozzle, a flow restricting device near the inlet end of said fuel conduit, a throttle controlling the discharge of mixture from said mixing conduit, conduit means connected to said fuel conduit between said flow restricting device and its outlet and having an outlet port into said mixing conduit adjacent said throttle, at least a portion of said outlet port being exposed to suction below said throttle said suction and the impact of air flowing through the mixing conduit acting in conjunction with said flow restricting device to retard the discharge from said nozzle.

In witness whereof I have hereunto set my hand.

GEORGE M. BICKNELL.