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INTERNAL COMBUSTION ENGINE

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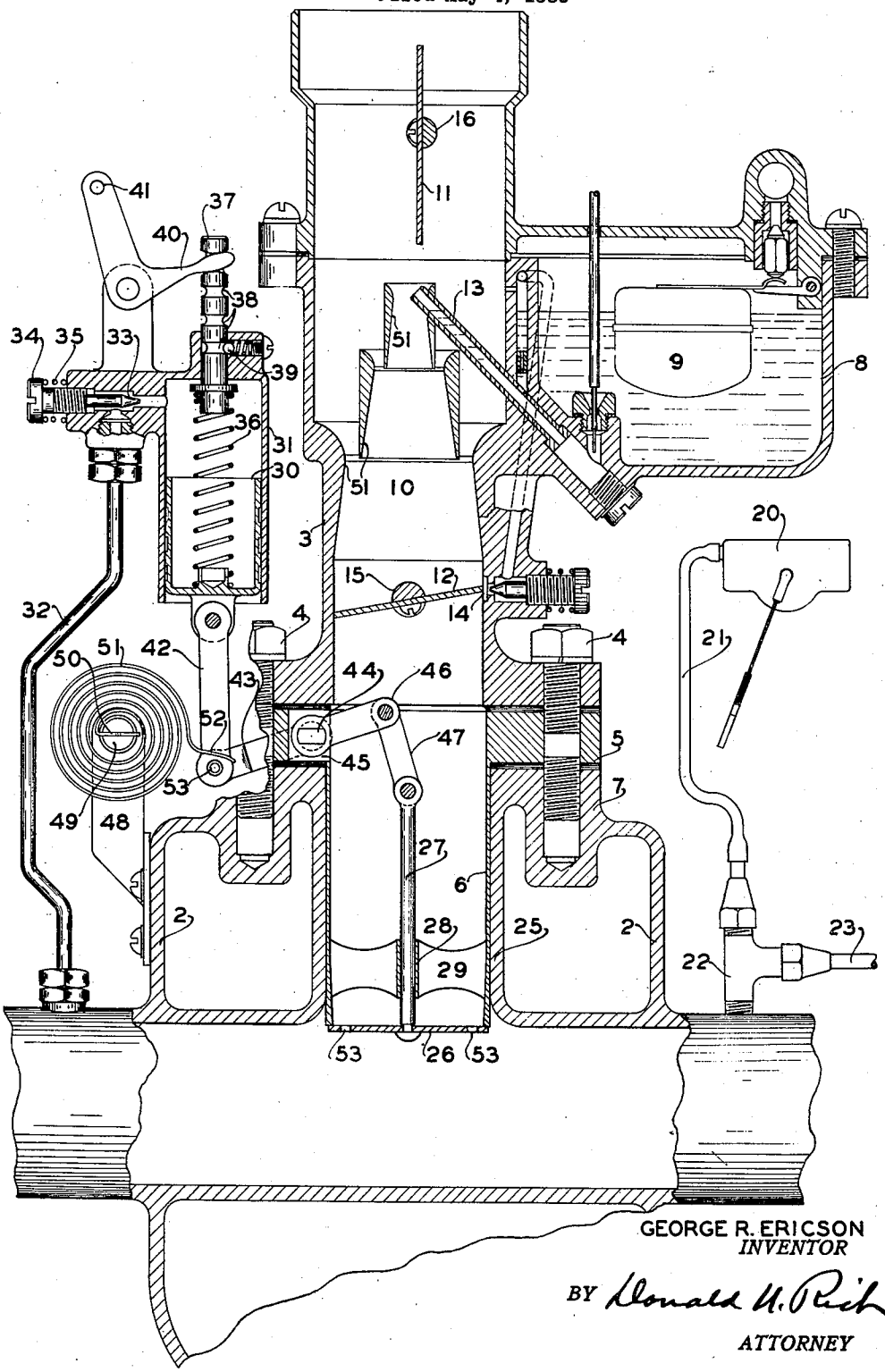

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INTERNAL COMBUSTION ENGINE

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25 Claims. (Cl. 123—103)

This invention relates to internal combustion engines, and more particularly to devices for controlling the quantity of fuel mixture which may be introduced into the cylinders under certain conditions.

It is well known that the power, speed and efficiency of engines may be increased by increasing the compression ratio, but the degree to which the ratio can be increased is limited by the tendency of the fuel mixtures to detonate or "knock." Such detonation is a well known problem in modern high compression engines, and special fuels have been used for the purpose of reducing the tendency to detonate. With the use of such fuels the compression ratio of an engine can be slightly increased without any greater detonation than would have occurred with the same engine and with the slightly lower compression ratio with the use of ordinary fuel. But even with the best non-detonating fuels the compression ratio cannot be satisfactorily increased to the point of highest efficiency, and present day engines are designed with the idea of compromising between reasonable freedom from detonation and reasonably high efficiency. Of course, the type of fuel to be used must also be taken into consideration, because "anti-knock" fuels are expensive, and the user of an automobile may prefer to use the cheaper "straight" fuels.

The objectionable detonation occurs only during certain special driving conditions, such as hill climbing at low speed, and acceleration. These conditions probably obtain during less than five percent of the time in the normal operation of an automobile. When the engine is being operated at high speeds, even when the throttle valve is wide open, the tendency to detonation is materially reduced by the fact that the carburetor and the fuel mixture inlet valve ports present such restrictions as to prevent the admission of full charges to the cylinders, so that the charges are not so highly compressed prior to ignition, and therefore, are not so likely to detonate.

I have found that detonation occurs more readily when the engine is hot, probably due to the fact that the expanding effect of the heat on the fuel mixture increases the compression, so that an engine will operate satisfactorily on a much higher compression ratio when the temperature is low than would be so under high temperature conditions.

Another problem in the design of the internal combustion engine is the proper vaporization and distribution of the fuel during low speed operation, particularly at low temperatures. When the throttle is open and the engine speed is low, substantial quantities of liquid fuel are discharged into the intake manifold and if there is neither sufficient heat nor velocity of the air stream to vaporize this fuel, the distribution will be uneven and the operation of the engine will be very unsatisfactory.

Another difficulty which occurs in the operation of automotive internal combustion engines is that such devices as windshield wipers, fuel supply device, and brake boosters are frequently dependent on the suction in the intake manifold for motive power, and when the throttle is opened wide at low speeds, these devices fail to operate.

It is an object of this invention to prevent the introduction of a sufficient charge to the cylinders to cause detonation without substantially restricting the supply of mixture to the engine under conditions which would not cause detonation.

It is a further object of this invention to provide a device for restricting the flow of fuel mixture to the cylinders when the throttle is not in closed position and when the speed of the engine is low.

It is a further object of this invention to provide a device for maintaining a substantial predetermined vacuum in the intake manifold at all times during the operation of the engine under its own power without interfering with the flow of the mixture to the cylinders whenever, due to the closing of the throttle or due to the high speed at which the engine is being operated, such predetermined vacuum exists in the manifold.

It is a further object of this invention to provide a device of the character described in the preceding paragraph and having means for varying the restricting effect thereof in accordance with the temperature.

It is a further obect of this invention to provide a device which will improve the vaporization and distribution of fuel in starting and in low temperature and wide open throttle conditions.

It is a further object of this invention to provide a device which will insure the maintenance of at least a predetermined degree of suction in the intake manifold whenever the engine is operating under its own power, so as to insure the proper operation of the windshield wiper, brake booster, and other suction operated accessories.

Other objects of this invention will appear from the following description and accompanying drawing, referring to which:

The drawing shows a diagrammatic vertical cross section of an internal combustion engine

carburetor, intake manifold and wind shield wiper having my invention applied thereto.

The reference numeral 1 indicates the intake manifold of an internal combustion engine. This manifold, if desired, may be provided with a heating device such as the exhaust jacket 2, although with the use of my invention it is not necessary to apply as much heat to the mixture as would otherwise be necessary.

A conventional carburetor 3 is attached to the intake manifold or exhaust jacket by means of suitable studs or bolts 4. A flange member 5 having a downwardly extending sleeve 6 formed thereon is mounted between the bottom flange of the carburetor and the upper flange 7 of the intake manifold. It will be noted that the carburetor shown is of the downdraft type but the use of this type of carburetor is not in all respects essential to my invention.

The carburetor may be of any suitable type but preferably comprises a constant level chamber 8 in which the level of fuel is maintained by float 9 and a mixing conduit generally indicated by the reference numeral 10 and having a choke valve 11 and throttle valve 12, fuel being supplied to the mixing conduit from the constant level chamber by means of the main nozzle 13 and low speed nozzle 14, the construction and operation of which are well known to the art. It will be noted that the throttle valve is pivotally mounted in the walls of the mixing conduit by means of the shaft 15 and adapted to be manually operated and that the choke valve is pivotally mounted in the air inlet by means of the shaft 16 which may be operated either manually or automatically.

A windshield wiper 20 shown on a reduced scale is connected to the intake manifold 1 by means of a tube 21 so that the wiper may be operated by suction developed in the manifold. The tube 21 is connected to the manifold by means of a fitting 22 which is also provided with a connection 23 which leads to the brake booster, vacuum tank, and any other suction operated accessories. The construction and operation of these are well known, and since they are not necessary parts of my invention, they are not shown.

The sleeve 6 extends downwardly thru the riser 25 which leads to the inlet manifold in a manner similar to that shown and described in the Bicknell Patent #1,994,011 issued March 12, 1935. It differs from the Bicknell structure, however, in that it is not open and unobstructed but is provided with an inverted poppet valve 26 attached to a vertical shaft 27 which is slidably mounted in a guide 28 in the center of the sleeve. The guide 28 is carried by struts 29 which are attached to the walls of the sleeve and to the guide 28.

The valve 26 is operated by a piston 30 slidably mounted in the cylinder 31, the upper end of which is connected to the intake manifold by means of a tube 32. The effective capacity of the suction connection 32 is adjusted by means of a valve 33 provided with a head 34 having a screw driver slot for manual adjustment, a spring 35 or other locking device is provided to keep the valve in adjusted position. A compression spring 36 is mounted in the cylinder 30 and normally tends to hold the piston in the lower position as indicated.

The upper end of spring 36 is attached to an adjustment rod 37 for the purpose of varying its length and thereby its pressure. The rod 37 is provided with grooves 38 for coincidence with the ball detent 39 and may be positioned manually or by any suitable means, such as a Bowden wire or linkage (not shown) from the dash board thru rocker arm 40 and attached at 41. The piston 30 is connected by means of a link 42 to a lever 43 which is fixedly mounted on a rotatable shaft 44. The shaft 44 extends from the outside of the flange 5 at which point it is connected to the lever 43 to the inside of the same flange where it terminates in a recess 45 and is rigidly attached to a lever 46 which is connected by means of a link 47 to the shaft 27. It will be noted that the lever 43 is longer than lever 46, so that the diameter of the piston 30 need not be excessive.

Mounted on the exhaust jacket 2 is a bracket 48 which carries a short shaft 49. The shaft 49 is provided with a slit 50 in which is fixed the inner end of a thermostatic coil 51. The outer end 52 of the coil projects over an extension of the pin 53 which serves as a pivot connection between link 42 and lever 43 so that when the temperature is high the coil 51, tending to rotate in a clockwise direction will add additional resistance to the opening of valve 26. It will be understood that the coil 51 may be a conventional bi-metallic thermostatic coil constructed and arranged to rotate in a clockwise direction when the temperature is increased in a manner well known in the art. The coil end 52 may be slitted if desired so that it may rest on the opposite ends of the pin 53, the lever 43, and the link 42 being located between the prongs of the fork.

While the relative strengths of the spring 36 and the coil 51 may be varied as desired to suit the requirement of a particular type of engine, I prefer to construct the spring 36 in such a manner as to provide sufficient resistance to the opening of the valve during operation in the lower ranges of temperature to insure vaporization of the mixture in accordance with the method outlined in my previously filed application #676,087 filed June 16, 1933, which matured into Patent No. 2,093,960, granted September 21, 1937, while in the higher ranges of temperature wherein detonation becomes more pronounced the additional resistance to the opening of the valve is provided as required by the clockwise rotation or unwinding of the coil 51.

It will be understood that in the use of present day fuels which vary greatly in their anti-knock qualities, means for adjustment of the resistance to valve opening to compensate for these variations in fuel is necessary. I prefer to do this by the adjustment of spring 36 in a manner heretofore described. For fuels having high anti-knock qualities the device is adjusted to the position shown in the drawing, in which the restricting effect of the valve 26 is small. For fuels having lower anti-knock qualities, more pressure is added.

The diameter of the piston 30 and cylinder 31 may be varied in accordance with the relative lengths of the levers 43 and 46 and the diameter of the valve 26, but I prefer to construct and arrange the relative proportions of these members together with the strength of the spring 36 and the pressure adjusting device so that a suction of ½ lb. per sq. in. to 3 lbs. per sq. in. existing in the manifold will be sufficient to cause the opening of the valve 26 to such a point that it will not interfere with the flow of fuel mixture into the manifold.

The relative sizes of the parts indicated in the drawing should not be construed as a limitation, but merely as an indication of the relative

sizes of parts in one type of device which has been successfully operated.

In operation, assuming the temperature to be low, the valve **26** is held in closed position by the spring **36**. When the engine is cranked suction would be applied not only to the piston **30** thru the pipe **32** but also to the head of the valve **26** thereby causing a slight opening of the valve to permit the transmission of suction to operate the carburetor. Drops of liquid fuel falling on the head of the valve **26** are quickly vaporized by the air stream which attains a high velocity as it flows thru the crack between the lower end of the sleeve **6** and the slightly opened valve thereby securing better distribution and vaporization of the mixture. When the engine starts to run under its own power if the throttle valve is open to a substantial extent, the valve **26** will remain in a nearly closed position thereby securing excellent vaporization. If the throttle valve is closed, a very high suction would be built up in the manifold sufficient to draw the piston **30** to its uppermost position and open the valve **26** to a point at which it will not interfere with the flow of fuel mixture to the engine. It will be understood, of course, that the valve **26** is not capable of improving the vaporization under these conditions but it is not necessary that it should do so because when the throttle is in closed position, the air stream attains a high velocity around its edges so that the fuel is efficiently vaporized.

After the engine has been thoroughly warmed up, the heat responsive device **51** is effected by the heat of the exhaust manifold or jacket and its tendency to assist the action of the spring **36** is increased so that if the throttle valve **12** is held in open position with the engine operating at low speed, the valve **26** is caused to present a substantial restriction to the flow of mixture into the manifold so that the cylinders are not filled with fuel mixture at atmospheric pressure but with a mixture at such a reduced pressure that objectionable detonation will not occur.

If the throttle is held in open position and the sped of the engine increases, the various restrictions in the mixing conduit the valve ports and particularly the venturi **51** is so great as to cause the pressure in the intake manifold to fall below that of the atmosphere and eventually below the predetermined pressure for which the valve is set. This tends to reduce the restricting effect of the valve **26**, and at maximum speeds eliminates it altogether, it being noted that the pressure of the atmosphere acts on the lower end of the piston **30** while the upper end of the piston is affected by the suction existing in the intake manifold due to the connection **32**.

The vaporizing valve **26** is located at a bend or branched portion of the intake manifold and directly receives the force of the gaseous mixture stream which would otherwise strike the bottom of the transverse portion. This change of direction dissipates a portion of the kinetic energy in the fluid stream, but this energy, otherwise lost, is partially relied upon to open the valve in varying degrees as determined by the rate of flow. The poppet valve thus functions to direct the mixture stream evenly through the branched portions of the manifold.

It will be seen that I have provided a device which is capable of insuring the maintenance of at least a predetermined vacuum in the manifold under all conditions of operation so that the compression ratio may be increased without increasing detonation and so that the windshield wiper and other vacuum operated accessories will be kept in operation whenever the engine is running under its own power.

In certain installations it may be desirable to provide some means of bypassing the valve **26** or preventing its absolute closing. For instance if the inlet and exhaust valves of the engine do not seat properly it may be incapable of producing any substantial vacuum while it is being cranked although it may run fairly well under its own power. Under such conditions there would be no means of starting the engine. I, accordingly, provide one or more small openings **53** which do not have any appreciable effect on the operation of the engine under its own power but which will permit the starting of the engine under the above described condition.

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, an intake passage, a flow controlled valve for controlling the admission of fuel to said intake passage and a heat responsive device for urging said valve toward closed position when the engine is heated to its normal operating temperature.

2. In an internal combustion engine, an intake passage, a carburetor for supplying fuel mixture to said intake passage, a manually controlled throttle valve for said carburetor, a second valve mounted posterior to said throttle valve for controlling the flow of fuel mixture to said engine, a heat responsive device for influencing the operation of said second valve under normal operating temperatures, and suction controlled means for further influencing the operation of said second valve.

3. In an internal combustion engine, a fuel mixture inlet passage, a carburetor for supplying fuel mixture to said inlet passage, and means to assist in vaporizing liquid fuel and for resisting excessive drop in suction in said passage during operation of the engine comprising a flow controlled valve mounted in said fuel mixture inlet passage posterior to said carburetor, and a suction operated piston for influencing said suction operated valve.

4. In an internal combustion engine, a fuel mixture inlet passage, a carburetor for supplying fuel mixture to said inlet passage, a suction operated valve mounted in said fuel mixture inlet passage posterior to said carburetor, a suction operated piston for influencing said suction operated valve, and a heat responsive device for further influencing said suction operated valve.

5. In a device of the class described, an intake manifold, a suction operated device connected thereto for operation by suction existing therein, said manifold having a fuel mixture inlet, a carburetor for supplying fuel mixture to said mixture inlet, said carburetor having a manually operated throttle valve at its outlet, a suction-influenced valve mounted between said carburetor and said intage manifold, a suction operated piston connected to said suction-influenced valve and tending to open it when suction is applied to said piston, and a suction connection for applying suction derived from said intake manifold to said suction operated piston.

6. In a device of the class described, an intake

manifold, a suction operated device connected thereto for operation by suction existing therein, said manifold having a fuel mixture inlet, a carburetor for supplying fuel mixture to said mixture inlet, a manually operated throttle valve for said carburetor, a second valve mounted between said throttle valve and said intake manifold, a suction operated piston connected to said second valve and tending to open it when suction is applied to said piston, and a suction connection for applying suction derived from said intake manifold to said suction operated piston, and a heat responsive device for influencing the action of said suction operated piston.

7. In a device of the class described, an intake manifold having a fuel mixture inlet and a branched portion, means for supplying fuel mixture to said inlet, a poppet valve mounted at said branched portion and directly in line with said inlet, a suction operated piston, and a connection between said piston and said poppet valve whereby said piston affects said valve in inverse proportion to the absolute pressures in said manifold so as to function as a vaporizer at low suctions.

8. A device as specified in claim 7 further including means yieldingly resisting opening of said valve, said piston being exposed to suction in said manifold and connected to said valve so as to open the same upon increases in suction in said manifold.

9. A device as specified in claim 7 further including spring means urging said piston in one direction, said piston being exposed to suction in said manifold and to the atmosphere and connected to said valve whereby force is applied tending to open said valve against said spring means upon increases of suction or flow in said manifold.

10. In an internal combustion engine having an intake manifold, said manifold including transverse passages and an inlet passage connected at an angle to said transverse passages, said inlet passage being provided with valve means for restricting the flow of mixture therethrough, said valve means including a seat which is substantially coaxial with said inlet passage, and a valve disposed to direct fuel evenly into said transverse passages and resiliently movable directly proportional to flow and suction in said manifold in a direction parallel to the axis of said inlet passage.

11. In an internal combustion engine having an intake manifold, said manifold including a transverse passage and an inlet passage connected at an angle thereto, means for heating a portion of the wall of said transverse passage, valve means for restricting said inlet passage when the manifold suction is low and by pass means for permitting the flow of a limited amount of fluid from said inlet passage to said transverse passage.

12. Structure as specified in claim 10 further including a device for biasing said valve directly responsive to pressure differences between the interior of said intake manifold and the atmosphere.

13. In an internal combustion engine, an intake manifold, means for supplying fuel mixture thereto, a flow restricting device between said means and said manifold, said device comprising a valve which is yieldably held in flow restricting position and movable toward open position by increase of manifold suction and manual means for selectively varying the restrictive effect of said device during operation of the engine in accordance with engine conditions.

14. In an internal combustion engine, an intake manifold, means for supplying fuel mixture thereto, a flow restricting valve between said means and said manifold, said valve being constructed and arranged to be moved toward non-restricting position in response to increases in engine suction, a spring for urging said valve towards closed position, and readily accessible means for varying the force exerted by said spring in accordance with engine conditions.

15. The combination of elements specified in claim 14 further including means responsive to pressure differences between the atmosphere and the interior of said manifold for influencing said valve in direct proportions to said pressure differences.

16. In an internal combustion engine, an intake manifold having a plurality of transverse passages, and a fuel inlet mixture passage entering said manifold at the junction of said passages, a member mounted at the junction of said passages and substantially concentric with the mixture inlet passage, said member being movable longitudinally with respect to said mixture inlet passage to variably restrict the flow of mixture therethrough, said member being held in non-restricting position when the rate of flow through said manifold is high, and a heat responsive device for controlling a function of said member.

17. In an internal combustion engine, an intake manifold having a plurality of transverse passages, and a fuel inlet mixture passage entering said manifold at the junction of said passages, a member mounted at the junction of said passages and substantially concentric with the mixture inlet passage, said member being movable longitudinally with respect to said mixture inlet passage to variably restrict the flow of mixture therethrough, said member being held in non-restricting position when the rate of flow through said manifold is high, spring means for moving said member toward flow restricting position, and a suction operated device for opposing the force of said spring.

18. In an internal combustion engine having an intake manifold including transverse passages and an inlet passage connecting the same, means for heating portions of the walls of said transverse passages, valve means for yieldingly restricting said inlet passage and disposed to direct the flow of fluid therethrough toward the heated portions of said transverse passage wall, said valve means being constructed and arranged to be moved toward closed position when the suction in said inlet passage is low, and a device for biasing said valve means directly proportional to pressure differences between the interior of said intake passage and the atmosphere.

19. In an internal combustion engine having an intake passage and a fuel mixing device for supplying mixture to said passage, a valve mounted between said device and said passage, yieldable means for holding said valve in a flow restricting position, a suction operated device connected to said valve capable of moving it to open position in response to a predetermined degree of suction.

20. In an internal combustion engine having an intake passage and a fuel mixing device for supplying mixture to said passage, a valve mounted between said device and said passage, yieldable means for holding said valve in a flow restricting position, a suction operated device connected to said valve capable of moving it to open position

in response to a predetermined degree of suction, and readily adjustable means for controlling the predetermined degree of suction to which said valve will respond.

21. In an internal combustion engine, an intake manifold, a fuel and air mixing device for supplying fuel mixture to said intake manifold, a flow controlled valve posterior to said device for controlling the admission of fuel mixture from said fuel mixture supply device to said manifold, said valve being movable toward open position by increases in flow, and a piston operated by manifold suction for moving said valve toward open position upon increases of suction.

22. In an internal combustion engine having an intake manifold, said manifold including transverse passages and an inlet passage connected at angles thereto, means for heating portions of the walls of said transverse passages, and valve means for yieldingly restricting said inlet passage and constructed and arranged to direct the flow of fluid therethrough toward the heated portion of said wall, said valve being constructed and arranged to be moved toward closed position when the manifold suction is low.

23. In a device of the class described, an intake manifold including a part for connection with a carburetor and a portion extending at an angle from said part, a poppet valve extending across the path of flow in said connecting part and movable to variably restrict the opening between said part and said portion, yielding means influencing said valve to maintain a predetermined minimum suction in the manifold, and a piston exposed to suction in said manifold and connected to said valve whereby said valve is moved away from said opening upon increases in either the suction or the flow in said manifold.

24. In an internal combustion engine, a fuel and air mixing device comprising a venturi and fuel discharge passage, an intake passage, a flow-controlled vaporizing valve posterior to said mixing device for controlling the admission of fuel mixture to said passage, means yieldingly resisting opening of said valve, and means operative in direct proportion to the suction in said intake passage posterior to said valve for varying the effect of said means upon said valve.

25. In an internal combustion engine, a carburetor including a throttle valve, an intake manifold, an intake passageway for the final fuel and air mixture between the carburetor and intake manifold, an intermediate valve in said passageway for controlling the flow of said mixture, a cylinder communicating at one end with a region of substantially atmospheric pressure and at the other end with a suction portion of said intake passageway disposed on the engine side of the intermediate valve, a piston positioned within the cylinder and operatively connected to said intermediate valve, and a resilient member exterior of the said passageway and exerting a closing effort on the intermediate valve, the piston being movable within the cylinder under the influence of the depression in said intake passageway against the action of said yieldable member to operably move said intermediate valve.

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