May 14, 1963 L. B. READ 3,089,648

THERMOSTATIC IDLE

Original Filed Dec. 30, 1957

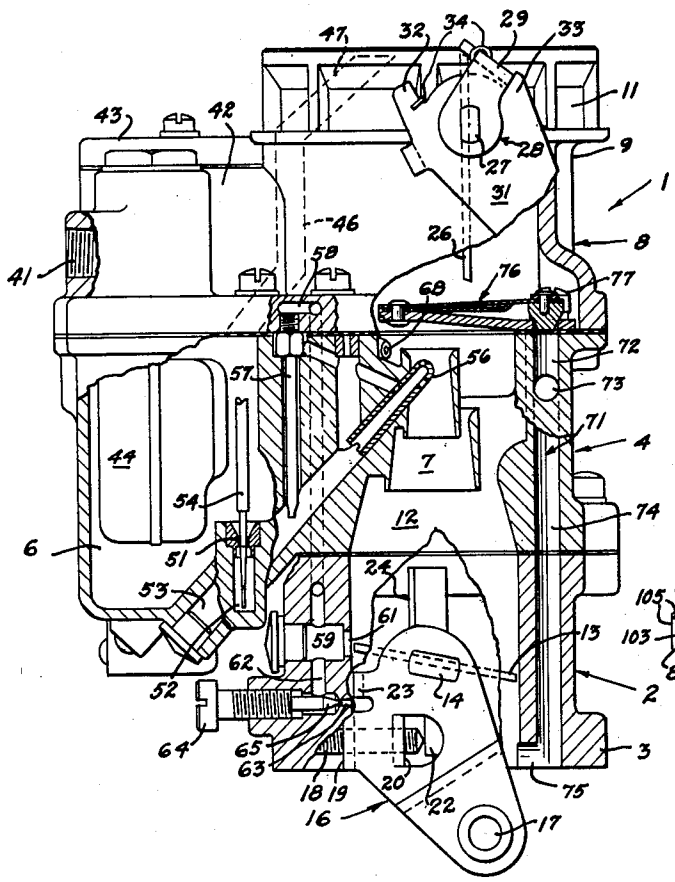


FIG. 1.

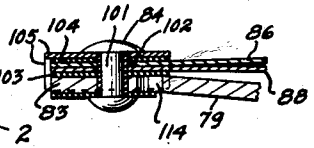


FIG. 3.

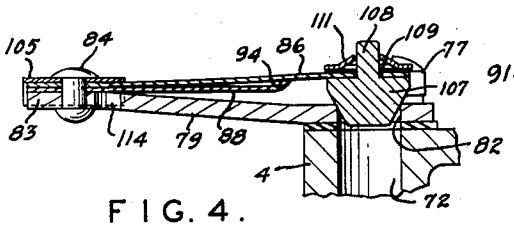


FIG. 4.

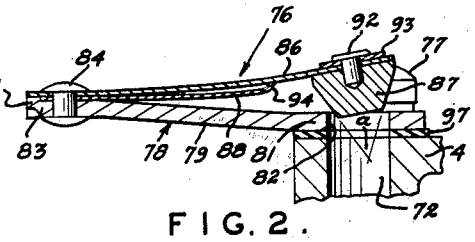


FIG. 2.

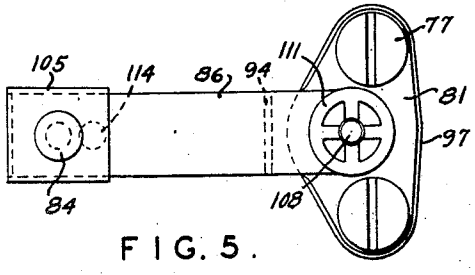


FIG. 5.

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THERMOSTATIC IDLE

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Original application Dec. 30, 1957, Ser. No. 705,983. Divided and this application Dec. 1, 1960, Ser. No. 72,962

2 Claims. (Cl. 236—93)

This invention relates to fuel systems for internal combustion engines, and more particularly to an improved system for maintaining a satisfactory fuel-air combustible mixture during idle operation.

This application is a division of my copending application Serial Number 705,983, filed December 30, 1957, now Patent No. 2,986,380.

In fuel systems for internal combustion engines equipped with carburetors, fuel and air is metered by the carburetor to form a combustible mixture. The mixture is drawn through an induction system into the engine. The induction system includes a carburetor mixture conduit in which the fuel and air is mixed. The mixture conduit normally includes an air horn equipped with an air cleaner for the admission of clean air to the induction system, a choke valve in the air horn, and a throttle valve downstream from the choke valve. Carburetors are normally provided with two basic fuel systems: first, an idle system which functions when the throttle valve is closed or nearly closed to provide a substantially constant, small quantity of fuel for idle operation of the engine; and, second, a high-speed fuel system which provides increased but varying quantities of fuel for operation at varying speeds above idle speed. By opening the throttle valve from the closed position, a transition from the idle fuel system operation to the main fuel system operation is effected. In order that this transition be as smooth as possible, an accelerating fuel pump system is usually provided for furnishing a small additional quantity of fuel during the transition period. All of the fuel systems are usually supplied from a fuel chamber in the carburetor, the level of the fuel in the carburetor being controlled by a float and needle valve assembly. The fuel chamber is normally vented, either to the atmosphere, or by internal vents, such as a balance tube, into the air horn to maintain substantially the same pressure in the air horn and in the fuel chamber.

During idle operation the desired fuel-air mixture is substantially richer to keep the engine operating, as is well understood in the art. Should the fuel-air mixture become too rich during idle operation, the engine will run roughly, and may stall. The mixture ratio provided by the idle fuel system during idle operation is substantially constant and determined by manual adjustments, but certain factors may cause variations. For example, excessive richness can result from fuel vapors passing from the fuel chamber through internal vents and into the air horn, particularly during hot, prolonged idle operation. Also, if the air entering the mixture conduit is overly hot, the air density will be reduced sufficiently that the limited quantity of air mixing with the fuel will provide an idle mixture far too rich for proper engine operation.

Briefly, the present invention relates to a hot idle compensator system for a carburetor provided with a by-pass passage from the air horn to a mixture portion downstream of a substantially closed throttle valve to admit increasing metered volumes of clean air to the mixture portion responsive to increases in air temperature in the air horn during idle operation of an internal combustion engine. The passage is controlled by a temperature responsive metering valve in the air horn. It is desirable that the valve be as nearly as possible responsive only to the temperature of the incoming air, but engine suction also affects its operation. Therefore, when the incoming air temperature is exceedingly high, the valve opens, permitting an additional quantity of air to mix with the fuel from the idle system and provide a smoother, more consistent idle operation of the engine. During idle operation in the normal temperature range, the valve opens responsive to a drop in engine suction to admit additional air to the mixture portion and thereby slightly increasing engine speed.

It is therefore an object of this invention to provide a smoother, more consistent idle operation in an internal combustion engine.

Another object of this invention is to provide an improved fuel system for an internal combustion engine.

Another object of this invention is to assure the admission of sufficient air during idle operation to provide a proper fuel-air combustible mixture for an internal combustion engine throughout a varying range of air temperatures above normal operating temperature.

Another object of this invention is to provide an improved temperature responsive valve for controlling the flow of air or other fluid.

Another object of this invention is to provide an improved temperature responsive metering valve which is simple and inexpensive to manufacture, and is dependable in operation.

Another object of this invention is to provide a simpler and improved anti-stall device for the fuel system of an internal combustion engine.

Additional objects and advantages will be apparent from the following description and drawings, in which:

FIG. 1 is a schematic partial sectional view in elevation of a carburetor illustrating an embodiment of the invention including a temperature responsive valve assembly shown in the closed position;

FIG. 2 is an enlarged sectional view of a portion of FIG. 1, illustrating the valve assembly in an open position;

FIG. 3 is a sectional elevation view of another embodiment of a portion of a valve assembly;

FIG. 4 is a sectional elevation view of still another embodiment of a valve assembly; and

FIG. 5 is a plan view of the valve assembly illustrated in FIG. 4.

Referring to the drawings, FIG. 1 illustrates the operative environment of the invention and one modification of an air valve assembly. A dual barrel carburetor **1** includes a base section **2** having a flange **3** for attaching the carburetor to an intake manifold on an engine (not shown), a body section **4** including a fuel chamber **6** and a venturi cluster **7**, and a cover section **8** including an air horn **9** having a reinforced rim **11** to which an air cleaner (not shown) is secured. Incorporated in the base, body, and cover sections is a pair of mixture or induction conduits **12**, only one of the conduits being illustrated. The base section of mixture conduit **12** has mounted therein a throttle valve **13** fixed to a shaft **14** rotatably mounted in the base section **2**. As illustrated in the drawing, the throttle **13** is in its closed position, and sufficient clearance is provided between the periphery of the throttle and the mixture conduit **12** to permit air to flow around the throttle valve during idle operation of the engine. Other modes of providing air downstream from the closed throttle valve may be substituted for the partially open throttle valve illustrated. For example, the throttle valve may be completely closed and an air by-pass provided around the throttle valve. Such a by-pass is normally provided with an adjusting screw for controlling the amount of air flowing therethrough during idle operation, as illustrated in United States Patent 2,376,228. Fixed to one end of the throttle shaft **14** projecting outwardly from the base section **2** is a control lever **16** having an eye **17** for receiving a control link.

An adjusting screw 18 is threadably mounted in a pair of inturned flanges 19 and 20 on the throttle control lever 16 and engages a stop 22 on the exterior of the base section 2 to permit adjustment for adequate clearance at idle setting between the throttle valve 13 and the mixture conduit 12. The fully open position of the throttle valve is limited by an inturned flange 23 on the throttle lever, and a second stop 24 on the base section 2. The wide-open position of the throttle valve 13 may be adjusted by bending the flange 23 on the throttle control lever 16.

The cover section 8 of the carburetor includes the portion of the mixture conduit 12 providing the air horn 9. Mounted in the air horn 9 is a choke valve 26 secured to a shaft 27 rotatably mounted in the walls of the air horn 9. Fixed to the choke shaft 27 is a small lever 28 having an inturned flange 29. Rotatably mounted on the choke shaft 27 is a larger lever 31 provided with means to receive a connecting control link (not shown). The larger lever 31 has a pair of projecting lugs 32 and 33 between which is received the flange 29 on the smaller lever 28. A spiral spring 34 encasing the choke shaft 27 engages both lug 32 on the large lever 31 and the lug 29 on the small lever 28 to urge the choke valve 26 closed. As shown in FIG. 1, the choke valve 26 is wide open, but, when the choke valve is fully closed, the spring 34 permits a slight opening of the valve for the flow of air through the mixture conduit, responsive to engine suction. If desired, the choke valve 26 may be provided with a conventional thermostatic control for urging the choke valve closed during warm-up, and a conventional suction motor control for opening the choke valve slightly when the engine first fires during starting. The cover section 8 also contains a threaded fuel inlet 41 leading to the fuel chamber 6. A housing portion 42, having a top 43, in the cover section 8 contains various mechanisms to be referred to hereafter.

Mounted in the fuel chamber 6 in the body section 4 is a float valve 44 which controls a needle valve assembly (not shown). The float valve is responsive to rise and fall of the fuel level in the chamber to close and open the needle valve assembly. As illustrated in the drawing, an internal vent 46, in this instance including a balance tube 47, connects the fuel chamber 6 above the normal fuel level and the air horn 9. The purpose of the balance tube is to maintain substantially the same pressure on the fuel in the fuel chamber 6 and in the air horn 9, and compensate for a drop in the pressure of the air as it passes through the air cleaner. Opening into the fuel chamber 6 is a main orifice 51 which is connected by a passage 52 to a main fuel passage 53. A metering rod 54 is received in the main orifice 51 for varying the effective size of the orifice by a mechanism (not shown) in the housing 42. The mechanism is actuated by the position of the throttle valve 13 to admit more fuel when the throttle is open. The main fuel passage 53 terminates in a main nozzle 56 which discharges into the venturi cluster 7. The aforementioned fuel circuit provides fuel for the engine during normal and high-speed operation. During idle operation of the engine, fuel is drawn from the main fuel passage 53 through an idle tube 57, from which it passes through a passage system 58 to a chamber 59 in the base section 2 of the carburetor. A port 61 connects the chamber 59 and the mixture conduit 12 and has a portion opening downstream of the fully closed throttle valve 13. A passage 62 connects the chamber 59 with an idle adjustment port 63. An adjusting screw 64 provided with a needle valve 65 adjusts the effective opening of the port 63. With the throttle valve 13 closed, fuel is drawn through the idle ports 61 and 63 by engine suction. During normal and high-speed operation, the throttle valve 13 is open and fuel is drawn through the main fuel nozzle 56 by the passage of air through the venturi cluster 7.

During the transition from idle to normal operation, the throttle valve 13 is opened from the closed position illustrated in FIG. 1. Upon opening the throttle valve, the idle system gradually ceases to function, and the main fuel system gradually starts to function. An accelerating pump system is provided for adding a slight additional amount of fuel through a nozzle 68 and into the venturi cluster 7, responsive to initial opening movement of the throttle 13 from the closed position. The pump actuating mechanism is contained in the housing 42.

As shown in FIG. 1, an air passage system 71 through the carburetor body and base connects the air horn 9 and the mixture conduits (as 12) downstream from the throttle valves (as 13) in their closed position. The passage system 71 includes a single inlet passage 72 opening into the air horn centrally of the mixture conduits and into a cross-over passage 73, between its ends which connect with branch passages 74 each opening through slots 75 into one of the mixture conduits 12. Only one branch passage 74 is shown. A valve assembly 76 for closing the passage system 71, and for metering the flow of air through the passage system 71, is mounted in the air horn 9, and is secured to the carburetor body 4, preferably by bolts 77.

Referring to FIGS. 2 and 5, this embodiment of the valve assembly includes a substantially T-shaped body 78 having a leg 79 and a head 81. A pair of bolt holes are provided in the head for receiving bolts 77 threaded into the carburetor body 4 to secure the valve assembly to the body. Between the bolt holes is a third hole 82 providing a valve seat and an opening for the passage of air into the air passage 72. Fixed to the foot 83 of the leg 79 by a rivet 84 is one end of a temperature responsive, bimetallic actuating arm 86. Secured to the other end of the arm 86 is a frusto-conical valve 87 which engages the valve seat 82 to close the passage 72. When the assembly is completed, the arm 86 should be arched slightly against its inherent resiliency when the valve 87 is closed against the seat 82. To dampen the actuating arm 86, particularly against vibration and noise, a dampening member or bridge 88 is fixed by the rivet 84 between the actuating arm 86 and the valve body 78. The dampening member 88 is maintained in alignment with the arm 86 by abutting engagement between the end of the dampening member 88 and an offset portion 91 on the body 78. Similarly, the actuating arm 86 may be maintained in alignment by extending the offset 91 on the valve body, but this should not be necessary, because the actuating arm 86 will stay in proper alignment through engagement of the valve 87 fixed to the other end of the arm 86 and the valve seat 82. The valve 87 is rigidly attached to the actuating arm 86 by a rivet 92. Between the head of the rivet 92 and the arm 86 is a washer 93. The dampening member 88 has its end nearest the frusto-conical valve 87 bent up slightly as at 94 to lightly engage the actuating arm 86, which is slightly arched, as previously described.

It is necessary that the bimetal actuating arm 86 and dampening member 88 be responsive, as nearly as practicable, to the temperature of the air in the air horn 9. The valve body 79 should be of low heat conductivity material, as steel, and is insulated from the carburetor body 4 by an insulating gasket 97. In some practical applications, this has been found to provide sufficient insulation so that the actuating arm is not substantially affected by the heat in the carburetor body.

The arm 86 and dampening member or bridge 88 are more completely insulated from the heat of the carburetor body and the valve body, as illustrated in FIG. 3. In this embodiment, the shank 101 of the rivet 84 is completely insulated by an insulating sleeve 102 from the walls of the holes in the body 78, dampening member 88, and actuating arm 86. An insulating member 103 is inserted between the dampening member 88 and the valve body 78. An insulating member 104 is also inserted between the actuating arm 86 and a U-shaped clip 105, to be

further described hereinafter. The lower head of the rivet is also insulated from the valve body 78, and similar insulation may be provided between the upper head of the rivet and the U-shaped clip 105. The insulating member between the valve body and the lower head of the rivet is not absolutely necessary, but retards the flow of heat into the rivet. Gasket 97 would normally also be used with this embodiment.

In the embodiment illustrated in FIGS. 4 and 5, the valve 107 is loosely secured to the actuating arm to permit slight play between the actuating arm 86 and the valve 107 to facilitate proper and automatic alignment of the valve and the valve seat 82. A stem 108 on the valve 107 projects through an enlarged hole 109 in the actuating arm 86, and a "True-Arc" type spring washer 111 grips the stem to permit play in all directions. The stem 108 is substantially smaller than the hole 109 in the actuating arm. In this embodiment it is necessary to control within certain limits the up-and-down movement of the valve 107 with respect to the arm 86 in order to properly calibrate the carburetor. In the preferred embodiment about .005 inch has been found to be satisfactory.

In the embodiment of FIGS. 3–5, alignment of the valve seat 82, dampening member 88, and actuating arm 86 is maintained by a U-shaped clip 105 which engages the side edges of members 86 and 88 and the valve body 78. In FIG. 3 the sides of the U-shaped clip may be insulated from the thermostatic members by suitable insulating material.

It has been found desirable to form the frusto-conical cone faces of the valves 87 and 107 with an interior angle *a* (FIG. 2) of about 50°. When the valve is open, metering of air through the hole 82 is controlled in part by the length of the frusto-conical valve. Shortening the valve increases the flow of air into the passage. The frusto-conical valve 87 or 107 permits the valve to open slowly, without any substantial or noticeable increase in engine speed, and permits a controlled metering of air as the valve opens a greater amount in response to increases in air temperature. The valve is preferably made of brass.

Both the dampening member or bridge 88 and the actuating arm 86 should be of the same bimetallic material in order to function properly. Otherwise, one would open more rapidly than the other, and calibration of the carburetor would be made more difficult. In FIGS. 3–5 the valve body is provided with a hole 114 near the foot 83 of the leg 79. This hole facilitates bending the leg 79 to adjust the valve 107 and valve seat 82, and further retards the flow of heat toward the connection between the valve body, dampening member, and actuating arm.

The operation is as follows: When the engine is started, the choke valve 26 is maintained closed, either by manual positioning of lever 31, or by an automatic choke. As the engine warms up, the choke 26 is progressively opened until it is in its fully open position, as shown in FIG. 1, when the engine is at normal operating temperatures. When the throttle 13 is opened, the idle system ceases to function, and fuel is drawn through the main nozzle 56 by the rush of air through the venturi cluster 7. To assure a smooth transition from idle to normal fuel operation, additional gasoline is injected into the venturi cluster 7 by the pump system through the pump nozzle 68. The valve assembly 76 is closed when the air in the air horn is at normal temperature. The valve is maintained closed both by the resiliency in the actuating arm 86 pressing the valve 87 or 107 against the valve seat 82, and by suction in the air passage 71 holding the valve on the valve seat. In the normal operating temperature range, it may be desirable on a particular engine to adjust the valve spring so that should the engine speed drop below the normal idle speed, the engine suction is lowered sufficiently to permit the spring 86 to open the valve 87 or 107, admitting more air to the mixture conduit 12 through slot 75, leaning out the combustible mixture, thereby increasing the engine speed. As is well understood in the art, proper manual adjustment of screw 64 set the mixture for idle and idle speed is adjusted by screw 18. The valve assembly is calibrated to open at a temperature slightly above the normal air temperature. For example, if the normal operating air temperature is 130, the valve assembly should open between 140° and 150°. The amount of opening of the valve increases with an increase in air temperature, and, because of the frusto-conical valve, the amount of air entering the mixture conduit through the passage is metered. The frusto-conical valve also prevents a snap or pop opening of the valve, as would result with other type of valves such as a flat valve engaging the valve seat. Sudden full opening of the valve causes an almost immediate and substantial rise in engine speed, which is undesirable. As the engine becomes hotter, fuel will vaporize more rapidly in the fuel chamber and pass into the air horn. Thus, not only is the density of the air decreased, but it also contains excessive fuel vapor, which results in an excessively rich idle mixture.

As mentioned previously, the throttle valve is not tightly closed in the mixture conduit during idle operation, but is open slightly to permit air around the throttle valve by setting screw 18. Alternately, a by-pass around the throttle valve, or any other method of admitting idle air to the mixture conduit downstream from the throttle valve, may be utilized. If such an auxiliary idle passage is utilized, the supplementary air passage may be combined therewith. Incoming air temperature is closely related to the engine temperature as follows: The engine is cooled by water passing through a radiator, and the air entering the air cleaner normally is picked up after it has passed through the radiator core, cooling the water. Therefore, as the engine temperature increases, the water temperature increases, as does the air temperature.

It is especially important that valve mount 79 and the thermostatic strip be located so as to accurately sense the temperature of the incoming air without, at the same time, interferring with direct access of the air to the respective mixture conduits and fuel nozzles therein. For instance, these ports may be placed, as shown, directly in or above the dividing wall between adjoining barrels in a dual or four-barrel carburetor. It should be understood that a four barrel carburetor is merely two duals combined and there is a wall between the pair of primaries and a wall between the pair of secondaries.

Although this invention has been described with particular reference to certain features, materials, functions, and embodiments, various changes will be apparent to one skilled in the art, and the invention is therefore not to be limited to such features, materials, functions, and embodiments, except as set forth in the following claims.

I claim:

1. A thermostatic valve assembly comprising a flat body member including an elongated leg and a transversely extending mounting head at one end of the leg angularly disposed with respect thereto, said mounting head projecting substantially laterally at each side of the leg to provide a relatively large sealing area for overlying a connected member, openings formed in the outer end portions of said mounting head, connecting means extending through the openings in the outer end portions of said head, a valve port formed in said head intermediate of its transverse length and centrally of a longitudinally extending medial line through said leg, the outer free end of said leg being bent to lie generally in a plane above said mounting head and to be positioned in offset relation thereto and formed with an opening therein, the opening in said leg having a fastening means extending therethrough, an elongated flat thermostatic member secured at one end portion to the top of said leg and centrally thereof by said fastening means, said thermostatic member having its other end portion projecting over and spaced above the valve port in said head, a second thermostatic member

fixed to said fastening means and interposed between said first thermostatic member and said leg and extending longitudinally along a portion of the length of the first thermostatic member, the outer free end of said second thermostatic member engaging the inner adjacent surface of the first thermostatic member to oppose the movement of the first thermostatic member towards the valve port in said head, a conical valve member mounted at the free end of the first thermostatic member for movement through the valve port in said head for opening and closing said port, and means for aligning the first and second thermostatic members and the free end portion of said leg.

2. The structure of claim 1 characterized in that a pair of longitudinally spaced inner and outer openings are provided at the outer end portion of the leg, the outer opening receiving the fastening means and the inner opening being located at the point of transverse bend to provide a weakened transverse leg structure to facilitate the offsetting of the free end of the leg from said head.

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