United States Patent

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[33] **Japan**
[31] **43/21804**

[54] **CONTROL APPARATUS IN AN ENGINE SUCTION CONDUIT TO PREVENT INCREASE IN THE FUEL-AIR RATIO DUE TO ADHERED FUEL ON THE CONDUIT WALLS**
8 Claims, 2 Drawing Figs.

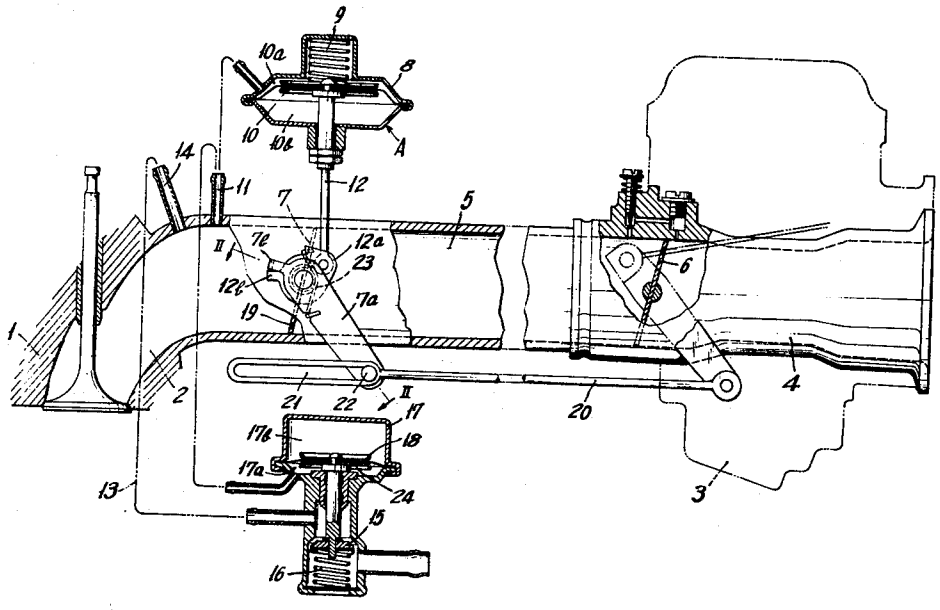
[52] **U.S. Cl.** **123/119,** 123/97, 123/124
[51] **Int. Cl.** **F02m 23/00** F02m 23/02; F02m 23/04
[50] **Field of Search** 123/119D2, 119D, 124, 97B

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Attorney—Waters, Roditi, Schwartz & Nissen

ABSTRACT: A second throttle valve is placed in a suction conduit through which an air-fuel mixture passes to the engine cylinders, the second throttle valve being disposed downstream of a manually operated first throttle valve and being connected to a device which is responsive to the suction pressure prevailing in the conduit when the first throttle valve is closed such that the second throttle valve is also closed, there being an air inlet conduit opening into the supply conduit to supply a measured burst of ambient air into the supply conduit downstream of the second throttle valve to compensate for admission to the cylinders of fuel adhering to the walls of the supply conduit whereby the air-fuel ratio of the mixture supplied to the cylinders is maintained. Additionally, the first and second throttle valves are coupled together and a spring is interposed between the second throttle valve and the device responsive to the suction pressure in the supply conduit so that when the first throttle valve is opened during acceleration, the second throttle valve is opened therewith against the opposition of the spring irrespective of the pressure prevailing in the supply conduit.



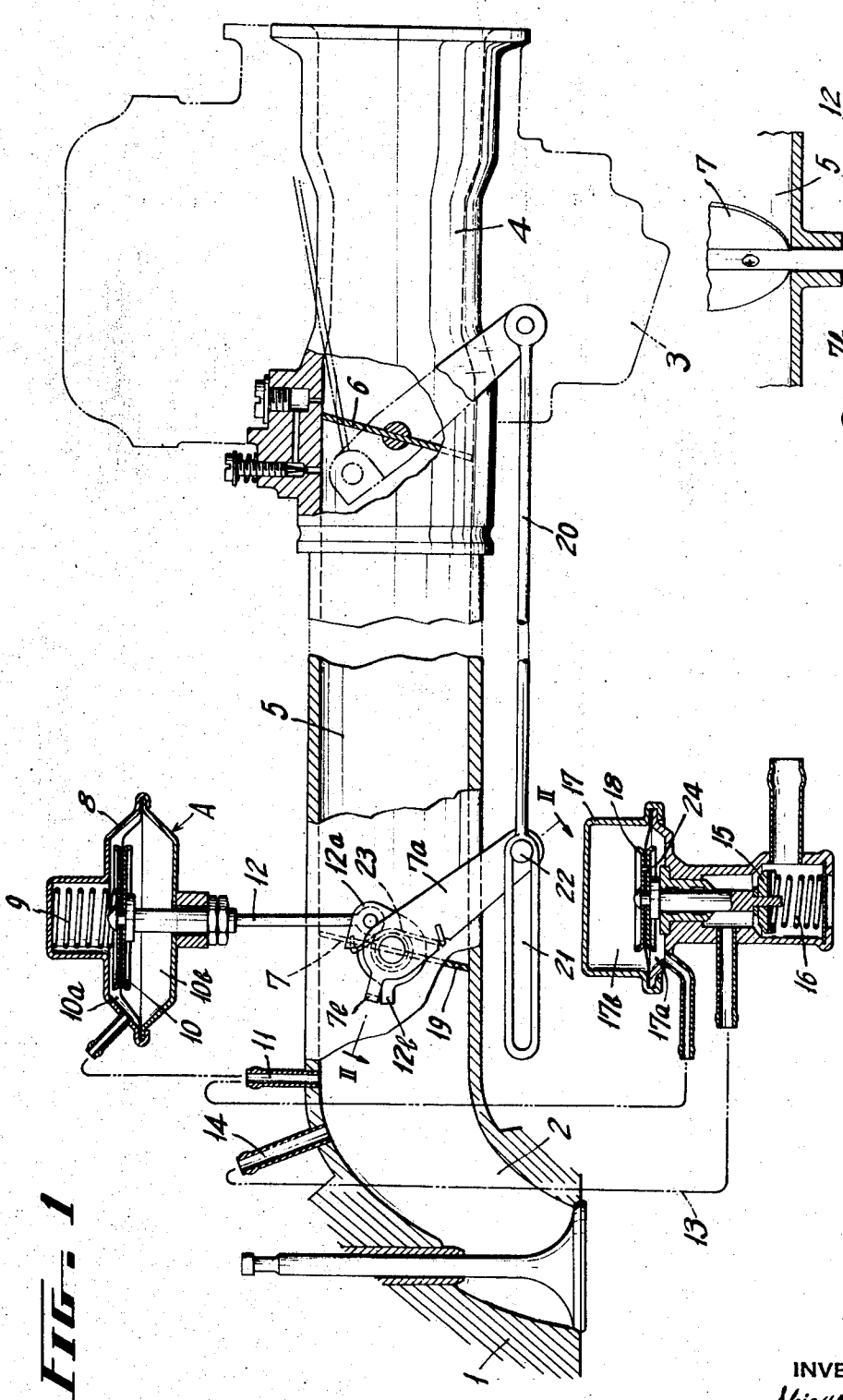


FIG. 1

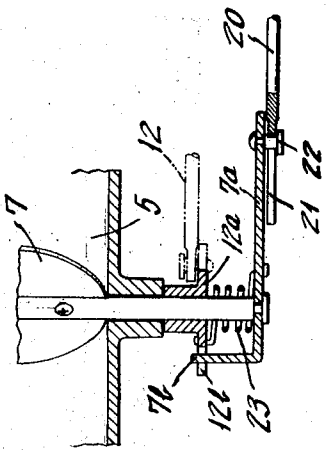


FIG. 2

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CONTROL APPARATUS IN AN ENGINE SUCTION CONDUIT TO PREVENT INCREASE IN THE FUEL-AIR RATIO DUE TO ADHERED FUEL ON THE CONDUIT WALLS

BRIEF SUMMARY OF THE INVENTION

It is usual in an internal combustion engine that when the engine is operated, liquid fuel adheres to the inner surface of the walls of the suction conduit thereof. Consequently, when the throttle valve is closed at the time of an engine brake operation, the adhering fuel is induced by the large negative pressure which is produced to flow into the engine cylinders so that the fuel-air ration is greatly increased and may produce unfavorable and irregular combustion.

In order to overcome this, it is known to employ a second throttle valve in the fuel-air mixture supply conduit downstream of the conventional, manually operated first throttle valve. This second throttle valve is connected to a device which at the time of an engine brake operation causes the second throttle valve to be closed by the negative pressure prevailing in the conduit due to the closing of the first conduit.

This known apparatus, however, is deficient in that, though the adhered fuel within the conduit upstream of the second throttle valve is prevented from flowing into the engine cylinders, the adhered fuel within the conduit downstream of the second throttle valve cannot be intercepted and it flows into the engine cylinders as in the conventional arrangement to still cause an increase in the fuel-air ratio.

The known apparatus is additionally deficient in that when the first throttle valve is then opened for acceleration, the second throttle valve remains closed and is not opened immediately due to the fact that the negative pressure operated apparatus is still in an operative condition by the negative pressure which initially remains, whereby rapid acceleration cannot be obtained.

An object of this invention is to provide a second throttle valve arrangement as above which is free from the deficiencies as mentioned hereinbefore and is characterized in that, an air supply conduit which opens into the interior of the passage for the fuel-air mixture downstream of the second throttle valve is opened only at the initial stage of the period when the second throttle valve has been closed to supply ambient air to said passage and hence maintain the fuel-air ratio in said passage. Additionally, the first throttle valve and the second throttle valve are connected together and there is interposed between the second throttle valve and the negative pressure operated device a spring for allowing a relative opening movement of the second throttle valve so that when the first throttle valve is opened, the second throttle valve is opened therewith against the opposition of said spring.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view partially broken away and in section of one embodying example of this invention; and

FIG. 2 is a sectional view taken along line II–II in FIG. 1.

DETAILED DESCRIPTION

Referring to the drawing, numeral 1 denotes the body of an internal combustion engine, and numeral 2 denotes a suction opening thereof, which is in communication with a carburetor 3 and an air cleaner (not shown) to receive external air by means of a suction pipe 4. The suction pipe 4 has a section 5 in which a fuel-air mixture travels to the suction opening 2. A manually operable throttle valve 6 in the carburetor 3 constitutes a first throttle valve and a second throttle valve 7 is provided downstream of valve 6. At the time of an engine brake operation when the first throttle valve 6 is closed, a large negative pressure is produced in the passage 5 downstream of valve 6. A negative pressure operated apparatus A is adapted to close the second throttle valve 7 by the negative pressure existing in passage 5. The negative pressure operated apparatus A comprises a casing 8 whose interior is divided into upper and lower chambers 10*a* and 10*b* by a diaphragm 10 urged downwards by a spring 9, and the interior of the upper chamber 10*a* is in communication with a negative pressure responsive opening 11 formed in the pipe 4 downstream of the second throttle valve 7. The diaphragm 10 is connected to the second throttle valve 7 through a connecting rod 12. Thus, when a negative pressure is produced when the first throttle valve 6 is closed at the time of an engine brake operation, the pressure in the interior of the chamber 10*a* drops to elevate the diaphragm 10, causing the second throttle valve 7 to undergo a closing operation through the connecting rod 12.

When the second throttle valve 7 is closed, any fuel adhering to the walls of section 5 of pipe 4 upstream of valve 7 is prevented from flowing into the engine 1 side but adhered fuel within the pipe 4 downstream of valve 7 cannot be prevented from entering the engine and this fuel acts to increase the fuel density in the air fuel mixture to unfavorably influence combustion. To prevent this the following arrangement is provided. Namely, the passage 5 downstream of the valve 7 is provided with an air supply opening 14 which is in communication with the outside air through a passage 13, so that by the produced negative pressure, external air is supplied to passage 5 through the opening 14 for preventing an increase in the fuel-air ratio of the mixture.

If, however, the external air supply is continued, then the fuel-air ratio will decrease which also causes unfavorable combustion in the engine. The following arrangement is provided to prevent this. Namely, the passage 13 is provided with a valve 15 for opening and closing the same, and the valve 15 is urged to its closing side by a spring 16. The valve 15 is connected to a diaphragm 18 contained within a casing 17 so as to define lower and upper chambers 17*a*, 17*b*. The lower chamber 17*a* is in communication with the negative pressure responsive opening 11 and the chamber 17*b* is also in communication with opening 11 through a small opening 24 in the diaphragm 18. Thus, if a negative pressure is generated, the diaphragm 18 is lowered to open the valve 15 against the action of spring 16, so that the interior of the passage 5 is supplied with external air. As the upper and lower chambers 17*a* and 17*b* within the casing 17 then become equalized in pressure through the small opening 24, the diaphragm 18 loses the bias force caused by the negative pressure, so that the valve 15 is brought into a closed position by the action of spring 16 to terminate the external air supply automatically.

If the second throttle valve 7 is designed to be of such an airtight sealing type that the front and rear thereof are fully sealed tightly in its fully closed position, then in the case when the engine brake operation with the valve 7 closed is continued, that portion of the passage 5 downstream of valve 7 cannot be supplied with any fuel at all resulting in dryness of the walls of passage 5, so that when a burst of fuel-air mixture is then supplied for acceleration power, the fuel contained in the mixture is attracted to the dry walls which may produce an accidental fire in the engine and the acceleration becomes rough. To prevent this, the valve 7 itself is provided with a small hole 19 providing communication between the front and rear thereof. Alternatively, the valve 7 is constructed to provide a gap between the periphery thereof and the wall of the passage 5 in its fully closed position, so that fuel-air mixture may be passed even when the valve 7 is fully closed.

It is desirable that, when the first throttle valve 6 is opened for acceleration, the second throttle valve 7 is also opened in accordance therewith even if the negative pressure operated apparatus A remains in its operative condition. For satisfying this requirement, the following arrangement is made. Namely, a link 20 connected at one end with the first throttle valve 6 is connected at its other end with the second throttle valve 7 through a long opening 21 and a pin 22, and a spring 23 is interposed between an arm 7*a* connected to the second throttle valve 7 and an arm 12*a* connected to the rod 12 so that the valve 7 can be opened against the opposition of spring 23 even when the rod 12 is in its elevated position. If, accordingly, the first throttle valve 6 is opened from the condition illustrated in

FIG. 1, the second throttle valve 7 is also opened against the opposition of spring 23 through the link 20, whereby the negative pressure downstream of the valve 7 is decreased and this influences the diaphragm 10 through the negative pressure responding opening 11 to cause downward movement of diaphragm 10 by the spring 9, thus conforming to the now open position of valve 7, Numerals 7*b* and 12*b* denote engaging flanges projecting respectively from the arms 7*a* and 12*a*.

The operation of the apparatus will next be explained in the following.

If the first throttle valve 6 is closed for engine braking, a negative pressure is produced downstream of valve 6 and the pressure influences the diaphragm 10 through the negative pressure responding opening 11 to close the second throttle valve 7.

Accordingly, the valve 7 serves effectively to prevent the liquid fuel previously adhered to the walls of the passage 5 from flowing into the engine 1 by the negative pressure.

The valve 15 is opened soon after the closing of the valve 7, so that the portion of the passage 5 downstream of valve 7 will be supplied with external air and thereby any increase of the fuel-air ratio by adhering fuel on the walls of passage 5 downstream of valve 7 is prevented. The valve 15 is then closed automatically with a slight delay, so that continued supply of external air is prevented.

If the first throttle valve 6 is then opened for acceleration, the second throttle valve 7 is also opened in accordance therewith even if the negative pressure operated apparatus is kept in its operative condition by the negative pressure which instantaneously remains and thus a rapid acceleration is obtained.

Thus, according to this invention, increase of the fuel-air ratio by adhered fuel upstream of the second throttle valve 7 is prevented by the closing of said valve and further, increase of the fuel-air ratio by adhered fuel downstream of the second throttle valve 7 is prevented by the external air supply to the passage downstream of valve 7, so that the influence of the adhered fuel can be substantially decreased. The supply of the external air is made only at the initial stage of the period after the closing of the second throttle valve, so that excessive decrease of the fuel-air ratio due to the continual supply of the external air is prevented. Additionally, the second throttle valve is opened at the same time that the first throttle valve is opened for acceleration, so that the acceleration response is not adversely affected by the second throttle valve.

We claim:

1. In an engine having a main conduit for the supply of a fuel-air mixture thereto: a first throttle valve movable between open and closed positions for controlling flow of the fuel-air mixture in the conduit, a second throttle valve in said conduit downstream of the first throttle valve, said first throttle valve producing substantial suction pressure in said conduit when closed, means responsive to the suction pressure in said conduit and coupled to the second throttle valve to close the second throttle valve when the first throttle valve is closed, and means responsive to the suction pressure in the conduit to introduce ambient air into the conduit downstream of the second throttle valve when the first throttle valve is closed, said means for introducing ambient air into said conduit comprising means for terminating the introduction of the air shortly after such introduction.

2. In an engine as claimed in claim 1 wherein said means for introducing ambient air into said conduit comprises an air supply conduit, and valve means controlling introduction of ambient air into said air supply conduit.

3. In an engine as claimed in claim 2 wherein said valve means comprises a connection with said main conduit to enable the valve means to be operated by the suction pressure prevailing in the main conduit when said first throttle valve is closed.

4. In an engine as claimed in claim 3 wherein said valve means comprises a casing and a diaphragm in said casing dividing the same into first and second chambers, spring means acting on said diaphragm to urge the same in a direction to close said valve means, one of said chambers being coupled with said connection so as to be subjected to the pressure in the main conduit, to open the valve means against the opposition of the spring means, by the suction pressure in the main conduit when the first throttle valve is closed, said means for terminating the introduction of ambient air into the main conduit being constituted by an opening in said diaphragm to provide communication between the chambers and hence equalize the pressure therebetween a short time after said one chamber has been subjected to said suction pressure in the main conduit.

5. In an engine as claimed in claim 1 comprising means coupling said first and second throttle valves to cause the second throttle valve to be opened concurrently with the first throttle valve irrespective of the suction pressure prevailing in the main conduit.

6. In an engine having a main conduit for the supply of a fuel-air mixture thereto: a first throttle valve movable between open and closed positions for controlling flow of the fuel-air mixture in the conduit, a second throttle valve in said conduit downstream of the first throttle valve, said first throttle valve producing substantial suction pressure in said conduit when closed, means responsive to the suction pressure in said conduit and coupled to the second throttle valve to close the second throttle valve when the first throttle valve is closed, and means coupling said first and second throttle valves to cause the second throttle valve to be opened concurrently with the first throttle valve irrespective of the suction pressure prevailing in the main conduit, said means coupling the first and second throttle valves comprising a link connecting said throttle valves, and spring means between said second throttle valve and said means which closes the second throttle valve in response to the suction pressure in said main conduit whereby, when the first throttle valve is opened, the second throttle valve is simultaneously opened against the opposition of said spring means.

7. In an engine as claimed in claim 6 wherein said means which closes the second throttle means comprises a casing, a displaceable diaphragm in said casing dividing the same into first and second chambers, means coupling the diaphragm with said second throttle valve to operate the latter in accordance with displacement of the diaphragm, a spring acting on said diaphragm to urge the same in a direction tending to open the second throttle valve, and means connecting one of the chambers with the main conduit to provide communication therebetween such that suction pressure in the main conduit will act in said one chamber and displace the diaphragm against the action of the spring and cause the second throttle valve to close.

8. In an engine as claimed in claim 7 wherein said second throttle valve has an opening therein providing communication in said main conduit upstream and downstream of the second throttle valve.