Sept. 10, 1940.

J. R. FISH

2,214,273

CARBURETOR

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5 Sheets-Sheet 1

Fig. 1.

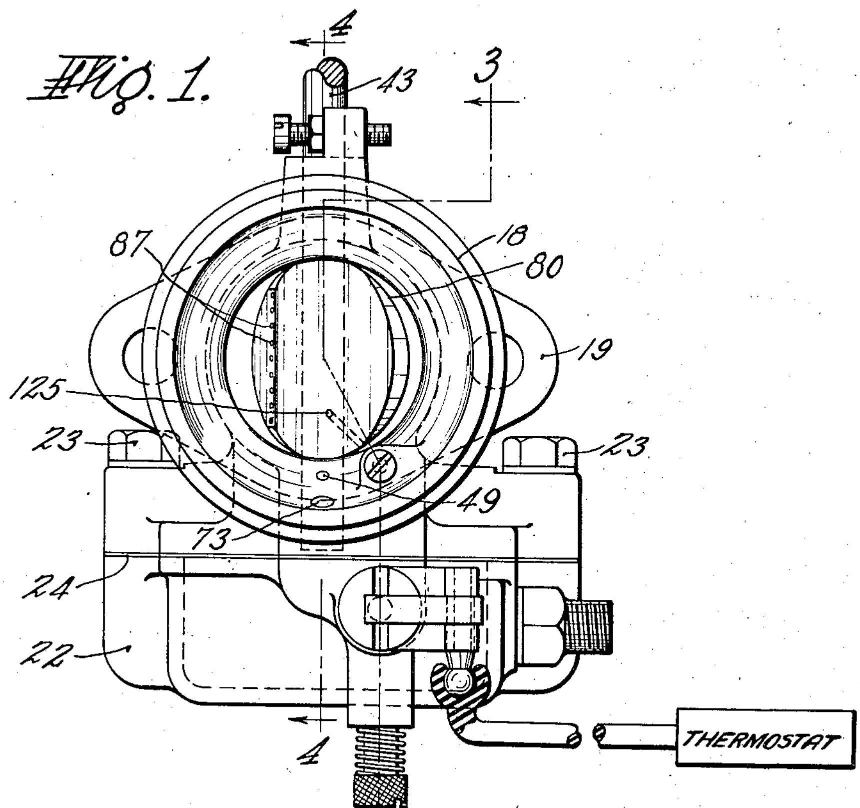
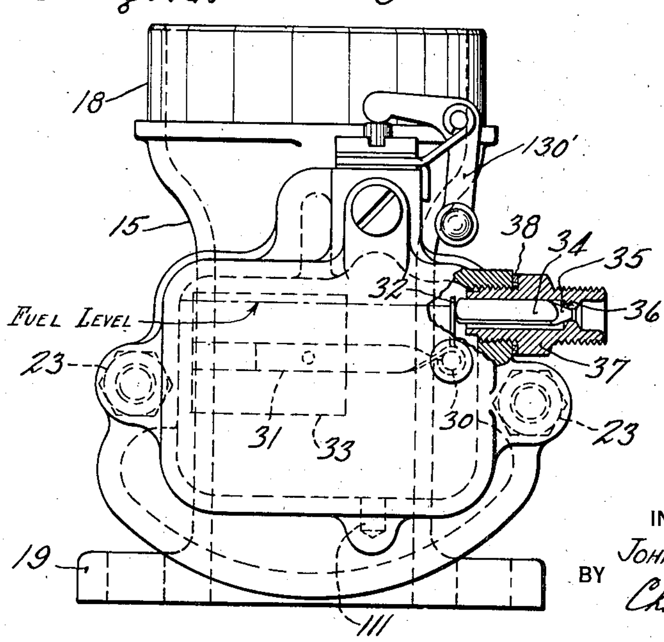


Fig. 2.



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ATTORNEYS

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Fig. 3.

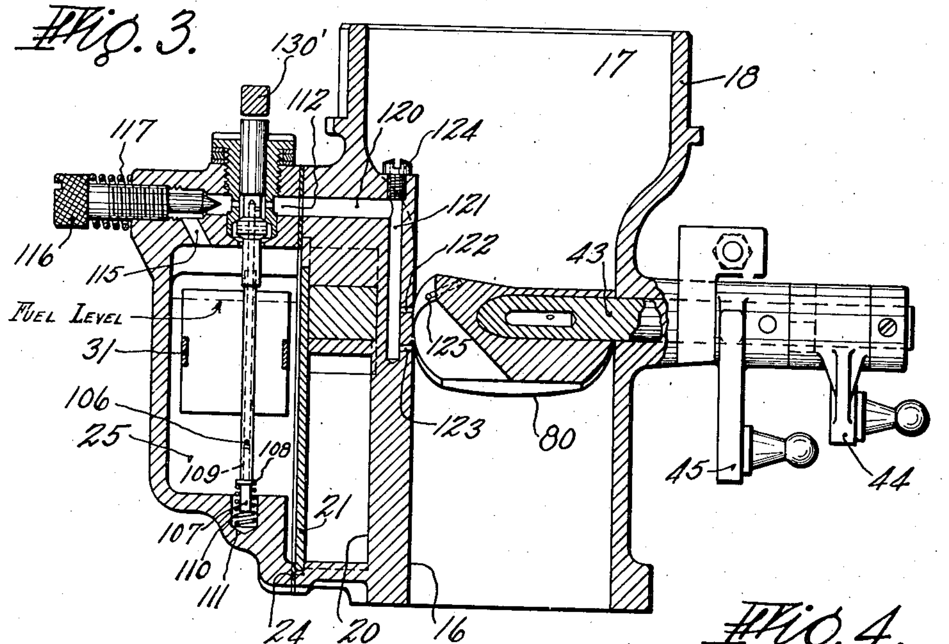

Fig. 4.

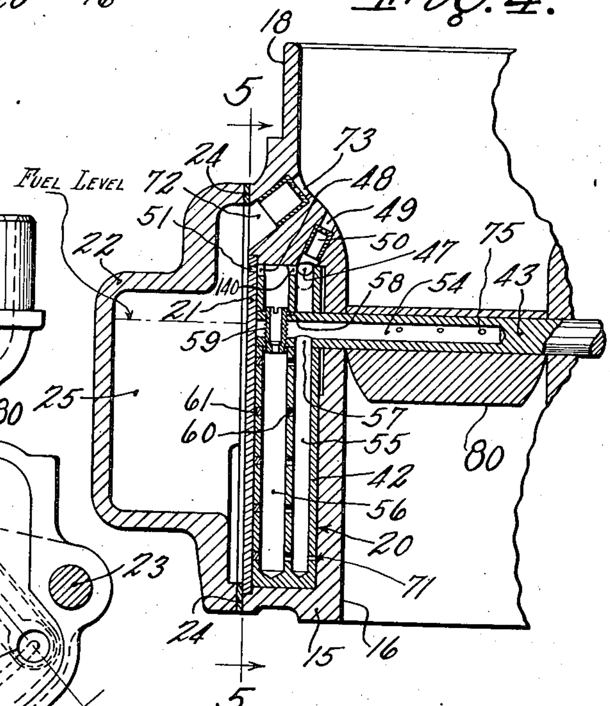

Fig. 5.

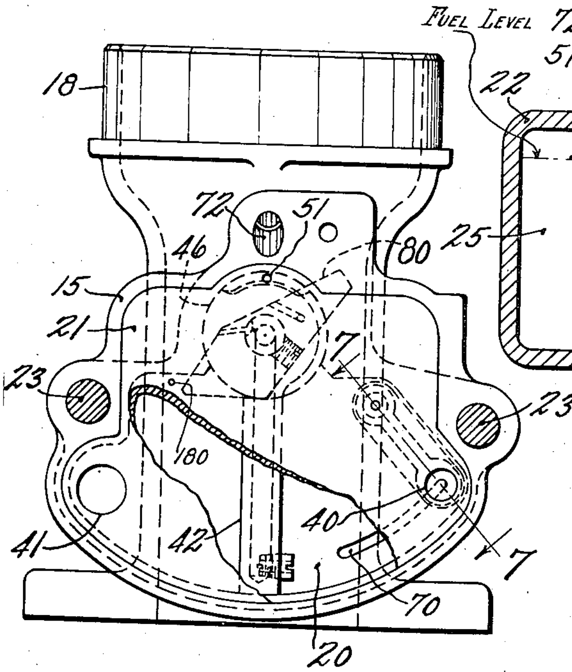

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Fig. 6.

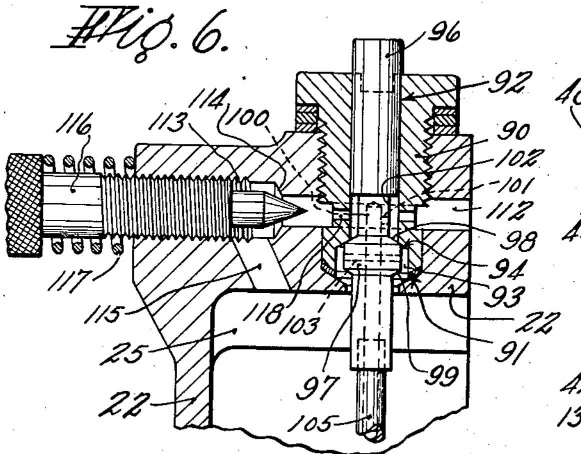

Fig. 11.

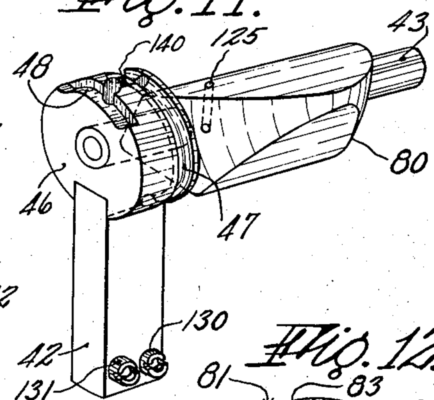

Fig. 12.

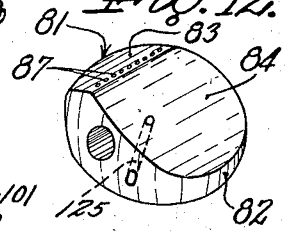

Fig. 7.

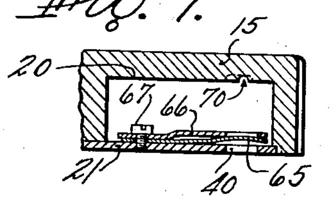

Fig. 13.

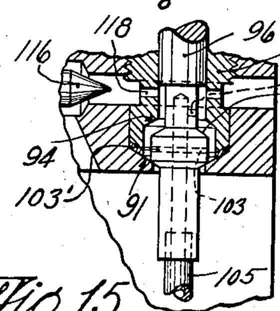

Fig. 14.

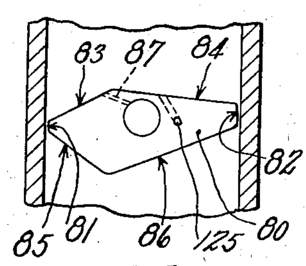

Fig. 8.

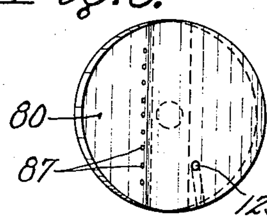

Fig. 15.

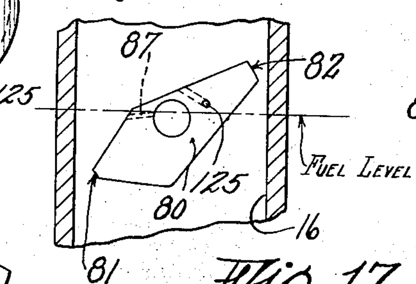

Fig. 9.

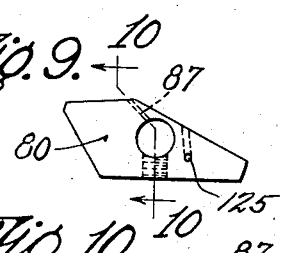

Fig. 16.

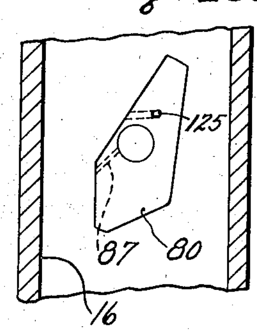

Fig. 10.

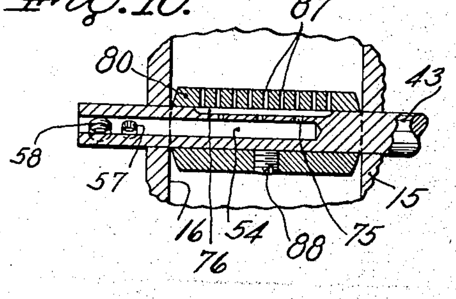

Fig. 17.

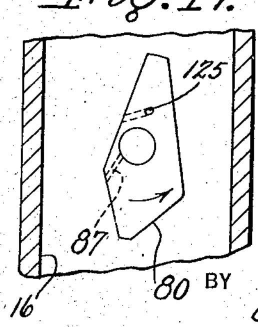

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Fig. 18.

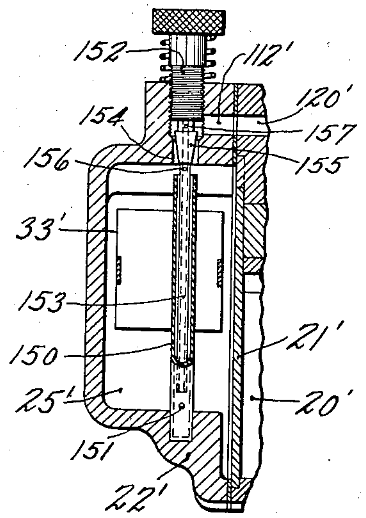

Fig. 19.

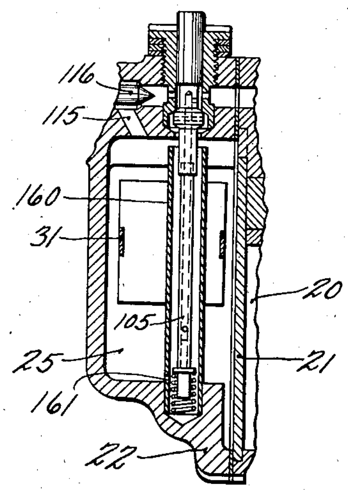

Fig. 20.

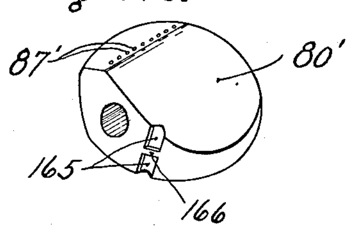

Fig. 22.

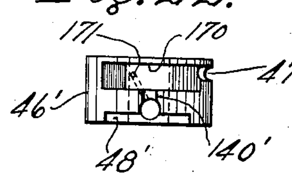

Fig. 23.

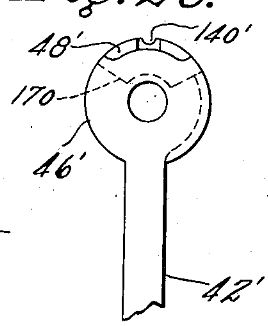

Fig. 21.

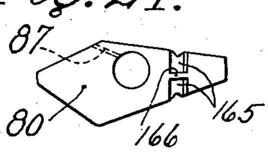

Fig. 24.

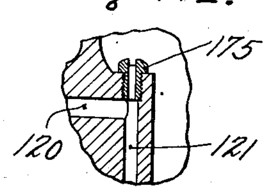

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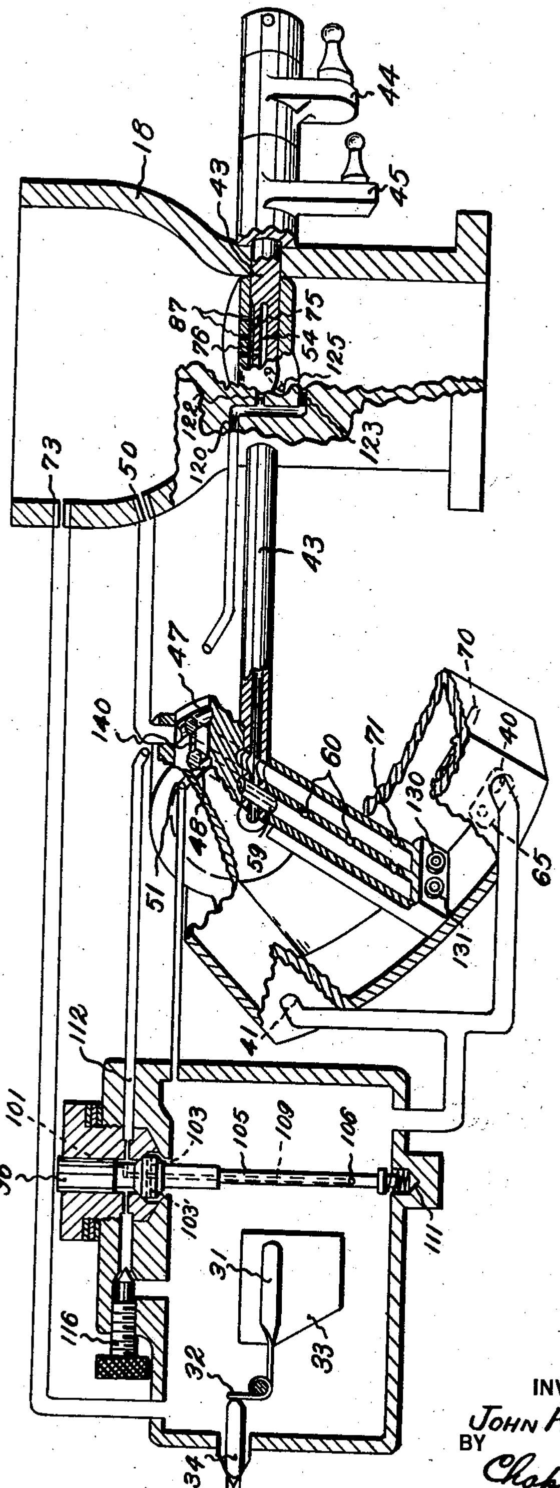
Fig. 25.



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Patented Sept. 10, 1940 2,214,273

UNITED STATES PATENT OFFICE

2,214,273

CARBURETOR

John Robert Fish, West Springfield, Mass.

Application February 10, 1934, Serial No. 710,690

13 Claims. (Cl. 261—41)

This invention relates to carburetors for internal combustion motors. One object of the invention is to provide a carburetor in which the varying mixture requirements under different motor operating conditions will be met automatically and wthout the use of mechanically operated or spring operated fuel or air jets. Another object is to provide an improved idling and starting system for carburetors. Another object is to provide improved control for the action of the carburetor during rapid acceleration of the motor. A specific object is to improve upon the carburetor disclosed in my prior application for patent Serial No. 682,980, filed July 31, 1933, particularly in the direction of simplifying the mechanism thereof, decreasing its cost in manufacture, producing greater compactness and improving the mixing of the fuel and air in correct proportions over the entire range of motor operating conditions.

Referring to the drawings:

Fig. 1 is a top plan view of a down draft carburetor embodying my invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is a section taken on line 3—3 of Fig. 1;

Fig. 4 is a section on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 4 with certain portions broken away;

Fig. 6 is an enlarged sectional detail of the idling mechanism;

Fig. 7 is a sectional detail on line 7—7 of Fig. 5;

Figs. 8 and 9 are respectively a top plan and an end elevation of the throttle;

Fig. 10 is a detail showing the manner in which the throttle is assembled on its shaft;

Fig. 11 is a perspective detail showing the assembly of the throttle, throttle shaft, and fuel arm;

Fig. 12 is a perspective view of the throttle;

Fig. 13 is a detail similar to Fig. 6 but showing the parts in position for starting with a cold motor;

Figs. 14 to 17 are diagrammatic views showing different positions of the throttle;

Fig. 18 is a detail, corresponding to a portion of Fig. 3, showing a modified form of idling system;

Fig. 19 is a similar view showing a second modified form of idling system;

Fig. 20 is a perspective view of a modified form of throttle;

Fig. 21 is an end elevation of the form of throttle shown in Fig. 20;

Fig. 22 is a top plan, and Fig. 23 a side elevation, of a modified form of fuel arm; and

Fig. 24 is a detail corresponding to a portion of Fig. 3 but showing a further modification.

Fig. 25 is a diagrammatic view of the several parts of the carburetor showing the connection and function.

The carburetor has a body portion 15 formed with a cylindrical bore or mixing passage 16. In the present case, as contrasted with the carburetor shown in my prior application, this bore is made cylindrical so that it can be easily machined; the necessary variations in the form of the passage being produced by the formation of the throttle. At its upper end the passage is preferably widened into the usual bell mouth 17 having an external flange 18 upon which an air cleaner can be mounted. The carburetor is secured to the intake manifold by suitable bolts passing through holes in a bottom flange 19. To one side of the mixing passage 16 a fuel chamber 20 is formed, this being closed by a plate 21 recessed into the body 15. A cap casting 22 is held by screws 23 against the plate 21, a gasket 24 being used to prevent leakage.

The casting 22 is provided with a float chamber 25. Extending transversely of this chamber is a pivot pin 30 (Fig. 2) upon which is mounted an angle lever conveniently made of pressed metal and having a pair of substantially horizontal arms 31 and a vertical arm 32. The arms 31 are secured to a float 33 preferably of cork in any suitable manner, such as riveting. The arm 32 bears against a needle 34 having a tapered end 35 adapted to fit against a seat 36 formed in a nipple 37. The point of the needle is preferably blunted to reduce the movement of the float necessary to produce the required gasoline flow. The sides of the needle 34 are slabbed off so as to permit the passage of fuel between it and the hole in the nipple in which it slides. The level of the liquid in the float chamber can be adjusted accurately by varying the thickness of the gaskets 38 against which the nipple seats, or by bending the arm 32.

Communication between the float chamber and the fuel chamber 20 is secured by holes 40 and 41 (Fig. 5) formed in the plate 21. Within the fuel chamber 20 is a fuel arm 42 secured preferably by a press fit on one end of the throttle shaft 43 (Fig. 11). The exposed end of the throttle shaft bears hand throttle and foot accelerator levers 44 and 45 (Fig. 3) of any desired type. The top of the fuel arm is made cylindrical as at 46 and fits snugly into the curved upper end of the fuel chamber. This cylindrical top is provided with a groove 47 extending a considerable distance around its circumference and with a groove 48 opening sideways onto the side of the fuel arm adjacent the plate 21, the two grooves being connected by a passage 140. The groove 47 communicates at its bottom end with the fuel chamber and remains in communication, throughout the movement of the throttle arm, with a hole 49 (Fig. 4) passing through the wall of the carburetor body into the portion of the passage 16 above the throttle. In order to regulate the amount of air or fuel which will pass through the hole 49 a jet 50 is located in the hole. This jet is conveniently formed from a cartridge-shaped piece of metal adapted to be held within the hole merely by being forced therein. Hole 49 is preferably reduced to form a shoulder against which the jet is driven. A small drilled hole in the end of the jet 50 gives the desired opening, this construction permitting the jet to be replaced by another with a different size hole when desired. The groove 48 is less in extent than the groove 47 and communicates with the upper portion of the float chamber by means of hole 51 in the plate 21. The cross passage 140 furnishes a connection between the groove 47 and the hole 51 and thus keeps the air pressures in the float chamber and in the delivery side of the fuel chamber substantially equal. It also serves as a by-pass, together with hole 51, to give a control of the accelerating action of the fuel arm which will be described below. It may also be noted here that the pressure in the passage 49 is slightly below that in the float chamber due to the location of the passage 49 in a more constricted part of the mixing passage than the jet 73 which governs the float chamber pressure as will be described. The passage 50 will thus assist in keeping the pressure or delivery side of the fuel chamber 20 always full of fuel. In fact, the reduction in pressure due to the passage 50 can readily be made so large that without the balancing effect of the connection 140, 51 to the float chamber, fuel would actually be raised out of the passage 50. A hole 180 (Fig. 5) is preferably formed in the plate 21 on what may be termed the inactive side of the fuel chamber to prevent the trapping of air therein.

Before the fuel arm and the throttle shaft are assembled the throttle shaft is formed with an axial bore 54 (Figs. 4 and 10). Two long bores 55 and 56 are formed in the fuel arm, extending from the cylindrical top of the arm down to a point closely adjacent its bottom. A hole 57 is formed from one side of the throttle shaft into its central bore and a parallel hole 58 is passed completely through the throttle shaft and provided with screw threads. The shaft and the fuel arm are assembled so that hole 57 faces the bottom side of the long bore 55, the top part of the throttle shaft serving to block off the upper portion of this bore so that no communication is afforded between the bottom end of the bore 55 and the groove 47. A jet 59 is then threaded into the hole 58 from above, serving both to regulate the amount of air which can pass downwardly into the bore 56 and to block off all direct communication between the bore 54 and the bore 56. This jet also acts as a plug closing off the end of the bore 54 which lies adjacent the plate 21. A series of holes 60 are passed through one wall of the arm and through the partition separating the bores 55 and 56, the portion of these holes in the outer wall of the arm being then closed by plugs 61. These holes permit the passage of fuel, air, or both, from the bore 56 into the bore 55 in a manner which will be described below. The lower end of the bores 55 and 56 are opened to the pressure side of the fuel arm by jets 130 and 131 respectively. The jet 131 provides a delicate adjustment of the flow of fuel through the main fuel jets, particularly effective at wide throttle openings, and may be omitted if desired.

Fuel flows into the fuel chamber through the hole 40 in the plate 21. If the arm 42 is swung toward the right in Fig. 5 fuel would tend to be pushed back through this hole unless some provision were made for preventing it. A light spring feather valve 65, the free end of which moves between the hole 40 and a stop plate 66, acts as a check valve to prevent this reverse movement of the fuel. The feather valve and the stop plate are conveniently held to the plate 21 as by a screw 67. As in my prior application referred to, a groove 70 in the body 16 registers with a hole 71 in the fuel arm when the latter is near its open throttle position to facilitate flow of fuel into the passage 55 and somewhat enrich the mixture, producing the ratio of fuel and air necessary to give the highest power. A hole 72 formed in the carburetor body connects the upper portion of the float chamber 25 with the main passage 16 as is best shown in Fig. 4, the amount of air passing through this hole being regulated by an apertured jet 73 formed in the same manner as jet 50. The relative size of the jets has a decided effect on the performance of the carburetor as will be described.

The bore 54 which extends into the throttle shaft 43 is provided with one or more radial holes 75 (Fig. 10) extending into one or more external longitudinal grooves 76 in the throttle shaft. In the case shown three of these holes 75 have been provided. The throttle 80 which fits upon the throttle shaft has the shape of a sphere with its sides flattened off. The spherical surface is left around the central zone of the throttle so that it will substantially fill the passage 16 when the throttle is closed as in Fig. 14. The flattened sides are indicated in Fig. 14 as 83, 84, 85 and 86, being preferably arranged at such an angle that the central portion of the throttle is considerably thickened. A row of holes 87 extend from the surface 83 into communication with the longitudinal groove 76 in the throttle shaft. It will be apparent from a consideration of Figs. 14 to 17 that the holes 87 open above the normal gas level when the throttle is in closed position, and that their openings would sink progressively to and below this level as the throttle is opened. The flow of gas is thus facilitated in accordance with the added requirements due to wide throttle openings. The opening of the holes 87 is preferably just below the widened portion of the throttle, which itself drops below the axis of the throttle, as the latter is opened. The holes thus lie in the zone of low pressure created within the passage 16 due to the increase in velocity of the air flowing by the constricted zone formed by the presence of the thickened portion of the throttle. The throttle is held firmly in position on the shaft 43 in any convenient way as by a set screw 88, preferably set opposite the groove 76 so as to prevent leakage between the edges of this groove and the throttle. The distribution of fuel flow across the passage 16 may need to be varied to suit particular installations and with the construction described above this can be done by varying the sizes, number, and location of the several holes 87, or by varying the sizes, number, and location of the holes 75 or the form of the groove 76.

The carburetor is provided with a starting system similar in its general outline to that described in my prior application referred to above, although having certain features of advantage. Referring particularly to Figs. 6 and 13, a screw plug 90 is threaded into a hole in the upper portion of the float chamber casting 22, having a lower conical end adapted to fit against a conical seat 91 with the intervention if desired of a suitable gasket. The plug 90 has a hole 92 extending longitudinally through it, this hole having an enlargement 93 joined with the main portion of the hole by a conical seat 94. Within the plug 90 is located a plunger 96 having an enlarged portion 97 fitting within the enlargement 93 of the plug and provided with conical surfaces 98 and 99 adapted to fit against the surfaces 94 and 91 respectively. A longitudinal bore 100 extends part way up through the plunger 96 and has a radial hole 101 extending from it to the surface of a reduced portion 102. Radial holes 103 also extend from the bore 100 to the surface of the enlargement 97.

The lower end of the plunger 96 has an enlarged bore adapted to receive the upper end of a tube 105 extending between the float carrying arms 31 and having a hole 106 (Fig. 3) opening into the float chamber well below the fuel level therein. Communication is thus established between the fuel in the float chamber and the bore 100. At its lower end the tube is conveniently supported by an end piece 107 having a flange 108 resting against the lower end of the tube and a plug 109 extending into the tube. A spring 110 surrounds the member 107, being compressed between the flange 108 and the lower end of a recess 111 formed in the bottom of the float chamber. The plunger 96 is thus normally held in elevated position and is guided for a limited vertical movement. The tube 105 is located in what may be termed the hydraulic center of the fuel reservoirs, so that its action is substantially unaffected by the tilt of the car.

Extending in a generally horizontal direction through the upper portion of the float casting chamber 22, so as to intersect the vertical bore in which the plug 90 is threaded, is a bore 112. This bore is provided with screw threads 113 on its outer end and with a conical seat 114 forming the connection between the main horizontal portion of the bore and a downwardly extending hole 115 entering into the float chamber. A needle valve 116 is threaded into the bore so as to oppose the seat 114 and is held in adjusted position by a friction spring 117. This needle valve serves to vary the flow of air from the float chamber past the starting plunger 96 as will be described below. The bore 112 registers with a bore 120 formed in the main carburetor casting 15. This latter bore in turn registers with a vertical bore 121 drilled downwardly beside the main conduit 16 and having holes 122 and 123 entering this conduit respectively just above and substantially below a horizontal plane passing through the axis of the throttle. The hole 123 is below the throttle and at all times clear of it. The upper portion of the bore 121 is closed as by a plug 124. The holes 122 and 123 are displaced from the central vertical plane of the throttle as will be best seen from Fig. 1, the section line 33 on which Fig. 3 has been taken having been chosen so as to show these holes in section. A diagonal hole through the throttle joining the upper portion 84 thereof with the spherical side 82 is adapted to make connection with the hole 122.

The operation of the improved carburetor will be considered first when the parts are in the position for starting the engine. Under these conditions the plunger 96 will be held down as by a bell crank 130′ operated from the driver's seat in any conventional manner or by a thermostatic arrangement. The throttle is nearly closed as in Fig. 14. The condition of the starting plunger when depressed is shown in Fig. 13 in which it will be seen that communication betwen the upper portion of the float chamber and the passage 112 is cut off by contact of the surfaces 99 and 91 and that the only air flow that can take place is past the needle valve 116. Flow of fuel however can take place through the hollow tube 105, and the holes 101 and 103. Fuel thus passing up the tube 105 under the influence of the engine suction will be drawn through the transverse passage 112, and mixed with the air passing the needle valve 116. Some fuel may pass through the main throttle openings 87 but the main flow will be through the hole 123 which is below the throttle and thus subject to the suction of the engine under the metering control of the jet 106. A rich mixture suitable for starting is thus produced, which may be increased temporarily still further by a few quick openings of the throttle, causing a priming action by ejection of fuel through the main fuel openings by the action of the fuel arm. It will be noted that the starting system operates by delivering a mixture of the correct richness without restricting the air passage as with the usual choke.

When the engine has warmed up the bell crank 130′ may be rocked to release the plunger 96, which then rises under the influence of the spring 110 to the position shown in Fig. 6. In this position the holes 103 are cut off from the passage 112 but are opened through the enlargement 93 to the top of float chamber 25. Air will therefore pass into the hollow plunger through the holes 103 and will satisfy a portion of the suction exerted on the passage 112. The air passing into the holes 103 will reduce the amount of fuel passing through hole 101, and the size of the latter can therefore be increased. This avoids the danger of plugging present when a small jet is used. The hydraulically centered position of tube 105 previously described, together with this effect of holes 103, prevents the changes in the amount of fuel passing through hole 101 that would occur were 101 of large size and subject to a fluctuating hydraulic head. At the same time the richness of the mixture will be cut down by the fact that the passage 101 is the only one connecting the fuel tube 105 with the passage 112 whereas formerly both the hole 101 and the holes 103 acted in this manner. With the throttle practically closed a mixture of fuel and air suitable for idling, when augmented by the flow of air past the throttle, and controlled by the adjustment of the needle valve 116 is supplied to the passage 16 through the hole 123.

As the throttle is opened for normal running of the engine at ordinary speeds the air flow past the end 81 of the throttle will produce a low pressure zone into which the fuel discharging from the holes 87 will pass. The holes themselves open into a portion of this zone of rather higher pressure than its minimum and some dilution of the mixture is accomplished by passage of air past the end 82 of the throttle. As the throttle is opened more and more to give increased speed to the motor the holes 87 not only drop below the fuel level and thus increase the gravity flow of fuel through them but at the same time enter more nearly into the low pressure zone caused by the constriction in the passage 16. This is clearly illustrated in Figs. 16 and 17. It will be observed that in Fig. 17, which represents substantially full throttle, the back side of the throttle, i. e. the side remote from the holes 87, passes less and less air owing to the constriction of that side of the passage by the widened portion of the throttle. This furnishes a way of reducing the dilution of the mixture and thereby increasing its richness as is required for full power.

Under normal running conditions, as the engine changes from slow idling speed to the speeds generally adapted for open country travel, it is desirable to shift more and more of the fuel supply from the starting system to the main throttle and to do this gradually and without any abrupt changes. This result is of course partially accomplished by the mere opening of the throttle which satisfies some of the motor suction so that the suction on the passage 112 is reduced. The hole 125 however, is so positioned that as the throttle is in substantially closed position it registers with the hole 122 and permits passage of air from the upper surface of the throttle to this latter hole. A partial satisfaction of the suction exerted through the hole 122 is thus brought about and the supply of fuel through the starting system reduced. As the throttle is opened the hole 125 gradually moves out of registry, closing the hole 122 and thus reducing the neutralizing effect of the passage 125 on the gas flow through the passage 123. This compensates for the decrease in suction resulting from the partial opening of the throttle. The hole 123 is so proportioned as to supply more fuel than is required for idling, but the right amount for speeds just above idling. The neutralizing action of passage 125 corrects the flow at idling speeds to the correct amount by drilling the hole 125 at an angle as shown, its opening onto the throttle surface is in the form of an ellipse, making much more gradual the change of registration of the hole 125 with respect to the hole 122 as the throttle opens.

Fuel passing through the holes 87 in the throttle must of necessity come through the passage 55 in the fuel arm. The fuel can reach that passage directly through the jet 130; through the hole 71 and the groove 70, which as described above are effective only at high throttle openings, and through the nozzle 131 and the holes 60 if that nozzle is used. For ordinary operation the entry through nozzle 130 alone needs to be considered. The fuel in the chamber 55 is subject to several forces, considering the arm 42 to be stationary. The first is the hydrostatic head of fuel in the float chamber, causing the fuel to seek the float chamber level in the throttle bore 54. The second is the pressure existing in the mixing chamber 16 at the outlet holes 87. The third is the pressure existing above the fuel level in the float chamber as determined by the withdrawal of air through passage 112 and its entry through the jet 73 and the chain of passages 49, 140, 48, and 51. The fourth is the air pressure in the arm chamber 56 as determined by its connections with the float chamber through 59, 48, and 51, and with the mixing passage through 59, 140, 47 and 49. It will be apparent that any desired balance between these pressures can be secured by a proper proportioning of the various jets, and that the desired balance for specific installations can be had by empirical study of the requirements for different motor operating conditions. A few of the relations preferably maintained will be considered below.

The size of the jet 73 is such that when the motor is idling, or running at relatively low speeds, substantially no pressure drop occurs in the float chamber. If the jet 73 were so restricted that the air taken out through passage 112 caused a substantial pressure drop in the float chamber a reverse air flow from the throttle would take place, draining the bore 54 and a part of the chamber 55. This would prevent instant flow of fuel on opening the throttle and would be undesirable. The reason for this effect is apparent when it is considered that during idling and low motor speeds with the throttle nearly closed the holes 87 are subjected to nearly atmospheric pressure.

The size of the jet 73 can also be chosen to give a leaning effect as the motor speed increases with constant throttle opening (as when a down grade is encountered) and therefore to improve the economy of operation. The reduction in pressure at the hole 123 and at the throttle openings 87 increases with the air speed past the throttle, on account of the greater conversion of pressure head into velocity head. If the float chamber pressure is kept substantially atmospheric by admitting enough air through jet 73 the gas flow through the holes 87 and 123 would be increased as the differential pressure went up. By reducing the size of jet 73 the float chamber pressure may be lowered to any desired degree as the pressure at 87 and 123 is lowered, since the increased air flow out of these holes will cause a drain of air from the float chamber which will lower the pressure therein to a balance determined by the freedom of entry of air through the jet 73.

The angle at which the jet 73 opens into the mixing passage 16, as well as its vertical position in the passage, can also be used to regulate the action of the carburetor under different conditions. If, for example, the jet points straight up the static air pressure upon it will be augmented by the velocity head of the air when the motor operating condition is such as to produce a large air flow through the passage 16. If the hole is tilted at a substantial angle the aspirating effect of the air rushing past it at high speeds will cause the static air pressure to be reduced by the amount of this aspirating action. Between the extremes possible lies a range which may be utilized to cause the carburetor to adapt itself automatically to the requirements of the particular engine to which it is applied. As one example, there is a reduction in the air pressure within the mixing passage as the air velocity through it increases (considering the throttle opening constant) due both to the increased conversion of static pressure into velocity head and to the effect of frictional resistance. This would result in the differential pressure between the float chamber and the fuel openings being increased, richening the mixture. By a suitable change in the angle of the nozzle 73 the aspirating effect may be made use of to reduce the float chamber pressure with increasing air flow in the same or a slightly greater ratio as the reduction of pressure in the mixing passage, keeping the richness of the mixture constant or leaning it somewhat. The leaning effect of the nozzle 73 is more pronounced at higher air speeds through the mixing passage.

The nozzle 73 can if desired be extended to a point such that the temperature of the air entering it is determined by the warmth of the engine. By this means the float chamber pressure will be reduced automatically as the engine warms up, producing thermostatic control of the richness of the mixture without the use of any moving parts.

When the throttle is suddenly opened the fuel arm 42 is swung in a counterclockwise direction as viewed in Fig. 5. This forces the fuel in the right hand portion of the fuel chamber to flow much more rapidly into the jets 130 and 131 and therefore out of the throttle openings and also forces a sudden stream of fuel out through the passage 47 and the jet 50. Both of these effects act to greatly richen the mixture at the instant of acceleration. It will be observed that the main portion of excess fuel flows through the main fuel opening of the throttle, this being a very desirable condition as better atomization of the fuel can be secured thereby. If the throttle is rapidly closed a reverse action occurs, the fuel arm 42 moving clockwise as viewed in Fig. 5. The passage 47 being in communication with the atmosphere, air is drawn into the fuel chamber temporarily and the flow of fuel through the throttle openings is very substantially reduced. This is an extremely desirable condition as it avoids the flooding generally accompanying a sudden reduction of speed in the motor.

In Fig. 18 a modified idling system is shown, in which the adjustment for starting has been eliminated and much greater simplicity has been attained. In this figure the parts generally similar to those in the form previously described have been designated by primed numerals. Into the bottom of the cap casting 22′ enclosing the float chamber 25′ is set a tube 150 having a hole 151 near its bottom. A screw 152 is threaded into the upper part of the casting, and bears a second tube 153 extending through a hole 154, generally corresponding to the hole 115 of the previously described form, and into the tube 150. The sizes of the two tubes are sufficiently dissimilar so that a free space for fuel exists between them, the outer one acting as a fuel well having a single inlet 151. A conical enlargement 155 of the tube 153 extends into the hole 154 so that an adjustment of the amount of air passing from the float chamber into the passage 112′ can be regulated by turning the screw 152. A hole 156 opens from the interior of the tube 153 into the upper portion of the float chamber, above the fuel level; and a hole 157 opens from it into the passage 112. These holes act like the holes 103 and 101 in the form first described.

With this modified construction the screw 152 is set so that the proper idling adjustment is obtained when the motor is warm, the additional enriching of the mixture required for starting the cold motor being obtained by opening the throttle rapidly one or more times. This acts, as in the case of acceleration previously described, to cause the fuel arm to eject fuel through the openings 49 and 87. One additional feature of this modification will also be considered. It will be apparent that whereas the passage of fuel through the tube 153 is governed by the differential of the various air and liquid pressures acting, the entry of fuel into the outer tube 150 through hole 151 is governed solely by the static head of the fuel in the float chamber since the top of the tube 150 is open to the interior of the float chamber. In idling the hole 151 keeps the level within tube 150 substantially up to the level in the float chamber. The idling system supplies practically all of the fuel at idling speeds, and continues to supply a major portion of the fuel at low driving speeds. In one installation which has proved successful the amount of fuel supplied by the idling and throttle openings is about even in the neighborhood of 25 miles per hour. Above this speed, or at heavier loads, the throttle openings predominate in the supply of fuel. As the differential pressures feeding fuel through the jet 123 increase beyond the capacity of hole 151 the level within tube 150 drops, and the fuel delivered is held at the amount fed through hole 151 under the constant head acting on it, except for the amount consumed in lowering the level in the outer tube. If this level is lowered enough both fuel and air will be taken in at the bottom of tube 153.

Considering low driving speeds, an increase in the car speed without increase in throttle opening, due to a lightening of the load, would tend to reduce the pressure at the opening 123, which is in the lowest pressure zone of the mixing passage. Were this not counteracted the differential pressure feeding fuel through 123 would be increased, giving an undesirably rich mixture. It is desirable to lean down the mixture under these conditions to promote economy. With the idling system just described there is a definite maximum limit to the amount of fuel which can be fed through it in a given time. Any influences, such as a speeding up of the motor due to decrease of load, which decrease the pressure at the opening 123 without requiring an opening of the throttle, thus act to decrease the percentage of the fuel requirements supplied by the idling system. The effect of the tube 150 is thus somewhat similar under light running conditions to that exerted by the angle of the jet 73 at higher speeds.

In the form shown in Fig. 19 a tube 160 surrounds the tube 105 of Fig. 6, and has a hole 161 near its bottom. Except for this change the idling system is exactly as shown in Figs. 6 and 13. The effect of the outer tube, which is open to the float chamber at its top, is the same as the tube 150 of Fig. 18. The idling system of Fig. 19 is substantially the same as that shown in my prior application Serial No. 682,980 except that it is more simple in design and has definite advantages in simplicity of manufacture.

In Figs. 20 and 21 a modified form of throttle is shown, in which a groove 165 is used in place of the hole 125. This grove registers with the hole 122 in the mixing passage wall, and has a varying contour or an intermediate partition 166 set so that when the throttle is closed the partition is just below the hole 122. This hole is preferably set so that it lies on a horizontal plane through the axis of the throttle, and with the partition 166 located below it, is in communication with the upper side of the throttle. The same effect is thus produced as with hole 125 in subjecting the hole 122 to substantially atmospheric pressure and reducing the fuel flow through hole 123. As the throttle is opened the restriction or partition 166 the latter of which is preferably thin in comparison with the diameter of the hole 122, passes over the hole and gradually places it in connection with the mixing passage at a point below the throttle. A somewhat better transition from one condition to the other is obtained than in the first form described, where the connection of hole 122 to the atmospheric side of the throttle was made through hole 125 and the connection to the engine side was formed by the movement of the rear side of the throttle above the hole 122. The partition is preferably set at an angle in the groove to still further smooth the transition. The location of the hole 122 circumferentially of the throttle may be chosen so that the portion of the throttle which blocks the hole moves over the hole with any desired relative speed. It will be apparent that the further the blocking portion of the throttle is removed circumferentially from the axis of the throttle the greater will be its speed with relation to a given angular speed of the throttle, and the more abrupt will be the transition between the two conditions referred to above.

In Figs. 22 and 23 is shown a modification of the fuel arm so that a well or reservoir is provided in it by which a continued enrichment of the mixture is obtained during acceleration. In principle the action is much the same as the well 120 shown in my prior application. In the present case the groove 47′ (corresponding to the groove 47 of the form first described) is widened and deepened to form a well 170 connected by a passage 171 with the chamber 56 in the fuel arm. As the fuel arm is swung counterclockwise in Fig. 5 to open the throttle fuel will run up the groove 47′ and fill the chamber 170. This fuel will run out gradually through the hole 171, and will continue to enrich the mixture (both by adding to the amount of fuel in chamber 56 and by decreasing the air flow to that chamber due to its passage through the metering jet 59 and the chamber itself) for a sufficient time to complete acceleration of the motor; thus carrying on the effect of the fuel ejected through the openings 87 and 49 by the quick opening of the throttle. If the throttle is closed before the well 170 is drained the remaining fuel will be drawn back into the fuel chamber through the groove 47′.

In Fig. 24 is shown an air metering jet 175 substituted for the screw 124. Such a jet is useful in regulating the engine speed at which the supply of fuel is taken over from the idling system by the throttle openings 87. By admitting air to the idling system at 175 the depressing effect of the operation of this system on the float chamber pressure will be neutralized to a degree depending on the size of hole in the jet 175. This raising of float chamber pressure will cause increased flow of fuel through the throttle openings 87 at low throttle openings, but will have relatively little effect at wider throttle openings as it is then exceeded in its effect by the other forces acting. The economizing effect of the idling system at intermediate engine speeds, referred to above, can also be controlled by this means.

The cross sectional shape of the throttle can be varied to produce what variations in the quality of the mixture may be required at different throttle openings and engine speeds. For example, a change in throttle shape so as to cut down the gap between the left hand side of the throttle and the adjacent wall of the passage 16 in Fig. 17 will cause a greater air velocity at this point with a consequent decrease in pressure. This increases the differential pressure acting on the fuel discharging through the throttle openings. A change in the contour of the other side of the throttle causes a variation in the amount of air admitted past that side to dilute the mixture as described above. The point where the holes 87 open onto the throttle surface, or their angle, also affects their operation, since the nearer they are to the side wall of the mixing passage the lower will be the air pressure acting on them. This is true even in the substantially closed throttle position of Fig. 14, as there is always a gap at 81 with some air flowing through. Indeed, by a shift in the holes 87 towards the adjacent throttle edge it is possible to do away with the idling fuel supply entirely, as the reduced pressure into which the holes 87 open will cause fuel flow through them at idling speeds. The additional fuel required for starting can be obtained by successive openings of the throttle to cause the fuel arm to force fuel out of the holes 87. In case this system is adopted the tube 105 and plug 90 of Fig. 6 are omitted and the holes through which they passed closed. The air passages 115, 112, 120, 122, 123, and the needle 116, are kept, however, in order to exert the governing effect on the float chamber air pressure described above.

I claim:

1. A carburetor having a mixing passage, a throttle rotatable on a transverse axis therein, a main fuel supply opening into the passage, an auxiliary idling jet opening into the mixing passage on that side of the throttle which is towards the engine, a fuel passage supplying fuel to said jet, an opening from said fuel passage to a point in the mixing passage on the atmospheric side of the throttle, said opening being positioned so as to be covered by the throttle when the throttle is closed, and an air duct in the throttle positioned to register with said opening when the throttle is closed to admit air under substantially atmospheric pressure to said opening and thereby reduce the flow of fuel through the auxiliary idling jet, and to pass by said opening as the throttle opens.

2. A carburetor having a mixing passage, a throttle rotatable on a transverse axis therein and having a plurality of fuel passages spaced apart along the surface of the throttle in the general direction of the axis of the throttle, a hollow shaft supporting said throttle, means for supplying fuel to said hollow shaft, a distributing passage formed in the mating surfaces of the shaft and throttle and extending longitudinally of the shaft a sufficient distance to open into all of said fuel passages and permit distribution of fuel through them, and a plurality of spaced openings between said distributing passage and the hollow interior of the shaft.

3. A carburetor having a mixing passage, a throttle rotatable on a transverse axis therein and having fuel passages opening onto its surface, means for supplying fuel to said passages, an idling jet opening into the mixing passage on that side of the throttle towards the engine, a fuel passage supplying fuel to said jet, and an air duct registering with a by-pass in the throttle valve in certain positions of said throttle valve for admitting air to said fuel passage at substantially the pressure of the air in the mixing passage at a point adjacent the throttle valve, thereby to reduce the flow of fuel through the jet in certain positions of the throttle.

4. A carburetor having a substantially cylindrical mixing passage, a throttle pivoted within the passage on an axis transverse thereto, said throttle being formed as a sphere having the diameter of the inside of the mixing passage, and, flattened along four faces to produce a thickened portion at one side of the axis, and having fuel passages opening onto one of said flattened faces adjacent the thickened portion, and means for rotating the throttle from a closed position extending across the manifold to an open position in which the thickened portion lies on that side of the throttle axis which is towards the engine.

5. A carburetor having a substantially cylindrical mixing passage, a throttle pivoted within the passage on an axis transverse thereto, said throttle being formed with a thickened portion at

one side of the throttle axis and with fuel passages opening into the throttle surface adjacent said thickened portion, and means for rotating the throttle from a closed position into a position in which the thickened portion of the throttle lies on that side of the axis which is towards the engine, the throttle being so shaped that when it is in fully open position the enlarged portion is spaced further from the passage wall on that side of the throttle containing the fuel holes than on the opposite side.

6. A carburetor having a mixing passage, a throttle rotatable on a transverse axis therein and having fuel passages opening onto its surface so positioned as to pass towards the engine side of the axis as the throttle is opened, means for supplying fuel to said passages, an auxiliary idling jet opening into the mixing passage on the engine side of the throttle, a fuel passage supplying fuel to said jet, an opening from said fuel passage into the mixing passage so as to be closed by the throttle when the throttle is closed, and an air duct in the throttle adapted to register with said opening when the throttle is closed to admit air to said opening and thereby reduce the flow of fuel through the auxiliary idling jet.

7. A carburetor having a vertical substantially cylindrical mixing passage, a throttle mounted for rotation upon a transverse axis therein, said throttle being substantially circular in cross-section when viewed on at least one plane including the axis of rotation, and being thickened in its middle and tapered towards its ends when viewed in cross-section on a plane transverse to said axis of rotation, said throttle having fuel passages opening onto a surface thereof which is located above the axis of the throttle when the throttle is closed, and positioned to descend within the mixing passage when the throttle rotates towards open position, said fuel passage openings being located adjacent the thickened portion of the throttle, and means for supplying fuel to said passages at a level below that of the openings of the fuel passages when the throttle is closed but above said openings when the throttle is open.

8. A carburetor having a substantially cylindrical vertically extending mixing passage, a throttle mounted for rotation upon a transverse axis therein, said throttle being substantially circular in cross section when viewed on at least one plane including the axis of rotation whereby it may substantially close the mixing passage when in one position of rotation, and being asymmetrically thickened in its middle and tapered towards its ends when viewed in cross section on a plane transverse to said rotation, the thicker portion being towards the engine manifold when the throttle is closed, said throttle having fuel passages opening onto its surface adjacent its thickened portion and on the side of the throttle remote from the engine manifold when the throttle is closed, whereby when the throttle is opened the fuel passage openings will be lowered within the mixing passage and a greater space will be left between the throttle and the mixing passage on the side of the throttle where the fuel passages are located, and means for supplying fuel to said passages.

9. A carburetor comprising a mixing passage, a throttle therein, a constant level supply chamber, a main fuel jet opening onto the surface of the throttle, means conducting fuel and air from said chamber to the main fuel jet, an idling jet opening into the mixing passage on the engine side of the throttle and connected both below the fuel level in said chamber to withdraw fuel therefrom and above the fuel level therein to draw air therefrom, and a metering jet opening into the mixing passage on the side of the throttle remote from the engine and connected to said chamber above the fuel level therein to control the differential pressure between the chamber and the first-named jets.

10. A carburetor comprising a mixing passage, a throttle therein, a constant level supply chamber, a main fuel jet opening onto the surface of the throttle, means conducting fuel and air from said chamber to the main fuel jet, an idling jet opening into the mixing passage on the engine side of the throttle and connected both below the fuel level in said chamber to withdraw fuel therefrom and above the fuel level therein to draw air therefrom, and a jet opening into the mixing passage on the side of the throttle remote from the engine and connected to said chamber above the fuel level therein.

11. An idling system for carburetors comprising a mixing passage, a float chamber, a well open at its top to said chamber above the fuel level therein and having a restricted opening into said chamber below the fuel level therein, an idling jet opening into the mixing passage, and connections from said jet to the chamber above the fuel level therein and to said well beneath the normal fuel level therein, whereby the admission of fuel into the idling system cannot exceed, for more than the time required to drain the well, the amount entering the well solely under the static pressure of the fuel in the float chamber.

12. A carburetor having a mixing passage, a throttle therein, a fuel chamber, a float chamber, a fuel arm connected to the throttle, cooperating with the fuel chamber to form a pump, and oscillating in the fuel chamber, a main fuel passage through the arm and opening into the surface of the throttle, a well formed in the upper part of the arm, a connection between the fuel chamber and the float chamber including a check valve to prevent back flow, a passage leading from said well to the fuel chamber up which fuel may be forced on a throttle-opening movement of the arm and down which it may run on a throttle-closing movement thereof, and a passage from said well to the main fuel passage.

13. A carburetor having a mixing passage, a fuel jet therein, a throttle in the mixing passage, a fuel chamber, means for maintaining a substantially constant level of fuel therein, a swinging arm in said chamber connected directly to the throttle for movement therewith, a float chamber, a connection between the float and fuel chambers to supply the fuel chamber with fuel at a substantially constant level, a check valve in said connection preventing reverse flow of fuel to the float chamber when the swinging arm is moved by the opening of the throttle, a pair of passages in said arm each having openings leading into the fuel chamber on that side of the arm which is forwardly positioned as the arm is moved by the opening of the throttle, one of said passages having an air supplying connection and openings leading into the second passage, said air supplying connection being so positioned as to be blocked by an excess of fuel when the arm is moved by a rapid opening of the throttle.

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