

June 19, 1951

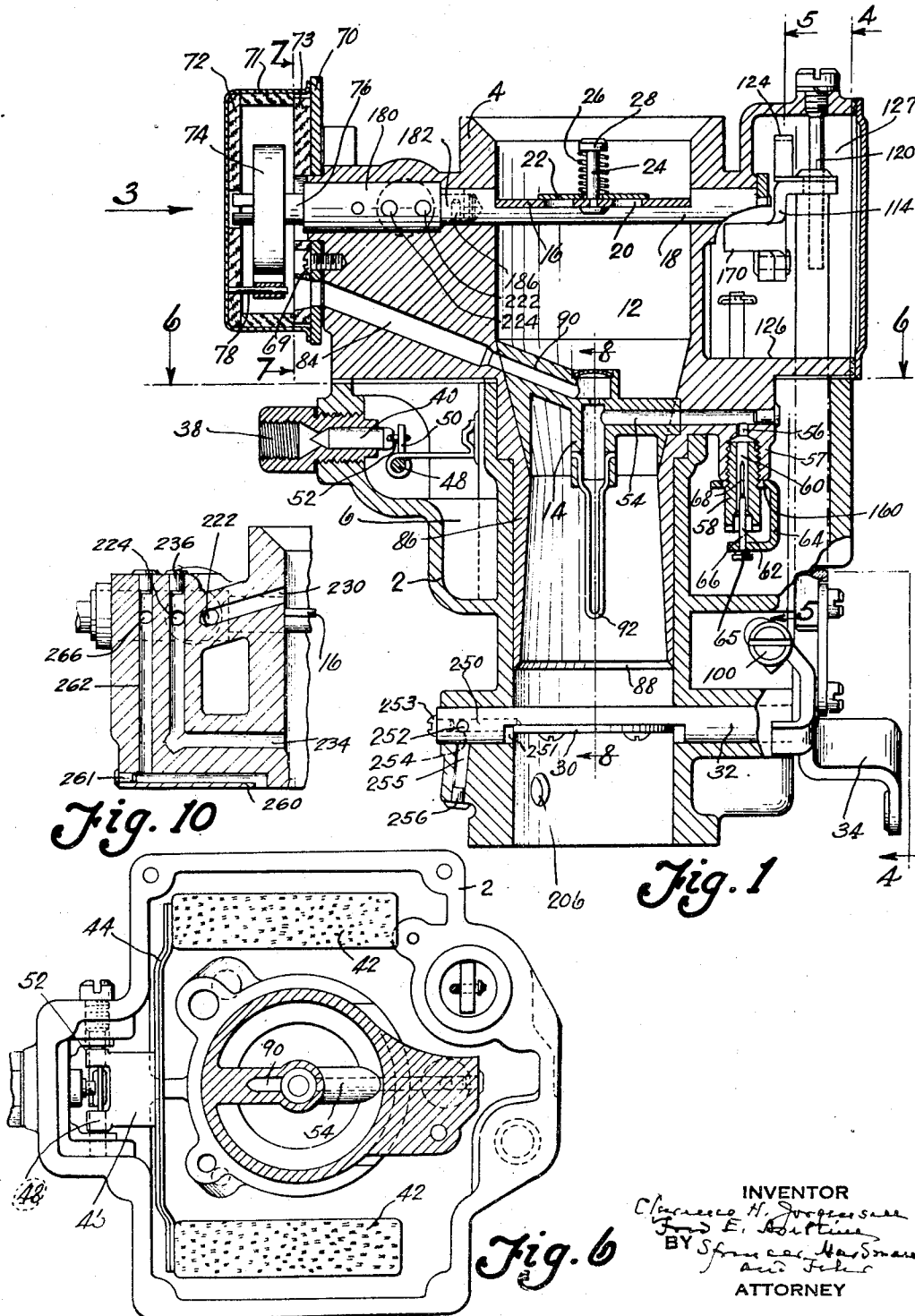
C. H. JORGENSEN ET AL

2,557,111

CHARGE FORMING DEVICE

Filed Oct. 22, 1943

4 Sheets-Sheet 1



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June 19, 1951

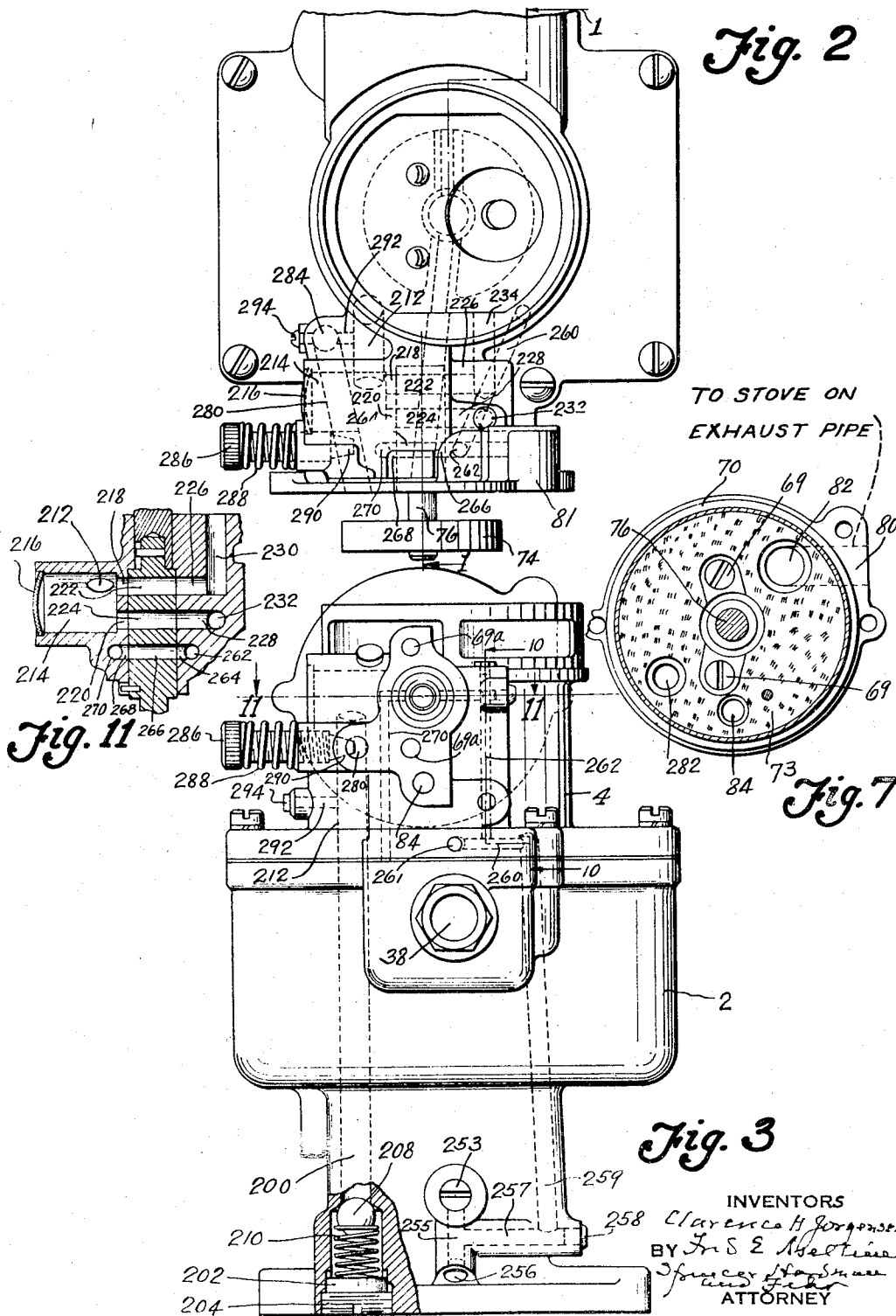
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4 Sheets-Sheet 3

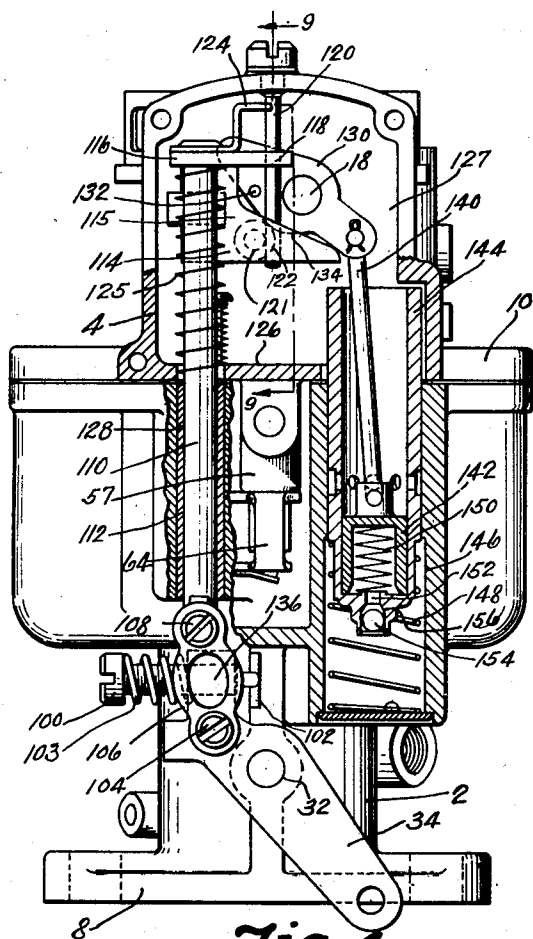


Fig. 4

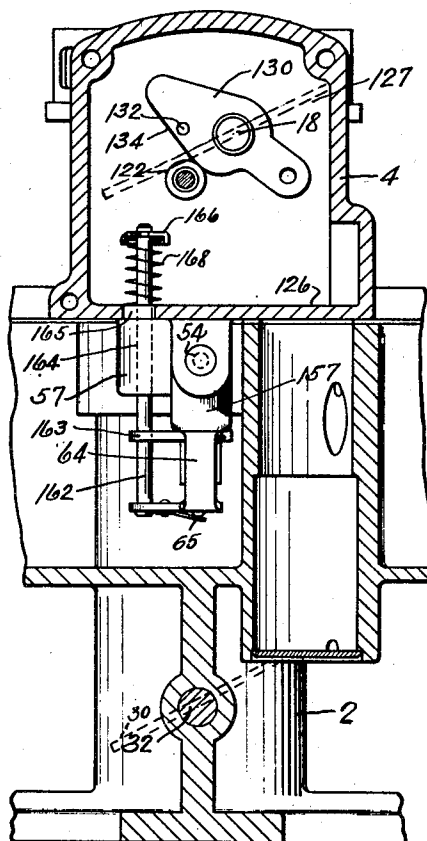


Fig. 5

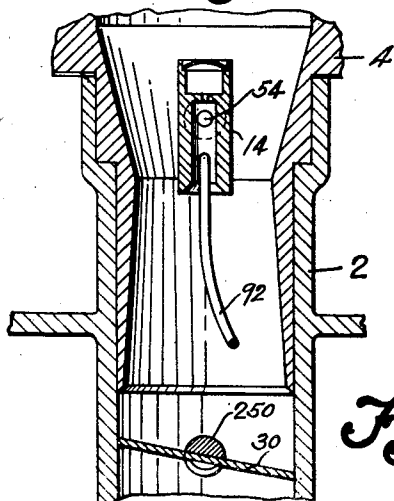


Fig. 8

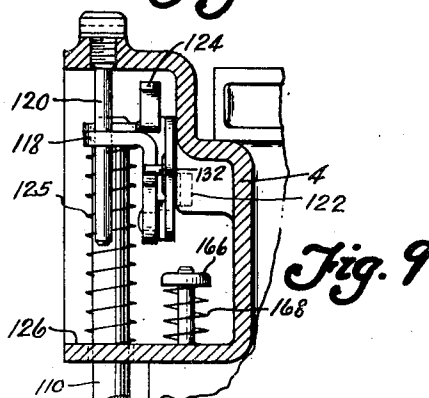


Fig. 9

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4 Sheets-Sheet 4

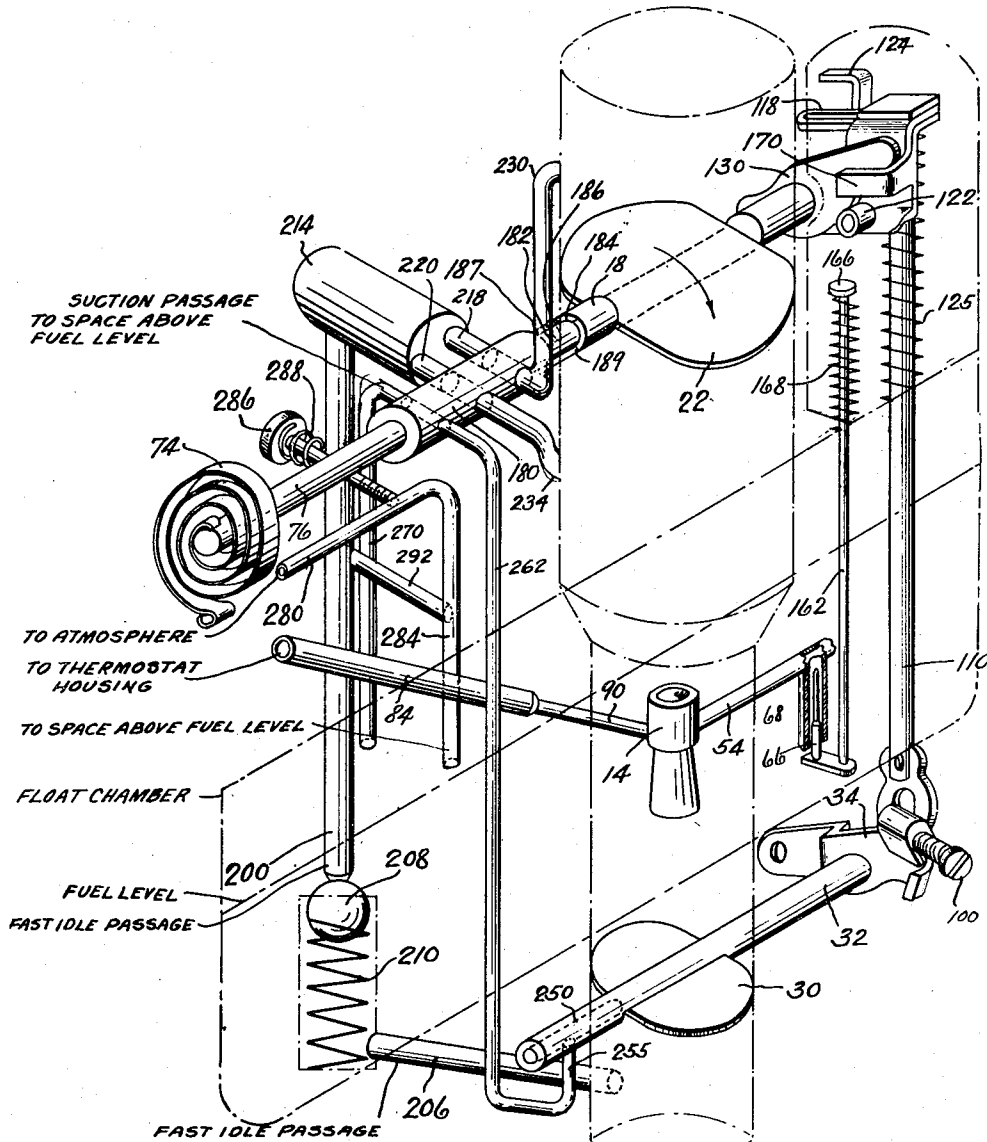


Fig. 12

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2,557,111

CHARGE FORMING DEVICE

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Application October 22, 1943, Serial No. 507,312

30 Claims. (Cl. 123-119)

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This invention relates to charge forming devices for internal combustion engines, more particularly to charge forming devices of the type which are provided with an automatic choke mechanism for facilitating starting at low temperatures.

The principal object of the present invention is to provide a device of the character referred to in which means are provided for more accurately regulating the proportions of fuel and air in the mixture supplied to the engine, particularly during starting and during the warm-up period, than has been heretofore possible, so as to bring about as nearly ideal engine operation as is possible under all operating conditions.

With this object in view, a principal feature of the invention consists in controlling the supply of fuel introduced into the intake passage of the charge forming device by creating and maintaining a partial vacuum in the space above the fuel in the float chamber and to variably regulate the degree of vacuum maintained in such space automatically in accordance with different operating conditions so that the pressure differential which causes the flow of fuel is varied in accordance with different operating conditions to variably regulate the mixture richness.

More specifically, the partial vacuum maintained over the fuel is controlled through the medium of the temperature, the suction effective at different points in the intake passage and the position of the throttle so that a variation in any one of these factors will have an effect upon the degree of vacuum above the fuel and consequently upon the pressure differential which causes the flow of fuel whereby the fuel flow is responsive to variations in operation conditions.

An additional feature of the invention comprises an automatic choke valve for regulating the admission of air to the intake passage which is controlled by suction effective on the valve and a thermostat responsive to variations in engine temperature, in combination with means operated by said choke valve and its control means for controlling the degree of vacuum above the fuel in the float chamber.

A further feature of the invention resides in the specific mechanism for controlling the opening of the choke valve in response to increase in suction thereon and in the mechanism by means of which opening of the throttle controls the movement of said choke valve.

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 present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical section through the device substantially on the line 1-1 of Fig. 2.

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Fig. 2 is an incomplete plan view with the thermostat housing removed.

Fig. 3 is a side elevation showing a detail of the device in section.

Fig. 4 is a vertical section on the line 4-4 of Fig. 1.

Fig. 5 is a vertical section on the line 5-5 of Fig. 1, with part of the operating parts omitted.

Fig. 6 is a section on the line 6-6 of Fig. 1 showing the top of the lower portion of the housing in plan.

Fig. 7 is a detail section on line 7-7 of Fig. 1.

Fig. 8 is a detail vertical section on the line 8-8 of Fig. 1.

Fig. 9 is a detail section on line 9-9 of Fig. 4.

Figs. 10 and 11 are fragmentary vertical and horizontal sections on the lines 10-10 and 11-11, respectively, of Fig. 3.

Fig. 12 is a diagrammatic view illustrating the various suction passages and moving parts of the device.

Referring to Fig. 1, the device comprises two housing sections 2 and 4, the lower section 2 having the fuel chamber 6 formed therein and being adapted to be secured to the intake manifold in the usual way, by means of a flange 8 at the bottom of section 2, as shown in Fig. 4. The upper section 4 is flanged at the lower portion thereof as indicated at 10, and such flange constitutes a cover for the fuel chamber 6. When the two sections are secured together, as shown in the drawings, they unite to form an intake passage which may be indicated generally by the reference numeral 12 and which extends downwardly through both the sections 2 and 4, such passage being substantially at the center of the fuel chamber so that there will be substantially no variation in the fuel level maintained at the fuel outlet upon changes of inclination of the engine upon which the carburetor is used, the fuel inlet being indicated at 14 and being substantially at the center of the intake passage. As will be pointed out more specifically later, the float which controls the admission of fuel to said fuel chamber is also arranged in substantially concentric relation to the axis of the mixture passage.

As shown, the charge forming device is of the down draft type and an air inlet is provided in the upper end of section 4, and is controlled by an air valve 16 which is secured to a shaft 18 journaled for rotation in the wall of section 4 of the housing and rotatable to move the valve to different positions by mechanism which will be hereinafter more fully described, in order to automatically and accurately control the admission of air.

The valve 16 is provided with an opening 20 at its center which is controlled by a small valve 22 loosely mounted and slidable on a pin 24 which

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is secured to the main valve. The small valve is held in position to close the orifice 20 by a spring 26 which surrounds the pin 24 between the face of the small valve and an enlarged head 28 on the pin. The valve is so arranged that it opens upwardly and is adapted to open when an occurrence such as backfire would cause a positive pressure to be built up within the carburetor. The valve 22 is a pressure relief valve and its opening prevents any damage to the parts.

The flow of mixture from the carburetor to the engine is controlled by a throttle valve 30 which is secured to a shaft 32, rotatably mounted in the wall of lower section 2 of the housing and operated by means of an operating arm 34 which is secured in any desirable way to one end of the shaft 32 which projects beyond the wall of housing 2, and extends through an orifice in arm 34 where the end of the shaft is riveted over the arm. This arm is manually operated in the usual way to regulate the quantity of mixture and the engine speed.

Fuel is admitted to the fuel chamber 6 through an inlet 38 controlled by a valve 40 which is operated by a suitable float mechanism to maintain a constant level of fuel within the chamber. The float mechanism includes two members 42 which, as shown, are made of cork, but may be made of thin spun metal and these members are secured to a cross-bar 44 which is connected midway between the float members 42 to an angular member 46 which is pivoted on a pin 48 suitably secured in the wall of the fuel chamber and the member 46 is provided with a vertically extending arm 50. This arm is connected to a reduced portion 52 of the valve 40 by a link which passes through a hole in the part 52 and around the arm 50 so as to hold such valve against its seat when the level of fuel within the float chamber reaches a certain height and pulls the valve off the seat if the fuel level falls. The float and valve, therefore, act to maintain a substantially constant level of fuel in the chamber. The floats 42 are so arranged that they are substantially concentric with the axis of the intake passage in order to maintain the proper level of fuel in the fuel chamber at various angles of inclination of the vehicle.

Fuel is supplied to the intake passage through the fuel inlet or nozzle 14 and a fuel passage 54 communicates with the nozzle at a point intermediate its ends, such passage communicating at its opposite end with a vertical fuel passage 56 formed in a boss 57, which constitutes a portion of the housing section 4 that extends downwardly into the fuel bowl, and at its lower end the fuel passage is enlarged as indicated in Fig. 1. Into this enlarged portion of the fuel passage 56 is screwed a metering plug 58 which has a passage 60 therethrough communicating directly with the passage 56 and controlled by means of a fuel valve 62 which is raised or lowered in a manner described hereinafter to regulate the size of the fuel feeding orifice, through which fuel flows from the fuel supply chamber.

The valve is supported by a bracket 64 into which it may be screwed or it may extend through a hole in the bracket and be held in position by a flat spring member 65, one end of which is secured to the bracket and the other end of which extends beneath the enlarged head at the lower end of the valve, as shown in Fig. 1. The valve is raised or lowered to control the fuel flow by vertical movement of the supporting bracket and such valve is provided with two fuel con-

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trolling surfaces 66 and 68, these surfaces being of different diameters and separated by an abrupt shoulder as shown in Fig. 1. As shown, the fuel valve is in its upper position with the larger portion of such valve projecting into the fuel inlet so that such inlet is greatly restricted, but when the fuel valve is moved downwardly in a manner later described to bring the small portion 68 of such valve into a position to cooperate with the fuel inlet, the latter will be less restricted and the flow of fuel will, of course, be greater.

On the left side of housing section 4, as viewed in Fig. 1, is secured by screws 69, engaging threaded holes 69a, a detachable plate 70 and to this plate is clamped by screws (not shown) or otherwise, a detachable housing indicated generically by the reference numeral 71, which, as shown, is lined with cork insulation indicated at 72, while an insulating disk or washer 73 is attached to the plate 70. In the housing is a thermostat 74 which comprises a coil of bimetallic material connected at one end to a shaft 76 which controls the operation of the air inlet or choke valve 16 in a manner to be described hereinafter, and at its other end the thermostat is looped over a pin 78 which is secured to the housing 71. Hot air is supplied to this thermostat housing 71 through the inlet 80 formed in a boss 81 integral with plate 70 and which communicates with the space within the housing 71. This air passage 80 is of angular shape so that it communicates with the interior of the housing 71 through the orifice 82 in the face of the plate 70. The hot air is adapted to be supplied to the inlet 80 by means of a conduit extending from the passage 80 to a point adjacent the exhaust manifold (such conduit not being illustrated in the drawings).

A hot air passage is provided for supplying heated air to the fuel nozzle, such passage being indicated by the reference character 84 and extending from the interior of the thermostat housing 71 to the upper end of the nozzle at a point above the point of communication of fuel passage 54 with the nozzle. This passage supplies hot air to more thoroughly atomize and to partially vaporize the fuel which is supplied to the nozzle and at the same time, the suction effective on such passage at the nozzle maintains the flow of heated air through the thermostat housing. With this construction, the suction which is effective at the nozzle and which is relatively high when the choke valve is closed at low temperatures, is the suction which causes the flow of heated air through the thermostat housing and the same air which is effective to heat the thermostat is also utilized to mix with and heat the fuel within the nozzle.

The fuel nozzle terminates substantially at the point of highest suction in the large Venturi tube 86 which is integral with and depends from the upper section 4 of the main housing, extending down into and fitting closely within that portion of the intake passage which is formed within the lower section of the housing 2 and is indicated by the numeral 88. The nozzle, itself, is formed as a part of a separate bridge member 90 which extends across the Venturi tube 86 and is secured in place therein in any suitable way, such bridge member having formed therein parts of the conduits 54 and 84, which register with the parts of the conduits 54 and 84 which are formed in housing section 4, the construction being illustrated in Fig. 1.

A wire which is bent in U-shape with the closed end of the U extending downwardly, is secured

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in the nozzle outlet and is numbered 92. This wire, at its lower end, is bent toward one side of the intake passage, as shown in Fig. 8, so that fuel dripping off of such wire will be more readily mixed with the ingoing air which flows adjacent the side of the intake passage when the engine is operating at low speed. Some of the fuel dropping from the wire is picked up by the ingoing air between the end of the wire and the throttle, while some will fall on the throttle to the right of the shaft 32 and will flow toward the lower edge of said throttle where the flow of air is at highest velocity when the throttle is nearly closed. This fuel will be picked up by the high velocity air current and with this arrangement there is better mixing and less tendency to form a film of fuel on the intake passage wall than there would be if the wire were not used. Thus the wire is a means to procure a better mixture and better distribution when the engine is idling.

Attention is called particularly to the fact that in the device disclosed herein the usual conventional idling jet, supplying fuel for idling above the throttle, is not provided, fuel for idling being supplied by the main nozzle and flowing down the wire as above referred to. There is also means to bring about faster than normal idling at low engine temperatures, which will be later described.

The air intake valve 16 is controlled in its opening movement by the action of the thermostat previously referred to and the suction effective on the valve, itself, which is unbalanced, so that it will open under the influence of suction. The mechanism through which the thermostat controls the valve will be described hereinafter, but the valve is also subject to control by the throttle and the mechanism operated by the throttle for controlling such valve will now be described. The throttle operating arm 34 is provided with a stop screw 100 which is adjustable in the arm and engages a fixed abutment 102 to take the normal closed or idling position of the throttle in the usual way. A spring 103 is provided to hold the stop screw in any adjusted position.

Pivotally connected to the arm 34 by a screw 104 is a short link 106, the other end of which is pivotally connected by a screw 108 to a vertically extending rod 110 which is slidable in a bushing 112 secured in some suitable manner in the lower section 2 of the housing. The rod at its upper end, carries a member which is indicated generically by the numeral 114 and such member includes a vertical portion 115 and a flat horizontally extending arm 116 which is secured directly to the top of the rod 110 and is provided with an opening 118 in the opposite end thereof through which extends a rod 120 screwed into the top of the housing and serving as a guide to prevent any rotary movement of the rod 110. The member 114 has a cam roller 122 supported on a pin 121 projecting from the vertical portion 115 of member 114 and operating in a manner hereinafter described. Secured on the rod 110 above the horizontal portion 116 of the member 114 is an angular arm 124 which is adapted to cause an opening of the air intake valve when the throttle is wide open for the purpose of eliminating the effect of flooding in a manner set forth hereinafter.

A spring 125 surrounds the rod 110 between the member 114 and the floor 126 of a chamber 127 in the upper housing section 4 into which the

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upper end of rod 110 projects and in which the member 114 and cooperating parts are located. The spring extends into an opening in the floor 126 and engages the upper end of the bushing 112 in which the rod 110 slides and which is located in the lower housing section as shown in Fig. 4. This spring 125 assists the ordinary throttle spring in returning the parts to normal position and also takes up lost motion in the throttle operated connections.

The cam roller 122 and the arm 124 operate to effect movement of the air intake valve 16 and also control movements of the valve by action of suction and in order that this movement may be brought about, the shaft 18 on which the valve 16 is mounted has secured at the right end thereof, as seen in Fig. 1, an arm 130. Mounted on and projecting from this arm is a pin 132 and this pin is adapted to be engaged by the angular arm 124 to effect opening of the choke to some extent when the throttle moves to full open position, in order to allow sufficient air to enter the carburetor to eliminate the effect of flooding, such air carrying the surplus fuel collected in the intake passage manifold and engine cylinders when flooding occurs, out through the exhaust ports as the engine is cranked by the starting motor, thus removing the excess fuel from the induction system and cylinders and enabling the engine to be started.

It will be understood that the opening movement of the throttle does not actually move the choke valve toward open position unless the throttle is moved to a wide open position for the purpose just set forth, partial opening movements of the throttle merely controlling the opening of the choke valve as the latter is moved by the force of engine suction. When the throttle is in its closed or idling position, the surface of the cam roller 122 is adjacent the cam surface 134, on the arm 130 which is secured to the choke valve shaft 18, and with which the roller cooperates so that practically no opening movement of the choke valve can take place, only sufficient air being admitted around the choke valve to provide a supporting medium for the fuel supplied for idling by nozzle 14 in order to carry such fuel past the throttle where it is mixed with additional air in a manner to be described. As the throttle is moved toward its full open position, the surface of the cam roller 122 is moved away from the cam 134, so that the valve 16 is allowed to open further. In other words, the roller 122 acts as a stop to control the opening movement of the air intake valve, but when the throttle is moved toward closed position, the choke valve is positively and mechanically moved to substantially closed position by the engagement of roller 122 with the cam 134.

The link 106 is provided with an opening 136 therein so that the length of this link may be varied by applying pressure to the sides of the link opposite the opening. In this way the initial position of the cam roller 122 relative to the cam 134 is controlled and the setting of the choke valve when the throttle is in its normal closed or idling position is determined. This means is effective to determine the initial position of the choke valve when operating at normal temperature. When cold, the thermostat will hold the choke fully closed.

Means are provided whereby upon any opening movement of the throttle of any magnitude, the air inlet valve is momentarily urged toward closed position in order to provide a proper mix-

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ture for acceleration. In order to bring about this movement of the air intake valve, the arm 130 is pivotally connected at its right end, as seen in Figs. 4 and 5, to a piston rod 140, which is connected with a piston 142 slidable within a cylinder 144, which is, itself, slidable within a larger cylinder 146, formed in the lower section 4 of the housing. A spring 148 normally holds the inner cylinder 144 in its upper position, as shown in the drawings and the piston 142 is hollow as shown in Fig. 4 and a spring 150 extends upwardly from the closed lower end of the cylinder 144 to the top of the hollow piston. The closed end of the cylinder 144 is provided with a passage 152 therein which is controlled by a ball check valve 154 adapted to close the passage 152 whenever the ball is in its upper position, in which position it seats upon a tapered surface 156.

The upper end of the cylinder 144 lies immediately below the right end of the vertical portion of member 114, as seen in Fig. 4, so that when the throttle is opened and member 114 is pulled downwardly, by reason of its connection with the throttle actuating mechanism, such member will engage cylinder 144, after a predetermined downward movement, and move the cylinder downwardly. This downward movement of the cylinder 144 will cause the passage controlled by the check valve to be closed and when this passage is closed, the downward movement of the cylinder 144 tends to carry the piston 142 with it, in a sort of dash pot action, thus moving the choke valve toward closed position to an extent determined by the movement of the throttle, so as to temporarily restrict the air inlet to a greater degree in order that a somewhat enriched mixture shall be provided for the acceleration period which immediately follows an opening of the throttle.

The construction above described also brings about a resistance to opening movements of the choke valve, as effected by variations in suction. Any movement of the choke valve toward open position must, necessarily, through the connection of arm 130 to rod 140, lift the piston 142, and of course the upward movement of this piston is resisted by the dash pot mechanism above described, so that upon opening movement of the throttle there may be an actual closing of the choke valve brought about by the mechanism previously described and followed by a delayed opening of the choke valve in response to engine suction when motion of the throttle had ceased. Upon any independent opening of the choke valve without accompanying opening of the throttle, as might occur upon change of load, for example, there is a resistance to the movement of the choke valve by the dash pot mechanism, so that the valve will not open rapidly enough to upset the mixture proportions and form too lean a mixture for proper operation of the device.

The opening of the throttle also effects opening of the fuel valve. As stated hereinbefore, the bracket 64 which supports the fuel valve is slidable upon the surface of the nipple 58 which is screwed into boss 57 as previously set forth. In order to permit this sliding movement of the bracket, the upper surface thereof is provided with an orifice 160 which is of such a size as to slide relatively freely on the outer surface of the nipple 58, as shown in Fig. 1. A rod 162 extends through the horizontally extending arms 163 of the bracket 64 and is fixedly secured to the arms 163 of the bracket. This rod extends upwardly

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through a bore 164 in the boss 57 and through an opening 165 into the chamber formed in the upper section 4 of the main housing in which the throttle operated mechanism for controlling the choke is located, as shown in Fig. 5. The rod is provided with a washer 166 which is secured to the top end in any suitable way and between the washer and the floor 126 of the chamber above referred to, is a spring 168 which normally holds the rod and the bracket which supports the fuel valve in their uppermost position, with the larger part 66 of the fuel valve cooperating with the fuel inlet orifice. Extending to the left from the member 114, as seen in Fig. 1, is a projecting lug 170, best shown in Figs. 1 and 12, which lies above the upper end of the rod 162 and when the throttle is opened, this lug is moved downwardly engaging the rod and moving it downwardly also. This movement of rod 162 is effective to move the fuel valve to such a position that the small portion 68 thereof is adjacent to the fuel inlet orifice when the throttle is opened a predetermined amount, and cooperates therewith to regulate the flow of fuel. The fuel valve is what might be termed a two-stage fuel valve, the larger portion thereof being effective to restrict the fuel inlet to the same extent throughout the movement of the throttle until the throttle is opened to a predetermined extent and from that point on to the fully opened position of the throttle, the smaller portion of the fuel valve constitutes the restriction for the fuel inlet, and regulates the flow of fuel.

As previously set forth, the position of the choke valve is controlled not only by the throttle through the medium of the mechanism above described, but also by the thermostat 74 and the effect of suction on the unbalanced valve itself. The thermostat is not connected directly to the shaft 18 on which the air inlet or choke valve 16 is secured, but one end of the thermostat is connected to the short stub shaft 76 previously referred to and this shaft operates to control the choke valve. Shaft 76 is journaled for rotation in a bore in the housing section 4, as shown in Fig. 1, and between its ends the shaft has an enlarged portion 180 which has certain passages bored therethrough so that such stub shaft can act as a valve to control the flow through certain conduits formed in the housing walls, which are adapted to register with the passages in the shaft, and can also move to perform certain controlling functions with respect to the valve as specifically described later.

At that end of shaft 76 which lies adjacent the end of the choke valve shaft 18, there is a reduced portion 182 of lesser diameter than the choke valve shaft and the choke valve shaft is bored out at its adjacent end and cut away as indicated at 184, to form a half cylinder into which the reduced portion 182 of the stub shaft fits, when the device is assembled, as best shown in the diagrammatic view Fig. 12, and which forms a bearing in which the reduced portion 182 of shaft 76 rotates. The reduced portion 182 of the stub shaft carries a pin 186 which cooperates with a longitudinal edge 187 of the cut away portion 184 of shaft 18 and as shaft 76 is rotated upon expansion of the thermostat, serves to variably limit the opening movement of the valve under the influence of suction as the temperature increases and has not reached normal operating temperature. The engagement of pin 186 with the edge 187 also serves to move the valve toward closed position as the shaft 76 is

reversely rotated upon reduction of temperature.

The operation of these parts can best be understood from consideration of the diagrammatic showing in Fig. 12. The parts are shown in normal position with the pin 186 engaging one side of the cut away part 184 of shaft 18 to hold the choke valve closed. This is the position the parts assume at quite low temperatures, the stub shaft 76 being moved to the position shown by the thermostat upon contraction of the latter, which occurs when it is cold. As the thermostat expands upon increase of temperature, the stub shaft 76 rotates in a clockwise direction as viewed from the left end of said shaft. This rotation of shaft 76 moves the pin 186 away from that surface of the cut away portion 184 as the temperature rises and the valve 16 can follow the movement of the pin, as the valve moves under the influence of engine suction until the pin is again engaged by the edge 187 of the cut away portion 184, when further opening movement of the valve will be stopped. The pin acts, thus, as a stop to determine the opening movement of the choke valve, and for any given temperature the valve moves open only until it engages the pin 186 and the force of suction is balanced by the force of the thermostat. It will, of course, be understood that the position assumed by the valve, when the throttle is open and the opening of the valve is not limited by the throttle, is always one in which the force of the thermostat and the suction are balanced unless the thermostat is fully expanded, at normal engine temperatures, or above, when, with the parts constructed as shown, it exerts no control on the position of the valve. If the valve were occupying any given position and the suction were increased without any change in temperature, as when the engine speed increases due to a change in angle of inclination of the road, the valve would move open against the pressure of the thermostat until the force exerted thereby and the force of the suction is again balanced.

When normal operating temperature is reached, the pin is moved so far it no longer can act as a stop, and at normal operating temperature and all temperatures above normal the thermostat is without controlling effect if the cut away portion 184 is of the extent shown herein. It will be understood that the size of the cut away portion may be varied to accomplish different effects. In fact the extent of the cut away portion may be reduced so that when normal temperature is reached the pin 186 will engage the edge 189 of the cut away portion 184 so as to hold the choke open at normal or higher operating temperatures. As shown, this will not occur and the choke valve merely floats freely in the air stream at high temperatures when the throttle approaches open position except as controlled by the mechanical connection to the throttle.

As stated previously herein, the full opening of the throttle will effect a partial opening of the choke valve against the force of the thermostat through the medium of manually operable mechanical means, as previously described, if the temperature is low and the choke is being held in closed position by the thermostat at the time the opening of the throttle takes place.

As stated hereinbefore, the enlarged portion 180 of the shaft 76 acts as a valve to control the flow through various conduits. Certain of these conduits comprise a fast idle system which will now be described and others comprise a means

for creating a vacuum above the fuel in the float chamber as will be set forth later.

It is, of course, well recognized that means for causing faster than normal idling of the engine must be provided to be effective during that period when the engine is operating at less than normal temperature, because if such means is not provided, the engine has a definite tendency to stall. Usually the means for bringing about fast idling of the engine during the warm up period comprises some form of device for holding the throttle open to a greater degree at such time, than during normal idling when the engine is hot, such device being ineffective when the engine is idling under normal conditions with the engine at normal operating temperature.

According to the present invention, the roller 122 which controls the choke valve is moved to a definite position when the throttle is moved to its closed or idling position and the position to which the choke valve is moved is determined by the roller at normal temperatures, the positioning of the roller determining the normal idling speed. To secure the proper mixture and the necessary quantity of such mixture at low temperatures, the choke valve may be moved farther toward full closed position than the position determined by the roller 122 and in fact may be fully closed by the thermostat. This will increase the suction on the fuel nozzle to a degree greater than that produced at normal idling to effect a greater flow of fuel than takes place at normal idling and certain passages are provided, controlled by the thermostatically operated shaft 76, and which are effective to convey air around the throttle valve to a point posterior thereto so as to mix with the increased supply of fuel resulting from the increase in suction on the fuel nozzle. One of said passages communicates with the intake passage at a point between the choke valve and the throttle and acts to assist the closed choke valve in causing an increase in fuel flow by creating an increase in suction at said nozzle. The means for closing the choke valve beyond the position to which it is moved by the throttle as the latter is closed has already been described and comprises the pin 186 mounted on the thermostatically operated stub shaft 76, which engages the edge 187 of the cut away portion 184, as seen in Fig. 12, to move the shaft 18 counter-clockwise and the choke valve, which is secured thereto, to fully closed position, when the temperature is low, regardless of the position of the throttle unless the latter is so wide open that arm 124 engages pin 132 to hold the choke valve open for the purpose of deflooding, as has been previously set forth.

The passages included in the fast idling system, above referred to, comprise a relatively large vertical passage 200, extending through both housing sections 2 and 4 which, at its lower end communicates with a small chamber 202 formed in the casting and closed by a plug 204. This chamber is connected with the intake passage by a short diagonal bore 206 and received within the chamber 202 is a ball check valve 208 and a spring 210 which normally holds the check valve closed, but is overcome by engine suction when such suction is high enough to cause the valve to open and permit a flow of air from the passage 200 through the chamber 202 into the intake passage through the diagonal bore 206.

The passage 200 extends only to the top of the lower housing section 2 and at that point registers with the lower end of a passage 212 which is

formed entirely in the upper housing section 4 and is slightly inclined with respect to the vertical. The passage 212 leads to small chamber 214 formed in the wall of the main housing section 4, as shown in dotted lines in Fig. 2, and closed by a metal plug 216, secured in position in any suitable way. Connecting with the right hand end of chamber 214 as seen in Fig. 2 are two very short passages 218 and 220 which register with two passages 222 and 224 respectively, formed in the portion 180 of stub shaft 76 when said shaft is in the position it occupies when the temperature is low. When the stub shaft is in this position, the passages 222 and 224 therein also register with two passages 226 and 228 respectively. The passage 226 connects with a passage 230 which leads directly into the intake at a point anterior to the choke valve. The passage 228 connects with a vertical passage 232 which connects at its lower end with a horizontal passage 234 similar to and below the passage 230 and connects the lower end of the passage 232 with the intake passage at a point posterior to the choke valve and anterior to the fuel nozzle. A plug 236 closes the upper end of passage 232.

The function of the above described mechanism is apparent. At low temperatures the stub shaft 76 which operates as a valve to control the action of the several passages described is in such position that the passages 222 and 224 therein register with the pairs of passages 218—226 and 220—228 respectively, so that the high vacuum created within the bore 200 will be communicated through the passages 230 and 234 to the intake passage at points above and below the choke valve. It will be understood, of course, that with the throttle in substantially closed position, which it occupies for idling, the vacuum effective on the ball check valve 208 is sufficient to unseat the valve and is therefore communicated to the bore 200. A flow of air through both the passages 230 and 234 is thus brought about and such air flows through the passage 206 into the intake passage to be mixed with the fuel supplied by the main fuel nozzle. The flow of fuel from the nozzle is greater than the flow when idling at high or normal operating temperatures because the suction maintained at the fuel nozzle is increased both by the additional restriction of the air intake, due to the substantially complete closing of the choke valve by the thermostat, and the communication of the high vacuum maintained above the throttle to the space in the intake adjacent the nozzle, through the passage 234. The effect of the passage 234 on the vacuum within the intake passage is modified and substantially reduced by the admission of air to the bore 200 through the passage 230 and connecting passages, but the vacuum in said intake passage is increased to some extent to aid the action of the choke valve previously described. The effect of the mechanism in its entirety is to produce a greater flow of fuel than that which takes place for idling at normal temperatures and to supply additional air, to mix with the increased quantity of fuel, through the bore 200 and passage 206, so that a larger quantity of a somewhat richer mixture is provided than is provided for normal idling. This causes a considerable increase in the idling speed of the engine.

When operating under load at low temperatures with the throttle partly or fully open, the suction effective on the ball check is not enough to open it. Of course, when idling even at nor-

mal temperatures, the suction is sufficient to open the ball check, but under these conditions the thermostat has moved the valve formed by the stub shaft 76 to a position where the passages leading from the bore 200 to the intake passage adjacent the choke valve are cut off and the whole fast idle system is rendered inoperative.

Devices are also provided to maintain a partial vacuum above the surface of the fuel in the float chamber for purposes more fully set forth later and the effectiveness of one of these devices is also controlled by the stub shaft 76. The devices so controlled include the passage 250 extending axially along the center of the throttle shaft 32, as shown in Fig. 1, and connecting with the intake passage at the point 251. The passage 250 connects with the passage 252 extending across the throttle shaft and at the end of the throttle shaft the passage 250 is closed by a plug 253. A very small passage 254 extends from the periphery of the throttle shaft to the cross passage 252 and when the throttle valve is in closed position, as shown in Fig. 1, the passage 254 connects the cross passage 252 with a substantially vertical passage 255 formed in the wall of the casting and closed at its lower end by a plug 256. When the throttle is in open position, the passage 255 connects directly with the cross passage 252.

At a point intermediate its length, passage 255 connects with a horizontal passage 257, as shown in Fig. 3, closed by a plug 258 and connected with a vertical passage 259. The passage 259 extends into the upper housing section 4 and at its upper end connects with a diagonal horizontal passage 260 bored in the extending horizontal flange of housing section 4 and closed by a plug 261. The passage 260, at a point intermediate its ends, connects with a vertical passage 262 closed by a suitable plug at its upper end and connecting with a short horizontal passage 264 with which a passage 266 in the portion 180 of stub shaft 76 registers when said shaft is in position to render the previously described fast idle device effective, and when such shaft is in position to hold the choke valve substantially closed. When in registry with the passage 264, the passage in the stub shaft also registers with a very short passage 268 which connects with the upper end of a vertical passage 270 which extends downwardly through the wall of housing section 4 and terminates in the space above the fuel in the float chamber. Such passage may have a removable calibrated plug comprising a fixed restriction of relatively small size, positioned in such passage near its lower end.

It will be apparent from the foregoing description of the several passages 250 to 270 that when the throttle valve and the stub shaft 76 are in certain positions, there will be an open conduit extending from a point in the intake passage posterior to the throttle valve to a point above the fuel in the float chamber, so that the high vacuum maintained at points posterior to the throttle may be communicated to the space above the fuel within the float chamber, thus maintaining a partial vacuum therein under certain conditions which is effective to oppose the suction at the nozzle and to variably control the fuel flow.

The degree of partial vacuum which is maintained is partially dependent on the position of the stub shaft 76 and throttle shaft 32, and also on a suction connection extending from the fast

idling device to the space above the fuel in the float chamber and a conduit admitting air to this suction connection which is adjustable so as to variably control the effect of the suction connection in accordance with variations in the quantity of air admitted. The suction passage is connected to the fast idling system between the stub shaft 76 and the connection of passage 200 with the mixture passage, so that whenever the suction on the fast idling system is sufficient to unseat the check valve 208, such suction is communicated to the fuel in the fuel chamber and is modified as desired by adjustment of the amount of air admitted to the suction passage. Also this admission of air acts to reduce to some extent the vacuum maintained in the fast idling system when the latter is in operation.

The suction connection and air admitting means which connects with the fast idle passage includes a horizontal passage 280 which is bored in the upper housing section 4 and extends through the detachable plate 70, communicating with the atmosphere at a point 282 within the housing for the thermostat. At its inner end, the passage 280 connects with a vertical bore 284 which extends directly downwardly through the wall of the housing section 4 and terminates at a point above the fuel in the float chamber. This passage connects the top of the float chamber with the atmosphere and the size of the passage is regulated by a manually adjustable set screw 286, held in any adjusted position by the spring 288 and provided with a tapered end 290 projecting into the passage 280 as shown in Fig. 2.

The passage 284 which communicates with the space above the float chamber is connected directly with the fast idle passage 200 by means of a short horizontal passage 292 bored in the wall of housing section 4 and closed at its outer end by a suitable plug 294. Through the medium of these passages the suction of the fast idle system is communicated to the space above the fuel. The degree of suction in the fast idle system and as communicated therefrom to the float chamber is variably controlled as indicated above by the adjustment of the set screw 286.

The primary purpose of the devices for maintaining a partial vacuum in the space above the fuel in the float chamber is to regulate the mixture proportions so as to provide mixture of proper fuel ratio to best operate the engine under certain different operating conditions. For example, these devices prevent overrichness of the mixture during fast idling and operation under load at relatively small throttle openings while the engine is cold and also serve to increase the richness for operation at wide open throttle, heavy load, to give maximum power.

The means for communicating the high vacuum of the space posterior to the throttle to the float chamber is without effect at relatively high temperatures or at any time or under any conditions that the stub shaft 76 is rotated to such a position that the several passages through the shaft are closed. As a matter of fact the high vacuum connection 255 and associated passages are only effective when the fast idle system is effective because the same rotation of the shaft 76 that will render the fast idle system inoperative will also close the passage leading from the fuel bowl to the passage 255.

Whenever shaft 76 is in position to render the fast idle system operative, whether idling or operating under load, at engine speeds up to approximately a vehicular speed of 20 M. P. H., it

has been found that there was in this device a tendency to create sufficient suction at the nozzle, when operating cold with closed choke, to produce a somewhat overrich mixture. At normal temperatures the position of the choke follows that of the throttle and the choke will open to a position determined by the position of the cam roller 122 which moves with the throttle, so that the choke is not entirely closed when the temperature is not low and the suction effective on the nozzle is not so great, for reasons already set forth. As a result, the mixture is not as rich at normal temperatures, with closed or nearly closed throttle, as when operating cold, so that the degree of the partial vacuum maintained over the fuel does not need to be as great. Therefore, the shaft 76 is utilized to close the passage leading to the high vacuum side of the throttle when the temperature reaches a predetermined degree, so that after such a temperature is reached only the suction connection leading from the fast idle system to the float bowl is effective.

When the temperature is low and the shaft 76 is in the position shown in the drawings and with the throttle in closed or nearly closed position, the high vacuum maintained posterior to the throttle is communicated to the float chamber through the passage 250, small opening 254, and passages 255, 257, 259, 260, 261, 262, 264, 266, 268 and 270. If the float chamber were sealed, the vacuum created in the float chamber would be practically the same as that which exists in the space posterior to the throttle. However, the suction connection to the fast idle system acts to modify the effect of the high suction and the degree of modification is varied by the valve 286. The suction which is actually maintained is somewhere between that which would be maintained by the connection to the fast idle system and that which would be maintained by the connection comprising passage 255 and associated passages. By making the various passages of proper size and properly positioning the valve, any desired degree of vacuum may be maintained in the fuel chamber.

As the temperature increases, it is not necessary to maintain as high vacuum in the fuel chamber so the shaft 76 is so arranged that when the temperature rises and the shaft rotates clockwise as viewed in Fig. 12, it reduces the area of the suction passage and finally cuts it off entirely. Also, when the throttle opens relatively wide the vacuum posterior thereto falls and to compensate for this, the large passage 252 is moved to connect passages 250 and 255 and the small passage 254 is moved out of registry with 250 and 255 as the throttle is opened.

The passage 280 and connecting passages, which admit air to the float bowl are always effective and the suction connection from such passages to the fast idle system is always effective, but the effect these passages produce depends entirely on the setting of the valve 286 and the area of the suction passage leading from 284 to the fast idle system. This arrangement is employed to produce the proper mixture ratio for operation at normal temperatures. During idling and part throttle operation, the high vacuum is enough to unseat the ball 208 so that vacuum is communicated to the fuel chamber and this tends to lean the mixture, but at open throttle the suction will not unseat the ball. Therefore, at open throttle, no suction is communicated to the float chamber and this will

cause the mixture to be enriched for open throttle operation.

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 chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a valve in said air inlet adapted to be variably positioned to regulate the admission of air to said intake passage, means for controlling the position of said valve, means for maintaining a partial vacuum above the level of fuel in said fuel chamber and means controlled by the means for controlling the position of the air inlet valve for determining the degree of vacuum maintained.

2. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a valve in said air inlet adapted to be variously positioned to regulate the admission of air to said intake passage, means operated by the throttle for controlling the position of said valve, means for maintaining a partial vacuum above the level of fuel in said fuel chamber and means controlled by the throttle for variably determining the degree of vacuum maintained.

3. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a valve in said air inlet adapted to be variably positioned to regulate the admission of air to said intake passage, means for controlling the position of said valve, means for maintaining a partial vacuum above the level of fuel in said fuel chamber and means dependent upon temperature for determining the degree of vacuum maintained in said fuel chamber and for operating the means for controlling the position of the intake valve.

4. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means responsive to temperature for controlling the movement of said valve in response to suction, means for maintaining a partial vacuum in the space above the fuel in said fuel chamber, and means whereby said temperature responsive means is also effective to regulate the degree of vacuum maintained in said fuel chamber.

5. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable

able to different positions to control the admission of air to said intake passage, means responsive to temperature for controlling the movement of said valve in response to suction, means for maintaining a partial vacuum in the space above the fuel in said fuel chamber and means whereby operation of the temperature responsive means and the throttle controls the degree of vacuum maintained in said fuel chamber.

6. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means operable by the throttle for limiting the opening movement of said suction operated valve, means for maintaining a partial vacuum in the space above the fuel in said fuel chamber and means whereby movement of the throttle also controls the degree of vacuum maintained in the fuel chamber.

7. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means operable by the throttle for moving said suction operated valve toward closed position as the throttle is closed, means for maintaining a partial vacuum above the fuel in said fuel chamber, and means whereby the closing of the throttle is also effective to modify the degree of vacuum maintained in the fuel chamber as the throttle is moved toward closed position.

8. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means operable by the throttle for moving said suction operated valve toward closed position as the throttle is closed, means for maintaining a partial vacuum above the fuel in said fuel chamber, means operable in response to temperature to limit the opening of the suction operated valve in accordance with the temperature, means whereby the closing of the throttle is effective to modify the degree of vacuum maintained in said fuel chamber and means whereby said temperature responsive means is also effective to decrease the degree of vacuum in said fuel chamber as the temperature increases.

9. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to main-

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tain a partial vacuum in such space, thermally responsive means for controlling the opening of the air intake valve in accordance with temperature and means operable by said thermally responsive means for controlling the area of said conduit.

10. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, thermally responsive means for controlling the opening of the air intake valve in accordance with temperature, a stop member operable by said thermally responsive means to variably limit the opening of the air intake valve in accordance with engine temperature, and means whereby said stop member controls the effective area of said conduit.

11. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, thermally responsive means for controlling the opening of the air intake valve in accordance with temperature, and means operable by the throttle and the thermally responsive means for varying the effective area of said conduit as the throttle is moved to different positions and the engine temperature varies.

12. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, a second conduit for communicating the suction maintained posterior to the throttle to the space adjacent the fuel inlet in the intake passage in order to bring about faster than normal idling when such conduit is effective, a passage connecting such second conduit to the space above the fuel in the fuel chamber and means for varying the suction created by said second conduit in said fuel chamber.

13. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a

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point posterior to the throttle in order to maintain a partial vacuum in such space, a second conduit for communicating the suction maintained posterior to the throttle to the space adjacent the fuel inlet in the intake passage in order to bring about faster than normal idling when such conduit is effective, a passage connecting such second conduit to the space above the fuel in the fuel chamber, means for varying the suction created by said second conduit in the fuel chamber, and means operable when the throttle is moved to different positions to vary the area of said first conduit in order to regulate the suction created thereby.

14. A charge forming device for internal combustion engines, having in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, a second conduit for communicating the suction maintained posterior to the throttle to the space adjacent the fuel inlet in the intake passage in order to bring about faster than normal idling when such conduit is effective, a passage connecting such second conduit to the space above the fuel in the fuel chamber, means for varying the suction created by said second conduit in the fuel chamber, means operable when the throttle is moved to different positions to vary the area of such first conduit in order to regulate the suction created thereby, thermally responsive means for controlling the opening of the air intake valve in accordance with temperature and means operated by said thermally responsive means for also varying the area of said first mentioned conduit so as to vary the suction created thereby as the temperature changes.

15. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said air inlet, means operable by the throttle for limiting the opening movement of said air valve, and means operable upon opening movement of the throttle for temporarily moving said air valve toward closed position to enrich the mixture for acceleration.

16. A charge forming device for internal combustion engines having in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said air inlet, means operable by the throttle for limiting the opening movement of said air valve, and means operable upon opening movement of the throttle for temporarily moving said air valve toward closed position to enrich the mixture for acceleration and for retarding the subsequent opening movement of the air valve.

17. A charge forming device for internal combustion engines, having, in combination, a fuel supply chamber, an intake passage, a fuel inlet for supplying fuel to the intake passage, an air inlet for admitting air thereto, a choke valve for con-

trolling the admission of air through said inlet, a throttle valve for controlling the flow of mixture through the intake passage, a conduit for connecting the space above the fuel in said fuel chamber with the intake passage, posterior to the throttle in order to communicate the engine suction to said space, means for so controlling said conduit as to cause said conduit to be effective when the engine is operating at relatively low temperatures, but to render said conduit wholly ineffective when normal operating temperatures are reached, a second conduit connecting the space above the fuel in the float chamber with the intake passage, said second conduit being so arranged that it is effective at all operating temperatures, and means for causing the second conduit to become ineffective when the suction falls below a predetermined degree, so as to eliminate the effect of said second passage entirely when the manifold vacuum is low.

18. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means operable by the throttle for limiting the opening movement of said suction operated valve, means for maintaining a partial vacuum in the space above the fuel in the fuel chamber and means also operated by the throttle for variably controlling the degree of vacuum maintained in said space as the throttle is moved to different positions.

19. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said intake passage movable to different positions to control the admission of air to said intake passage, means operable by the throttle for moving said suction operated valve toward closed position as the throttle is closed, means for maintaining a partial vacuum above the fuel in said fuel chamber, and means also operated by the throttle upon closing movement thereof to modify the degree of vacuum in the fuel chamber as the throttle is moved toward closed position.

20. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, a valve operated by the throttle to vary the area of said conduit when the throttle is moved to different positions, and movable to a position to open said conduit when the throttle is moved to closed and substantially fully open positions.

21. A charge forming device for internal combustion engines, having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the ad-

mission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, a valve operated by the throttle to vary the area of said conduit as the throttle is moved to different positions, in order to vary the degree of vacuum maintained in the fuel chamber, thermostatically operated means to vary the area of said conduit, and manually adjustable means to vary the degree of vacuum independently of the position of the throttle and the thermostatically operated means.

22. A charge forming device for internal combustion engines, having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, and a valve operated by the throttle to vary the area of said conduit as the throttle is moved to different positions, in order to vary the degree of vacuum maintained in the fuel chamber, said valve having a plurality of passages formed therein which are moved into registry with said conduit when the throttle is moved to different positions.

23. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a suction operated valve in said air inlet, means operable by the throttle for limiting the opening movement of said air valve, means operable upon opening movement of the throttle for temporarily moving said air valve toward closed position to enrich the mixture for acceleration and means also operated by the throttle upon closing movement thereof to move the air inlet valve toward closed position.

24. A charge forming device for internal combustion engines, having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said intake passage for normal engine operation under load and for idling, an air inlet valve for controlling the admission of air to said intake passage, a throttle for controlling flow of mixture to the engine, means responsive to temperature for controlling the operation of the intake valve and operative to control the supply of idling fuel independently of the position of the air inlet valve so as to cause the fuel inlet to supply a larger quantity of fuel for idling when the temperature is low than when the temperature is high, said means being effective while the idling position of the throttle remains fixed.

25. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming

device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, and a valve operable by the throttle to vary the area of said conduit as said throttle is moved to different positions to variably control the supply of mixture, said valve being so constructed that the conduit is partially restricted when the throttle is moved to closed position and entirely unrestricted when the throttle is moved to substantially fully open position.

26. A charge forming device for internal combustion engines, having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, and a valve operable by the throttle to vary the area of said conduit as said throttle is moved to different positions to variably control the supply of mixture, in order to vary the degree of suction maintained in the fuel chamber as the throttle is moved to different positions, said valve being so constructed that the conduit is partially restricted when the throttle is in closed position, is unrestricted when the throttle is in substantially open position and completely restricted during an intermediate part of the throttle movement.

27. A charge forming device for internal combustion engines, having, in combination, a fuel chamber, an intake passage, a fuel inlet for supplying fuel to said passage, an air inlet for admitting air thereto, a valve for controlling the admission of air through said air inlet, a throttle valve for controlling the quantity of mixture supplied to the engine by said charge forming device, a conduit connecting the space above the fuel in said fuel chamber with the intake passage at a point posterior to the throttle in order to maintain a partial vacuum in such space, a valve operable by the throttle to vary the area of said conduit as said throttle is moved to different positions to variably control the supply of mixture, in order to vary the degree of suction maintained in the fuel chamber as the throttle is moved to different positions, a thermostatically operated valve controlling said conduit, a vent for admitting air to the space above the fuel in the fuel chamber, and a manually operable valve for regulating the area of said vent to control the degree of vacuum in said space independently of the position of said conduit controlling valves.

28. A charge forming device for internal combustion engines, having, in combination, a fuel supply chamber, an intake passage, a fuel inlet for supplying fuel to the intake passage, an air inlet for admitting air thereto, a choke valve for controlling the admission of air through said inlet, a throttle valve for controlling the flow of mixture through the intake passage, a conduit for connecting the space above the fuel in said fuel chamber with the intake passage posterior to the throttle, in order to communicate the engine suction to said space, thermostatic means operable in response to variations in engine temperature and means operated thereby for controlling said conduit, said means being positioned

by the thermostatic means to cause the conduit to be effective when the engine is operating at relatively low temperatures, but to render said conduit to be wholly ineffective when normal operating temperatures are reached.

29. A charge forming device for internal combustion engines, having, in combination, a fuel supply chamber, an intake passage, a fuel inlet for supplying fuel to the intake passage, an air inlet for admitting air thereto, a choke valve for controlling the admission of air through said inlet, a throttle valve for controlling the flow of mixture through the intake passage, a conduit for connecting the space above the fuel in said fuel chamber with the intake passage posterior to the throttle, in order to communicate the engine suction to said space, thermostatic means operable in response to variations in engine temperature and means operated thereby for controlling said conduit, said means being positioned by the thermostatic means to cause the conduit to be effective when the engine is operating at relatively low temperatures, but to render said conduit wholly ineffective when normal operating temperatures are reached, and a second conduit connecting the space above the fuel in the float chamber with the intake passage, said second conduit being so arranged that it is effective at all operating temperatures.

30. A charge forming device for internal combustion engines having, in combination, a fuel chamber, an intake passage, a fuel inlet supplying fuel to said passage, an air inlet for admitting air thereto, a throttle valve for controlling the flow of mixture through said passage, a valve in said air inlet adapted to be variably positioned to regulate the admission of air to said intake passage, a member for controlling the position of said valve, means operated by the throttle for controlling the position of said air inlet valve means for creating a partial vacuum above the level of fuel in said fuel chamber and means controlled by said member and by the throttle for controlling the effectiveness of said means for creating a vacuum in order to vary the degree of vacuum maintained in said fuel chamber.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,740,917	Beck	Dec. 24, 1929
1,814,601	Johnson	July 14, 1931
1,842,690	Stokes	Jan. 26, 1932
1,861,352	Miquelon	May 31, 1932
2,035,177	Mennesson	Mar. 24, 1936
2,040,254	Fitzgerald	May 12, 1936
2,082,293	Linga	June 1, 1937
2,095,739	Goodman	Oct. 12, 1937
2,127,444	Emerson	Aug. 16, 1938
2,139,355	Coffey	Dec. 6, 1938
2,142,503	Ericsson	Jan. 3, 1939
2,163,904	Winkler	June 27, 1939
2,195,867	Mallory	Apr. 2, 1940
2,229,851	Hufford	Jan. 28, 1941
2,262,408	Read	Nov. 11, 1941
2,263,027	Beard	Nov. 18, 1941
2,271,116	Bracke et al.	Jan. 27, 1942
2,325,372	Coffey	July 27, 1943
2,340,876	Gilbert	Feb. 8, 1944