Aug. 31, 1954

J. T. RAUEN

CARBURETOR

2,687,710

Filed Nov. 15, 1948

4 Sheets-Sheet 1

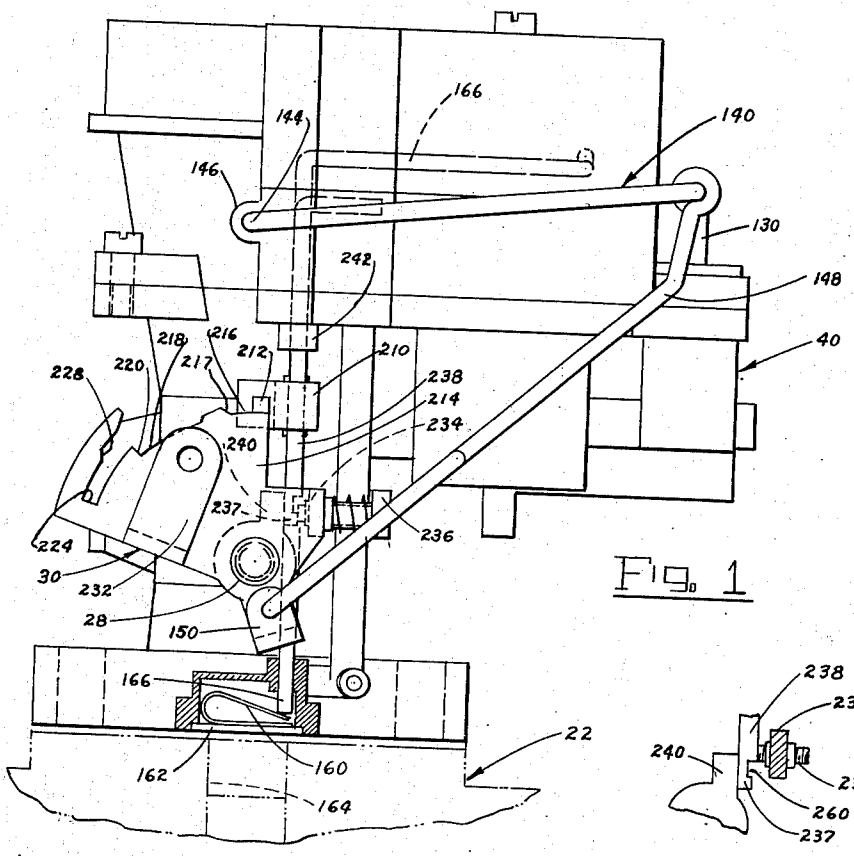


Fig. 1

Fig. 14

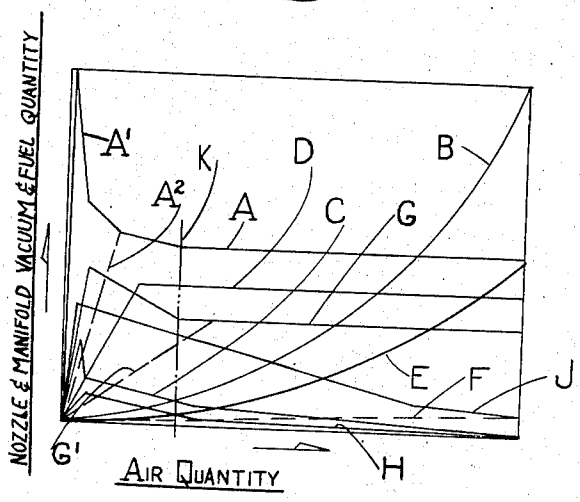


Fig. 11

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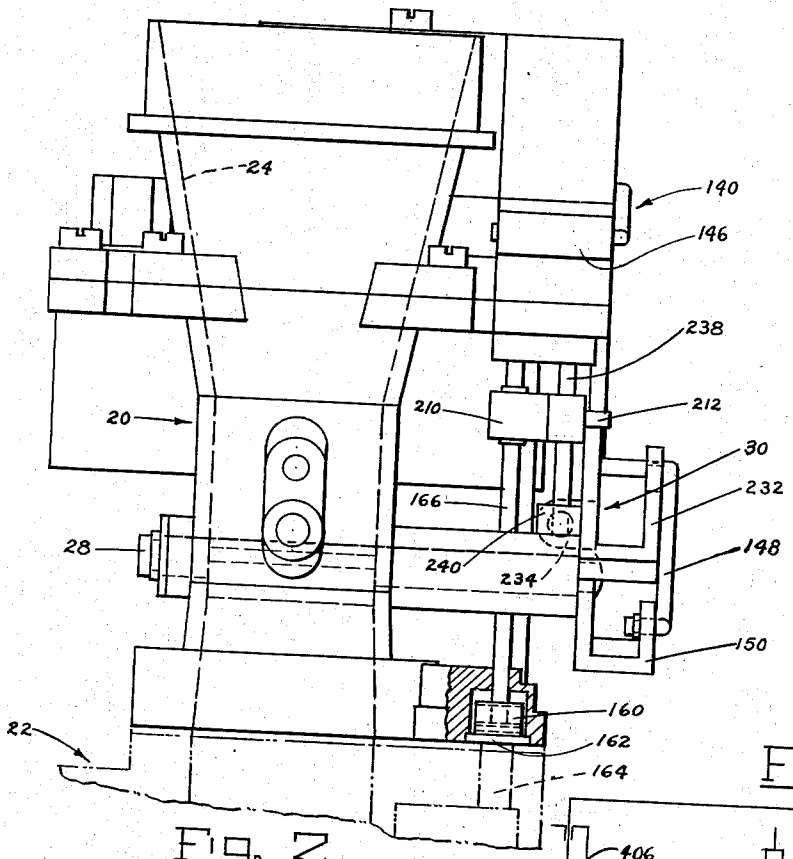


Fig. 2

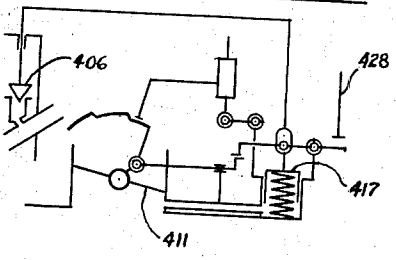


Fig. 13

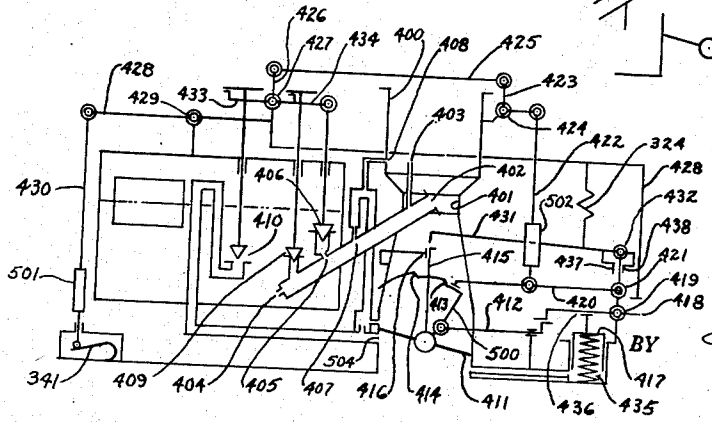


Fig. 12

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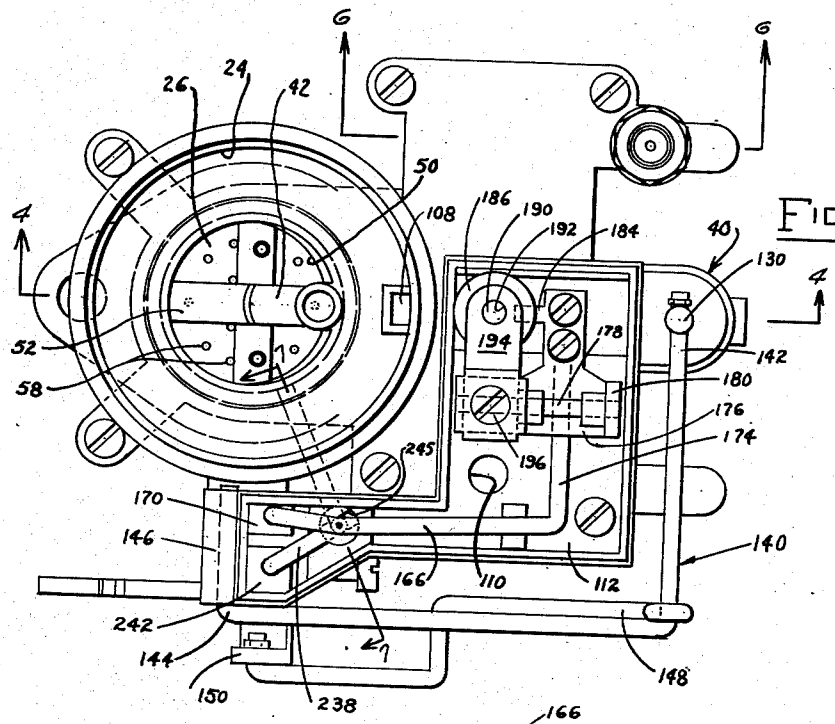


Fig. 3

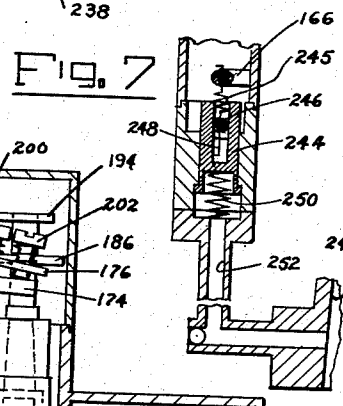


Fig. 7

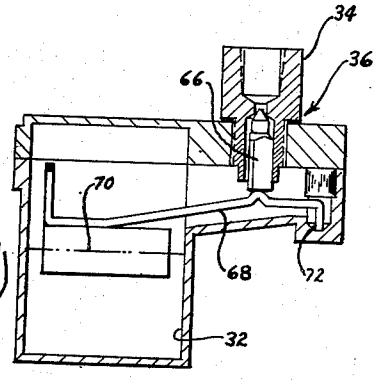


Fig. 6

Fig. 5

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CARBURETOR

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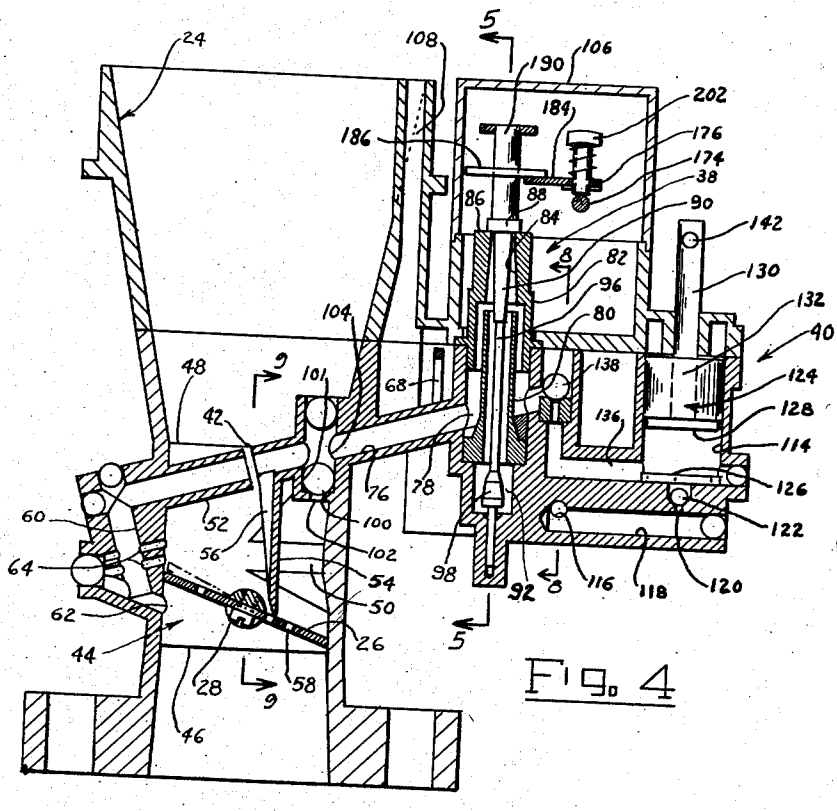


Fig. 4

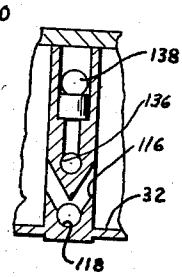


Fig. 8

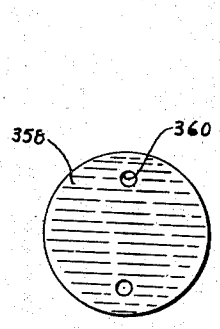


Fig. 10

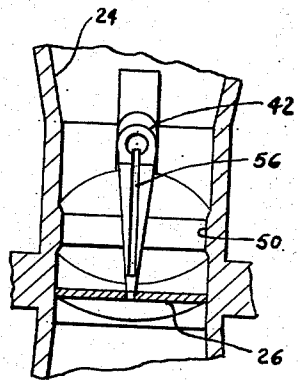


Fig. 9

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UNITED STATES PATENT OFFICE

2,687,710

CARBURETOR

John T. Rauen, Detroit, Mich.

Application November 15, 1948, Serial No. 59,997

31 Claims. (Cl. 123—119)

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This invention relates to carburetors and has particular reference to certain new and useful improvements in carburetors of the type commonly referred to as plain tube carburetors.

Principal objects of the invention are to provide:

A plain tube type of carburetor having means which will enable a cold engine to be started without the aid of a conventional choke;

A plain tube type of carburetor having means whereby a cold engine may be satisfactorily operated the instant immediately following cold starting and thence throughout the warming up period of the engine without the aid of a conventional choke;

A plain tube type of carburetor having means which will properly supply fuel to the engine from a single fuel feeding system and without the aid of a second fuel feeding system, such as those now employed and conventionally known as the "idle" or "low speed" system;

A plain tube type of carburetor having means for supplying fuel to the engine from a single fuel feeding system including a single nozzle at a rate sufficiently uniform so as to enable the engine to idle smoothly;

A plain tube type of carburetor having a throttle constructed and arranged so that fuel can flow through the throttle, as distinguished from flowing over and around the throttle, for the purpose of obtaining smooth engine operation at idle and off idle speeds;

A carburetor having means to prevent the pressure of backfiring from being transmitted through the fuel feeding system to the float chamber;

A carburetor having a thermostatic control for the fuel supplying means in which the thermostatic control is constructed and arranged so that in the event of failure of the thermostat, the carburetor will be adjusted so as to provide for cold starting of the engine and operation thereafter;

A carburetor having means for controlling within close limits the fuel level within the carburetor bowl so as to eliminate objectionable operation of the engine which is now experienced due to fluctuations in the level of fuel in the carburetor bowl;

A carburetor having means to eliminate from a "flooded" engine an excess of fuel which has been occasioned by a previous attempt at starting the engine in order to expedite the starting of the engine therafter;

A carburetor having a throttle which is constructed and arranged so as to close beyond the normal hot idle position for cold starting whereby a high vacuum in the intake system of the engine may be obtained for quick starting of an extremely cold engine;

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A carburetor having means including fixed fuel and air jets to control the fuel required for all phases of engine operation and starting thereof; and

A new and improved carburetor which is simple in construction and more efficient and dependable in operation than carburetors of the type now available.

Other and further objects of the invention will be apparent from the following description and claims and will be understood by reference to the accompanying drawings, of which there are four sheets which by way of illustration show preferred embodiments and the principles thereof and what I now consider to be the best mode in which I have contemplated applying those principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a side elevational view of a plain tube type of carburetor embodying the invention;

Fig. 2 is a side elevational view with parts broken away of the carburetor as shown in Fig. 1, looking at the left-hand side thereof;

Fig. 3 is a plan view of the carburetor with parts omitted;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a sectional view taken generally along the line 5—5 of Fig. 4, looking in the direction of the arrows, with certain parts shown in elevation;

Fig. 6 is a sectional view through the carburetor taken along the line 6—6 of Fig. 3, looking in the direction of the arrows;

Fig. 7 is a fragmentary sectional view taken along the line 7—7 of Fig. 3;

Fig. 8 is a fragmentary sectional view taken along the line 8—8 of Fig. 4;

Fig. 9 is a fragmentary sectional view taken along the line 9—9 of Fig. 4;

Fig. 10 is a plan view showing a modified form of throttle valve;

Fig. 11 is a chart of curves showing the various fuel air mixture ratios which the carburetor herein disclosed will produce;

Fig. 12 is a schematic view illustrating a modified form of carburetor;

Fig. 13 is a schematic view showing a modification of Fig. 12; and

Fig. 14 is a fragmentary view showing the throttle stop mechanism in the cold idle position.

As illustrated in Figs. 1 to 10 of the drawings, a plain tube type of carburetor embodying the invention comprises in general a body 20 adapted to be mounted upon the manifold part 22 of the induction system of an internal combustion engine and having a main air passage 24 through which air flows into the induction system. A throttle 26 is arranged in the air passage 24 so as to control the flow of air therethrough and is mounted on shaft 28 which is rotatably mounted in the body 20. The shaft 28 projects beyond the body 20 and has secured thereto a lever indicated generally at 30 forming part of a means by which the throttle may be opened or closed. The usual spring (not shown) biases the throttle to its closed position, as shown in Fig. 4.

The carburetor body provides a fuel reservoir 32 to which fuel is supplied through the fitting 34 and under the control of the float controlled valve indicated generally at 36. A fuel supplying system is provided for feeding fuel from the reservoir 32 to the main air passage 24, and this includes a fuel metering means indicated generally at 38, an accelerating pump indicated generally at 40, and a fuel nozzle 42 arranged in the air passage 24 upstream relative to the throttle 26 and to which nozzle 42 fuel is supplied from the reservoir by means of the pump 40 and under the control of the fuel metering means 38.

The air passage 24 includes a throat indicated generally at 44 which is arranged between the lines 46 and 48. A portion 50 of the wall of the air passage 24 defining the throat 44 projects inwardly so as to compensate for the displacement in the throat of the throttle shaft 28 and the nozzle 42 and the tube 52 so as to maintain substantially uniform velocity and pressure in the throat 44 from one end thereof to the other.

The nozzle 42 includes a depending pen point shaped extension 54 which extends downwardly to and adjacent the throttle 26 in its closed position as shown in Fig. 4. The extension 54 is provided with a groove 56 through which liquid fuel can flow downwardly toward the end of the extension 54 and on to the throttle 26 without the uniformity of flow of such fuel being interrupted or disturbed. From the lower point of the extension 54 the liquid fuel flows on to the throttle 26. The throttle 26 is provided with a series of minute holes 58 of the order of $\frac{1}{32}$ of an inch in diameter. The fuel flowing on to the throttle 26 will tend to form a film across such holes 58, and the flow of air through such holes will carry the fuel with it and atomize it in the passage 24 below the throttle.

A modified form of throttle is shown in Fig. 10 and consists of a valve member 358 provided by a body of a porous material, such as sintered metal, having mounting holes 360 for the screws which secure the throttle to the shaft 28. The porosity of the throttle 358 provides the same function in obtaining uniformity of fuel flow as do the holes 58 in the throttle 26 and also provides a degree of atomization verging on vaporization, which is an improvement over the specific form of the throttle indicated at 26. The porosity of the valve 358 should be such so as to be the equivalent to one ⅛ inch diameter hole in the throttle. The throttle 26 is shown in full lines in a completely closed position, which setting will permit the starting of the engine when cold, although the throttle 26 and the throttle 358 need not be completely closed for starting.

This arrangement feeds small amounts of liquid fuel at closed throttle position to the engine uniformly in such a manner that the fuel will be atomized rather than be fed in drops which would tend to cause the engine to run roughly at idle speed.

The tube 52 is arranged in the throat 44 in line with and spaced from the end of the nozzle 42 and forms a leg of a by-pass 60 around the throttle 26 in its closed position, the other end of the by-pass terminating in a jet or orifice 62 which opens into the throat 44 just below the throttle 26 in its closed position. The by-pass 60 transmits the suction from the engine side of the throttle 26 when the same is closed to the end of the nozzle 42 so as to provide sufficient vacuum at the end of the nozzle 42 to obtain the flow from the nozzle of the required amount of fuel for operating the engine at idle and off idle positions of the throttle.

The passages 64 extending between the by-pass 60 and the throat 44 provide a graduation of the vacuum produced at the end of the nozzle 42 by the by-pass as the throttle 26 is moved from its closed toward its open position. The dotted line position of the throttle 26 as indicated in Fig. 4 indicates the normal hot idle position of the throttle 26. At idle engine speed, and the first portion of off idle engine speed, air mostly flows through by-pass 60, entering at openings 64 and at one end of tube 52.

Almost all of the very small amount of fuel flowing during the above stated engine speeds, does so in a small liquid stream through nozzle 42 passage, to the groove 56, which by capillary action draws the fuel downwardly onto the throttle valve 26 where air passing through the valve 26 carries the fuel with it at a steady speed into an atomized state upon emersion from the throttle valve at the low pressure side thereof.

The groove 56 prevents what would otherwise be a natural globular fuel formation at the end of nozzle 42, which formation causes the fuel flow speed to vary, resulting in irregular, rough, engine operation at idle and off idle speeds up to where energetic atomization takes place at the end of nozzle 42.

At engine speeds in excess of the above stated idle speed, increasing portions of the total fuel flowing, passes through the by-pass 60, and emerges, in a well atomized state, from openings 64, in addition to opening 62, as the throttle position exposes openings 64 to the low pressure side of the throttle valve 26.

At engine speeds in excess of such speed where the vacuum set up in the throat 44 by the air speeding to the engine through the air passage 24, balances the vacuum under the throttle valve 26, to which openings 62 and 64 and the by-pass 60 are subjected, the liquid fuel stream previously emitted from the nozzle 42 is converted into an atomized state, and atomized fuel is then emitted from all mentioned outlets.

This last mentioned state of fuel flow occurs with all engine speeds associated with full open throttle engine operation, except, the very lowest engine speed where liquid fuel could again emerge from nozzle 42.

The entire fuel track, from the top of standpipe 80, is so constructed that globular fuel formation does not occur even at the recess 101 in the fuel track, after the fuel has once filled this recess.

Feeding fuel to, and through, the throttle in

the above stated manner provides also, less carburetion noise about the engine.

The float controlled valve 36 may be of conventional construction and includes the movable valve member 66 which is adapted to be seated by a wire bracket 68 when the fuel in the reservoir attains the level indicated at 70. The bracket 68 is generally of C-shape, and the ends are pivoted as indicated at 72, the intermediate parts of the bracket 68 being secured to the floats 74 disposed in the reservoir or bowl 32. The floats 74 are relatively shallow and of large cross section so as to be sensitive to the level of fuel in the bowl 32 and thereby control the fuel level 70 within close limits.

The fuel metering means 38 is constructed and arranged to meter the flow of fuel from the bowl 32 to the air passage 24 in response to the suction therein. The nozzle 42 is formed at one end of a passage 76, the other end of which communicates with a chamber 78. A standpipe 80 is seated in the chamber 78 and projects upwardly above the fuel level in the bowl 32 for a distance which is sufficient to prevent fuel from flowing out of the bowl 32 into the passage 76 due to normal tilting of the car in which the carburetor may be mounted.

The upper end of the chamber 78 is formed by a hollow tubular member 82 into which the upper open end of the pipe 80 projects. There is sufficient clearance between the upper end of the pipe 80 and the lower end of the tubular member 82 to permit a free flow of fuel therebetween. However, the upper end of the pipe 80 is so disposed with respect to the lower end of the passage 84 that the air which flows into the tubular member 82 through the passae 84 and into the space between the upper end of the pipe 80 and the lower end of the tubular member 82 will wipe liquid fuel off the upper end of the tube so as to expedite the flow of fuel from the tube 80 into the chamber 78. This action is of particular significance at idling speed of the engine.

The passage 84 at its upper end terminates in an orifice which forms a valve member 86 through which air flows into the chamber 78 of the fuel metering system 38. The flow of air through the valve member 86 is regulated or metered by the valve member 88 which as illustrated includes an annular portion that seats upon the valve member 86 and a depending tapering pin 90 that projects downwardly through the passage 84. It should be noted that the passage 84 at its upper end is of uniform cross section for a short distance, and therebelow tapers outwardly away from the pin 90 which tapers inwardly.

The valve 88, 86, hereinafter designated as an air metering valve, as illustrated herein is closed during the cranking of the engine to start the same and is controlled so as to open as soon as the engine fires, and such valve 88, 86 as disclosed herein is at least partly open at all times during operation of the engine. It would be possible, however, to so arrange the valve 88, 86 that it may be open slightly during cranking of the engine.

The lower end of the pipe 80 communicates with a valve chamber 92 which is in communication with the bowl 32 through passages 94 whereby fuel is supplied to the valve chamber 92 and the interior of the pipe 80, and fuel will stand in the pipe 80 at the same level that it stands in the bowl 32 when the engine is not operating.

The pin 90 may be formed as part of a rod 96 which extends downwardly through the tube 80 and the valve chamber 92 into a guide formed below the valve chamber 92. Within the valve chamber 92 the rod 96 is provided with a valve member 98 which together with the lower end of the pipe 80 forms a liquid fuel metering valve for regulating or metering the flow of liquid fuel from the bowl 32 upwardly through the pipe 80. The valve member 98 moves with the valve member 88, and as illustrated the valve member 98 will cooperate with the lower end of pipe 80 to restrict the flow of fuel upwardly into the pipe 80 upon opening movement of the valve member 88 after the valve member 88 has opened a certain amount following the starting of the engine.

The height of the fuel level 70, the distance that the pipe 80 projects above the fuel level 70, the liquid fuel metering valve 98, and the valve orifice which it controls, and the air metering valve 86, 88 form the variables by which fuel and air mixture ratios are controlled.

With the parts of the fuel metering means 38 arranged as illustrated in Fig. 4 and with the throttle 26 set as illustrated in full lines, cranking of the engine will create sufficient vacuum at the end of the nozzle 42 to produce sufficient fuel flow to enable a cold engine to be started, and at the same time the setting of the throttle 26 is such as to obtain vaporization of fuel within the passage 24 below the throttle in order to enable the engine to start. As soon as the engine starts to fire, mechanism hereinafter described will open the valve 88, 86 to a position to provide continuous running of the engine thereafter.

In order to prevent pressure in the passageway 24, such for example as that due to backfiring, from being transmitted back through the nozzle 42 and passage 76 into the fuel reservoir there is provided a pressure responsive valve which includes the ball valve member 100 which during normal operation is seated in a recess 101 communicating with and below the passage 76. The recess is provided with a port 102 which communicates with the throat or venturi 44 of the air passage, and the ball valve member 100 normally is seated so as to close the port 102. However, sudden increase in pressure in the passage will lift the ball valve member 100 and position it so as to obstruct the orifice 104 thereby effectively to prevent the transmission of pressure back through the fuel metering means 38 into the carburetor bowl 32.

The air metering valve 86, 88 and other working parts of the carburetor are enclosed by upstanding walls provided on one of the members that form the body 20 of the carburetor and a removable cover 106. In order to get air into the space below the cover 106 there is provided an air passage 108 which opens into the upper part of the carburetor bowl and an opening 110 in the wall 112 which closes the top of the bowl 32.

The carburetor also is provided with an accelerating pump indicated generally at 40 which is arranged to be actuated by opening movement of the throttle. The pump 40 includes a cylinder 114 which is arranged to draw fuel from the bowl 32 through passages 116 (Fig. 8), 118 and 120, and past check valve 122 which is arranged to close the passage 120 upon the delivery stroke of the piston 124. A valve retainer 126 holds the valve 122 in the enlarged upper portion of the passage 120.

The piston 124 includes a head 128 fixed to one end of stem 130 which is reciprocally mounted in a guide above the cylinder 114. There is a rather large clearance between the periphery of the head 128 and the walls of the cylinder 114

so that upon the delivery stroke of the piston some of the fuel in the cylinder will by-pass the head 128. A piston member 132 freely slidable on the rod 130 is adapted under the influence of gravity after the downward stroke of the head 126 to displace such by-passed fuel past the head 128 so as to thereby provide for delivery of fuel from the accelerating pump 40 after the delivery stroke of the head 128.

Fuel is delivered from the cylinder 114 through passage 136 and past check valve 138 into the chamber 78, and thence through the passage 76 to the nozzle 42. The piston rod 130 is adapted to be reciprocated by a crank indicated generally at 140, one end 142 of the crank extending through the rod 130 and the other end 144 of the crank being pivoted in the bearing 146. A rod 148 pivotally connected at one end to an arm 150 of the throttle lever 30 is pivotally connected at its other end to the crank 140 so that upon opening movement of the throttle the accelerating pump 40 will be actuated to supply fuel to the nozzle 42 in addition to that supplied thereto through the fuel metering means 38.

The fuel metering means 38 is controlled by the temperature condition of the engine, and to this end there is provided a thermostat or thermally responsive element 160 which is disposed on a plate 162, the plate 162 closing the top of a passage 164 which is in communication with the interior of the engine exhaust passage forming the hot spot of manifold 22. The thermostat 160 is enclosed in a housing which forms a guide for one end of thermostat rod 166. Thermostat rod 166 is further supported for sliding movement in a guide 170, and above the guide the thermostat rod extends laterally through guide 172, and the end 174 of the thermostat rod extends below a lever 176.

The lever 176 is pivotally supported on a pin 178 which is supported by upstanding brackets 180 and 182. The lever 176 is provided with a laterally extending arm 184 which projects below a collar 186 secured on the upper part 190 of valve member 88. The part 190 is slidably arranged in a guide 192 formed by a hole in a bracket 194. The bracket 194 is secured by screw 196 on the top of bracket or post 182. The lever 176 is provided with two screws 200 and 202, the lower ends of the screws projecting below the lever 176 for engagement with the end 174 of the thermostat rod. The screw 200 is designated for convenience as the hot idle mixture adjusting screw and is arranged to cooperate with the end 174 of the thermostat rod so as to determine the hot idle position of the air metering valve member 88. The screw 202 is the cold idle mixture adjusting screw and cooperates with the end of the thermostat rod 174 to determine the cold idle position of the air metering valve member 88.

The collar 186 on the upper part 190 of the air metering valve member 88 is above the arm 184 on the lever 176, and the elevation of the lever 176 is determined by either the screw 200 or the screw 202 and the elevation of the end 174 of the thermostat rod.

As shown in Fig. 4, the parts of the carburetor are arranged for starting a cold engine and the thermostat 160 is cold and in its contracted condition. As the thermostat 160 is heated up due to the absorption of heat from the manifold 22 and the engine, it expands and the upper arm of the thermostat 160 will react against the lower end of the thermostat rod 166 and push the rod upwardly, whereupon the other end 174 of the thermostat rod will by reacting on the lower end of the screw 202 lift the lever 176 and the air metering valve 88 so as to open the air metering valve and permit the flow of air into the passageway 84. As the valve member 88 is elevated, the valve seat or orifice 86 will be opened and the size of the orifice will increase as the valve member 88 moves upwardly.

It will be observed that the end 174 of the thermostat rod has a slight downward slope toward the right-hand side thereof (Fig. 5), and after a certain amount of upward movement of the end 174 of the thermostat rod the lower end of the screw 200 will engage the end 174 of the thermostat rod while the screw 202 will be moved out of contact with the thermostat rod upon upward movement of the lever 176. Thus, when the engine is cold the screw 202 will by cooperation with the end 174 of the thermostat rod determine the position of the air metering valve member 88, while when the engine is hot the screw 200 will by cooperation with the end 174 of the thermostat rod determine the position of the air metering valve member 88.

The fuel metering means 38 are also controlled to some extent by the throttle 26, and to this end the thermostat rod 166 has secured thereto an arm 210, the arm 210 being provided with a finger 212 which is in engagement with an edge of a sector 214 formed as a part of the throttle lever 30. The edge of the sector 214 includes portions 216, 217, 218, 220, 224 and 228 which cooperate with the finger 212, so as to shift the thermostat rod and thereby, through the mechanism previously described, shift or permit the shifting of the air metering valve member 88 of the fuel metering means 38, or to limit the opening movement of the throttle.

The throttle lever 30 includes an arm 232 to which the accelerator pedal may be connected for imparting movement to the throttle lever 30 so as to open the throttle 26. The throttle lever 30 also includes an arm 234 carrying an adjusting screw 236 threadedly mounted thereon, the end of the screw projecting to the left of the arm 234 (Fig. 1) being engageable with the lower end 237 of a throttle rod 238 so as to determine the position to which the throttle will close under the influence of the usual spring. The spring shown around the shank of the screw 236 functions to hold the screw in the position as adjusted, the head of the screw 236 having the usual slot for receiving a screwdriver so that the closing position of the throttle 26 may be adjusted.

The carburetor body is provided with a boss 240 against which the lower end 237 of the throttle rod abuts so that the throttle adjusting screw 236 will clamp the lower end 237 of the throttle rod between the end of the screw 236 and the boss 240. The throttle rod 238 extends through a hole in the arm 210 and is slidably mounted in a guide 242 provided by the body of the carburetor. The upper end of the throttle rod 238 above the guide 242 projects through a slot 245 in a piston member 244 (Figs. 3 and 7). The end 246 of the throttle rod extending into the slot in the piston is provided with a hole through which one end of a spring 248 extends. The slot in the piston 244 through which the end 246 of the throttle rod projects extends downwardly from the top of the piston 244 to a point somewhat above the middle of the height thereof. The piston 244 is biased upwardly by a spring

250. The lower end of the piston is in communication with the air passage 24 below the throat 44 by means of the duct 252 so that vacuum in the manifold below the throttle 26 is transmitted through the duct 252 to the lower side of the piston 244.

The spring 248 has its lower end turned laterally so that it will not pull out of the hole in the end 246 of the throttle rod when the spring 248 is pulled upwardly, it being noted that the spring 248 can move to a certain extent relative to the end 246 of the throttle rod and vice versa. The upper end of the spring 248 is secured to the thermostat rod 166, and when the thermostat rod 166 moves upwardly it will under certain circumstances exert an upward tension on the end 246 of the throttle rod for lifting the throttle rod 238. The lower end of the throttle rod 238 is illustrated in Fig. 1 in the "hot idle" position and is clamped between the boss 240 and the end of the screw 236 by the usual throttle closing spring.

With the parts arranged as shown in Figs. 1 and 7, opening movement of the throttle lever 30 will release the throttle rod 238 and permit the same to drop until the end 246 of the throttle rod hits the lower end of the slot 245 in the piston. This will bring the notch 260 (Fig. 14) into alignment with the end of the screw 236, and if the throttle 26 is allowed to close, the screw 236 will seat in the notch 260. This position is the cold starting position of the throttle rod 238, and when so arranged the throttle 26 will be positioned as shown in Fig. 4.

The lower end of the slot 245 in the piston is indicated by the heavy, horizontally extending line that is positioned immediately below the end 246 of the throttle rod and above the lower end of the spring 248 in Fig. 7. Upon starting of the engine the suction in the passage 24 will pull the piston 244 downwardly, thereby permitting the end 246 of the throttle rod to drop downwardly until stopped by the lower end of the spring 248 or the lower end of the slot 245, and the lower end 237 of the throttle rod 238 will then be positioned in its cold idle position as shown in Fig. 14, assuming that the throttle is opened upon starting of the engine.

The lower end of the throttle rod 238 is provided with a notch 260 and above the notch 260 the thickness of the throttle rod 238 is greater than below the notch 260. If the throttle is allowed to close immediately after starting, the throttle 26 will not return to the full or dotted line positions as shown in Fig. 4, but will remain partly open. This will be due to the fact that the thick part of the rod 238 above the notch 260 will, through engagement with the screw 236, prevent the throttle lever 30 from returning to the positions indicated in Fig. 4. This will provide a fast idle for cold engine operation.

When the thermostat rod 166 moves upwardly it will, through the spring 248, lift the end 246 of the throttle rod 238 so as to position the throttle rod in its hot idle position as shown in Fig. 1.

Opening movement of the throttle lever 30 with the parts arranged as shown in Fig. 1 will effect opening movement of the air metering valve 88, 86. The finger 212 as shown in Fig. 1 is in engagement with the edge portion 216 of the throttle lever 30. Opening movement of the throttle lever 30 will move the throttle lever 30 and the throttle shaft 28 clockwise, and during such movement the finger 212 will be moved upwardly when it is engaged by the cam edge portion 217 of the lever 30, and further clockwise

movement of the throttle lever 30 will bring the edge portion 218 below the finger 212, thereby raising the finger 212. Such elevation of the finger 212 will lift the thermostat rod 166 and through it the air metering valve member 88, as previously described, in order to open the air metering valve 86, 88 of the fuel metering means 38.

Since the full suction at the nozzle 42 is transmitted to the fuel in the pipe 80 of the fuel metering means when the valve 86, 88 is closed, it will be apparent that a rich mixture is provided for starting a cold engine. However, as soon as the valve member 88 moves upwardly to open the air metering valve, air will be metered into the passageway 84 which will reduce the suction effect on the fuel in the pipe 80 and thereby reduce the richness of the fuel mixture which will be supplied by the nozzle 42 after the throttle is opened, and this movement of the air metering valve 86, 88 in response to opening movement of the throttle will change the mixture from that required to start a cold engine to that required for operating a cold engine.

The length of the edge portion 218 of the throttle lever 30 and the position thereof correspond with the range of throttle opening required for operating a cold engine, the right-hand end of the edge portion positioning the finger 212 higher than the left-hand end of such edge portion. The right-hand end of the edge portion 218 immediately adjacent the cam 217 will position the air metering valve member 88 so as to provide a fuel mixture for operating a cold engine at idling speeds. Further opening movement of the throttle lever 30 to bring the left-hand end of the edge portion 218 below the finger 212 will permit a small amount of closing movement of the air metering valve member 88 so as to provide a mixture for operating a cold engine at speeds above idle.

The portion 220 of the throttle lever functions as a stop to limit opening movement of the throttle when the engine is cold, and will upon engagement with the finger 212 prevent further opening movement of the throttle. However, the positioning of the finger 212 by the edge portion 218 will position the air metering valve member 88 to provide for a full power mixture for the engine when cold when the portion 220 is in the path of movement of the finger 212. If the throttle lever is permitted to move toward the closed position of the throttle when the engine is cold, the pin 236 will engage the throttle rod 238 above the notch 260 so as to keep the finger 212 on the right-hand end of the edge portion 218 of the throttle lever so as to position the metering valve member 88 in order to provide a mixture for operating a cold engine at idle speed.

As the thermostat rod 166 is moved upwardly by the thermostat 160 so as to open the air metering valve 88, 86 as the engine warms up, the richness of the mixture supplied by the fuel metering means 38 will be reduced and the finger 212 will be lifted to a position above the path of movement of the stop 220, thereby permitting full open position of the throttle when the engine is hot. The edge 224 of the throttle lever 30 is engageable with the finger 212 so as to function as a stop to limit opening movement of the throttle 26 when the engine is hot. When the engine is hot the finger 212 will cooperate with the cam surface 228 to partly close the air metering valve member 88 so as to provide a richer mixture for the engine at full open throttle or

full power than is provided for engine operating conditions less than full power or full open throttle.

In other words, after the engine is warmed up, the thermostat 160 and the thermostat rod 166 position the air metering valve so as to provide an economy mixture for hot engine operation, and when full power operation is desired the cam 228 will reduce the air orifice opening of the air metering valve 88, 86 so as to provide a richer mixture for full power hot operation than is provided for hot economy operation.

Fig. 12 is a schematic view of another form of plain tube type of carburetor embodying the invention. As therein shown, the main air passage 400 forms a venturi of which 401 is the throat. The high speed nozzle 402 ends in the throat 401 and contains an air bleed 403. The opposite end of the nozzle 402 is provided with an economy fuel supply jet 404 and a full power hot jet 405 under the control of a valve 406 (shown closed). The "low speed" or idle system fuel jet 407 is also arranged to feed fuel from the nozzle 402 into the idle system, and the idle system further includes an air bleed 408. The nozzle 402 is provided with a valve 409 which controls the flow of fuel into the nozzle 402 during warm-up operation of the engine. The idle system is also provided with a valve 410 (shown open) which controls or regulates the flow of fuel into the idle system during cold starting and warm-up. The idle system delivers fuel in a conventional manner into passage 400 adjacent throttle 411.

The throttle 411 is provided with an operating lever 500 similar to lever 30 to which the conventional control rods (not shown) are attached. The lever 500 has a pivotal connection with one end of rod 412. The lever 500 includes cams 413 and 414 and an interval arm or lever 415 which is engageable with a stop 416 so as to provide a stop to determine the "cold starting" position of the throttle 411. A vacuum operated piston 417 partially actuates a lever 418 pivoted at 419 adapted to engage the rod 412 to position the throttle 411 in its "cold idling" position. Rod 412 also cooperates with lever 418 to limit the "cold" full open position of throttle 411, the same as stop 220 in Fig. 1. The "hot" full open stop, not shown, for throttle 411 being also similar to stop 224, Fig. 1.

A lever 420 pivoted at 421 is adapted to follow the cams 413 and 414 during movement of the throttle 411 and is connected to a rod 422 which in turn is connected to lever 423. Lever 423 is pivoted at 424 and connected to rod 425 in turn connected to lever 426. Lever 426 is pivotally connected at 427 to lever 428 which is pivotally mounted at 429 and connected to the rod 430 which engages the thermostat 341. The lever 428 is also engageable with the lever 418 for actuating the same to disengage the rod 412 when the engine is hot for allowing the throttle to return to its "hot idle" position as regulated by the lever 431 pivoted at 432.

Motion of lever 431 is limited by arms 437 and 438 and is adapted to engage the throttle lever 415 to hold the same away from stop 416. A spring 324 yieldingly connects lever 431 and lever 428 whereby the lever 431 is moved out of the path of the throttle during cold starting and warm-up operation of the engine.

The lever 426 through its arm 433 is adapted to engage the head of the valve 410, and arm 434 of lever 426 is adapted to engage the head of valve 409 and is pivotally connected to the operating shaft of valve 406. Spring 435 biases the vacuum operated piston 417 upwardly. A lost motion connection 436 permits the piston 417 to move without correspoding movement of the lever 418 when the lever 418 is overruled by the lever 428.

Preparations for starting a cold engine

As the engine cools from normal hot, the thermostat 341 allows the rod 430 to move downwardly. The rods 422 and 430 tend to gravitate downwardly as indicated by weights 501 and 502. This action of rod 430 rotates the lever 428 counterclockwise and raises the fulcrum 427 carrying the lever 426, which causes a slight clockwise rotation of the lever 426 about its connection with the valve 406. Such slight rotation of the lever 426 plus the raising of fulcrum 427 causes the arm 433 of the lever 426 to engage the head of the valve 410 and raise it to fully open the fuel passage to the idle system and simultaneously nearly engaging the head of valve 409, the valve 406 remaining closed because its head forms a pivot for the slight rotation of the lever 426.

Rotation of lever 428 disengages lever 418, allowing the lever 418 to fall upon the piston 417 and simultaneously stretching the spring 324 to urge the lever 431 upwardly. As the lever 431 is at such time engaged by the throttle lever 415, it will not move until the throttle lever has been manually opened slightly. After such throttle action the lever 431 is out of the path of throttle lever 415, and throttle lever 415 will then stop against 416. Simultaneously with the slight clockwise rotation of lever 426, motion is transmitted through rod 425 and bell crank lever 423 and rod 422 to lever 420, allowing lever 420 to be engaged by cam 413 which it had been raised clear of during hot engine operation hereinafter described. The carburetor is now adjusted ready to start a cold engine.

Starting a cold engine

Cranking of the engine by means of the conventional electric starter with the throttle positioned as regulated by the stop 416 creates sufficient vacuum on the engine side of the throttle 411 to draw through the open valve 410 sufficient additional fuel to enable the engine to start practically instantly, and also substantially instantly to vaporize at least part of the fuel which is discharged into the passage 400 by the jet 504 to which fuel is supplied under control of the valve 410, and by the normal idling system.

Upon firing of the engine, the throttle 411 is manually opened, at least far enough to allow the rod 412 to be engaged by the lever 418, whereupon the throttle 411 is positioned partly open to supply to the engine a mixture which will sustain the engine in continuous operation at cold idle speed.

The aforementioned operation of the engine creates a vacuum in the induction system in an amount of the order of 18 inches of mercury approximately, more than sufficient to actuate the piston 417 against the spring 435, the spring 435 having a strength sufficient to oppose movement of the piston 417 until a vacuum of about 4 inches of mercury exists in the induction system, which occurs at full open throttle operation. The underside of the piston 417 on which the spring 435 bears is in communication with the passage 400 on the downstream side of the throttle. Movement of the piston 417 as described allows the levers 412 and 418 to engage as previously described, and to disengage should the engine be stopped while still in the cold condition, and

thereby cause the lever 418 to be disengaged from the rod 412 by force of the spring 435 urging piston 417 against lever 418.

The above described throttle movement upon starting of the engine and as positioned by engagement of rod 412 and lever 418 also positions cam 413 directly under lever 420 and thereby transmits motion through lever 420, rod 422, lever 423, and rod 425 to lever 426 with the effect of closing the valve 410 to lessen the amount of fuel allowed to flow to the engine to a degree which properly supports warming up operation of the engine. The valve 410 is thereafter gradually fully closed by heating up of the thermostat 341 as warming up proceeds to completion in a manner the reverse of the action as previously described.

Simultaneously with the foregoing described rotation of lever 426, the valve 406 is opened to allow fuel to flow through the jet 405 into the nozzle 402 to provide fuel in addition to the amount always supplied through the jet 404, and this occurs only after the throttle 411 is opened in excess of about one-fourth of its total opening movement. With the jets 404 and 405 open, fuel required for cold operation of the engine is provided while the throttle is open to an amount less than the angular position of the cam 414 which is about one-third to one-half of throttle opening.

Simultaneously with the above described rotation of lever 426, the arm 434 of lever 426 engages the head of valve 409 but does not open the valve. The jet 405 controls the quantity of fuel entering the nozzle 402, regardless of the extent to which valve 406 is opened in excess of that to which the jet 405 will pass fuel.

At the completion of the warm up under conditions as described, the lever 431 is hung upon the lever 415 of the throttle, and rod 412 and lever 418 are still engaged. Slight opening movement of the throttle disengages the rod 412 from the lever 418 and allows the thermostat to move the lever 418 away from further engagement with rod 412, and the lost motion connection 436 allows the piston 417 to move its full amount without corresponding motion of lever 418. At the same time the lever 431 is allowed to fall into the path of the throttle lever 415, adjusting the throttle 411 to the normal hot idle position. The thermostat is allowed to complete its motion to the extent of lowering the fulcrum 427 of lever 426 to a point where rotation of lever 426 will no longer actuate the valves 410 and 409, and simultaneously pivoting lever 426 about the valve 406 raises 420 and 422 to clear the cam 413 but still allowing the cam 414 to engage the lever 420 for future actuation of valve 406.

Operation during driving of the vehicle immediately following cold starting

The same actions of the carburetor controls, including the thermostat 341, take place during this phase of engine operation. A substantial portion of throttle opening movement is required before the cam 414 engages the lever 420. Meanwhile the delivery of fuel from the idle system and through the valve 410 has ceased because the throttle 411 when opened beyond cold idle position gradually renders the idle system ineffective. The increased volume of air associated with such gradual opening of the throttle 411 gradually increases the quantity of air passing through the venturi 401, and in consequence the quantity of fuel drawn through the nozzle 402 and the jets 404 and 405 sustains proper engine operation.

When the throttle is opened beyond the angular position of the cam 414, the lever 420 is raised an additional distance in excess of the distance as regulated by the cam 413 and such additional motion is transmitted to lever 426 and thereby further lifts the valve 406 but causing no additional quantity of fuel to pass through jet 405. This further opening movement of the throttle also opens the valve 409, allowing additional fuel into the nozzle 402 to support "cold," "full power" operation of a cold engine. Simultaneously the valve 410 is closed. Simultaneous with full opening of the throttle the vacuum on the engine side of the throttle is reduced and the spring 435 raises the piston 417 and the lever 418 out of the path of the rod 412. As the throttle is closed, an inverse actuation of the foregoing members occurs in order to properly position the throttle at its "cold idle" position.

Normal hot operation

At the completion of the engine warm up the lever 418 is moved out of the path of the rod 412 and the lever 431 into the path to the throttle, and thereafter the throttle is positioned to the idle position thereof for normal hot engine operation. The lever 420 is raised so that it no longer engages the cam 413 but only the cam 414. The fulcrum 427 of lever 426 is lowered to where the valves 406, 409 and 410 are fully closed and only the fuel feeding jets 404 and 407 remain open. Rotary motion of lever 426 during normal hot operation originates from the cam 414 and the throttle 411, and the arm 433 merely moves away from the head of valve 410 while the arm 434 of lever 426 raises the valve 406 sufficient for full fuel flow through the nozzle 402 as governed by the jet 405 while the valve 409 is retained closed since the fulcrum 427 is lowered sufficiently to allow the above described action of raising the valve 406 without opening the valve 409.

In the modification shown in Fig. 13 the piston 417 alone actuates the valve 406, and the arm 434 of lever 426 is not used to operate the valve 406 but only the valve 409 which in such arrangement would be lifted during cold starting of the engine prior to the opening of valve 406 as described. The operation of valve 406 by piston 417 takes place at any time that the vacuum on the engine side of the throttle 411 falls below say four inches of mercury, and irrespective of the position of the throttle or the speed of the engine. Thus the valve 406 will be open during both cold and hot engine starting and closed immediately upon starting of the engine, providing the throttle valve 411 is positioned as illustrated and described during engine starting. The action of valve 406 as just described in no way interferes with the engine starting operations. The construction and operation of the modification illustrated in Fig. 13 is otherwise the same as that shown in Fig. 12.

Fig. 11 is a chart of of curves which graphically illustrates the relative values of various fuel curves and various pressures in the induction system relevant to carburetor operation obtainable with carburetor disclosed in Figs. 1 to 10. The curve marked A is a curve showing the fuel air mixture ratio for starting and operating a cold engine. The peak of hump portion A1 of curve A shows the air fuel mixture ratio during the cranking of the engine. The air fuel mixture ratio curve for wide open throttle op-

eration of a cold engine at full power follows the line A2 instead of hump A1.

The curve marked B indicates the vacuum produced by the fuel nozzle within the fuel metering system with the air metering valve 88, 86 open for cold operation of the engine. The curve marked C indicates the vacuum within the metering system during cold operation with the air metering valve 88, 86 open for cold operation of the engine, and due to the passage 60 and the angular position of the throttle. The curve marked D is the curve showing the fuel air mixture ratio for full open throttle operation of the engine when hot, and the curve marked E is the curve showing the vacuum within the metering system when the valve 88, 86 is open for hot operation of the engine. Curve F indicates the vacuum in the manifold during wide open throttle operation between zero and maximum air quantity. J is the curve showing manifold vacuum during progressive opening of the throttle from zero to maximum air quantity. The curve marked G is the hot economy fuel air mixture curve, the peak of the hump portion thereof indicating the hot idle portion of such curve, and the downwardly sloping portion between the peak and the level part of the curve indicating the fuel mixture curve at off idle positions of the throttle. The dotted portion G1 indicates the shape that the economy curve would have if the passage 60 were omitted, and the curve H is a curve showing the vacuum within the metering system during normal hot operation due to the passage 60 and the angular position of the throttle and the open position of metering valve 88, 86. The E curve and the H curve combine to produce the hump portion of curve G, and the B curve and the C curve combine to produce the hump portion A1 of curve A. The line K indicates a point relative to zero and maximum air quantity at which the effects of passage 60 ceases to influence the vacuum at the end of nozzle 42 and its corresponding effect upon the shape of curves A, D and G. Substantially similar curves would be obtained from the carburetors shown in the modified figures. These curves indicate that the cold operating air fuel mixture curve is richer than the hot full power curve, and that the hot full power curve is richer than the hot economy curve.

Certain subject matter disclosed herein is disclosed and claimed in my prior copending application Serial No. 360,046, filed October 7, 1940, for "Carburetors," now patent No. 2,453,728, issued November 16, 1948, and of which the present application is a continuation in part.

While I have illustrated and described preferred embodiments of my invention, it is understood that these are capable of modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a carburetor for supplying air and fuel to the induction system of an internal combustion engine in response to the absolute air pressure therein, an air passage of predetermined length, and open at both ends thereof, one end being adapted for communication with said induction system and the other end open to the atmosphere, said air passage also being so constructed and arranged throughout a portion of its length whereby air entering one end of said air passage at a given absolute air pressure, enroute to the opposite end of said passage, is subjected to absolute pressure changes as the air approaches, and leaves, said portion, a throttle valve, operably disposed in said portion for varying the said absolute air pressure in said portion and for regulating the flow of air and fuel through said portion and said air passage, to said induction system, fuel supplying means for delivering fuel into said air passage and having at least one fuel outlet disposed in said portion upstream, relative to said throttle, absolute pressure transmitting means for conveying the absolute air pressure occurring at one side of said throttle, when said throttle is less than full open, to the other side of said throttle, adjacent said fuel outlet in said fuel supplying means, both ends of said absolute pressure transmitting means terminating in said portion, said portion being adapted to maintain said absolute air pressure substantially constant throughout the length of said portion at least during such conditions as are associated with full open throttle.

2. A plain tube type of carburetor for supplying fuel to the induction system of an internal combustion engine comprising an air passageway, a throttle in said passageway operable for regulating the flow of air and fuel through said passageway into the induction system, means for delivering fuel to said air passageway in response to suction therein, air metering means operable for supplying and controlling the supply of air to said fuel delivering means for regulating the supply of fuel therethrough to said air passageway, means operable in response to the temperature condition of the engine for regulating said air metering means so as to decrease the richness of the mixture supplied to said fuel delivering means as the engine warms up, and means responsive to partial opening movement of the throttle for adjusting said air metering means so as to decrease the richness of the mixture supplied through said fuel delivering means upon opening movement of the throttle when the engine is cold.

3. In a carburetor for supplying fuel to the induction system of an internal combustion engine, a passageway through which air and fuel flow to the induction system, a throttle valve operable for regulating the flow of fuel and air through said passageway into the induction system, means for supplying fuel to said air passageway, and means operable in accordance with the temperature condition of the engine for positioning said throttle in a position closed beyond the normal hot idle position of the throttle for cold starting whereby a high vacuum in the induction system may be obtained for quick starting of a cold engine.

4. In a plain tube type of carburetor for supplying fuel to the induction system of an internal combustion engine, a passageway through which air and fuel flow into the induction system having a throttle therein for controlling the flow of fuel and air to the induction system of the engine, means including a nozzle for delivering fuel to said passageway, fuel metering means for controlling the supply of fuel to said nozzle through said fuel delivering means, and means operable in response to the positioning of the throttle, the temperature condition of the engine, and the vacuum in the induction system downstream of said throttle for controlling said fuel metering means so that fuel is supplied to said engine through said passageway in accordance with the requirements of the engine.

5. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passage through which air and fuel flows to said induction system, a throttle valve operably disposed in said passage for regulating the flow of fuel and air therethrough enroute to said induction system, fuel delivering means adapted to supply fuel into said passage, fuel metering means operably disposed in said fuel delivering means and adapted to regulate the flow of fuel through said fuel delivering means to suit the operating condition of said engine as related to quantities of fuel supplied to said engine, when said engine is less than normal hot, the same said fuel metering means also being adapted to regulate the flow of fuel through said conveying means to suit the operating conditions of said engine as related to quantities of fuel supplied to said engine when said engine is normal hot, operating means associated with said fuel metering means, and operable in part responsive to movements of said throttle for regulating said fuel metering means to change the said fuel flow as compatible with either of said engine operating conditions of less than normal hot and normal hot, and stop means to limit said throttle opening movement to less than full open position while said engine is less than normal hot, said stop means being inoperable when said engine is normal hot.

6. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passage, a throttle valve in said air passage and operable for regulating the flow of fuel and air through said air passage, into said induction system, means for delivering fuel into said passage comprising a plurality of fuel outlets, said passageway being constructed and arranged so as to maintain substantially uniform pressures at all of said fuel outlets during substantially full open throttle operation.

7. In a carburetor for an internal combustion engine, a main air passage, suction regulating means comprising a throttle valve for controlling the suction in said main passage while said engine is being started, and during engine operation thereafter, and for controlling the flow of fuel to said engine from said main passage during said engine starting and operation, means for delivering fuel to said main passage in response to said suction therein, said means for delivering fuel comprising a plurality of fuel outlets in said main passage, at least one of which is disposed downstream relative to said throttle, valve-type fuel metering means operably disposed in said fuel delivering means, connecting means operable in response to actuating means, for adjusting said fuel metering means whereby fuel is supplied through said fuel delivering means to said main passage and said engine in accordance with the requirements of said engine, said actuating means comprising said suction regulating means, and other means, operable independently of said suction regulating means, for adjusting said fuel metering means so that fuel may be metered by said fuel metering means in quantities to suit the temperature condition of said engine, said connecting means being connected to said fuel metering means and said suction regulating means and said other means in such a manner as to permit movement of said suction regulating means without corresponding adjustment of said fuel metering means and so that said fuel metering means may be adjusted independently of movement of said suction regulating means, whereby said fuel metering means as adjusted by said actuating means remains so adjusted during substantial movements of said suction regulating means, and means limiting the adjustment of said metering means by said other means.

8. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which air flows into said induction system, a throttle in said air passageway for regulating the flow of air and fuel through said air passageway into the induction system, means for supplying fuel to said air passageway including a main fuel nozzle arranged to discharge fuel into said air passageway upstream relative to said throttle, said nozzle having a fuel conveying extension projecting toward and in close proximity to said throttle and adapted to convey a continuous stream of liquid fuel from said nozzle to said throttle, and a by-pass for transmitting vacuum from the downstream side of said throttle to said nozzle for effecting the delivery of fuel to said fuel conveying extension of said nozzle when said throttle is closed beyond a predetermined position during both hot and cold engine operation.

9. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which air flows into said induction system, a throttle operable for regulating the flow of air and fuel through said air passageway into the induction system, means for supplying fuel to said air passageway including a nozzle arranged to discharge fuel into said passageway upstream relative to said throttle, and means for transmitting vacuum in said passageway from the downstream side of said throttle to the end of said nozzle for effecting the delivery of fuel through said nozzle into said air passageway on the upstream side of said throttle when said throttle is less than full open during both hot and cold engine operation.

10. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which fuel and air flow into said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means for supplying fuel to said air passageway including a nozzle adapted to discharge fuel into said passageway upstream relative to said throttle, and a by-pass for transmitting the vacuum from the downstream side of said throttle to said nozzle, said by-pass being operable at idle engine speeds to effect the flow of fuel from said nozzle into said passageway on the upstream side of said throttle during both hot and cold engine operation.

11. A carburetor according to claim 10 wherein said nozzle is provided with a fuel conveying extension extending from said nozzle to a point adjacent said throttle, said extension being constructed and arranged to convey liquid fuel in a continuous stream from said nozzle onto said throttle at idle engine speeds.

12. A carburetor according to claim 10 wherein said air passageway is constructed and arranged to maintain the pressure existing therein as regulated by said throttle such that throttle positions in excess of idle effect the flow of atomized fuel from said nozzle and from said by-pass into said air passageway.

13. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which fuel and air flow into said induction system, a throttle in

said air passageway for regulating the flow of fuel and air therethrough, means for supplying fuel to said air passageway comprising a nozzle terminating in a main fuel outlet adapted to discharge fuel into said passageway on the upstream side of said throttle at engine speeds in excess of idle engine speeds, and a by-pass communicating at one end with said passageway on the downstream side of said throttle and at the other end thereof with the end of said nozzle for transmitting vacuum from downstream of said throttle to said main fuel outlet when said throttle is set for hot or for cold idle engine operation so as to thereby effect the flow of fuel from said main fuel outlet.

14. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which fuel and air flow into said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means for supplying fuel to said passageway including a nozzle arranged to discharge fuel into said passageway upstream relative to said throttle at engine speeds in excess of idle, said nozzle having a fuel conveying extension thereon projecting toward and in close proximity to said throttle, by-pass means for transmitting a vacuum from the downstream side of said throttle to said nozzle when said throttle is set for hot or for cold idle engine speeds, said by-pass means being operable to effect the flow of fuel from said nozzle onto said fuel conveying extension at said idle engine speeds, said nozzle and extension thereon being constructed and arranged to convey liquid fuel in a continuous unbroken stream onto said throttle at idle engine speeds.

15. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which fuel and air flow into said induction system, a throttle in said passageway for regulating the flow of fuel and air therethrough, means for supplying fuel to said passageway including a nozzle adapted to discharge atomized fuel into said passageway upstream relative to said throttle at engine speeds in excess of idle, said air passageway having a portion thereof constructed and arranged to maintain substantially constant the air-pressures existing in said portion, at least during such conditions as are associated with full open throttle, a by-pass communicating at one end with said portion of said air passageway on the downstream side of said throttle and at the other end thereof with said nozzle for transmitting vacuum from the downstream side of said throttle to said nozzle when said throttle is set for idle engine speeds during both hot and cold engine operation, said by-pass being operable to effect the flow of fuel from said nozzle into said passageway upstream relative to said throttle at idle engine speeds, said nozzle including a fuel conveying portion adapted to convey a continuous stream of liquid fuel from said nozzle onto said throttle at idle engine speeds, said throttle and said nozzle being located in said portion of said passageway, said throttle being so arranged relative to the end of said by-pass which is on the downstream side of said throttle as to provide a varying amount of vacuum at said nozzle through said by-pass upon movement of said throttle from and toward idle positions thereof, thereby effecting a gradual transition from the flow of a continuous liquid stream of fuel to the flow of atomized fuel from said nozzle, and vice versa.

16. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which fuel and air flow into said induction system, a throttle valve in said air passageway for regulating the flow of fuel and air through said passageway, and means for supplying fuel to said passageway upstream relative to said throttle valve, said throttle valve being adapted to extend across said passageway in the closed position thereof and including at least a portion thereof comprised of sintered metal, said sintered metal portion providing a tortuous path for the flow of fuel therethrough.

17. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway through which air and fuel flow into said induction system, a throttle operable for regulating the flow of air and fuel through said passageway into said induction system, means for supplying fuel to said passageway including a main fuel supply system and an idle fuel supply system, valve means associated with each of said fuel supply systems for regulating the quantity of fuel supplied by said systems, thermostatic means operable in response to engine temperature and operably connected to said valve means, vacuum means operable in response to the vacuum in said induction system and operably connected to said valve means, and connecting means operably connecting said throttle to said valve means, said thermostatic means, said vacuum means, and said connecting means each being arranged to operate said valve means independently of operation of said valve means by other of said means, said thermostatic means being capable of overruling said vacuum means and said connecting means.

18. In a carburetor for supplying fuel to the induction system of an internal combustion engine, a passageway through which air and fuel flow into said induction system, a throttle valve in said passageway for controlling the flow of air and fuel through said passageway, means for supplying fuel to said passageway, control means including a fuel control valve adapted to be positioned for regulating the supplying of fuel through said fuel supplying means during both cold and hot engine operation, said control means being controlled in part by said throttle valve, and means to prevent opening movement of said throttle valve from changing the positioning of said fuel control valve from its cold operating position to its hot operating position when said engine is cold or warming up.

19. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway including a throttle member adapted to extend across said air passageway when said throttle is closed for idle engine operation, fuel supplying means including fuel metering means, and fuel passage means adapted to deliver substantially all of the fuel supplied to said induction system during idle engine operation to the upstream surface of said throttle member, said fuel passage means extending into close proximity with said surface of said throttle member and being constructed and arranged to form a path along which fuel is conveyed from said metering means onto said throttle surface in an unbroken liquid stream having a uniform rate of flow substan-

tially the same as the rate of fuel flow through said metering means, said fuel passage means having a fuel outlet opening into said air passageway upstream of said throttle and through which outlet said fuel flows in said unbroken liquid stream during idle engine operation, said fuel passage means including a fuel flow facilitating means at said outlet in the form of a surface producing a capillary action on the fuel at said outlet for maintaining the flowing fuel in said liquid stream and at said same rate of flow at said outlet during idle engine operation.

20. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means to supply fuel to said passageway comprising a fuel metering means having an outlet from which only liquid fuel is discharged, means forming a fuel passage extending from said metering means outlet and having a fuel outlet opening into said passageway upstream of said throttle and through which outlet fuel is discharged when the throttle is closed for idle engine operation, said fuel passage sloping downwardly continuously from said metering means outlet to said upstream fuel outlet so as to form a path adapted to convey an unbroken stream of liquid fuel from said metering means outlet to said fuel outlet during idle engine operation, a fuel flow facilitating means associated with said fuel outlet for conveying fuel from said fuel outlet to said throttle, said fuel flow facilitating means extending into close proximity with the upstream surface of said throttle and forming an extension of said downwardly sloping fuel passage and having a surface exerting a capillary action on the flowing fuel at said outlet so as to cause all of such fuel to flow from said outlet onto said extension and along said extension in its unbroken liquid state and at said uniform rate of flow onto said throttle during idle engine operation.

21. A carburetor according to claim 20 wherein said flow facilitating means projects toward said throttle and is spaced from a point on said throttle surface with a spacing of less than the length of one drop of fuel.

22. A carburetor according to claim 21 wherein said throttle, at least at said one point, is composed of sintered metal.

23. In a carburetor for supplying fuel to the induction system of an internal combustion engine, an air passageway, a throttle valve in said air passageway operable for regulating the flow of fuel from said air passageway into said induction system, fuel supplying means including fuel metering means, and fuel passage means adapted to supply fuel from said metering means to said air passageway upstream relative to said throttle valve when said throttle valve is closed for idle engine operation, said fuel metering means including a portion completely filled with liquid fuel, the outlet from which portion forms a high point in said passage means, said passage means extending from said high point into close proximity with the upstream surface of said throttle valve wherein a low point is provided, the surfaces of said fuel passage means forming a continuously downwardly sloping path from said high point to said low point for conveying fuel in an unbroken liquid stream to said surface of said throttle valve during idle engine operation.

24. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means to supply fuel to said passageway including a fuel passage having a plurality of outlets therefrom adapted to discharge fuel into said air passageway at full open throttle engine operation, one of said outlets opening into said air passageway upstream of said throttle and another of said outlets opening into said air passageway downstream of said throttle when said throttle is closed for idle engine operation, said one upstream outlet being adapted to discharge fuel into said air passageway at full open throttle engine operation, said downstream outlet subjecting said fuel passage to the vacuum below the throttle when the throttle is closed and thereby effecting discharge of fuel from said fuel passage for idle engine operation, other of said outlets being operable to discharge fuel into said passageway during off-idle engine operation, said air passageway having a restricted portion into which portion said outlets open.

25. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means to supply fuel to said passageway including a fuel passage having an outlet opening into said air passageway upstream of said throttle and an outlet opening into said air passageway downstream of said throttle when said throttle is closed for idle engine operation, said upstream outlet being adapted to discharge fuel into said air passageway at full open throttle engine operation in response to absolute air pressure in said air passageway, said downstream outlet subjecting said fuel passage to the vacuum below the throttle when the throttle is closed and thereby effecting discharge of fuel from said fuel passage for idle engine operation, said air passageway having a restricted portion, said upstream and downstream outlets both being disposed in said restricted portion of said air passageway.

26. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway, means to supply fuel to said passageway comprising a fuel metering means having an outlet from which only liquid fuel is discharged, fuel passage means extending from said metering means outlet and terminating in close proximity with the upstream surface of said throttle and having an intermediate portion provided with a fuel outlet opening into said passageway upstream of said throttle and through which outlet fuel is discharged into said passageway during full open throttle engine operation, said fuel passage sloping downwardly continuously from said metering means outlet to said upstream fuel outlet and being formed to provide a path adapted to cause fuel for idle engine operation to flow along said passage means in an unbroken liquid stream from said metering means outlet to said upstream fuel outlet during idle engine operation,

said passage means including a surface at said fuel outlet producing a capillary action on the flowing fuel during idle engine operation to maintain the flowing fuel in said unbroken liquid stream as such fuel flows from said fuel outlet to the termination of said passage means.

27. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway and including a throttle member adapted to extend across said air passageway when said throttle is closed for idle engine operation, fuel supplying means including fuel metering means, and fuel passage means extending from said metering means and having its termination in close proximity with the upstream surface of said throttle member and being adapted to deliver substantially all of the fuel supplied to said induction system during idle engine operation to said upstream surface of said throttle member, said fuel passage means sloping continuously downwardly and being constructed and arranged to form a path along which fuel is conveyed in an unbroken liquid stream having a uniform rate of flow substantially the same as the rate of fuel flow through said metering means during idle engine operation, the terminal portion of said fuel passage means having a surface producing a capillary action on said stream of liquid fuel so as to cause all of the fuel flowing through said passage means during idle engine operation to flow to the said termination of said passage means in said unbroken liquid stream.

28. In a carburetor adapted to supply fuel to the induction system of an internal combustion engine, means providing a passageway through which fuel and air flow to said induction system, a throttle in said air passageway for regulating the flow of fuel and air through said passageway and including a throttle member adapted to extend across said air passageway when said throttle is closed for idle engine operation, fuel supplying means including fuel metering means having an outlet from which only liquid fuel is discharged and fuel passage means extending from said metering means outlet, said metering means including an air inlet opening into said passage means, said passage means having a fuel outlet therefrom opening into said passageway upstream of said throttle member and through which outlet air and fuel are discharged during full open throttle engine operation, said passage means being adapted to convey a stream of liquid fuel from said metering means outlet to said fuel outlet during idle engine operation, said passage means having a cross-sectional area substantially greater than the cross-sectional area of said stream of fuel which is conveyed by said passage means during said idle engine operation and sloping downwardly continuously from said metering means outlet to said fuel outlet so as to form a path adapted to cause fuel to flow along said passage means to said fuel outlet during idle engine operation in an unbroken liquid stream having a uniform rate of flow substantially the same as the rate of fuel flow through said metering means outlet, said passage means having its termination in close proximity to the upstream surface of said throttle member and including a fuel flow facilitating means in the form of a surface producing a capillary action on said unbroken stream of liquid fuel at said outlet during idle engine operation so as to cause all of such fuel to flow in said unbroken liquid stream and at said uniform rate of flow to said termination of said passage means.

29. A carburetor according to claim 28 wherein said termination of said passage means is spaced from one point on said upstream throttle surface with a spacing of less than the length of one drop of fuel.

30. A carburetor according to claim 29 wherein said throttle member at said one point is composed of sintered metal.

31. In a carburetor adapted to supply fuel and air to an internal combustion engine; fuel and air mixture supplying means including a passageway, fuel conveying means, valve-type throttle means, and valve-type vacuum modifying means; said passageway forming a part of the induction system of said engine; said conveying means having a fuel outlet therefrom for conveying fuel to said passageway in response to the vacuum therein; said throttle means being disposed in said passageway and operable for controlling in part the quantity of air flowing through said passageway, the quantity of fuel supplied through said conveying means and the amount of vacuum in said passageway downstream of said throttle means during cold engine starting and operation; said vacuum modifying means being operable for controlling in part the amount of vacuum in said conveying means and thereby the amount of fuel supplied by said conveying means during said cold engine starting and operation; said conveying means being adapted to convey an amount of fuel adequate for said cold starting and operation, the same said fuel conveying means being adapted to convey an amount of fuel adequate for hot engine starting and operation; said carburetor including throttle operating means, a plurality of throttle stop means, other means and connecting means; said stop means being operable in part responsive to said other means and cooperable with said throttle operating means; a first of said stop means providing a full open position of said passageway during hot engine operation; a second of said stop means providing a position of said throttle means in which said passageway is opened to an extent to provide a predetermined amount of vacuum for cold starting of said engine; a third one of said stop means providing a position of said throttle means at which said passageway is opened to an extent less than as provided by said first stop means to limit the amount of vacuum for cold engine operation; said other means being operable independently of said throttle operating means for adjusting said supplying means whereby the latter will provide fuel and air in proportions and quantities suited to the temperature condition of said engine; said connecting means connecting said supplying means, said throttle operating means, said second and third stop means and said other means in such manner as to permit substantial movement of said throttle operating means without corresponding adjustment of said vacuum modifying means, and so that said vacuum modifying means may be adjusted by said other means independently of movement of said throttle operating means, whereby said supplying means as adjusted by said other means to provide said adequate cold engine fuel supply remains so adjusted during substantial movement of said throttle operating means.

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