Sept. 21, 1937. G. R. ERICSON 2,093,960

CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

Original Filed June 16, 1933 2 Sheets-Sheet 1

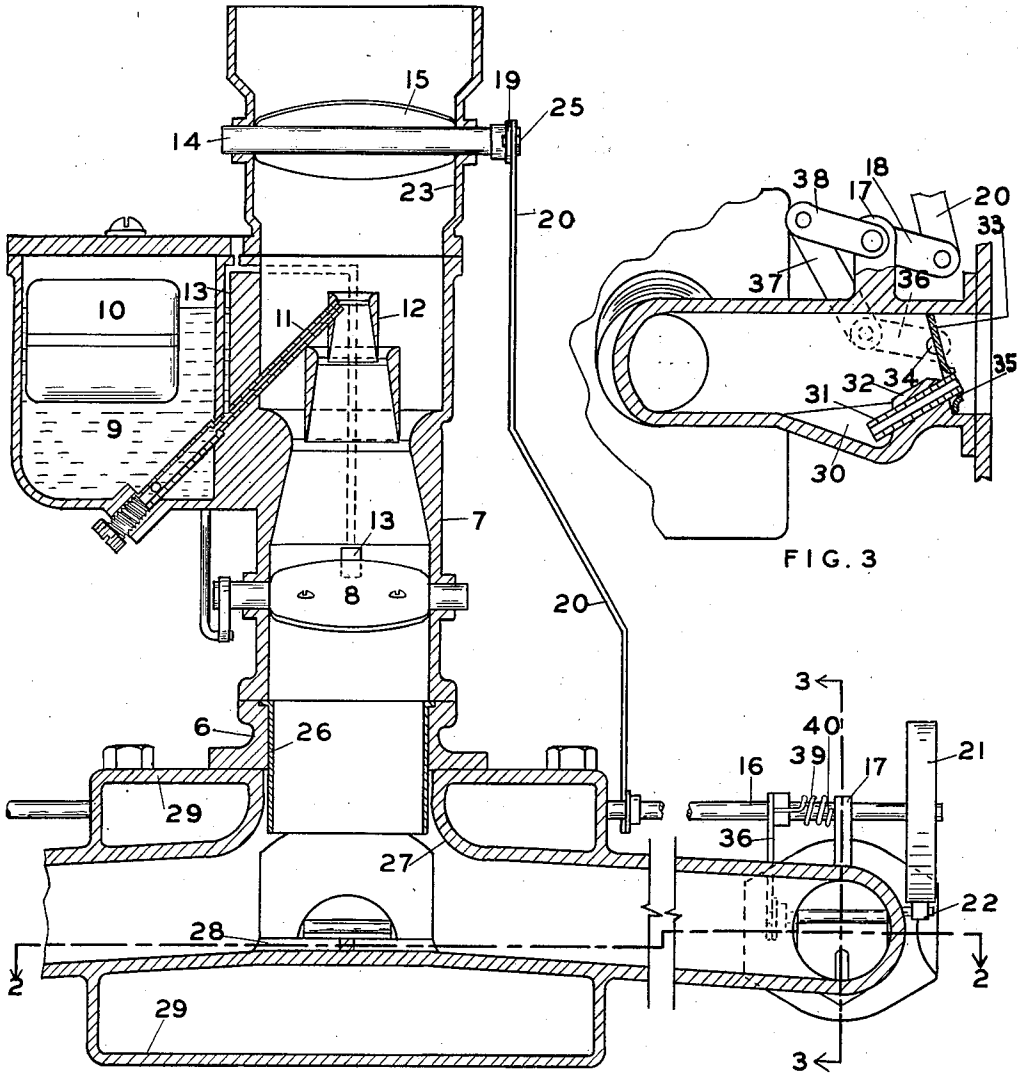


FIG. 1

FIG. 3

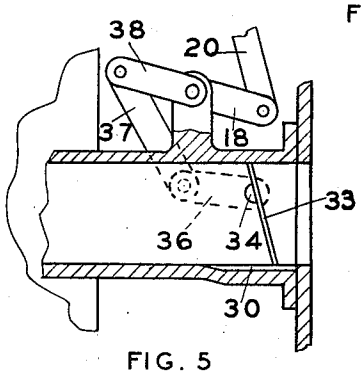


FIG. 5

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CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

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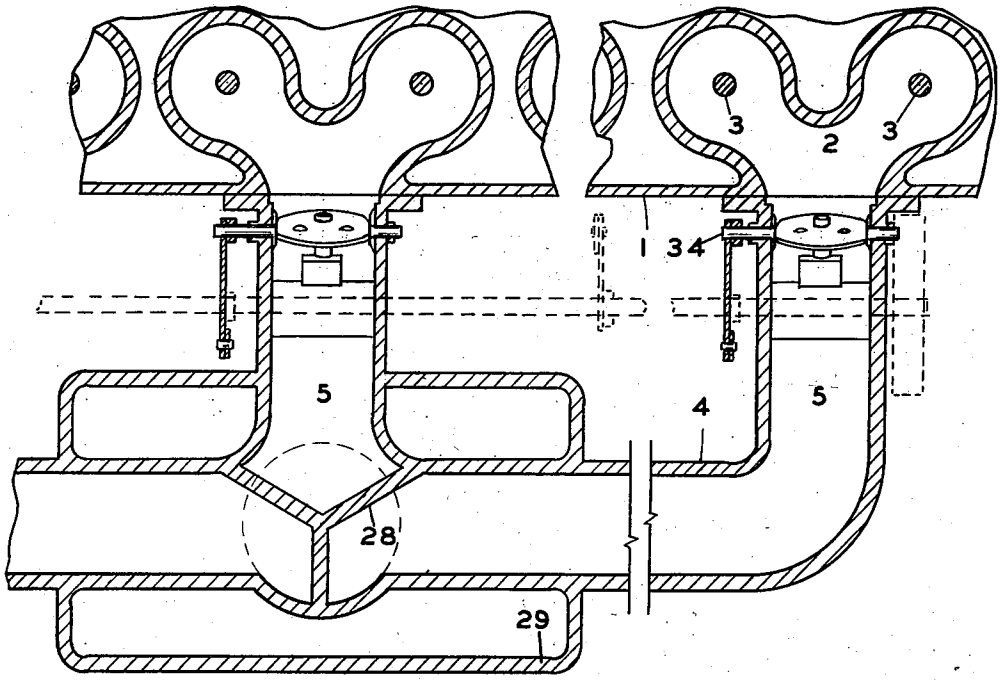


FIG. 2

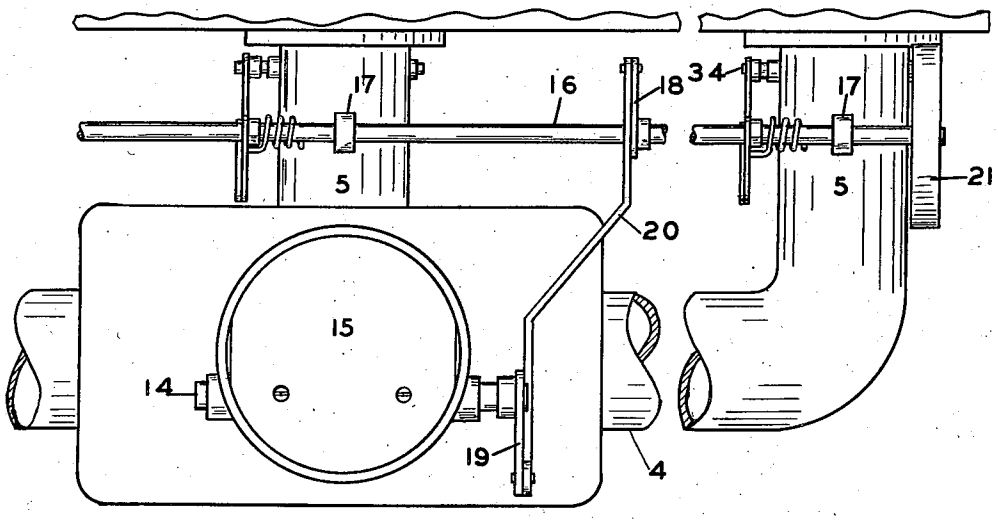


FIG. 4

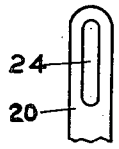


FIG. 6

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CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

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Application June 16, 1933, Serial No. 676,087
Renewed August 27, 1936

28 Claims. (Cl. 123—52)

This invention relates to improvements in charge forming devices for internal combustion engines, and particularly to the provision of a device for insuring the vaporization of the fuel when the temperature is so low as to render vaporization difficult, as when starting an automobile engine which has been standing all night and exposed to low temperature. The invention is also useful at normal operating temperatures for vaporizing comparatively heavy fuels which do not vaporize easily.

In the operation of internal combustion engines at low temperatures and particularly in starting such engines which have been allowed to become thoroughly cold, there is great difficulty in obtaining a proper mixture of vaporized fuel and air for the cylinders due to several factors. One important factor is that when the temperature is low the fuel will not vaporize and if once vaporized it is likely to re-condense in the manifold before it reaches the cylinders. Another factor is that at low temperatures the lubricating oil is highly viscous and the starting motor can not turn the engine over at sufficiently high speed to create any air velocity in the intake manifold such as would have a spraying or vaporizing effect on the gasoline.

In starting internal combustion engines under low temperature conditions it is customary to substantially close the air inlet of the carburetor as by a choke valve or air throttle so that the suction developed by the engine would be concentrated on the fuel nozzle, which, being fed from a constant level fuel tank will squirt raw gasoline into the carburetor from whence it will run into the intake manifold. If the carburetor is of the downdraft type and if the engine is standing on a substantially level base the liquid fuel will pour it down from the carburetor into the manifold and be drained into the valve port of the engine.

It will be well understood that in engines of the over-head valve type the fuel may drain directly from the valve ports into the cylinders when the inlet valves are open, but in the L-head type the valve port extends upwardly from its connection with the intake manifold to the cylinders so that there is no chance for the fuel to flow directly into the cylinders and the fuel is likely to collect in a puddle or basin formed by the inlet manifold and the inlet port. When such a puddle of fuel is collected and when the engine begins to run under its own power, the speed of air flow thru the intake manifold increases to such a point that the puddle of fuel is likely to be swept into the cylinders causing an overloaded condition at best and in some cases entering the cylinder in such quantity as to cause breakage of the piston on the next compression stroke. It also frequently happens that the great excess of raw gasoline entering the cylinders may wet the spark plugs and so prevent the ignition of the charge.

In cases where the engine is mounted in an inclined position substantially all the fuel from the carburetor may be drained to one end of the manifold and to one inlet port. Such a port would mean that these two cylinders would probably be flooded and the rest of the cylinders would not receive a rich enough mixture to fire at all.

It is the object of this invention to produce a charge forming device for internal combustion engines so designed as to prevent the formation of puddles of raw fuel in the inlet manifold during the cranking of the motor when the choke is closed.

It is a further object of this invention to provide a device to insure the positive spray and atomization of the raw fuel at a point directly adjacent the valve port and so directing the spray that it will pass directly into the open valve port of the cylinder whenever the valve is open and that regardless of the fact that the cranking of the engine may be accomplished at a very low speed.

It is a further object of this invention to produce a spraying device located closely adjacent each of the valve inlet ports and to so arrange this spraying device that all of the suction produced by each cylinder on its suction stroke will be applied directly to the spraying device which is adjacent its inlet port.

It is a further object of this invention to provide a device for insuring the draining of fuel in substantially equal quantities from the carburetor to each of the valve inlet ports regardless of the fact that the engine may be standing in an inclined position to provide collecting devices or basins at each of the valve inlet ports to receive any raw fuel that may be delivered to that port and to provide a spraying device for taking up the raw fuel from the basin and spraying it into the valve inlet port as fast as it accumulates in the basin.

It is a further object of this invention to provide a fuel vaporizing device for internal combustion engines having a valve adjacent the inlet ports of the engine, said valve being openable by suction and to provide a fuel nozzle

discharging adjacent the edge of the valve so as to obtain a completely vaporized charge of fuel at each suction stroke of the cylinder.

It is a further object of the invention to provide a device of the character described in the previous paragraph, together with means for moving the valve to a fully open position when the temperature is high so that the full speed operation of the engine will not be interfered with in any way.

It is a further object of this invention to provide a device as described in the two preceding paragraphs together with a connection between the choke valve of the carburetor and the valves which are located at the inlet ports of the engine and to connect these valves to a heat responsive device in such a manner that the valves will be closed when the temperature is low and also to arrange the valve mechanism in such a manner that the valves may be moved toward open position by increases of engine suction.

It is a further object of this invention to produce a generally new and improved device of the above described character.

Referring to the drawings:

Figure 1 shows a diagrammatic sectional elevation of a charge forming device constructed according to my invention.

Figure 2 shows a sectional plan view of the device taken along the lines 2—2 of Figure 1, looking in the direction of the arrows.

Figure 3 is a sectional elevation taken along the lines 3—3 of Figure 1, looking in the direction of the arrows.

Figure 4 is a plan view of the device.

Figure 5 is a view similar to Figure 3 showing a slightly modified form of the invention.

Figure 6 shows the upper portion of the link connecting the choke valve shaft.

Referring to the drawings the reference numeral 1 indicates the cylinder block of an internal combustion engine which, in this case, is of the L-head type. The valve ports 2 are preferably arranged to supply two adjacent inlet valves, the stems of which are indicated at 3. The device herein shown is adapted for a six cylinder motor with a three port manifold generally indicated by the reference numeral 4 and having branch conduits 5 to lead to each of the valve ports. The manifold is also provided with a riser 6 to which is attached a downdraft plain tube carburetor 7. The carburetor is provided with the usual throttle valve 8, float chamber 9, float mechanism 10, plain nozzle 11, Venturi stack 12 and idle passage 13. A shaft 14 is eccentrically mounted in the air inlet of the carburetor and the choke valve 15 is accordingly movable toward open position by suction.

A shaft 16 is mounted in pillow blocks 17 on the branches of the intake manifold. This shaft is provided with a lever 18 by which it may be rotated, and the lever 18 is connected to a similar lever 19 on the choke valve shaft by means of the link 20. A heat responsive coil thermostat 21 is mounted on the end of the shaft 16, the coil being adjacent the exhaust pipe of the engine so as to receive heat therefrom, and the outer end of the coil being anchored to some fixed part of the engine or manifold as indicated at 22. The arrangement of the bi-metallic coil thermostat is such as to rotate the shaft in an anti-clockwise direction with respect to Figure 3 whenever the temperature is increased or whenever the choke valve is moved toward open position by suction and vice versa. The opening movement of the choke valve is limited by the shape of the air inlet member 23 of the carburetor as indicated in Figure 4, thereby providing a definite fixed open position for the valve. As indicated in Figure 6, the upper end of the link 20 is provided with a slot 24 in which the pin 25 in the outer end of lever 19 may slide freely, so that while the thermostat will pull the choke valve to closed position it may continue to expand and rotate the shaft 16 under the influence of increasing temperature for sometime after the choke valve has reached its fully open position, the lever 20 simply sliding up with respect to the pin 25. The riser 6 is provided with a tube 26 which extends far enough down into the junction of the riser with the manifold to prevent liquid fuel being drained down along the curved portion 27 of the manifold wall which would result in delivery of too much fuel to one of the ports and too little to another if the engine was standing in idle position.

The floor of the manifold is preferably provided with three upstanding partitions 28 mounted at substantially 120° to each other and joining directly below the center line of the riser so that liquid fuel pouring down the riser or dripping from the lower skirt of the tube 26 will be substantially equally divided between the three branches of the manifold. Each branch of the manifold should slope downwardly to its discharge port as other considerations will permit, some slope being highly desirable to insure equal distribution when the engine is not standing in a level position. I have shown a casing 29 surrounding the junction of the three branches of the intake manifold with the riser. This casing may be used to carry a heating fluid such as the exhaust gas of the engine, but it should be distinctly understood that the use of such heating devices is not necessary in connection with this invention and on account of the fact that vaporization is obtained by other means hereafter to be described, the heating jacket or hot spot should be reduced in capacity or eliminated entirely in order to obtain the best results and the maximum volumetric efficiency of the engine.

In each of the branches of the intake manifold and adjacent the point where the intake manifold discharges into the inlet port of the engine, I provide a liquid fuel collecting basin 30, preferably having a short tube or nozzle 31 mounted therein and directed to receive fuel therefrom and discharge it toward the inlet port of the engine. In the construction shown in Figure 3 the tube 31 is mounted in a projection 32 which is cast integral with the intake manifold. A butterfly valve 33 is eccentrically mounted on a shaft 34 just posterior to the basin 30 and the valve 33, which may be called a vaporizing valve, is provided at its lower edge with an opening 35 surrounding or partially surrounding the end of the discharge nozzle 31. A small space between the end of the nozzle 31 and the opening 35 should be left partly for mechanical clearance and partly to insure the setting-up of an air blast adjacent the end of the nozzle upon the suction stroke of each cylinder which takes its fuel thru that port. Shaft 34 is connected to the shaft 16 by means of lever 36, link 27 and lever 38. The lever 38 is rotatably mounted on the shaft 16 but urged in anti-clockwise direction with respect to Figure 3 by means of a spring 39 which is coiled around the shaft 16, one end of the spring being anchored to the shaft 16 as indicated at 40 and the other being anchored to the

lever 36. The connection between the shaft 16 and lever 36 is such that the valve 33 closes before the choke valve 15 closes and also after the choke valve 15 has been fully opened, this being permitted by the arrangement of slot 24 and spring 39.

With regard to the construction shown in Figure 5, the principle is the same as that shown in Figure 3 except that the nozzle 31 is omitted and the basin 30 is extended to the inlet port and is made shallower. The construction shown in Figure 3 is preferred although slightly more expensive.

In operation when the temperature is low the bi-metallic thermostat 21 closes the vaporizing valves 33 and then closes the choke valve 15, the closing movement of the vaporizing valve 33 and the valve 16 may be simultaneous or partly simultaneous. If the quickest possible warm-up of the engine is desired without regard to economy, the operation of the valves 33 and 15 would be substantially simultaneous, but if maximum economy is desired the valve 15 should be almost fully opened before the vaporizing valve 33 starts to open. It will be understood, of course, that the thermostat acts as a spring and its tension on the vaporizing valve 33 will be continually decreasing as the temperature rises.

When the motor is cranked with the valves 15 and 33 closed the suction from each cylinder as it makes its suction stroke is conveyed to the valve 33 which may be moved toward open position or if the suction is not strong enough, a draught of air is created around the nozzle 31 and thru the opening 35 as well as thru the nozzle 31. This suction being communicated to the nozzle 11 causes fuel to be discharged from the nozzle 11 and also from the idle port 13 down into the intake manifold along the bottom of which it is drained to the basin 30. As fast as fuel accumulates in the basin 30 it is sucked out thru the nozzle 31 on the next suction stroke of a cylinder which draws from the adjacent port. The stream is squirted upwardly and toward the center of the siamezed port 2 but since only one of the valves at that port will be opened the draught will tend to deflect the spray from the nozzle 31 to the valve port which is open and into that cylinder, thus providing a thoroughly atomized firing mixture and preventing the accumulation of any large amount of fuel in the branches of the intake manifold.

When the motor starts to fire and run under its own power, a substantial opening movement will be imparted to each of the valves 33, whenever an adjacent cylinder makes the suction stroke, the valve 33 being urged toward closed position by the thermostat acting thru the spring 39 will insure the establishment of a high velocity current thru the port 35 and around the discharge outlet of the spray nozzle 31.

As the temperature increases, the tension on the valve 33 will be gradually reduced and also the choke valve will be opened. It will also be noted that prior to any increase in temperature or lessening of the tension of the thermostatic spring 21, the mere increase in speed of the motor will cause an increase of suction applied to the valve 33 and the valve 15. Since the tendency of the valves 33 to open under the influence of the suction act on the thermostat in the same direction as an opening movement of the valve 15, the general effect is to decrease the richness of the fuel mixture by admitting more air to the valve 15 as soon as the engine starts to run under its own power and also in the measure in which its speed increases after it starts to run under its own power. After the exhaust manifold of the motor has reached a sufficiently high temperature to heat the thermostat 21 up to its normal operating temperature, the valves 15 and 33 will be moved to open position and held there. It will be noted that the valves 33 are held in open position by the tension of the spring 39 and that the open position of these valves is fixed by the contact of their edges with the sides of that branch of the intake manifold. While the valve 15 is not necessarily forced to open position by the thermostat 21, such an action may be provided if desired by so arranging the length of the slot 24 as to make the bottom of the slot come in contact with the pin 25 when the desired temperature has been reached.

The invention is not limited to the structure shown but may be modified in various respects as will occur to those skilled in the art, and the exclusive use of all such modifications as come within the scope of the appended claims is contemplated.

I claim:

1. In an internal combustion engine, means forming an inlet port, an inlet valve controlling said port, a carburetor, a conduit for conveying fuel and air from said carburetor to said inlet port, a suction operated valve in said conduit adjacent said port, and means for opening said valve under certain conditions regardless of suction.

2. In an internal combustion engine, an inlet port, an inlet valve controlling said port, a carburetor, a conduit for conveying fuel and air from said carburetor to said inlet port, and a thermo-suction operated valve in said conduit adjacent said port.

3. In an internal combustion engine, a plurality of inlet ports, an intake manifold having branches connected to said port, a carburetor for supplying fuel to said manifold, suction operated valves in each of the branches of said manifold adjacent said port, and a heat responsive device for controlling said valves.

4. In an internal combustion engine, a plurality of inlet ports, an intake manifold having branches connected to said ports, a carburetor for supplying fuel to said manifold, suction operated valves in each of the branches of said manifold adjacent said ports, and a heat responsive device for controlling said valves, said valves having independent resilient connections to said heat responsive device whereby each individual valve may be operated by suction without operating the other valves.

5. In an internal combustion engine having a cylinder block, a valve port in said cylinder block, a valve controlling said valve port, a supply conduit for conveying fuel and air to said port, means for supplying fuel and air to said conduit, a suction operated valve in said conduit adjacent said port, means independent of suction for affecting the operation of said valve, and a by-pass leading from a comparatively low point in said conduit anterior to said valve to a point in said conduit posterior to said valve.

6. In an internal combustion engine having a cylinder block, a valve port in said cylinder block, a valve controlling said valve port, a supply conduit for conveying fuel and air to said port, means for supplying fuel and air to said conduit, a heat controlled valve in said conduit adjacent said port, and a by-pass leading from a com-

paratively low point in said conduit anterior to said valve to a point in said conduit posterior to said valve.

7. In an internal combustion engine having a cylinder block, a valve port in said cylinder block, a valve controlling said valve port, a supply conduit for conveying fuel and air to said port, means for supplying fuel and air to said conduit, a thermo-suction controlled valve in said conduit adjacent said port, and a by-pass leading from a comparatively low point in said conduit anterior to said valve to a point in said conduit posterior to said valve.

8. In a device of the class described, an intake manifold having a plurality of outlet ports, and an inlet port, a downdraft carburetor mounted on said inlet port, the branches of said manifold extending downwardly at a substantial angle from said inlet port to said outlet port, and upstanding partition means on the bottom of said intake manifold below said inlet port for causing the drainage of raw fuel to each of said ports in substantially equal quantities.

9. In a device of the class described, an intake manifold having an intake port and a plurality of outlet ports, a downdraft carburetor mounted on said intake port, and a heat operated valve at each of said outlet ports.

10. In a device of the class described, an intake manifold having an intake port and a plurality of outlet ports, a downdraft carburetor mounted on said intake port, and a thermo-suction operated valve at each of said outlet ports.

11. In a device of the class described, an intake manifold having a plurality of outlet ports and an inlet port, a carburetor connected to said inlet port, a choke valve for said carburetor, vaporizing valves mounted in each of said outlet ports, and connections between said choke valve and said vaporizing valves.

12. In a device of the class described, an intake manifold having a plurality of outlet ports and an inlet port, a carburetor connected to said inlet port, a choke valve for said carburetor, vaporizing valves mounted in each of said outlet ports, connections between said choke valve and said vaporizing valves, and a heat responsive device for controlling said valves.

13. In a device of the class described, an intake manifold having an inlet branch and a plurality of outlet branches, a downdraft carburetor mounted on said inlet branch, a throttle valve for controlling the discharge of fuel from said carburetor, a choke valve for controlling the admission of air to said carburetor, a suction operated fuel nozzle discharging into said carburetor between said throttle and choke valve, a suction operated vaporizing valve in each of said outlet ports, and means for closing said choke valve and the vaporizing valves when the temperature is low.

14. In a device of the class described, an intake manifold having an inlet branch and a plurality of outlet branches, a downdraft carburetor mounted on said inlet branch, a throttle valve for controlling the discharge of fuel from said carburetor, a choke valve for controlling the admission of air to said carburetor, a suction operated fuel nozzle discharging into said carburetor between said throttle and choke valve, a suction operated vaporizing valve in each of said outlet ports, and means for closing said choke valve and the vaporizing valves when the temperature is low, said means comprising a rotatable shaft mounted on said intake manifold, and a coil thermostat carried by said shaft.

15. In a device of the class described, an intake conduit, said intake conduit having a substantially horizontal discharge outlet, a carburetor for supplying air and fuel to said conduit, a fuel collecting basin in said discharge conduit, a valve in said discharge conduit at a point adjacent said fuel basin, at least a portion of said basin being anterior to said valve, and means for conducting fuel from said basin to the posterior side of said valve.

16. In a device of the class described, an intake conduit, said intake conduit having a substantially horizontal discharge outlet, a carburetor for supplying air and fuel to said conduit, a fuel collecting basin in said discharge conduit, a valve in said discharge conduit at a point adjacent said fuel basin, at least a portion of said basin being anterior to said valve, and means for conducting fuel from said basin to the posterior side of said valve, said valve being mounted on a horizontal shaft in said conduit, said shaft being eccentric with respect to said conduit, and yieldable means for holding said valve in closed position.

17. In a device of the class described, an intake conduit, said intake conduit having a substantially horizontal discharge outlet, a carburetor for supplying air and fuel to said conduit, a fuel collecting basin in said discharge conduit, a valve in said discharge conduit at a point adjacent said fuel basin, at least a portion of said basin being anterior to said valve, and means for conducting fuel from said basin to the posterior side of said valve, said valve being mounted on a horizontal shaft in said conduit, said shaft being eccentric with respect to said conduit, and yieldable means for holding said valve in closed position when the temperature is low, and for moving said valve to open position when the temperature is high.

18. In a device of the class described, an engine having a plurality of inlet ports, an intake manifold having branches connected to said ports, a downdraft carburetor connected to said inlet manifold for supplying liquid fuel and air thereto, fuel collecting basins in said intake manifold adjacent said ports, valves in said branches adjacent said ports and slightly posterior to said basins, and mean for conducting liquid fuel from said basins to a point posterior to said valves.

19. In a charge forming device for internal combustion engines, an intake manifold having a plurality of outlet ports and a downdraft inlet port, a downdraft carburetor connected to said inlet port, said carburetor comprising means forming a mixing conduit, said mixing conduit having a throttle valve at its outlet and a choke valve at its inlet, a suction operated liquid fuel nozzle discharging into said mixing conduit between said valve, and means connected with said choke valve for restricting the discharge outlet of the intake manifold when the choke valve is not in open position.

20. In a charge forming device for internal combustion engines, an intake manifold having a plurality of outlet ports and a downdraft inlet port, a downdraft carburetor connected to said inlet port, said carburetor comprising means forming a mixing conduit, said mixing conduit having a throttle valve at its outlet and a choke valve at its inlet, a suction operated liquid fuel nozzle discharging into said mixing conduit between said valves, and means for restricting each

of the discharge outlets of the intake manifold when the choke valve is not in open position, said means including a heat responsive device.

21. In a charge forming device for internal combustion engines, a carburetor having fuel and air mixing devices and a throttle controlled discharge outlet, a conduit leading from said discharge outlet to the inlet port of an engine, said conduit having a substantially horizontal portion, a horizontal shaft transversely mounted in said horizontal section at a point above the center line thereof, a valve carried by said shaft, and a by-pass connected to said horizontal section at a point anterior to said valve and at the lower portion of said section, said by-pass discharging into said section at a point beyond said valve.

22. In a charge forming device for internal combustion engines, a carburetor having fuel and air mixing devices and a throttle controlled discharge outlet, a conduit leading from said discharge outlet to the inlet port of an engine, said conduit having a substantially horizontal portion, a horizontal shaft transversely mounted in said horizontal section at a point above the center line thereof, a valve carried by said shaft, and a by-pass connected to said horizontal section at a point anterior to said valve and at the lower portion of said section, said by-pass discharging into said section at a point beyond said valve, said valve being operable by suction, and means including a bi-metallic coil thermostat for closing said valve when the temperature is low.

23. In a device of the class described, an intake manifold comprising a downwardly directed inlet passage and a plurality of outwardly and downwardly extending branches terminating in discharge ports adapted to be connected to the inlet ports of an internal combustion engine, suction operated vaporizing valves in each of said branches, means for moving said valves to closed position when the temperature is low, and means for moving said valves to open position regardless of suction when the temperature is high.

24. In a device of the class described, in intake manifold having an inlet port and a plurality of branches, said branches terminating in discharge outlets adapted to be connected to the inlet ports of an internal combustion engine, each of said branches having a suction operated valve therein, a fuel collecting basin anterior to each of said valves, and a by-pass leading from said basin to a point posterior to each of said valves.

25. In a device of the class described, an intake manifold having an inlet port and a plurality of outlet branches, thermo-suction operated valves in each of said branches, and by-passes at the lower edges of said valves.

26. In a device of the class described, an intake manifold having an intake passage and a plurality of outlet passages, a valve for restricting the flow of fluid through said intake passage, said valve being provided with a shaft on which it is eccentrically mounted whereby it may be moved toward open position due to the pressure difference existing in the fluid at the inlet and outlet sides of the valve, and means independent of such pressure differences for holding the valve in open position.

27. The combination with the fuel mixture passageway of an internal combustion engine, of an unbalanced valve therein adapted to be opened by suction of the engine, and thermostatic means to progressively open the valve independently of the suction, as the temperature rises.

28. The combination with the fuel mixture passage way of an internal combustion engine, of an unbalanced valve therein adapted to be opened by the suction of the engine, and a thermostatic spring tending to open the valve independently of the engine suction, as the temperature rises.

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