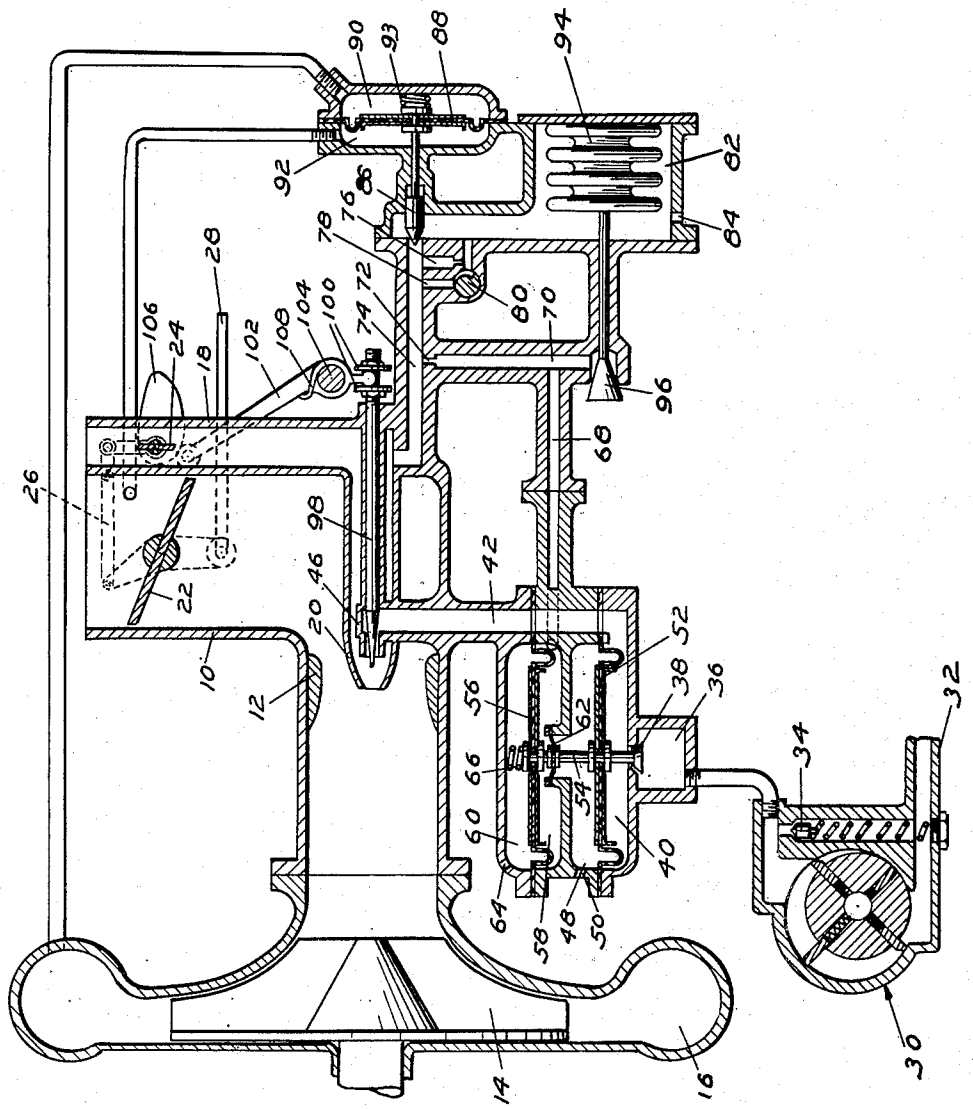
Dec. 3, 1940. F. C. MOCK 2,223,381

CARBURETOR

Filed Feb. 17, 1937



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Patented Dec. 3, 1940 2,223,381

UNITED STATES PATENT OFFICE

2,223,381

CARBURETOR

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Application February 17, 1937, Serial No. 126,133

16 Claims. (Cl. 261—46)

This invention relates to charge forming devices and more particularly to devices for forming a combustible mixture of air and fuel externally of an internal combustion engine and for supplying such mixture to the engine cylinders.

Charge forming devices of the type heretofore commonly used have supplied fuel under a substantially constant head, as by means of a float chamber, to a nozzle opening into a Venturi air passage so that fuel is aspirated from the nozzle by the suction produced in the venturi. In these devices the fuel in the nozzle is, at times, subjected to a very high degree of suction thereby causing boiling of the fuel which interferes with proper metering thereof.

It is one of the objects of the present invention to provide a charge forming device in which there is substantially no tendency for the fuel to boil, and to attain this object the device is so constructed that the fuel nozzle is not subjected at any time to the extremes of suction encountered in an ordinary carburetor. In addition the fuel is supplied under positive pressure which may always be equal to or in excess of atmospheric.

Another object of the invention is to provide a charge forming device in which icing is prevented. For this purpose the fuel nozzle is preferably arranged to discharge into the air stream at a point posterior to the throttle and into a part of the manifold which is relatively warm. Thus there is no chance for ice to collect on the throttle or on relatively cold parts of the manifold.

A further object of the invention relates to fuel metering and fuel control to maintain the fuel-air ratio at the optimum value for all operating conditions.

Other objects, advantages and novel features of the invention will be apparent from the following description of the accompanying drawing, in which the single figure is a diagrammatic view of a charge forming device embodying the invention.

The device illustrated includes an air conduit 10 shown with a right angle bend therein and having a venturi 12. One end of the conduit 10 may be open as shown to form a scoop tube or it may, if desired, be connected to a supercharger. The opposite end discharges into the inlet of a supercharger 14 which supplies the mixture to a manifold 16 connected to the engine cylinders, not shown.

Alongside of the conduit 10 there is a smaller conduit 18 terminating in a nozzle-like portion 20 substantially at the Venturi throat. The conduits 10 and 18 are controlled by throttle valves 22 and 24 interconnected by a link 26 in such a manner that when one is open the other is closed. Both throttle valves are controlled simultaneously by a link 28 connected to the valve 22 and extending to any convenient point for easy access by an operator.

Fuel is supplied by an engine driven pump 30 connected by a pipe 32 to any convenient source of fuel and having a by-pass from its outlet to its inlet controlled by a pressure responsive valve 34 to maintain the outlet pressure substantially constant. The pump discharges into a fuel chamber 36 which communicates past a control valve 38 with a diaphragm chamber 40 and the latter communicates through a passage 42 with a fuel nozzle 46. The diaphragm chamber 40 is divided from a chamber 48 which communicates with atmosphere through a vent 50 by a diaphragm 52 which is connected to the stem 54 of the valve 38. A similar diaphragm 56 also connected to the valve stem 54 serves to separate two chambers 58 and 60, the former of which is separated from the chamber 48 by a packing diaphragm 62 and the latter of which communicates with atmosphere through a vent 64. Preferably a light spring 66 is mounted in the chamber 60 and acts on the valve stem 54 to urge the valve open.

The chamber 58 is connected through passages 68 and 70, restricted orifice 72 and passage 74 to the conduit 18 so that the lower surface of the diaphragm 56 is subject to the suction prevailing in this conduit modified by certain other factors to be described later. The passage 74 communicates through a restricted orifice 76 and through a passage 78 controlled by a manually adjustable plug valve 80 with a chamber 82 having an atmospheric vent 84 slightly larger than the orifice 76. The passage 74 also communicates with the chamber 82 past a valve 86 controlled by a diaphragm 88 exposed on its opposite sides to the pressure in chambers 90 and 92, a spring 93 being provided to urge the valve 86 closed. The chamber 90 is connected to the manifold 16 and the chamber 92 is connected to the inlet end of the conduit 10 to be subjected to the pressure of air entering the device which may be atmospheric or greater than atmospheric when a supercharger is used. The chamber 82 houses bellows 94 connected to a valve 96 which controls admission of atmospheric pressure to the passage 70 and thence to the chamber 58. The bellows 94 is filled with air or other

suitable gas and sealed at some predetermined pressure, as, for example, 30" of mercury.

The fuel nozzle 46 is controlled by a needle 98 slidably mounted therein and which variably restricts the area thereof. The needle 98 carries a pair of plates 100 to receive between them one end of a lever 102 pivoted intermediate its ends at 104 and the opposite end of which engages a cam 106 carried by and turned with the shaft of valve 24. The cam 106 and the needle 98 may be given any desired contour to effect the desired fuel regulation but are so arranged that the valve 98 is opened as the main throttle 22 is opened. The pivot 104 preferably carries a coil spring 108 to hold the upper end of the lever 102 in engagement with the cam 106 and to move the valve 98 toward its closed position as the throttle 22 is closed.

The parts are shown in the idling position with the main throttle valve 22 closed and the valve 24 open, the valve 98 also being substantially closed to restrict the flow of fuel. In this position the conduit 10 is subjected to a high degree of suction, the absolute pressure therein being in the neighborhood of ten inches of mercury, and the manifold 16 is also at a subatmospheric pressure. The diaphragm 88 is accordingly subjected to a pressure differential between chambers 90 and 92 to open the valve 86 and the chamber 82 will be open substantially without restriction to the conduit 18. While the suction in this conduit is relieved to a large extent by air entering past the throttle valve 24, a subatmospheric pressure in the neighborhood of twenty-four inches of mercury exists therein and this pressure, relieved slightly by air entering through vents 72 and 84, will be communicated to the chamber 82 to cause the bellows 94 to expand and open valve 96. Since the opening controlled by this valve is substantially larger than the orifice 72, the chamber 58 will be subjected to substantially atmospheric pressure so that the diaphragm 56 will be balanced.

The chamber 48 being open to atmosphere through vent 50, it is apparent that the fuel pressure in chamber 40 must be equal to atmospheric pressure plus the force of spring 66 to balance the diaphragm 52. If the fuel pressure is too low the diaphragm 52 will move down to open the valve 38 and admit more fuel while if it is too high the valve 38 will tend to close until it falls. Thus fuel will be supplied to the nozzle 46 under a pressure equal to or slightly in excess of atmospheric. This, coupled with the fact that the fuel at nozzle 46 is subjected to a suction of only about six inches of mercury (atmospheric pressure minus 24" absolute in conduit 18) instead of the twenty inches to which it would be subjected if it discharged directly into the conduit 10 (atmospheric pressure minus 10" absolute in conduit 10), eliminates any tendency for the fuel to boil and insures accurate metering thereof by the valve 98.

As the throttle valve 22 is opened the flow of air through the conduit 10 increases and the suction therein decreases and at the same time the valve 98 is opened to increase the flow of fuel. Simultaneously the valve 24 is closed but the suction in the conduit 18 will not increase because its outlet into the conduit 10 is subjected to a decreasing suction.

When the throttle 22 is opened wide the pressure in the manifold 16 will be increased to substantially atmospheric pressure or greater due to operation of the supercharger and the valve 86 will be closed by the diaphragm 88 and spring 93. The pressure in chamber 82 will then rise to substantially atmospheric due to the fact that the vent 84 is of greater capacity than the combined capacities of the orifice 76 and the orifice 78, valve 80 being adustable to regulate to some extent the relative areas of the vents and orifices and consequently the pressure in chamber 82. With the valve 96 closed the pressure in chamber 58 will equal that in conduit 18 due to the connecting passages 68, 70, 72 and 74 and the diaphragm 56 will be subected to a pressure differential tending to open the fuel valve 38. Since this force must be balanced by fuel pressure in the chamber 40, the fuel pressure will be correspondingly increased to increase the flow through nozzle 46 and provide a richer mixture.

When the throttle 22 is wide open the suction in conduit 10 is very low, approximately one inch of mercury. Since the valve 24 is closed the same suction will prevail in the conduit 18 and will be transmitted to the chamber 58. Thus at open throttle the fuel pressure will be increased by an amount substantially equal to the suction in the air conduit.

It will be noted from the above that the fuel nozzle is not subjected to a very wide range of suction as is the case in an ordinary carburetor, particularly a carburetor having an anterior throttle. On the contrary the maximum variation in suction at the nozzle discharge does not exceed five or six inches of mercury, or between fifteen and twenty percent, as opposed to a variation of approximately twenty inches of mercury or nearly seventy percent in an ordinary carburetor. Accordingly the range of control required of the valve 98 is correspondingly less than in an ordinary carburetor and the fuel can be metered much more accurately.

Between the idling and open-throttle positions are an infinite number of throttle adjustments in the normal operating range in which the main throttle 22 occupies some position between fully closed and fully open. In these positions the valves 86 and 96 may occupy a partially open position to cause a pressure in the chamber 58 somewhere between atmospheric and that existing in the conduit 10. Thus the fuel pressure will be slightly increased to increase the flow from the nozzle 46.

Since the bellows 94 is sealed at a pressure of about 30" of mercury, or atmospheric pressure at sea level, it is sensitive to changes in barometric pressure due to changes in altitude. If the device is employed on an aircraft which rises above sea level, the reduced barometric pressure around the bellows 94, even with the valve 86 closed, will cause it to expand partially to open the valve 96. This will reduce the suction in chamber 58 to produce a corresponding reduction in fuel pressure so that the mixture will be leaner. Thus decreasing density of the air is automatically compensated for and a correct mixture is maintained.

It will be understood that in actual practice the vents 48, 64, 84 and the vent controlled by valve 96 are connected to the air inlet conduit 10 to be subjected to the pressure of the incoming air therein. This pressure is normally greater than atmospheric due to impact on the usual air scoop or to increased pressure due to a supercharger.

While only one embodiment of the invention has been shown and described it will be apparent that many changes could be made therein and it is not intended that the scope of the invention

shall be limited to the form shown or otherwise than by the terms of the appended claims.

What is claimed is:

1. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, means to supply fuel to said nozzle under positive pressure, and means responsive to the suction in one of said conduits to control the pressure of the fuel at the fuel nozzle.

2. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, means to supply fuel to said nozzle under positive pressure, and means responsive to the suction in said mixture conduit to control the pressure of the fuel at the fuel nozzle.

3. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, means to supply fuel to said nozzle under pressure, and means responsive to the suction in said mixture conduit to control the fuel pressure at the fuel nozzle.

4. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, a valve controlling said fuel nozzle, means controlled by said operating means to control said valve, and means to supply fuel under positive pressure to said nozzle.

5. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, a valve controlling said fuel nozzle, means controlled by said operating means to control said valve, means to supply fuel under positive pressure to said nozzle, and means responsive to the suction in said mixture conduit to control the fuel supply means to vary the fuel pressure.

6. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, a valve controlling said fuel nozzle, means controlled by said operating means to control said valve, and means to supply fuel under positive pressure to said nozzle, a pressure responsive regulating device to control the fuel pressure, a connection from said regulating device to the mixture conduit, a valve controlling communication of said connection with atmosphere, and means responsive to air density to control said valve.

7. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, a valve controlling said fuel nozzle, means controlled by said operating means to control said valve, and means to supply fuel under positive pressure to said nozzle, a pressure responsive regulating device to control the fuel pressure, a connection from said regulating device to the mixture conduit, a valve controlling communication of said connection with atmosphere, and means including a device responsive to manifold pressure to control said valve.

8. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, throttle valves in said conduits anterior to the points of fuel discharge and of fuel mixture discharge respectively, means for operating said throttle valves simultaneously to open one and close the other, a valve controlling said fuel nozzle, means controlled by said operating means to control said valve, and means to supply fuel under positive pressure to said nozzle, a pressure responsive regulating device to control the fuel pressure, a connection from said regulating device to the mixture conduit, a valve controlling communication of said connection with atmosphere, means responsive to air density to control said valve, a connection from said last named means to the mixture conduit, and means responsive to manifold pressure to control said last named connection.

9. In a charge forming device, an induction passage, a fuel mixture passage connected in parallel with the induction passage, a fuel nozzle discharging in the mixture passage, means for supplying fuel under pressure to the nozzle, throttles in the induction passage and the mixture passage anterior to the fuel nozzle to the connection between the passages, and a connection between the throttles for opening the mixture passage throttle as the induction passage throttle is closed and vice versa, the effective cross section of the mixture passage being small relative to that of the induction passage so that the suction existing within the mixture passage and effective at the nozzle will fluctuate within narrower limits than the suction in the induction passage posterior to the throttle thereof, and means responsive to suction within the mixture passage to control the pressure of fuel supplied to the nozzle.

10. The invention defined in claim 9 wherein the suction within the mixture passage is modified by barometric pressure for controlling the pressure of fuel supplied to the nozzle.

11. The invention defined in claim 9 wherein the means to control the pressure of fuel supplied to the nozzle is jointly responsive to pressure in the mixture passage, to barometric pressure, and to pressure anterior to the induction passage throttle.

12. A charge forming device comprising an air conduit, a throttle controlling said air conduit, a fuel mixture conduit discharging into said air conduit posterior to the throttle, a fuel nozzle discharging into said mixture conduit, means to supply fuel to said nozzle under positive pressure, a pressure responsive regulating device to control the fuel pressure at the fuel nozzle, and a pressure transmitting passageway interconnecting one of said conduits and the regulating device for controlling said regulating device.

13. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, means to supply fuel to said nozzle under positive pressure, a pressure responsive regulating device to control the fuel pressure at the fuel nozzle, a pressure transmitting passageway interconnecting one of said conduits and said regulating device, and means including a valve associated with said passageway for modifying the pressure transmitted to said regulating device.

14. A charge forming device comprising an air conduit, a fuel mixture conduit discharging into said air conduit, a fuel nozzle discharging into said mixture conduit, means to supply fuel to said nozzle under positive pressure, a pressure responsive regulating device to control the fuel pressure at the fuel nozzle, a pressure transmitting duct interconnecting one of said conduits and said pressure responsive regulating device, means including a valve for modifying the pressure transmitted to the regulating device by said duct, and means responsive to variations in air density for controlling said valve.

15. A charge forming device comprising an air conduit, a throttle in said air conduit, a fuel mixture conduit discharging into said air conduit posterior to said throttle, a fuel nozzle discharging into said mixture conduit, a throttle operated valve controlling the flow of fuel from said nozzle, means to supply fuel to said nozzle under positive pressure, and means responsive to the pressure in one of said conduits to control the pressure of the fuel at the fuel nozzle.

16. The invention defined in claim 15 wherein the means to control the pressure of the fuel supplied to the nozzle is jointly responsive to pressure in the said one conduit and to barometric pressure.

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