Oct. 21, 1958 T. A. MORRIS 2,857,145

INJECTION TYPE CARBURETOR

Filed Feb. 27, 1951

FIG. 1

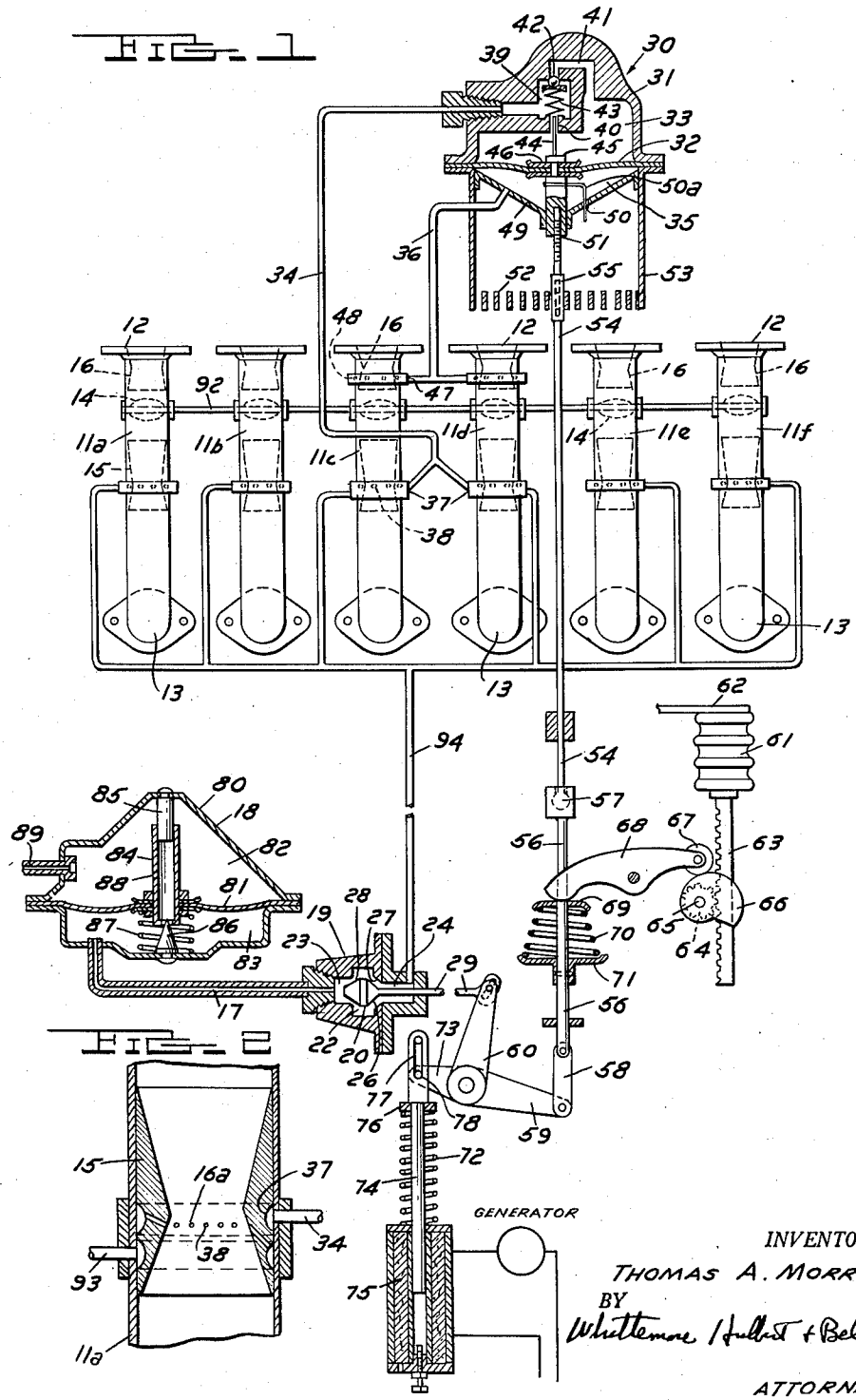


FIG. 2

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United States Patent Office

2,857,145

Patented Oct. 21, 1958

2,857,145

INJECTION TYPE CARBURETOR

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Application February 27, 1951, Serial No. 212,871

3 Claims. (Cl. 261—23)

The invention relates to a carburetor for feeding fuel to multicylinder internal combustion engines and is an improvement in carburetors of the general type shown in my Patent No. 2,428,377 issued October 7, 1947.

According to my present invention, a construction is provided for feeding liquid fuel from a single metering means through conduits connected to a plurality of separate inlet manifolds, each leading to the individual cylinders of the engine. Each inlet manifold is provided with a separate throttle valve, all of which are mechanically connected together so as to be simultaneously operated. The liquid fuel conduits communicate with the respective manifolds on the engine side of the throttle valves. The single metering means is controlled by a differential pressure obtained from the opposite sides of the throttle valve in one or more of the inlet manifolds, and the actuation of the metering means is caused by suction motor means responsive to said differential pressure. By feeding the liquid fuel directly into the manifolds leading to the individual cylinders instead of into a common manifold having branched connections, the distributive problems are overcome and surging due to the cross flow from the overlapping induction strokes is eliminated.

The invention is hereinafter fully described by reference to the accompanying drawings, wherein:

Figure 1 is a vertical section through a carburetor embodying my invention with some of the operating connections being diagrammatically shown; and

Figure 2 is an enlarged vertical section through the main Venturi of one of the inlet manifolds of Figure 1.

In Figure 1 there is shown a manifold construction for a six cylinder engine with separate downdraft inlet manifolds, 11*a*, 11*b*, 11*c*, 11*d*, 11*e* and 11*f* for each of the cylinders. Each of the inlet manifolds has its upper end 12 adapted to be connected to the air supply and the lower end 13 adapted to be connected to an individual cylinder of an internal combustion engine (not shown). Each manifold has a butterfly throttle valve 14, and a main Venturi member 15 on the inner side of said throttle valve, that is, between the throttle valve and the engine cylinder. The throttle valves 14 are mechanically connected together so as to be simultaneously operated and, as diagrammatically shown, this is accomplished by the common shaft 92. Each manifold also has a second Venturi member 16 on the outer side of said throttle valve, that is, between said throttle valve and the air supply. The main Venturi member 15 serves to admit liquid fuel into the air stream to thereby form the fuel mixture and for this purpose the Venturi member 15 is preferably provided with a circumferential series of small radial fuel ports 16*a* arranged at points adjacent the plane of greatest restriction in area. These ports 16*a* are supplied with liquid fuel from the fuel feed conduits 93, all of which are connected to the conduit 94 leading from the metering device 19 which in turn is connected by a conduit 17 to a pressure regulator 18.

The metering device 19 has slidably arranged therein a double ended needle valve 20 within the chamber 22.

Fuel from the conduit 17 enters the chamber 22 through the metering port 23 and leaves the chamber through the supply port 24 which leads to the conduit 94. The needle valve 20 has a shut-off face 26 adapted to bear against a seat 27 surrounding the port 24 and has a tapered metering valve portion 28 cooperating with the metering port 23 to regulate the amount of flow of the fuel. The needle valve 20 has an actuating stem 29 which is connected to the controlling mechanism.

The controlling mechanism for the liquid fuel metering device is responsive primarily to the suction produced by the two Venturi members 15 and 16 on opposite sides of the throttle valve 14 in one or more of the inlet manifolds. The controlling mechanism is preferably operated by a suction motor 30 which consists of a housing 31 containing a flexible diaphragm 32 dividing the housing into an upper chamber 33 responsive to the suction of the main or inner Venturi 15 by means of the connecting conduit 34 and a lower chamber 35 responsive to the suction of the second or outer Venturi 16 by means of the connecting conduit 36. The conduit 34 is connected to the annular passage 37 which in turn is connected to the throat of the main Venturi member 15 by a series of radial suction ports 38 intermediate the radial fuel ports 16*a*. The other end of the connecting conduit 34 communicates with a valve chamber 39 which is connected to the chamber 33 by a small passageway 40 and is also connected to the chamber 33 by the larger passageway 41 which, however, is normally closed by the check valve 42 held to its seat by a spring 43. In order to prevent any blocking of the small passageway 40, a pin 44 extends through this passageway and has an enlarged head 45 resting by gravity on the flanges 46 of the diaphragm 32. The connecting conduit 36 communicates with an annular passageway 47 which in turn leads to the throat of the second Venturi member 16 by a series of radial suction ports 48. The other end of the conduit 36 communicates with the chamber 35 below the diaphragm 32. This chamber is formed by the conical lower wall 49 having a bleed opening 50 for introducing atmosphereic air at a predetermined rate. The bleed hole 50 is kept clean from dirt accumulation by a spring wire 50*a* connected to the diaphragm 32 to move therewith and continually probe through the hole. A member 51 secured to the diaphragm extends through the conical wall 49. A thermostatic coil spring 52 is arranged within and connected to the annular wall 53 depending from the housing 31, which wall 53 is arranged in heat conductive relation to the engine (not shown). A rod 54 threadedly secured to the member 51 and passing through a bearing 55 is attached to the inner end of the thermostatic spring 52 in such a way that any change in temperature causes a rotation of the rod 54 to correspondingly increase or decrease the length between the diaphragm 32 and the rod 54. Another rod 56 has a swivel connection 57 with the rod 54 and is connected by a link 58 to a bell crank lever 59, the other arm 60 of which is connected to the stem 29 of the needle valve 20.

In order to permit the needle valve 20 to be responsive to changes in barometric pressure, I have provided the following construction. 61 is a metallic bellows secured to a stationary support such as the bracket 62 and the opposite end of the bellows is connected to a rack bar 63 which is in mesh with a pinion 64 on a shaft 65. On this same shaft is a cam 66 which engages a roller bearing 67 on one end of a lever 68, the opposite end of which engages the cap 69 for a conical spring 70 seated upon the sleeve 71 on the rod 56. This construction is to some extent a diagrammatic representation of a connection between the bellows 61 and the rod 56 to apply a variable force thereto cooperating with the force produced by the movement of the diaphragm 32. By suit-

ably fashioning the cam 66 this force produced by the bellows 61 will always be in the correct ratio to the change in the density of the air.

In order to insure a complete closure of the needle valve 20 against the seat 27, there is provided means for holding the needle valve to its seat when the engine is not in operation. This means comprises a spring 72 which bears against an arm 73 from the bell crank lever 59 and actuating said lever in a direction to seat the needle valve 20. The spring 72 is sleeved upon a rod 74 which forms the core member of a solenoid 75. One of the springs is seated on the casing of the solenoid and its opposite end engages a collar 76 which bears against a shoulder on a slotted head 77. A pin 78 on the arm 73 engages the slot in said head 77 and the arrangement is such that when the solenoid 75 is deenergized, a spring operating through the collar 76, head and pin actuates the arm 73 to hold the valve 20 to its seat. If, on the other hand, the solenoid 75 is energized, this will draw downward the rod 74 relieving pressure against the pin 78 so as to permit the bell crank lever 59 to be actuated solely by its other connections. The coil of the solenoid 75 may be connected to the electric generator of the engine so that it will always be energized when the engine is operating.

The discharge of fuel into the mixture conduits 11*a* to 11*f* is not dependent solely upon the suction of the main Venturi 15 but is under a positive head. It is essential that this head should remain constant and for this purpose the following construction is provided. 80 is a casing containing a flexible diaphragm 81 which divides the interior into two chambers 82 and 83. 84 is a tube connecting with and passing through the center of the diaphragm and slidably engaging at its upper end a pin 85. A port 88 connects the chamber 82 with the interior of the tube and the lower end of the tube which is in the chamber 83 is moved by the flexing of the diaphragm in relation to a metering member 86 which restricts the open area as the diaphragm moves downward and enlarges said area as it moves upward. A spring 87 resiliently lifts the diaphragm. The fuel conduit 17 is connected to the chamber 83 and a fuel supply conduit 89 is connected to the chamber 82. Thus the pressure of the liquid fuel in the chamber 82 is balanced against the spring 87 which lifts the diaphragm. Should the pressure increase in the chamber 82, this, by depressing the diaphragm and moving the tube 84 towards the metering device 86, restricts the opening for the passage of fuel into the chamber 83. On the other hand, if the pressure in the chamber 82 becomes less, the diaphragm will be raised and the discharge area around the metering device 86 enlarged. Therefore when the engine is in operation, the pressure within the chamber 83 is maintained substantially constant regardless of fluctuations in pressure of the liquids in the chamber 82.

In the operation of the device, fuel for the pressure regulator 18 is discharged through the feed conduit 17 into the metering device 19 which is controlled by the conjoint action of the suction motor 30, the thermostatic coil 52 and the bellows 61 responsive to changes in barometric pressure. The suction motor 30 is directly responsive to the manifold pressure by reason of the conduit 34 connected into the throat of the main Venturi 15, but it is also responsive to variations in velocity of the gases passing through the manifold by reason of the conduit 36 connected into the throat of the auxiliary Venturi 16 on the outer side of the throttle valve. By reason of this latter connection to the Venturi 16, an increase in the velocity of the air passing through the manifold will increase the discharge of fuel, while a decrease in the velocity of air will correspondingly decrease the discharge of fuel through said ports. However, the principal regulation of the metering device is obtained by reason of the change in vacuum produced at the throat of the main Venturi 15 in accordance with the manifold pressure. It will also be observed that the negative pressures derived from the two Venturis 15 and 16 are applied on opposite sides of the diaphragm 32 of the suction motor and therefore it is the resultant of the two forces on opposite sides of the diaphragm that determines the exact position of the needle valve 20 and thus determines the precise amount of fuel which enters the manifold under any given conditions of static pressure and velocity of the gaseous mixture passing through the inlet conduit.

In the construction illustrated, the suction motor 30 derives its actuating force from the connections to two of the six inlet manifolds but it controls the metering of the fuel to all six of the manifolds from the single metering device 19. It will be understood, however, that the conduits 34 and 36 may be connected to but a single inlet manifold or to all or any part of the same but in every case there is only one metering device which supplies the liquid fuel to all of the inlet manifolds on the engine side of the throttle valves in each manifold.

The primary function of the shut-off face 26 of the needle valve 20 is to completely close the connection between the fuel supply conduit 17 and the discharge ports 16*a* when the engine is not in operation. A further function of this element is to form an additional metering means which is effective under certain conditions in operation. Thus when the engine is operating under heavy load; the throttle may be fairly wide open but the speed of the engine and consequent velocity of the gaseous mixture through the inlet is relatively low. Under such conditions there is a tendency to discharge more fuel than required for the quantity of air. However, the shut-off face 26 of the needle valve 20 is tapered to engage the cooperating seat 27 and this operates as a metering device to restrict the fuel discharge as the suction is lowered until finally the valve closes to cut-off all fuel.

What I claim as my invention is:

1. In a carburetor for internal combustion engines, the combination of a plurality of inlet conduits leading to different cylinders of the engine, each conduit having respectively a throttle valve, a Venturi on the inner side of said throttle valve, a Venturi on the outer side of said throttle valve and a fuel injection port in said inner Venturi, a single metering means for the fuel supply, fuel connections between said single metering means and each of said fuel injection ports, a suction motor having a housing, a flexible diaphragm in said housing forming suction chambers on opposite sides thereof, said diaphragm being operatively connected to said metering means, a suction conduit from one or more of said inner Venturis connected to the chamber of said motor on one side of said flexible diaphragm and a suction conduit from one or more of said outer Venturis connected to the chamber of said motor on the opposite side of said flexible diaphragm.

2. In a carburetor for internal combustion engines, the combination of a plurality of inlet conduits leading to different cylinders of the engine, each conduit having respectively a throttle valve, a Venturi on the inner side of said throttle valve, a Venturi on the outer side of said throttle valve and a fuel injection port in said inner Venturi, a single metering means for the fuel supply, fuel connections between said single metering means and each of said fuel injection ports, suction motor means having two suction chambers and having movable diaphragm means associated with said chambers and operatively connected to said metering means, a suction conduit from one of said suction chambers connected to one or more of said inner Venturis and a second suction conduit from the other of said suction chambers connected to one or more of the said outer Venturis.

3. In a carburetor for internal combustion engines, the combination of a plurality of inlet conduits leading to

different cylinders of the engine, each conduit having a throttle valve and a fuel injection port between said throttle valve and the engine, a single metering means for the fuel supply, fuel connections between said single metering means and each of said fuel injection ports, suction motor means having two suction chambers and having movable diaphragm means associated with said chambers and operatively connected to said metering means, a suction conduit from one of said suction chambers connected to one or more of said inlet conduits on the engine side of the throttle valve, and a second suction conduit from the other of said suction chambers connected to one or more of said inlet conduits on the inlet side of the throttle valve, said last mentioned chamber

connected on the inlet side of the throttle being also provided with a bleed hole for introducing atmospheric air at a predetermined rate.

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