Nov. 16, 1954 C. H. JORGENSEN ET AL 2,694,558

CHARGE FORMING DEVICE

Original Filed March 5, 1943 5 Sheets-Sheet 1

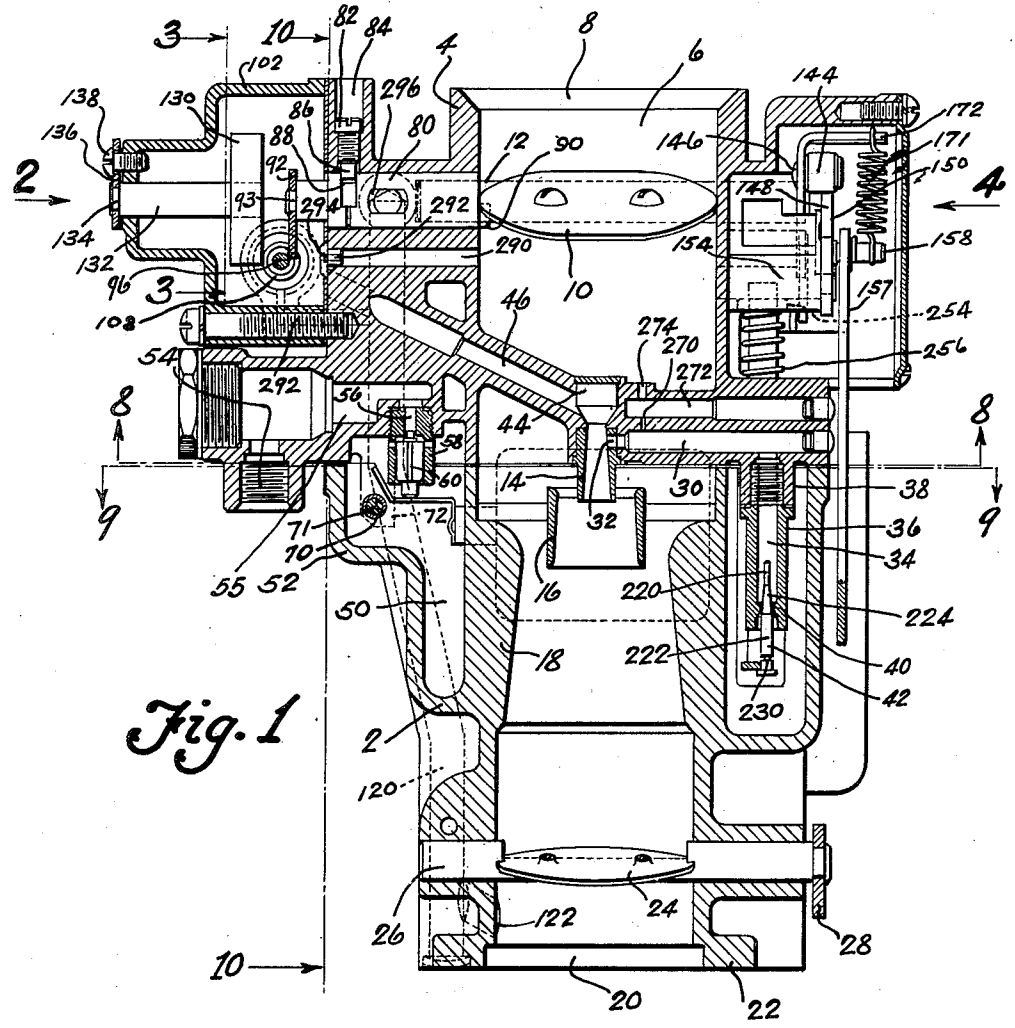


Fig. 1

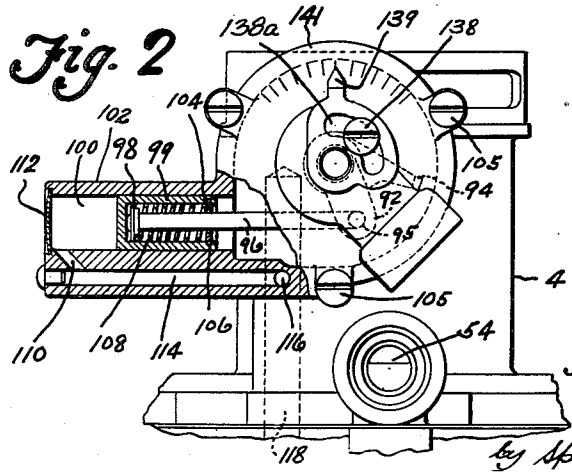


Fig. 2

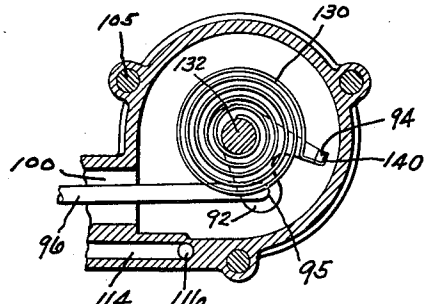


Fig. 3

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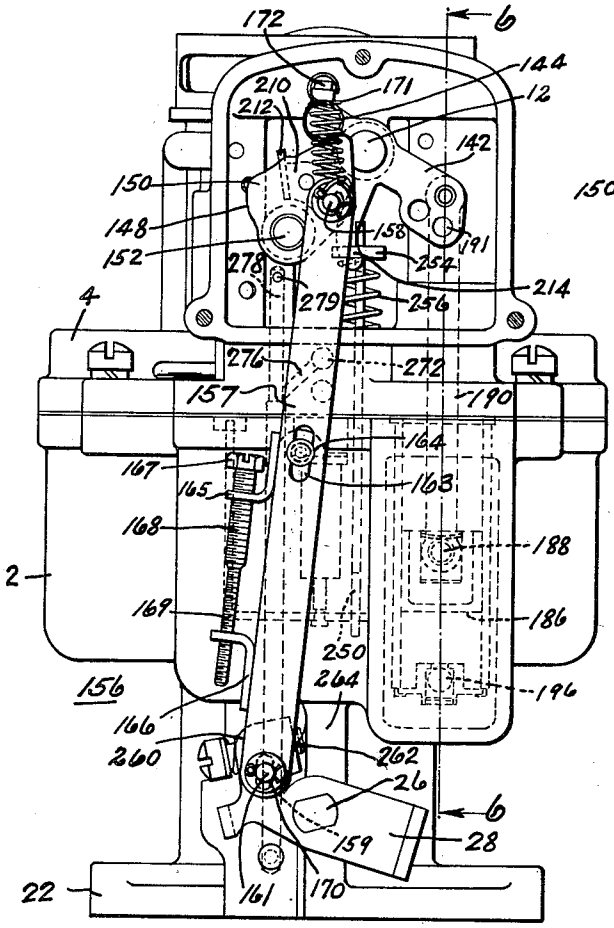


Fig. 4

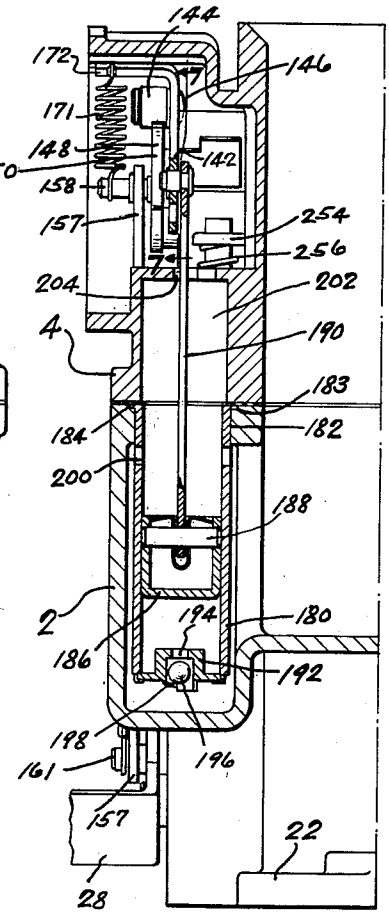
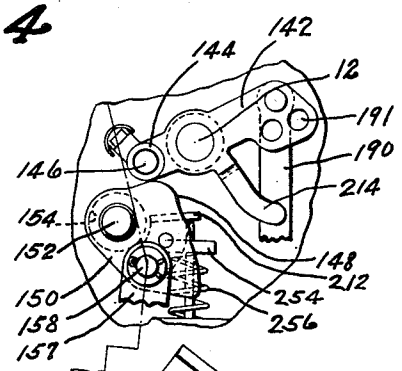


Fig. 6



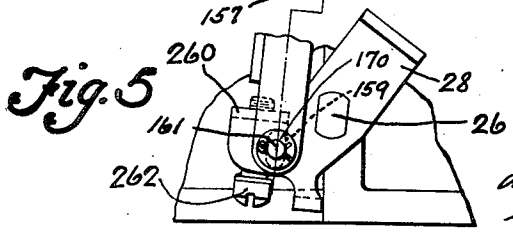


Fig. 5

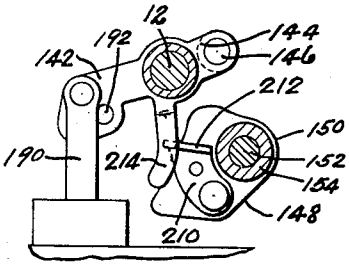


Fig. 7

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CHARGE FORMING DEVICE

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Fig. 8

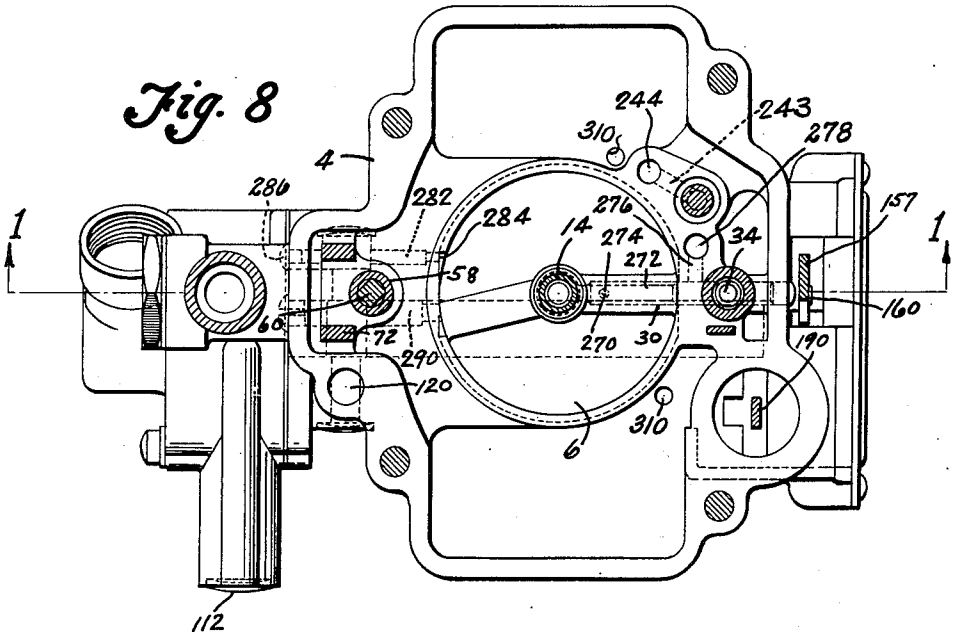
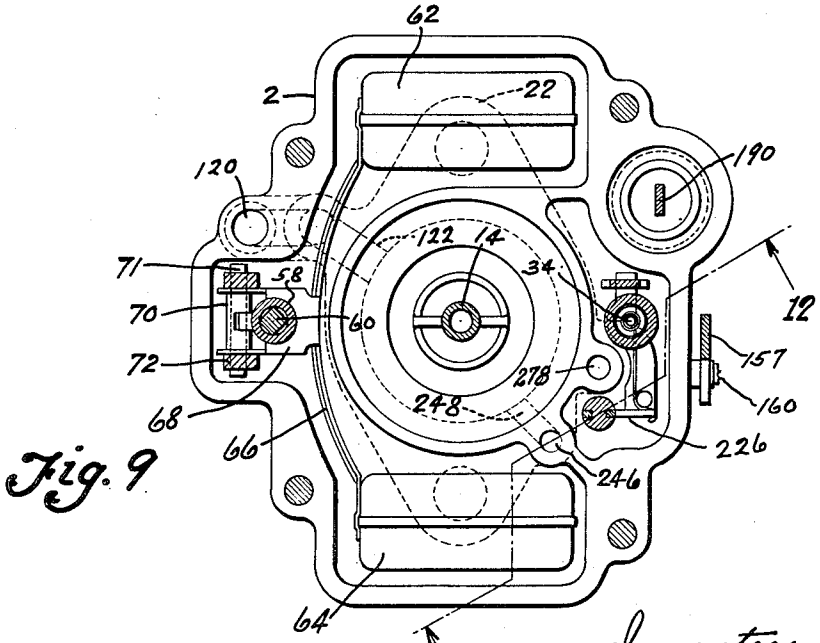


Fig. 9



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CHARGE FORMING DEVICE

Original Filed March 5, 1943 5 Sheets-Sheet 4

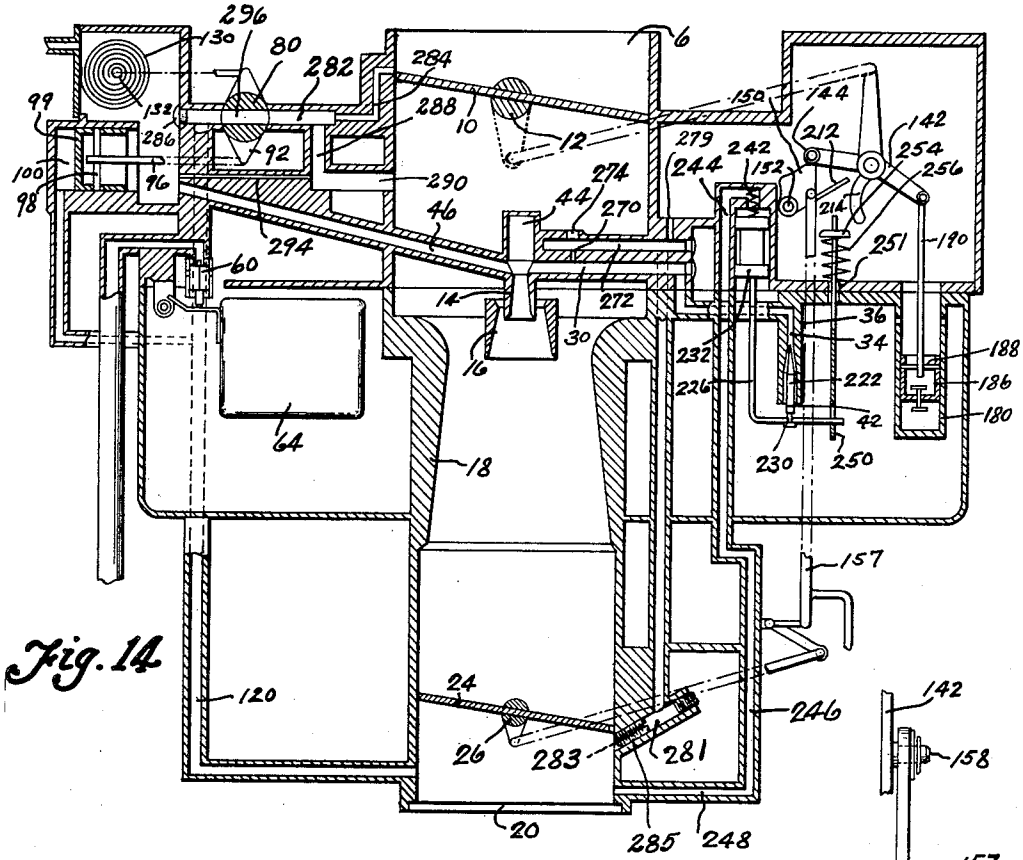


Fig. 14

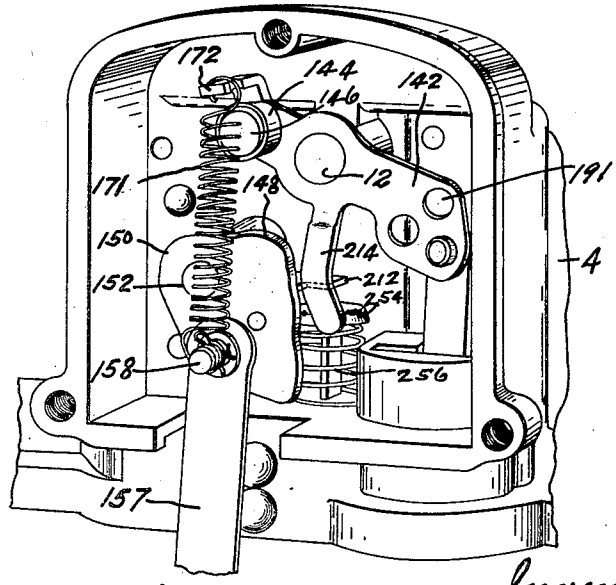


Fig. 13

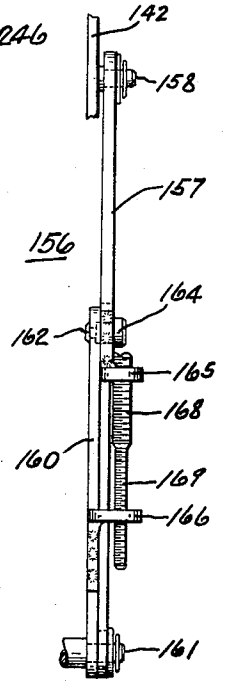


Fig. 15

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CHARGE FORMING DEVICE

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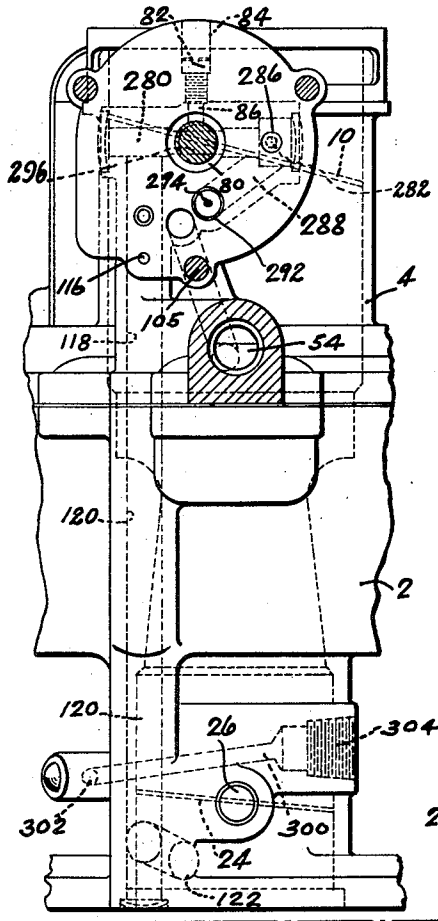


Fig. 10

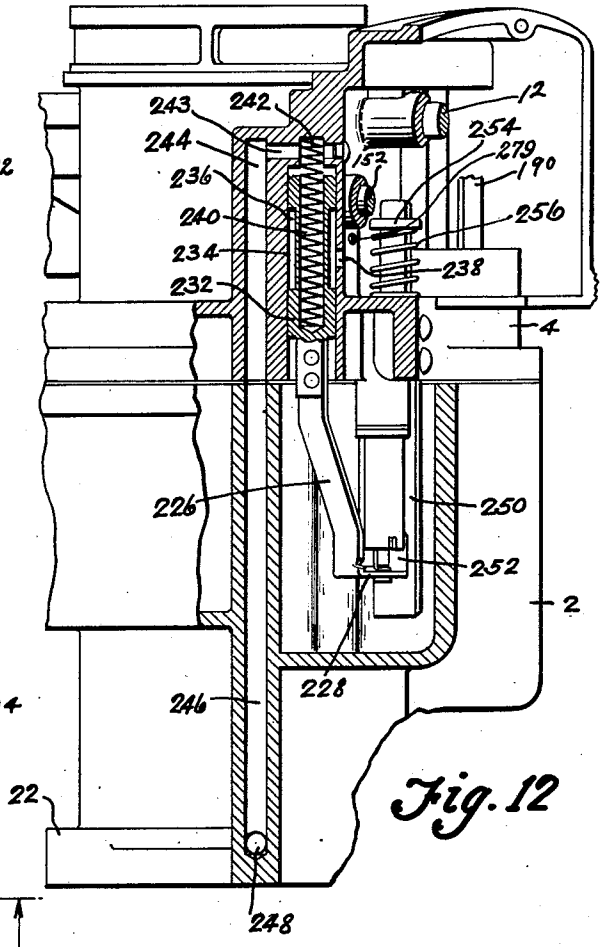


Fig. 12

11 11

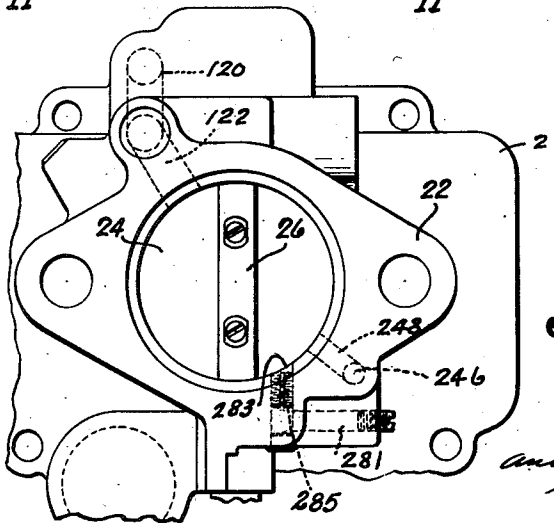


Fig. 11

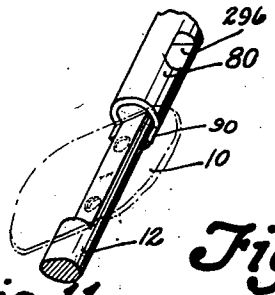


Fig. 16

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CHARGE FORMING DEVICE

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Continuation of abandoned application Serial No. 478,096, March 5, 1943. This application November 3, 1949, Serial No. 125,222

35 Claims. (Cl. 261—39)

This invention relates to charge forming devices for internal combustion engines and more particularly to that form of charge forming device which is provided with an automatic choke for variably controlling, without requiring the attention of the operator, the mixture proportions during certain operating conditions, in order to provide a mixture of such proportions as to most satisfactorily operate the engine under those conditions.

The principal object of the present invention is to produce a charge forming device of the character referred to which is effective to produce, under all conditions of operation, a fuel mixture which is accurately proportioned to bring about the most satisfactory operation of the engine. With this object in view, one feature of the present invention consists in the provision of a carburetor, or charge forming device, having an automatically controlled choke valve which is unbalanced so that its position is controlled, in part, by the effect of air entering the carburetor and is also controlled by a thermally responsive means which, at low temperatures, is designed to hold the valve closed and as the temperature increases, to limit the opening movement of the valve, the valve being further controlled by a suction-operated mechanism which is subject to the vacuum of the intake passage between the carburetor throttle and the engine.

A further feature of the invention consists in the provision of a choke valve which, although moved to closed position by the force of the thermostat as the latter contracts upon reduction of temperature, is not directly connected to the thermostat so that the thermostat does not actually move the valve toward open position but merely positions a stop member to determine the opening movement of the valve and the provision of a connection between this stop member and the suction-operated means so that the position of the stop member is determined by the joint effect of the thermally responsive element and the suction operated means and the choke valve is actually moved to whatever position it may assume by the action of the ingoing air only.

A further feature of the invention consists in the provision of means for conducting heated air from a point adjacent the exhaust manifold to a housing in which the thermally responsive means is positioned and from such housing to the main fuel nozzle so as to secure better vaporization of the fuel which is introduced through such nozzle.

A further feature of the invention consists in the provision of novel and improved means for effecting faster than normal idling of the engine during the warm-up period when the engine is first started into operation, such means comprising a passageway connected with the intake passage at a point between the carburetor throttle and the engine and also connected with the intake passage adjacent the choke valve at points both anterior and posterior to such valve.

An additional feature of invention consists in the provision of means operated by the throttle to move the choke valve toward closed position as the throttle is closed, and of resilient means connected to the throttle and tending to pull the choke valve open and effective to aid the action of air flow in opening the choke as the throttle is opened, in combination with a means for retarding relatively rapid opening movements of the choke valve as the throttle is opened or under any other conditions, whereby the movement of the choke valve toward open position is delayed in order to prevent the mixture from becoming too lean for proper engine operation if the choke valve is opened rapidly.

A further feature of the invention consists in the provision of a yielding connection between the suction operated piston, which is effective to move the stop member for controlling the position of the choke valve and such stop member.

An additional feature of the invention consists in an improved form of fuel supply means for supplying fuel to the main nozzle and to an outlet for suppling fuel at idling whereby the fuel for idling and for operation under normal conditions is supplied from the same fuel passage.

A still further feature of the invention consists in the provision of an automatically operated valve for controlling the admission of fuel to the fuel passage which is controlled by a suction operated piston responsive to the suction in the intake passage at a point posterior to the carburetor throttle valve; and is also controlled manually by the throttle valve to provide a richer than normal mixture at relatively wide open throttle position to produce the necessary power.

A further feature of the invention consists in the provision of a fuel controlling valve which is provided with fuel controlling surfaces having a plurality of steps of different cross-sectional areas and a tapered surface and which is movable under the influence of suction to restrict the fuel passage to a greater extent than normal during idling operation of the engine, to variably restrict the fuel passage during part throttle operation, and to open the fuel passage to its greatest extent when the throttle is moved to wide open position so as to enrich the mixture for wide open throttle operation.

Another feature of the invention comprises means operable by the throttle to positively move the choke valve toward closed position as the throttle is closed and to positively and variably limit the opening of the choke valve as the throttle is moved toward open position.

A still further and important feature of the invention resides in the construction of the main fuel supply conduit which conveys fuel from the constant level float chamber to the main and idling fuel jets, said conduit being secured in the air horn casting which is above the float chamber and extends downwardly into the fuel in the float chamber and connects at its upper end with passages in the air horn casting which lead to the main and idling jets. No part of the fuel supply conduit is formed in any part of the fuel chamber wall and in fact, no part of the conduit is in metallic contact with the fuel chamber so that the heating of the fuel supply is minimized, vaporization of fuel within the supply conduit is also minimized and any formation of vapor which forms will collect above the fuel level. For this reason any vapor formed will simply pass into the intake passage without forcing any liquid fuel into the passage and no percolation takes place.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a vertical section substantially along the broken line 1—1 of Fig. 8.

Fig. 2 is a detail elevation of the upper end of the intake passage and the thermostat housing seen from the left in Fig. 1 and partly in section.

Fig. 3 is a detail section on the line 3—3 of Fig. 1.

Fig. 4 is a side elevation of the carburetor seen from the right in Fig. 1.

Fig. 5 is a detail view of parts of the mechanism operated by the throttle which controls movements of the choke valve.

Fig. 6 is a section on the line 6—6 of Fig. 4.

Fig. 7 is a detail section on line 7—7 of Fig. 6.

Fig. 8 is a plan view of the upper section of the main housing looking upwardly on the line 8—8 of Fig. 1.

Fig. 9 is a plan view of the lower section of the main housing looking downwardly on the line 9—9 of Fig. 1.

Fig. 10 is a vertical section on line 10—10 of Fig. 1.

Fig. 11 is an end view looking upwardly on the line 11—11 of Fig. 10.

Fig. 12 is a vertical section on the broken section line 12—12 of Fig. 9.

Fig. 13 is an enlarged view in perspective of the throttle operated mechanism which controls the movement of the choke valve and which is shown in elevation in Fig. 4.

Fig. 14 is a diagrammatic view showing the operating parts and the fuel passage in diagram.

Fig. 15 is a detail side view of the linkage connecting the throttle and choke valve.

Fig. 16 is a perspective view of a detail of construction.

The charge forming device, or carburetor, comprises two castings numbered 2 and 4 which are secured together, the one above the other, as indicated in Fig. 1, and which form, when so secured together, an intake passage 6 which extends vertically through both castings. Air is admitted to this intake passage at its upper end through the air intake 8, which is controlled by an unbalanced choke valve 10 mounted on a shaft 12, journalled for rotation in any suitable way in the wall of section 4 of the housing and the movement of which is controlled in accordance with temperature and suction in a manner which will be described later. A fuel nozzle 14 in the form of a small venturi tube discharges fuel into the intake passage to be mixed with the air supplied through intake 8 to form a combustible mixture. This small venturi tube discharges at the most restricted portion of a larger venturi tube which, in turn, discharges at the point of greatest suction in a still larger venturi tube 18 which is integral with the housing section 2 and forms a part of the wall of the intake passage. The combustible mixture formed within the intake passage is supplied to the engine through the outlet 20 which communicates with the intake manifold, the carburetor being provided with a flange 22 so that it may be attached to the manifold in the usual way.

The quantity of mixture supplied to the engine by the carburetor is controlled by means of throttle valve 24 which is secured to the shaft 26 suitably journalled for rotation in the wall of housing section 2 and manually operable by the arm 28, secured to shaft 26 and connected to any suitable form of operating connection, extending to a point adjacent the operator of the vehicle. Fuel is supplied to the nozzle 14 by a passage 30 which communicates with an orifice 32, formed in the wall of the smallest venturi tube 14. The passage 30 also connects with a fuel passage 34, formed in a nipple 36, screwed into a threaded boss 38 formed integrally with housing section 2. The nipple 36, at its lower end, is provided with a restriction 40 with which a fuel valve indicated generally by reference number 42 cooperates to control the flow of fuel to the main nozzle as later described, this valve being manually and automatically controlled by mechanism which will also be later described.

Communicating with the venturi tube 14 through an orifice 44, which is formed in the wall of the venturi tube on the opposite side from the port 32 is a passage 46 through which heated air is admitted to form an emulsion, or primary mixture therein, with the fuel which is supplied through the port 32 and this primary mixture is discharged into the secondary venturi tube 16 where it is mixed with additional air flowing around the end of tube 14, and this mixture, in turn, is discharged into the largest venturi tube 18 where it is mixed with still further air flowing into the tube 18 around the outside of the tube 16 to form the mixture which is supplied to the engine without further dilution by air and is of proper combustible proportions. The passage 46 connects with the interior of the housing for the thermostat which controls the choke valve as more particularly described later.

Fuel is supplied to the fuel passage 34 from a constant level fuel chamber which is indicated by the reference numeral 50, formed in the lower housing section 2 around the venturi tube 18 and lies between the wall of such tube and the outer wall 52 of the casting, this space being substantially concentric with the intake passage. Fuel is supplied to chamber 50 through the fuel inlet 54 into which a suitable supply pipe may be screwed. Inlet 54 communicates with a passage 55 and connecting therewith is a passage 56 formed in a nipple 58 screwed into the wall of section 4 and slidably mounted in nipple 58 is float valve 60. This valve is operated by a float mechanism comprising two cork or spun-metal floats 62 and 64 which are secured to a curved sheet metal bar 66, which is connected to bifurcated arm 68, the ends of which are secured to a sleeve 70, suitably pivoted for rotation on a pin 71 which is supported by lugs 72 extending downwardly from and integral with the lower portion of housing section 4. The bifurcated element 68 has a flat horizontal portion which lies immediately beneath the float valve 60 and operates to close this valve when the level of fuel in the chamber reaches a predetermined height. The fuel valve is of ordinary construction, but the arrangement of floats with respect to the nozzle is such that substantially the same level of fuel is maintained at the nozzle, regardless of what the angle of inclination of the vehicle on which the carburetor is used, may be.

As stated previously, the admission of air to the carburetor is controlled by an unbalanced valve 10, the position of which is regulated in accordance with temperature and engine suction. The mechanism for controlling the operation of this choke valve will now be described. To control the movement of the choke valve there is provided a stub shaft 80 which is rotatable in a bore in the wall of housing section 4 and is held against longitudinal movement therein by a set screw 82 which is screwed into a recess 84 in the housing wall and has a reduced inner, or lower, end 86 which engages a slot 88 in the periphery of the stub shaft. The slot extends only partly around the periphery of the stub shaft so that it performs the dual function of preventing any longitudinal movement of the stub shaft and also, by reason of its limited length, limits the rotational movement of the stub shaft. The choke valve shaft 12 extends into a cylindrical recess in the right hand end of the stub shaft 80 as viewed in Fig. 1, so that the stub shaft provides a journal in which the shaft 12 rotates. The stub shaft has an arcuate projecting portion 90 which extends into the intake passage as shown in Fig. 16 and which engages the surface of the choke valve so that it forms a stop to control the opening movement of the choke valve. The extent of the arcuate projection 90 is such that there is some degree of lost motion between such projection and the choke valve, but when the stub shaft is in the position it would normally occupy when the temperature is low and no suction is present, or, in other words, when the engine is not running in cold weather, the choke valve would be held closed by engagement of projection 90 with the surface of the choke valve. The stub shaft is held in this position at low temperatures, by a thermostat which will be presently described, but may be moved from such position by action of engine suction or increase in temperature to permit opening of the choke valve.

The stub shaft 80 is provided with an actuating arm 92 which is secured to a reduced extension 93 projecting from the end of shaft 80 and is of generally rectangular shape, on which a similarly shaped orifice in the actuating arm 92 fits, but the actuating arm may be secured to the stub shaft in any other suitable way. The arm 92 has one end bent over at right angles thereto as indicated at 94 and the other end has an orifice 95 in which a bent end of a piston rod 96 is pivotally connected, a suitable cotterpin extending through the end of the rod 96 to hold the parts in assembled position. The rod 96 is provided with an enlarged head 98 which is received within the hollow interior bore of the piston 99 which is slidably mounted in a cylinder 100 formed in an extension of the small cover housing 102 in which the thermostat is positioned and which is secured to section 4 of the main housing at the left of Fig. 1, the housing 102 being held in position by screws 105 as shown in Fig. 2. A retaining washer 104 is received in a groove 106 at the inner end of the hollow piston and a compression spring 108 is positioned between the washer and the enlarged head 98 of the piston rod.

A diagonal passage 110 communicates with the interior of the cylinder 100 at the left of the piston as seen in Fig. 2, between such piston and a closure cap 112 which closes the end of the bore. This diagonal passage communicates with a passage 114 formed in the wall of housing 102 and connecting at its right hand end with a bore 116 which communicates with a vertical passage 118 formed in the wall of the housing section 4 as shown in Fig. 2 and which, in turn, communicates with a corresponding passage 120 in the housing section 2, as shown in Fig. 1. The passage 120 communicates with the intake passage through the diagonal bore 122 at a point posterior to the throttle. The high vacuum which is maintained posterior to the throttle is, therefore, communicated through the several passages to the space in the cylinder 100 between the piston and the closure cap

and this suction tends to pull the piston to the left. This compresses the spring **108** and through the spring moves the piston rod **96** to the left to move the stub shaft **80**, so as to move the previously described stop member **90** in such a direction as to permit the choke valve to open because of the pressure exerted thereon by the incoming air to whatever position is determined by the position to which the stop member is moved.

This movement of the choke valve is opposed by a thermostat when the temperature is low. The thermostat is indicated at **130** in Figs. 1 and 3 and is a coil thermostat, one end of which is secured in any suitable way to a pin **132**, which extends through an opening in the housing **102** so as to be rotatable therein and is provided with a reduced portion **134** to which a small plate **136** is secured by riveting or otherwise. This plate is adjustable with respect to housing **102** and is secured in adjusted position by a machine screw **138** which extends through a slot **138***a*, which limits the movement of the pin **132**, and so limits the adjustment of one end of the thermostat. One end of the coil thermostat is, therefore, fixed to the pin **132** which is set in the desired position by the means just mentioned and the other, or free end, of thermostat **130** is provided with a hook **140** which engages the bent-over projection **94** of the arm **92** through which stub shaft **80** is actuated. It will be apparent that if the piston **92** is moved under the influence of suction, it pulls against the end **140** of the thermostat and the force of the latter must be overcome before the stub shaft can be moved. As the engine temperature rises, the thermostat expands and the hooked end of such element moves clockwise in Fig. 3, so that it moves out of the path of the bent end **94** of the actuating arm **92**, with the result that when the normal engine temperature is reached, the thermostat is moved to such a position that it does not oppose motion of the piston **99** nor does the thermostat oppose movement of the valve due to flow of incoming air. The pin **132** is adjusted to vary the thermostat, so as to vary the initial pressure on the choke valve and may be set to create a relative lean or rich mixture to be produced, the mixture being richer as the initial pressure is increased and vice versa. To facilitate the initial setting of the thermostat the plate **136** is provided with a pointer **139** which cooperates with an indicating scale **141**.

In addition to the suction operated means, just described, for effecting a movement of the stub shaft toward a position to permit the opening of the choke valve, movement of the valve may be aided by mechanism which is actuated by the throttle, and throttle-operated mechanism also limits the opening movement of the choke valve. For this purpose the right hand end of the choke valve shaft **12**, as viewed in Fig. 1, has secured thereto in any suitable way, an arm **142** which is best illustrated in Figs. 4 and 5. This arm carries at one end a roller **144** which is pivotally mounted on a pin **146** supported by and projecting from the arm **142** and the roller engages the operating surface **148** of a cam **150** which has formed integrally therewith a pin **152**, pivotally mounted in a hollow boss **154** which is formed integrally with the main section **4** of the casting and extends therefrom as indicated in Fig. 1.

When the temperature is low, the thermostat holds the choke valve closed and when idling cold the choke valve is only opened very slightly against the force of the thermostat, if it is opened at all. When the normal high operating temperature is reached, however, the position of the choke is determined by the position of the cam **150**, which, as the throttle is moved toward closed position, is moved so as to move the choke toward closed position, through engagement of the cam with roller **144** and the position of the cam determines the degree of opening of the choke for normal idling, such opening being 15° or thereabouts. The operating mechanism by which the cam is moved by the throttle can be minutely adjusted so that the initial or hot idling position of the choke valve can be very accurately determined. To this end the operating linkage indicated in its entirety by the member **156** includes a link **157**, pivotally connected to a pin **158** projecting from the cam and a shorter link **160** which is pivotally connected with a relatively tight fit to the pin **161** extending from throttle operating arm **28**. Projecting from the link **160**, at its upper end, is a pin **162** which slides in a T-shaped slot **163** in link **157** and has an enlarged head **164** which holds links **157** and **160** together. Projecting from links **157** and **160** respectively, are ears **165** and **166** and these ears are provided with threaded orifices in which the screw **167** is received. The screw has threads of different pitch **168** and **169** engaging ears **165** and **166** respectively, so that rotation of the screw in one direction will spread the ears and increase the distance between pins **158** and **161** while a reverse rotation of the screw will move the ears toward each other and reduce the distance, the pin **161** sliding in slot **170** during movements of the screw. By this mechanism very accurate adjustments of the distance between the pins **158** and **160**, and correspondingly accurate adjustments of the position of the choke valve, when the engine is idling at normal temperature may be brought about.

In order to hold the roller **144** on the operating surface **148** of the cam, a spring **171** is provided connected at one end to the pin **158** and at the other end to a bent-over extension **172** which is integral with the arm **142**.

Obviously, any movement of the operating arm **28** which takes place in moving the throttle to vary the speed will operate the connecting linkage between the throttle and cam **150** so as to rotate the cam **150** in a clockwise direction as the throttle is opened and in a counterclockwise direction, as the parts are viewed in Fig. 4, when the throttle is moved toward its closed position. The engagement of the cam with the roller, as the throttle is moved to the closed position, in which the parts are shown in Fig. 4 will, through the medium of the arm **142** which supports the roller, move the choke toward closed position. When the throttle is moved toward open position, the connecting linkage is pulled downwardly. This will rotate the cam in a clockwise direction and will pull downwardly on the spring **171** tending to pull the end of the arm **142** downwardly and open the choke valve as the throttle is opened. This, of course, is a resilient connection and if the choke is held closed by the thermostat, or if there is any other resistance to the opening thereof, the spring **171** will yield and allow the throttle to move without a corresponding movement of the choke immediately. If cold, no movement of the choke will take place until the force of suction and the spring can overcome the force of the thermostat and the effect of a dash pot which resists opening movement of the choke.

Even if the engine temperature is high and the thermostat is exerting no force tending to close the choke valve, the movement of the choke valve toward open position does not take place simultaneously with the movement of the throttle. Such movement of the choke valve would be effected if the dash pot was not provided, but if such a movement were effected the mixture which is provided for the engine, when the throttle is opened, would tend to become too lean for proper operation of the engine during acceleration and in order to prevent such action taking place, the dash pot delays opening movement of the choke with reference to the throttle, even after normal operating temperature is reached. This dash pot is best shown in Fig. 6 and includes a cylinder **180**, which is received in a bore **182** at one side of the fuel chamber **52** and extends downwardly into the fuel chamber so as to receive fuel therefrom. The cylinder is provided with a laterally extending flange **183** which rests upon a shoulder **184** formed on the lower housing section so as to support the cylinder in the proper vertical position, as shown in Fig. 6, and when the carburetor is assembled, this flange is clamped tight against such shoulder between the two main housing sections **2** and **4**.

Slidable in the cylinder **180** is a piston **186** which is pivotally mounted on a wrist pin **188**, carried by the piston rod **190**, such rod at its upper end being connectible in any one of three holes **191** which are formed at one end of the arm **142** which is secured to the choke valve shaft. The three holes are provided so that the position of the upper end of the piston rod may be changed to some extent in order that the movement of the piston and the normal position of said piston with respect to the cylinder may be adjusted if desired. By such adjustment the length of the lever arm which operates the piston is adjustable and in this way the effective resistance of the dash pot may be changed somewhat. At its lower end, the cylinder **180** is provided with a valve housing **192** having an opening **194** at the top thereof. Received within the valve housing is a ball valve **196** which is retained within the valve housing by a bent-over tang **198** as shown in Fig. 6. The construction is such that when the dash pot piston is depressed, the ball is in the position shown in Fig. 6 and forms no substantial restriction to the flow of fuel, but when the piston **186** is moved up-

wardly upon opening movement of the choke valve, the ball is lifted to close the passageway **194**, so that the upward movement of the dash pot piston is resisted and can only take place as fast as fuel can enter the space below the piston. The reference character **200** indicates ports through which fuel may flow to and from the fuel chamber.

The upper section **4** of the main casting has a bore **202** which is in line with the cylinder **180** and is nearly closed at its upper end but has a small orifice **204** therein through which the piston rod **190** extends.

It will be apparent from the foregoing description that the dash pot will offer no resistance to closing movements of the throttle or choke valve, for upon such movements the piston **186** is moved downwardly, but upon opening movements of the throttle which, as the operating cam **150** is moved to permit the choke valve to be opened, the dash pot will cause a retardation in the opening movement of the choke. The spring **171** will yield and the throttle will move toward open position, the choke valve following to whatever position is determined by the position of the operating cam **150** as rapidly as the dash pot permits.

It will also be apparent from the foregoing description that upon closing movement of the throttle, the choke valve is positively moved toward closed position by action of the cam **150** through the medium of cam follower **144** with which the cam engages while upon opening movements of the throttle, the choke valve is pulled open by increased air flow and the effect of the yielding spring. It will also be understood that upon opening movements of the throttle the effect on the piston **99** does not aid in opening of the choke valve because there is a tendency for the suction effective thereon to drop as the throttle is opened.

At normal temperatures the thermostat exerts no force on the choke valve to hold it closed and when the air flow past the valve is low and the pressure differential very slight, there would be a tendency for the valve to vibrate or chatter if the spring **171** were not provided. The spring holds the cam follower roller **144** against cam **150** and prevents such action.

The only positive movement of the choke valve which may be brought about on an opening movement of the throttle, is a slight opening movement of the choke which, under certain conditions, may be effected by the throttle when the latter is moved to fully open position. This movement of the choke valve is effected primarily for the purpose of eliminating the effect of flooding in the event that the engine is cranked by the starting motor without starting. Let it be assumed for instance that the engine is to be started when the temperature is relatively low. At such a time the choke valve is held closed by the thermostat with sufficient pressure to prevent its being opened by action of the suction operated piston **99** when the engine is being turned slowly by the starting motor. Under some circumstances the engine fails to start and prolonged operation thereof by the starting motor will cause the flooding of the engine and induction passage with liquid fuel. This liquid fuel must be cleaned out before the engine can be started, and to enable this to be done means are provided which are so arranged that the opening of the throttle valve to wide open position will positively open the choke sufficiently to supply the necessary air. In order to enable the throttle to open the choke valve, the operating cam **150** has secured on the back thereof, as viewed in Figs. 4 and 7, a small plate **210** which has a lip portion **212** bent over at right angles to the cam. As the throttle is moved to full open position, this bent-over lip of the plate **210** engages an arm **214** which is formed integral with and projects downwardly from the arm **142** which is secured to the choke valve shaft. As the throttle approaches full open position, the arm **214** is engaged by the projecting lip **212** and the choke operating arm **142** is rocked in a counterclockwise direction, as seen in Fig. 4, to effect the result referred to.

As heretofore pointed out, the fuel inlet **40** is controlled by a fuel valve **42**. This valve adjacent the inlet **40** is constructed with three distinct parts either of which may cooperate with the inlet **40** to control the fuel flow as the valve is moved in a vertical path. Two of these parts are of the same diameter throughout their length, while the third is tapered. That part of the valve having the smallest diameter is indicated at **220**, while the largest portion of the valve is indicated at **222** and the tapered portion is intermediate parts **220** and **222** and is indicated at **224**. The valve is normally adapted to be retained in the position shown in Fig. 1, with the tapered portion adjacent restriction **40** to regulate flow therethrough, by means which will now be described, this position of the valve being that which it occupies for part throttle operation. When the engine is idling, the valve is lifted so that the part **222** thereof cooperates with the inlet **40** and when operating under wide open throttle conditions, at full power, the valve is permitted to drop so that the portion **220** thereof cooperates with the fuel inlet **40**.

The valve is carried by a member **226**, best seen in Fig. 12, which, at the lower end thereof, is bent to form a horizontal extension **228** and in a transverse slot formed therein, the valve is supported, such slot being of such a size as to engage in a peripheral groove **230** formed in the outer surface of the valve. Any movement of the member **226** in a vertical path will, of course, move the valve to one of its several positions. In order tc effect the movement of the member **226** it is secured at its upper end to a piston **232** which is vertically slidable in a bore **234** formed in the wall of the upper section **2** of the main casting. The piston **232** is enlarged at both its upper and lower ends so as to have a sliding fit with the wall of the cylinder **234** and between these enlarged portions, the piston has a wide peripheral channel **236** formed therein and an orifice **238** connects the channel with the space in which the throttle operated cam **150** is housed and in which atmospheric pressure is maintained, the orifice **238** constituting a vent. The piston is also hollow, being provided with an internal bore **240** in which is received a compression spring **242** which normally pushes down on the piston and tends to move the whole assembly in a downward direction.

Communicating with the cylinder **234** at its upper end is a horizontal bore **243** connecting with a vertical bore **244**, formed in housing section **4**, which is in alignment with a vertical bore **246** formed in the wall of housing section **2** and at its lower end communicating with a horizontal bore **248** which connects with the intake passage at a point between the throttle and the engine, so that through the several passages described the high vacuum, maintained posterior to the throttle, is communicated to the piston **232** and tends to lift such piston.

The upward movement of the piston **232** and of the fuel valve will be brought about by the vacuum posterior to the throttle when the vacuum is high enough, but downward movement of the fuel valve to restrict the fuel inlet to the least possible extent, so as to provide the desired mixture for high power is controlled by the position of the flat bar **250**, received in openings **251** formed in horizontal portions of housing sections **2** and **4** and suitably shaped to permit vertical movements of bar **250**, but preventing any turning movement of the bar.

At its lower end, the bar **250** has a slot **252** into which the horizontal portion **228** of the valve operating member **226** extends. The bar **250**, at its upper end, has a collar **254** secured thereon and a spring **256** surrounds the bar **250** between the collar and the horizontal portion of the housing section **4** so that the spring normally holds the bar **250** in its uppermost position, said bar being enlarged below the openings **251** to form a shoulder which engages the horizontal portion of housing section **2** to limit the upward movement of the bar. It is shown in its normal uppermost position in Fig. 12, this being its position when the engine is not in operation. In such position, the part **226** rests on the bottom of the slot **252**, and the fuel valve has its intermediate tapered portion adjacent the fuel controlling restriction **40**. The parts are in this position when the engine with which the device is used is to be started under ordinary circumstances. When the engine begins to run, the manifold vacuum lifts the piston to such a position that the part **222** of the valve is adjacent the fuel controlling restriction **40** so as to reduce the area of the fuel passage for idling. It will be understood that at idling the manifold vacuum effective upon the piston **232** is higher than at any other time.

As the throttle is opened to part throttle position, this vacuum is reduced and the spring **242** as well as the effect of gravity, causes the piston **232** and the valve supporting member **226** to move downwardly, so as to carry the valve to such a position that some part of the intermediate tapered portion **224** thereof is adjacent the

fuel controlling restriction. The parts remain in such position that some part of the intermediate portion **224** is adjacent the restriction substantially throughout the part-throttle operation of the device, but the position of the valve will vary somewhat with variations in throttle opening. When the throttle is opened fully, the small plate **210** is moved with the cam **150** to such a position that the lip **212** thereon strikes the upper end of the bar **250** and moves it downwardly. The lower end of the slot **252** is, therefore, moved below its normal position and the horizontal extension **228** of member **226** is permitted to move downwardly. This downward movement is effected by action of gravity and by reason of the pressure of spring **242** which can expand because the effect of suction on piston **232** is reduced when the throttle is opened. This movement of member **226** brings the smallest portion **220** of the fuel valve adjacent the fuel controlling restriction **40** and will result in an increased flow of fuel to the nozzle to produce the somewhat richer than normal mixture which is desirable when operating at substantailly open throttle, so that the engine shall have maximum power under such conditions.

In order to determine the idling position of the throttle, the operating arm **28** has a laterally projecting ear **260** formed thereon and threaded into this ear is a set screw **262**, the inner end of which is adapted to engage a rib **264** formed on the outside of the main carburetor housing at a point adjacent the throttle as indicated in Fig. 4. By adjustment of this set screw, the idle position of the throttle may be varied as desired and in the ordinary conventional manner.

To supply fuel for idling, a fuel feeding orifice **270** is provided to connect a horizontal fuel passage **272** positioned immediately above the main fuel passage **30** with such passage. The passage **272** is provided with a vent **274** opening into the main intake passage through which air may be admitted to the passage **272** so as to form an emulsion of fuel and air in such passage.

The passage **272** is connected by means of a passage **276**, shown in Fig. 4, with a vertical passage **278** which connects at its upper end with an orifice **279** opening into the space within the housing which contains the cam **150** and associated mechanism, the orifice **279** being a second atmospheric vent. The passage **278** extends downwardly to a point below the throttle valve where it connects with a bore **281** which is arranged at an angle to passage **278** and also to the horizontal, this bore connecting with the intake passage at the point **283** posterior to the throttle. A calibrated plug **285** may be positioned in the passage **278** near the lower end thereof, or in the bore **281** to control the supply of idling fuel. This is a plug of fixed size and any adjustment of the idling fuel which may be found necessary for idling at normal operating temperatures is accomplished by the previously described means for minutely adjusting the position of the choke valve when the throttle is closed. By so adjusting the position of the choke valve the fuel ratio of the idling mixture and the quantity thereof may be slightly varied. By variation of the quantity of air admitted the pressure differential effective on the idling fuel is also slightly varied to vary the quantity of idling fuel, and by variation in the quantity of air, the total quantity of idling mixture is also somewhat varied.

In carburetors which are provided with an automatic choke mechanism including an air intake or choke valve which is controlled in response to variations in engine temperature and suction, means are generally provided for the purpose of causing faster than normal idling of the engine when the engine temperature is relatively low in order to prevent stalling of the engine. Usually devices to bring about faster than normal idling comprise a means automatically operable in response to temperature and effective to maintain the throttle in a somewhat wider open position at low engine temperatures than its normal idling position, which it occupies when the engine is operating at normal temperatures.

According to the present invention, a means is provided to cause the engine to operate at greater than normal idling speed when the engine idles at low engine temperatures, but this means is entirely different from the conventional devices which are normally employed for this purpose and includes a passage communicating with the intake passage posterior to the throttle and also at two points adjacent the choke valve, one of such points of communication being anterior to and the other posterior to the choke valve. This passage is controlled by a valve which is operable by the thermostat which limits the opening of the choke valve, and the construction and function of the fast idling device will now be specifically described.

The fast idling passage includes the connecting passages **118** and **120** formed in the walls of the housing sections **2** and **4** and previously mentioned, and the passage **122** connecting passage **120** with the main intake at a point posterior to the throttle. At its upper end, the passage **118** connects with a horizontal passage **280**, best shown in Fig. 10. At its opposite end, the passage **280** connects with a horizontal passage **282** perpendicular to the axis of passage **280** and bored in the wall of housing section **4** in substantially the same horizontal plane as the passage **280**. One end of the passage **282** is connected with the main intake passage and is restricted as indicated at **284**, on Fig. 8, at its point of connection therewith. At the opposite end of passage **282** there is a closure plug **286**.

A diagonal passage **288**, in the wall of housing section **4** connects the passage **282** with another horizontal passage **290** which has an unrestricted connection with the main intake passage at a point below or posterior to the choke valve. At its opposite end, the passage **290** is partially closed by a plug **292** in which there is a small orifice **294**, as indicated in Figs. 10 and 14 which serves as a vent.

The thermostatically operated stub shaft **80** has a port **296** extending therethrough as best shown in Figs. 1, 10 and 16 and this port is in registry with and forms a part of the horizontal passage **280** when the stub shaft occupies the position to which it is moved by the thermostat when the engine temperature is low. With the stub shaft in this position, the passage **118** is in communication with both the passages **282** and **290**, so that the high suction of the manifold posterior to the throttle is communicated to both the passages **282** and **290**, and through these passages is communicated to the intake passage at the points of communication of the passages **282** and **290** therewith. The suction which is thus communicated to the intake passage posterior to the choke is, of course, less than that which is maintained between the throttle and the engine, because the passage **282** connects with the air intake anterior to the choke valve and serves to admit air at substantially atmospheric pressure to the passage **118** as does the small vent **294**. This reduces the suction communicated to the intake passage posterior to the choke valve through the passage **290**, but the suction which is so communicated to the intake passage is enough to cause some flow of fuel from the main nozzle to augment the normal idling fuel supply. The amount of air admitted through the above described passages also increases the normal supply of air for idling so that the amount of mixture for idling is increased and the engine is operated faster than it is when idling normally at high temperatures. As the stub shaft **80** is moved upon increase in engine temperature, the port **296** is gradually moved out of registry with the passage **280** so that when normal operating temperature is reached the fast idle mechanism is rendered entirely inoperative because the communication between passage **118** and the intake is entirely cut off.

Some trouble has been experienced with carburetors heretofore known which are provided with a separate idling fuel supply means admitting fuel above or posterior to the throttle, due to the provision of too lean a mixture at the instant the idling jet ceases to function and the fuel supply to the intake passage is from the main nozzle only. With the device disclosed herein, this difficulty is eliminated. With the construction shown, the idling fuel passage receives its fuel from the main fuel passage leading to the main fuel nozzle and the idling fuel passage connects with the main fuel passage at a point substantially immediately adjacent the main nozzle, so that there is no perceptible interval between the time the idling jet ceases to operate and the main nozzle begins. Indeed, with the structure disclosed, fuel may be supplied at the same time from both the idling and main jets with the throttle in certain positions and in opening the throttle from idling to open position, the fuel will be caused to flow through both idling jet and main nozzle at the same time, thus eliminating the so-called "transfer point," as

the instant of changing from the idling jet to main fuel nozzle for the supply of fuel has sometimes been called.

Another great difficulty encountered in conventional down-draft carburetors with present day fuels is that of percolation. In such conventional carburetors the constant level fuel supply is close to the manifold and gets sufficiently hot to vaporize fuel in the passages leading to the fuel inlets which supply fuel to the intake passage, particularly when the engine is stopped after running in warm weather. This formation of vapor will force liquid fuel out of the inlets into the intake passage. The fuel passages will again fill with fuel and the process will be repeated. This process is what is known in the art as "percolation" and in extreme conditions may be repeated often enough to completely empty the fuel chamber, causing flooding of the engine, making starting of the engine difficult and necessitating refilling of the float chamber by operation of the fuel pump before the engine can operate satisfactorily.

In the device disclosed herein, the difficulties occasioned by percolation are eliminated by the arrangement of fuel passages **34**, **30** and **272**. The conduit **34** has no metallic connection with the float chamber at all, but is screwed into the boss **38** which projects from the air horn casting **4** and projects downwardly into the fuel in the float chamber from above said chamber, the upper end of said conduit **34** communicating with the passage **30** which, in turn connects with passage **272** through orifice **270**, the passages **30** and **272** being formed in the air horn casting **4**. Passages **30** and **272** are wholly above the fuel level in the float chamber, as is the upper part of the conduit **34**, so that no fuel stands in the upper part of conduit **34** or in passages **30** and **272**, when the engine is not in operation.

Because the conduit **34** is not in metallic contact with the float chamber casting **2** and is entirely surrounded by the fuel, the conduit is heated to a considerably lesser degree than the wall of the float chamber and **30** and **272**, being formed in the air horn casting are also heated to a lesser extent than the float chamber.

Any vapor which might be formed in the float chamber will not enter the conduit **34** and the latter will not be hot enough for any material amount of vapor to form within the tube. However, since the upper part of the conduit contains no liquid fuel and neither do the passages **30** and **272**, any vapor which might form in the conduit would merely pass into the intake passages and cause no percolation whatever.

It will be apparent the provision of a gasket between the castings **2** and **4**, so that such castings are not in metallic contact, reduces the heating of conduit **34** to some extent. Even if a gasket was not used, the provision of the downwardly extending conduit entirely surrounded by the fuel in the float chamber reduces the heating of the conduit greatly by comparison with the conventional fuel supply passage which is formed in the wall of the float chamber. Also it will be understood that even if the conduit **34** got relatively hot so that more than a negligible amount of fuel vapor formed therein, such vapor would merely escape into the intake and not cause slugs of liquid fuel to be deposited therein so that the difficulties occasioned by percolation in the conventional downdraft carburetor would not occur.

In Fig. 10 there is shown a generally horizontal bore **300** formed in the wall of the intake passage which connects at its left end with another bore **302** communicating with the interior of the intake passage and at the right end thereof such bore is enlarged and threaded as indicated at **304** to form a recess into which a pipe leading to the timer is adapted to be connected. These passages are merely part of the suction passage for operating the timer, are entirely conventional and form no part of the present invention.

The reference numeral **310** indicates two vent orifices in the top of the fuel chamber which connect with passages leading to the housing in which the valve actuating mechanism is located, for the purpose of venting the float chamber to atmosphere.

This application is a continuation of application Serial No. 478,096, filed March 5, 1943, now abandoned.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A charge forming device for internal combustion engines, having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, means responsive to temperature and engine suction for limiting the opening movement of the choke valve, and means operable by the throttle for also limiting the opening movement of the choke valve.

2. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, means responsive to temperature and engine suction for limiting the opening movement of the choke valve, means operable by the throttle for also limiting the opening movement of the choke valve and means operable by the throttle for moving the choke valve toward open position.

3. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, means responsive to temperature and engine suction for yieldingly limiting the opening movement of the choke valve and means operable by the throttle for positively limiting the opening of the choke valve.

4. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable by suction toward its open position, means operable by the throttle valve for positively limiting the opening movement of the choke valve, and means also operable by the throttle valve for moving said choke valve toward open position when the throttle is opened.

5. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device and movable by suction toward its open position, means operable by the throttle valve for limiting the opening movement of the choke valve, said limiting means being movable by the throttle to permit progressively greater opening of the choke as the throttle is moved toward open position and means also operable by the throttle and effective to move the choke valve toward open position when the throttle is opened.

6. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device and movable by suction toward its open position, means operable by the throttle valve for limiting the opening movement of the choke valve, said limiting means being movable by the throttle to permit progressively greater opening of the choke as the throttle is moved toward open position and yielding means also operable by the throttle and effective to move the choke valve toward open position when the throttle is opened.

7. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable by suction toward its open position, means operable by the throttle to positively hold the choke valve in closed position when the throttle is closed and means operable by the throttle for effecting an opening movement of the choke valve as the throttle is moved to wide open position.

8. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable by suction toward its open position, means operable by the throttle to hold the choke valve in closed position when the throttle is closed, and yielding means operable by the throttle tending to move said choke valve toward open position as the throttle is opened.

9. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable by suction toward its open position, means operable by the throttle to hold the choke valve in closed position when the throttle is closed, yielding means operable by the throttle tending to move said choke valve toward open position as the throttle is opened and means operated by the throttle as

it approaches wide open position for positively opening the choke valve.

10. A charge forming device for internal combustion engines, having in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat exerting a force to hold said choke valve closed which is inverse to engine temperature, means whereby the suction created by operation of the engine is directly effective on the valve and tends to overcome the action of the thermostat and effect opening of the valve, means movable to different positions by engine suction and the thermostat to limit the opening of the choke valve in response to the direct action of engine suction, means operable by the throttle to hold the choke valve substantially closed when the throttle is in its substantially closed or idle position and movable by said throttle as the latter is opened to variably limit the opening movement of the choke valve.

11. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat exerting a force to hold said choke valve closed which is inverse to engine temperature, means whereby the suction created by operation of the engine is directly effective on the valve and tends to overcome the action of the thermostat and effect opening of the valve, means movable to different positions by engine suction and the thermostat to limit the opening of the choke valve in response to the direct action of engine suction, means operable by the throttle to hold said choke valve substantially closed when the throttle is in substantially closed or idling position irrespective of temperature and engine suction, said means being movable by said throttle as the latter is opened to variably limit the opening movement of the choke valve.

12. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat exerting a force to hold said choke valve closed which is inverse to engine temperature, means whereby the suction created by operation of the engine tends to overcome the action of the thermostat and effect opening of the valve, means operable by the throttle to hold said choke valve substantially closed when the throttle is in substantially closed or idling position irrespective of temperature and engine suction, said means being movable by said throttle as the latter is opened to variably limit the opening movement of the choke valve, and yielding means also operated by the throttle tending to pull said choke valve open as the throttle is moved toward its open position.

13. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, temperature responsive means tending to hold the choke valve closed at low engine temperatures, means whereby engine suction is effective to modify the force exerted by said temperature responsive means on said valve and to open the valve when the effect of suction is greater than that of the thermostat, yielding means operable by the throttle on all opening movements thereof and tending to open the choke valve whenever the throttle is opened, and means for resisting opening movements of the choke valve whether such movements are effected by engine suction or by the throttle operated means.

14. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, temperature responsive means tending to hold the choke valve closed at low engine temperatures, means whereby engine suction is effective to modify the force exerted by said temperature responsive means on said valve and to open the valve when the effect of suction is greater than that of the thermostat, yielding means operable by the throttle upon all opening movements thereof and tending to open the choke valve as the throttle is opened, and a dash pot for resisting any opening movement of the choke valve.

15. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, means responsive to temperature and engine suction for limiting the opening movement of the choke valve, means operable by the throttle for also limiting the opening movement of the choke valve and means for retarding the movement of said choke valve as it is moved toward open position.

16. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable toward open position by engine suction, a thermostat, means operable by the thermostat and movable thereby to a position to yieldingly hold the choke valve closed at low engine temperatures, but movable by the thermostat, when normal operating temperatures are reached, to a position where said means exerts no control on said choke valve and suction operated mechanism connected to said means for modifying the force exerted by said means to hold the choke valve closed when the engine is running.

17. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable toward open position by engine suction, a thermostat, means operable by the thermostat and movable thereby to a position to yieldingly hold the choke valve closed at low engine temperatures, but movable by the thermostat, when normal operating temperatures are reached, to a position where said means exerts no control on said choke valve and said valve can move freely in response to variations in suction, suction operated mechanism connected to the thermostatically operated means for modifying the force exerted by the thermostatically operated means to hold the choke valve closed when the engine is running, and means operable by the throttle for positively holding the choke valve substantially closed when the throttle is in its closed or idle position regardless of the temperature.

18. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable toward open position by engine suction, a thermostat, means operable by the thermostat and movable thereby to a position to yieldingly hold the choke valve closed at low engine temperatures, but movable by the thermostat when normal operating temperatures are reached, to a position where said means exerts no control on said choke valve and said valve can move freely in response to variations in suction, means operable by the throttle for positively holding the choke valve substantially closed when the throttle is in its closed or idle position regardless of the temperature and suction operated mechanism connected to the thermostatically operated means for modifying the force exerted by the thermostatically operated means to hold the choke valve closed when the engine is running.

19. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable toward open position by engine suction, a thermostat, means operable by the thermostat and movable thereby to a position to yieldingly hold the choke valve closed at low engine temperatures, and to limit the opening of said valve at higher temperatures which are less than the normal operating temperatures, said means being movable by the thermostat at normal engine operating temperature to a position where it exerts no control on the choke valve, suction operated mechanism connected to the thermostatically operated means for modifying the force exerted by the thermostatically operated means to hold the choke valve closed when the engine is running, and means operated by the throttle for limiting the opening movement of the choke valve in accordance with the position of the throttle at any operating temperature.

20. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, and movable toward open position by engine suction, a thermostat, means operable by the thermostat and movable thereby to a position to yieldingly hold the choke valve closed at low engine temperatures, and to limit the opening of said valve at higher temperatures which are less than the normal operating temperature, said means being movable by the thermostat at normal engine operating temperature to a position where it exerts no control on the choke valve, suction operated mechanism connected to the thermostatically operated means for modifying the force exerted by the thermo-

statically operated means to hold the choke valve closed when the engine is running, and means operable by the throttle for limiting the opening movement of the choke valve in accordance with throttle position at any operating temperature.

21. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat, a stop member operable by said thermostat and engaging a part of said choke valve so as to limit the opening movement of said valve, said stop member being movable by said thermostat at low temperatures to a position to yieldingly hold said valve closed and movable at high temperatures to a position where the choke valve can move to full open position before engaging said stop member, a suction operated member also connected to said stop member and exerting a force on said stop member against that of the thermostat, so that the force exerted by the stop member to prevent opening movement of the choke valve is reduced by the action of engine suction when the engine becomes self-operative, and a second stop member operable by the throttle and effective to limit the opening of the choke valve in accordance with the position of the throttle irrespective of the action of said first stop member.

22. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, a thermostat for operating said choke valve in accordance with engine temperatures, a single source of heat and means for conveying a heating medium from said source of heat to both the thermostat and the fuel inlet whereby both the thermostat and the fuel inlet are heated from the same source.

23. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, a thermostat for operating said choke valve in accordance with engine temperatures and a conduit for conveying a heating medium to a point adjacent said thermostat and to said fuel inlet, whereby the heating medium employed to heat the thermostat is also employed to aid in effecting vaporization of the fuel supplied by said fuel inlet.

24. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, a thermostat for operating said choke valve in accordance with engine temperatures, a housing for said thermostat, a conduit for introducing hot air into said housing so as to heat said thermostat and a conduit extending from said housing to the fuel inlet, whereby the hot air employed to heat the thermostat is used to heat the fuel in said fuel inlet.

25. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, means responsive to variations in engine temperature and engine suction for controlling the operation of said choke valve, means for holding the choke valve closed when the throttle is in its closed or idle position, a second fuel inlet for supplying fuel for idling of the engine and means for controlling the supply of fuel for idling, said last named means comprising mechanism for varying within certain limits the closed position of the choke valve.

26. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, means responsive to variations in engine temperature and engine suction for controlling the operation of said choke valve, means for holding the choke valve closed when the throttle is in its closed or idle position, a second fuel inlet for supplying fuel for idling of the engine and means for controlling the supply of fuel for idling, said last named means comprising mechanism for varying within certain limits the closed position of the choke valve, without varying the closed or idle position of the throttle valve.

27. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling admission of air to said device, a stop member responsive to variations in engine temperature and engine suction and movable to different positions independently of said choke for limiting the opening movement of said choke valve, an operating connection between the throttle and choke valves by means of which the choke valve is moved toward its closed position as the throttle valve is closed, and means for adjusting said operating connection so that the distance through which the choke valve is moved toward its closed position when the throttle is closed can be varied.

28. A charge forming device for internal combustion engines having, in combination, a mixture passage, a throttle valve, a main fuel inlet supplying fuel at a point in said mixture passage anterior to said throttle valve, a constant level fuel chamber, a main fuel supply passage leading from said fuel chamber to the main fuel inlet, a secondary fuel inlet for supplying fuel to the mixture passage at a point posterior to the throttle valve, a secondary fuel passage of constant size supplying fuel thereto and connecting with the main fuel supply passage relatively near the inlet thereof, and means for varying the amount of fuel supplied by said secondary fuel inlet without changing the size of said secondary fuel passage and without changing the position of the throttle valve.

29. A charge forming device for internal combustion engines having, in combination, a mixture passage, a throttle valve, a main fuel inlet supplying fuel at a point in said mixture passage anterior to said throttle valve, a constant level fuel chamber, a main fuel supply passage leading from said fuel chamber to the main fuel inlet, a secondary fuel inlet for supplying fuel to the mixture passage at a point posterior to the throttle valve, a secondary fuel passage of constant size supplying fuel thereto and connecting with the main fuel supply passage relatively near the inlet thereof, and manually adjustable means for varying the amount of fuel supplied by said secondary fuel inlet without changing the size of said secondary fuel passage and without changing the position of the throttle valve.

30. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat, means movable by said thermostat independently of the choke valve and tending to hold said choke valve closed at low engine temperatures, means whereby engine suction is effective when the engine is operating to modify the force exerted by the thermostatically operated means to hold the choke valve closed, means whereby engine suction is directly effective on the choke valve to open said valve when the direct effect of suction is greater than the force of the thermostatically operated means holding the valve closed and means other than the thermostatically operated means for holding the valve closed.

31. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat, means movable by said thermostat independently of the choke valve and tending to hold said choke valve closed at low engine temperatures, means whereby engine suction is effective when the engine is operating to modify the force exerted by the thermostatically operated means to hold the choke valve closed, means whereby engine suction is directly effective on the choke valve to open said valve when the direct effect of suction is greater than the force of the thermostatically operated means holding the valve closed, means operable by the throttle for opening the choke valve as the throttle is opened and means other than the thermostatically operated means for holding the valve closed.

32. In a downdraft carburetor for an internal combustion engine, having a mixture passage provided with an outlet adapted to communicate with the intake manifold when the carburetor is assembled thereon, a fuel inlet therefor, a constant level fuel chamber surrounding and integral with said mixture passage for supplying fuel to said fuel inlet, the bottom of which is located relatively close to the carburetor outlet at its point of communication with the intake manifold, said carburetor being formed of upper and lower castings, the lower casting being adapted to be directly connected through a gasket to the manifold and having the constant level fuel chamber formed therein while the other casting forms a cover for the fuel chamber and is provided with an air inlet for admitting air to the mixture passage

which extends through both said castings; means for preventing percolation comprising means intermediate the upper and lower castings for reducing the thermal contact therebetween, a fuel passage for conveying fuel to said fuel inlet located wholly in said upper casting and above the level of fuel in said fuel chamber, and a fuel conduit supported by said upper casting in communication with said fuel passage and extending downwardly from said upper casting into the fuel chamber in the lower casting to a point below the level of fuel therein, said fuel conduit being spaced from the wall of the fuel chamber so that it is entirely surrounded below the fuel level by the fuel therein.

33. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a throttle valve, a choke valve for controlling the admission of air to said device, a thermostat, a stop member operable by said thermostat and including a portion thereof for operatively engaging a part of said choke valve so as to hold the valve closed at low temperatures and movable upon increase in temperature to allow opening of the valve and to limit such opening movement as determined by the increase in temperature, said stop member being so positioned that the valve can open fully when normal engine temperature is reached, and a suction operated member connected to said stop member and effective to exert a force on said stop member in opposition to that of the thermostat, so that the force exerted by the stop member to prevent opening of the choke valve is reduced by the action of engine suction when the engine becomes self operative, said suction operated member being adapted to move the valve engaging portion of said stop member out of operative engagement with said choke valve.

34. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a mixture passage, a throttle valve for controlling the flow of mixture therethrough, a constant level fuel chamber, a fuel passage connecting said chamber with the fuel inlet and having a restriction therein, a fuel valve of varying cross sectional area and movable relatively to said restriction in order to bring different areas of the valve into cooperative relation with said restriction so as to regulate the flow of fuel to said fuel inlet, means operable by engine suction posterior to the throttle for positioning the fuel valve and effective to move said fuel valve toward closed position upon an increase in said engine suction in all positions of the throttle valve except when the latter is approximately wide open, a member connected at one end to the fuel valve and operable by the throttle valve to actuate said fuel valve, resilient means urging said member toward a position tending to close said fuel valve, throttle controlled actuating means engageable with the other end of said member only when the throttle is in the substantially wide open position to move said fuel valve toward the open position against the force of said resilient means, said actuating means being normally spaced from the latter end of said member and inoperative to influence the position of the fuel valve, except at the substantially wide open position.

35. A charge forming device for internal combustion engines having, in combination, a fuel inlet, a mixture passage, a throttle valve for controlling the flow of mixture therethrough, a constant level fuel chamber, a fuel passage connecting said chamber with the fuel inlet and having a restriction therein, a fuel valve of varying cross sectional area and movable relatively to said restriction in order to bring different areas of the valve into cooperative relation with said restriction so as to regulate the flow of fuel to said fuel inlet, means operable by engine suction posterior to the throttle for moving said fuel valve toward closed position upon an increase in suction and vice versa in all positions of the throttle valve except when the latter is approximately wide open, means operable to hold said fuel valve in an intermediate position when the engine is not operating under its own power, a member connected at one end to the fuel valve and operable by the throttle valve to actuate said fuel valve, resilient means urging said member toward a position tending to close said fuel valve, throttle controlled actuating means engageable with the other end of said member only when the throttle is in the substantially wide open position to move said fuel valve toward the open position against the force of said resilient means, said actuating means being normally spaced from the latter end of said member and inoperative to influence the position of the fuel valve, except at the substantially wide open position.

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