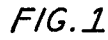


3,263,974

2 Sheets-Sheet 1



PAUL E. BRAUN
RICHARD J. FRIESMUTH
ALBERT A. PRUCHNO
INVENTORS
BY *John A. Faulkner*
Ernest A. Beutler
ATTORNEYS

Aug. 2, 1966

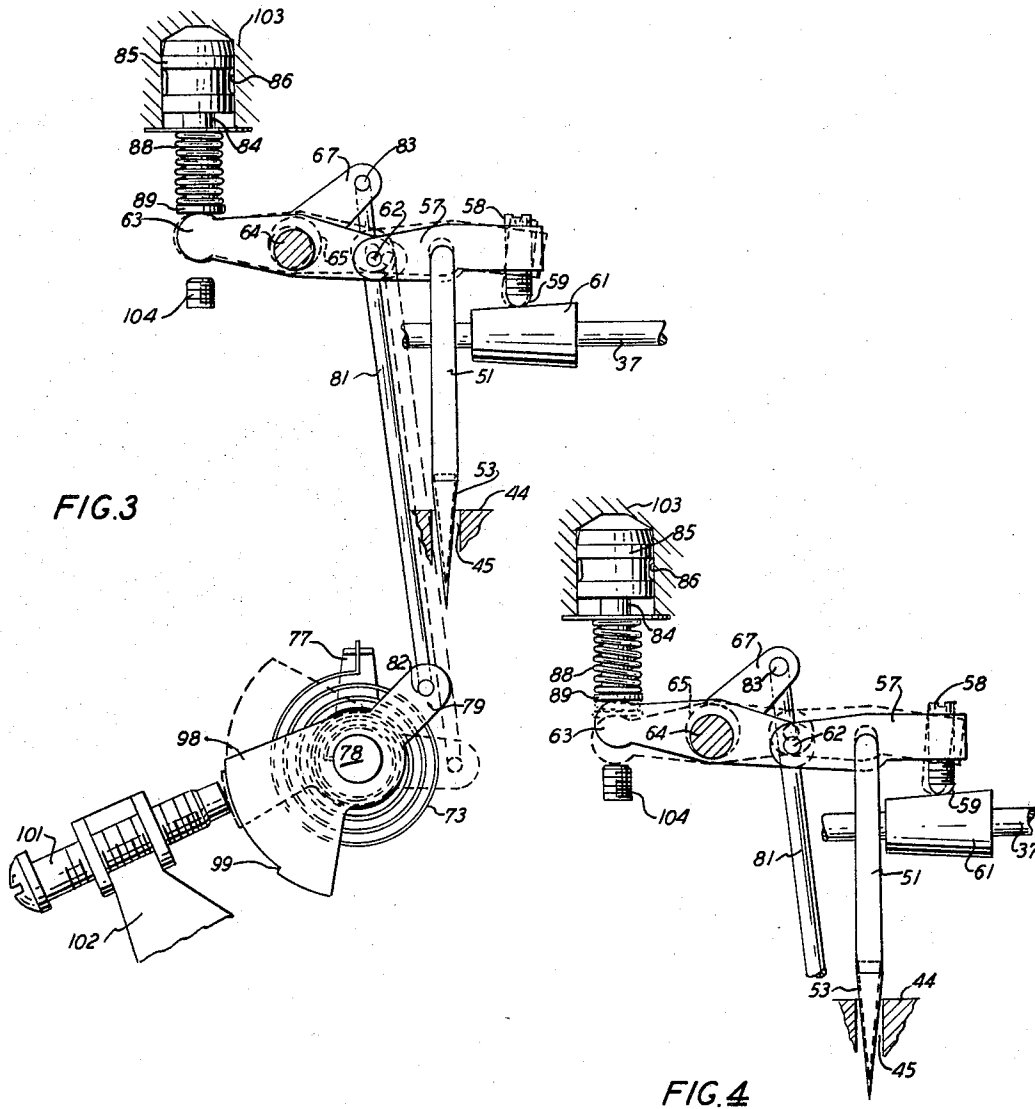
P. E. BRAUN ETAL

3,263,974

CONSTANT METERING FORCE CARBURETOR

Filed March 30, 1964

2 Sheets-Sheet 2



PAUL E. BRAUN
RICHARD J. FRIESMUTH
ALBERT A. PRUCHNO
INVENTORS

BY *John H. Faulkner*
Ernest A. Leutner
ATTORNEYS

1

3,263,974

CONSTANT METERING FORCE CARBURETOR

Paul E. Braun, Birmingham, Richard J. Freismuth, St. Clair Shores, and Albert A. Pruchno, Detroit, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Filed Mar. 30, 1964, Ser. No. 355,622

6 Claims. (Cl. 261—39)

This invention relates to a carburetor for an internal combustion engine and more particularly to a carburetor of the constant metering force type.

In one general classification of carburetors, fuel is discharged from a fuel nozzle into an induction passage between a manually positioned throttle valve and an automatically operated air valve. The air valve is automatically positioned to maintain a substantially constant pressure in the area between the air and throttle valves where the fuel is discharged. The amount of fuel discharged is controlled by a fuel metering valve that is actuated simultaneously with the air valve to maintain a substantial constant fuel-air ratio at all throttle openings. Since the outlet of the fuel nozzle is always exposed to substantially the same pressure, this type of carburetor is commonly called a constant metering force or constant depression carburetor. The term air valve carburetor also is employed.

Although the constant metering force type of carburetor will discharge a substantially uniform fuel-air ratio under most steady state conditions, there are stages of engine operation when a variation in the instantaneous fuel-air ratio is required. When starting at low temperatures, a richer than normal mixture should be discharged to insure that a combustible mixture reaches the engine cylinders after passing through the cold intake manifold and intake ports. For economy reasons it is desirable to run upon a leaner mixture than that required to produce the maximum power output. It is also necessary to temporarily open the fuel valve to a greater extent than the air valve during accelerations to compensate for the greater inertia of the fuel.

It, therefore, is the principal object of this invention to provide an improved, constant metering force carburetor that automatically adjusts the fuel-air ratio to compensate for variations in engine temperature and power requirements.

It is a still further object of this invention to provide an improved interconnection between the air and fuel valves of a constant metering force carburetor that permits simultaneous temperature and power enrichment.

A carburetor embodying this invention has an induction passage and a throttle valve for controlling the flow of mixture through the induction passage. Air valve means are positioned in the induction passage anterior to the throttle valve. The air valve means is positioned to maintain a substantially constant pressure between the air valve means and the throttle valve. A fuel discharge circuit controlled by a fuel metering valve discharges fuel into the induction passage between the air valve means and the throttle valve. A fuel metering cam is operatively connected for movement with the air valve means. A lever supported for movement about a pivotal axis has follower means in engagement with a cam surface of the metering cam. The fuel metering valve is operatively connected with the lever for actuation. Means responsive to engine operating characteristics are provided for moving the pivotal axis of the lever to alter the relationship between the air valve means and the fuel metering valve upon changes in the operating characteristics.

Further objects and advantages of this invention will become more apparent when considered in conjunction with the accompanying drawings wherein:

2

FIGURE 1 is a cross-sectional view of a carburetor embodying the invention.

FIGURE 2 is a top plan view of the carburetor shown in FIGURE 1 with portions broken away.

FIGURE 3 is an enlarged schematic view of the fuel metering circuit showing the provision for cold weather enrichment.

FIGURE 4 is an enlarged schematic view similar to FIGURE 3 showing the provision for power enrichment.

Referring now in detail to the drawings, the carburetor comprises a throttle body 11 having an induction passage 12 that is adapted to register with the intake manifold of an internal combustion engine. A throttle valve 13 is supported upon a throttle valve shaft 14 for controlling the rate of mixture discharge from the induction passage 12.

A main body portion 15 is affixed to the throttle body 11 by suitable fastening means (not shown). An induction passage 16 is formed in the main body portion 15 in alignment with the induction passage 12 of the throttle body 11. A fuel bowl 17 is formed in the body portion 15 at one side of the induction passage 16. A float 18 and float operated fuel inlet valve (not shown) maintain a uniform head of fuel in the fuel bowl 17.

A cover plate 19 having an air horn section 21 is affixed to the body portion 15 by suitable fastening means (not shown). An air inlet passage 22 in the air horn section 21 registers with the induction passage 16 of the body portion 15. An air valve 23 is fixed to an air valve shaft 24 that is journaled at opposite sides in the air horn section 21.

The air valve 23 is positioned to maintain a substantially constant pressure in the induction passage 16 by a servo device or pressure responsive motor, indicated generally by the reference numeral 25. The servo device 25 includes a housing 26 formed at one side of the cover plate 19. An annular cavity 27 formed within the housing 26 is open to the atmosphere through an enlarged aperture 28 that faces the air horn section 21. A flexible diaphragm 29 positioned across the mouth of the cavity 27 is held in place by a cover plate 31. The cover plate 31 is affixed to a housing 26 by a plurality of screws (not shown.) The cover plate 31 has an annular cavity 32 that is enclosed by the diaphragm 29 to provide a pressure responsive chamber.

The cover plate 31 is provided with a fitting 33 that is connected by a flexible conduit 34 to a fitting 35 that extends into the induction passage 16. The annular cavity 32 and one side of the diaphragm 29, therefore, experience the pressure within the induction passage 16. A decrease in pressure tends to cause the diaphragm 29 to be deformed to the left to decrease the volume of the cavity 32. A coil spring 36 interposed between the cover plate 31 and the diaphragm 29 resists this motion.

The diaphragm 29 actuates the air valve 23 by means of a control rod 37 that is affixed to the diaphragm, as at 38. The control rod 37 is journaled in a boss 39 formed adjacent the opening 28 and a bushing 41 positioned at one side of the air horn section 21. An offset end 42 of the control rod 37 extends through a bifurcated projection 43 of the air valve 23. It should be readily apparent that the servo device 25 tends to position the air valve 23 so that a substantially constant pressure will exist in the induction passage 16. The movement of the air valve 23 is also utilized to control the rate of fuel discharge through the fuel discharge circuit now to be described.

A fuel metering jet 44 having a calibrated orifice 45 is positioned in the bottom of the fuel bowl 17. The orifice 45 opens into a horizontally extending fuel passage 46 formed in the lower surface of the body portion 15. A plug 47 closes the outer end of the fuel passage 46. The

fuel passage 46 intersects a vertically extending fuel passage 48 formed in the body portion 15 between the fuel bowl 17 and the induction passage 16. A fuel discharge nozzle 49 extends from the upper end of the fuel passage 48 into the induction passage 16.

A fuel metering rod 51 is supported for reciprocation in a bore 52 formed in the cover plate 19. A tapered end 53 of the metering rod 51 extends into the metering jet orifice 45 to vary the rate of fuel discharge from the discharge nozzle 49. A coil spring 54 is preloaded between the cover plate 19 and a snap ring 55 positioned upon the metering rod 51 to urge the metering rod in a downward direction. The upper end of the metering rod 51 extends through an aperture 56 in a metering rod lever 57. A metering screw 58 is threaded through the forward end of the metering rod lever 57. A hemispherical lower surface 59 of the metering screw 58 engages a conical fuel metering cone 61 that is axially affixed upon the control rod 37. A pin 62 pivotally supports the metering rod lever 57.

As the control rod 37 is reciprocated by the diaphragm 29 to position the air valve 23, the metering screw 58 rides upon the cam surface of the metering cone 61. Axial movement of the metering cone 61 causes pivotal movement of the metering rod lever 57 about the pin 62 to vary the position of the metering rod 51 in the metering jet 44. It should be readily apparent that, as the air valve 23 is opened, the metering rod 51 will be raised in the metering jet orifice 45 to increase the rate of fuel flow in response to the increased air flow. By suitably shaping the surface of the metering cone 61, the desired fuel-air ratio may be obtained at all positions of the air valve 23. Adjustment of the metering screw 58 will vary the relationship of the metering rod 51 relative to the air valve 23. The fuel-air ratio discharged by the carburetor can be proportioned to provide economy of operation during normal engine performance. A richer than normal fuel-air ratio is required, however, at low engine temperatures and during periods of high power output. Means are provided to alter the relationship of the metering rod 51 relative to the air valve 23 automatically in response to these conditions.

The pin 62 that pivotally supports the metering rod lever 57 is itself supported for pivotal movement. The pin 62 is affixed to one end of an enrichment lever 63. The enrichment lever 63 is journaled upon an end 64 of a shaft 65 that is supported for rotary movement within a journal 66 formed in the cover plate 19. The shaft end 64 is disposed eccentrically to the pivot axis defined by the journal 66. A lever 67 is affixed to the outer end of the shaft 65 at one side of the carburetor.

The shaft 65 is rotated to accomplish cold weather enrichment by a temperature responsive mechanism, indicated generally by the reference numeral 68. The temperature responsive mechanism 68 includes a housing 69 that is supported at one side of the carburetor body portion 15 in a known manner. The housing 69 has a central cavity 71 that is enclosed by an insulated cover 72. The cover 72 is affixed to the housing 69 in any suitable manner. A coiled bimetallic spring 73 is supported within the cavity 71. One end of the bimetallic spring 73 is affixed to a slot 74 formed in an inwardly extending projection 75 of the cover 72. The other end of the bimetallic spring 73 is received in a slot in an outwardly extending projection 76 of a lever 77. The lever 77 is affixed to the inner end of shaft 78 that is journaled in the housing 69. A lever 79 is affixed to the exposed end of the shaft 78. A link 81 has an intumed lower end 82 received in an aperture in the outer end of the lever 79 and an intumed upper end 83 that is received in an aperture in the lever 67 at the other side.

The temperature responsive mechanism 68 may be the same general type of mechanism used in the automatic choke of a conventional carburetor. Reference may be had to Nastas Patent 2,862,488, entitled "Automatic

Choke," issued December 2, 1958, for the details of the temperature responsive mechanism and the manner of heating the bimetallic spring 73 in response to engine operation.

The end of the enrichment lever 63 remote from the pin 62 is engaged by a piston rod 84. The upper end of the piston rod 84 is press fitted into a vacuum piston 85 that reciprocates in a bore 86 formed in a projection 87 of the cover plate 19. A coil spring 88 is preloaded between an enlarged end 89 of the piston rod 84 and a plate 91 positioned over the mouth of the lower end of the bore 86. The upper side of the vacuum piston 85 and the bore 86 are exposed to intake manifold vacuum through a plurality of vacuum passages formed in the carburetor. A first passage 92 extends horizontally from the upper end of the bore 86. The outer end of the passage 92 is closed by a plug 93. A vertically extending passage 94 intersects with passage 92 at its upper end and a second, horizontally extending vacuum passage 95 at its lower end. The passage 94 extends through the cover plate 19 and the main body portion 15. The vacuum passage 95 opens into the induction passage 12 of the throttle body 11 on the downstream side of the throttle valve 13, as at 96. The outer end of the passage 95 is closed by a plug 97.

Operation

Assuming the engine is running, the pressure in the induction passage 16 will be dependent upon intake manifold vacuum and the position of the throttle valve 13, if the air valve 23 does not move. The pressure in the induction passage 16 is transmitted through the conduit 34 to one side of the servo diaphragm 29. The diaphragm 29 tends to seek an equilibrium position by reciprocating the control rod 37 and rotating the air valve 23. Simultaneous with movement of the air valve 23, the metering cone 61 is reciprocated. The movement of the metering cone 61 is reciprocated. The movement of the metering cone 61 is transmitted to the metering screw 58 to pivot the metering rod lever 57 about the pin 62. Pivotal movement of the lever 57 causes reciprocation of the metering rod 51 to adjust the rate of fuel discharge from the nozzle 49 in accordance with the position of the air valve 23.

Referring now to FIGURES 3 and 4, the temperature and power enrichment features will be described. Referring first to FIGURE 3, the solid line view represents the position of the mechanism at normal engine operating temperatures. If the temperature decreases, the bimetallic spring 73 will coil to rotate the lever 77 and shaft 78 in a clockwise direction. The lever 79 is also rotated in a clockwise direction to draw the link 81 downwardly. Downward movement of the link 81 rotates the lever 67 and shaft 65 in a clockwise direction. Because of the eccentricity of the end portion 64 relative to the journal 66, the lever 63 is pivoted upwardly about its point of contact with the piston rod end 89. This causes the pin 62 to be raised to pivot the metering lever 57 about the point of contact between the metering screw 58 and the metering cone 61. The pivotal movement of the lever 57 causes the metering rod 51 to be raised. Raising of the metering rod 51 withdraws the tapered end portion 53 partially from the metering orifice 45 to permit additional fuel flow through the discharge circuit. The cold weather positioning of the mechanism is shown in the dotted line portion of the figure. It should be readily apparent that the cold weather enrichment will continue to be effective regardless of the operation of the air valve 23. Said another way, the air valve 23 will continue to operate the metering rod 51, although a richer mixture will be discharged.

If desired, a fast idle cam 98 may be fixed for rotation with the shaft 78. The fast idle cam 98 has a stepped cam surface 99 that is contacted by an adjusting screw 101 that is threaded through a throttle lever 102. The

5

throttle lever 102 is affixed to the throttle valve shaft 14. During initial cold weather operation the adjusting screw 101 will contact the high point of the stepped cam surface 99 to provide a faster than normal engine idle.

For reasons of economy the normal fuel-air ratio discharged by the carburetor is somewhat leaner than that required to produce maximum power output. Maximum power output is achieved by providing the power enrichment adjustment shown in FIGURE 4. The intake manifold vacuum experienced through the vacuum passages 92, 94 and 95 acts upon the vacuum piston 85 drawing it upwardly against the action of the coil spring 88. The coil spring 54 acting through the metering rod 51 and metering rod lever 57 causes the enrichment lever 63 to be pivoted in a clockwise direction about the shaft end 64 so that piston rod end 89 is contacted by the enrichment lever 63 (FIGURE 1). The limit of movement in this direction is governed by the contact of the piston 85 with a countersunk portion 103 of the bore 86. The positions of the various parts during economy operation are shown in the solid line view.

During periods of high power demand the intake manifold vacuum will fall off. The pressure acting on the piston 85 will eventually reach a point at which the spring 88 urges the piston rod 84 and piston 85 downwardly to the dotted line position shown in FIGURE 4. The extreme movement in this direction is limited by the contact of the end of the enrichment lever 63 with an adjustable screw 104 that is threaded through the cover plate 19. The movement of the piston rod 84 causes the enrichment lever 63 to pivot in a counterclockwise direction around the shaft end 64. This rotation causes the pin 62 to be raised and pivot the metering rod lever 57 in a clockwise direction. The metering rod 51 is thus raised in the metering jet 44 to permit additional fuel flow.

It should be readily apparent that both the power and cold weather enrichment mechanisms can be operative at the same time. It should additionally be noted that these enrichments do not disturb the interconnection between the air valve 23 and the metering rod 51. The adjustments only alter the relationship between the air valve 23 and the metering rod 51 to provide the appropriate adjustment in the rate of fuel discharge.

Although the carburetor has been described as including a separate servo device for the actuation of the air valve, it is to be understood that an unbalanced air valve or other types of servo mechanisms than that disclosed may be used. Other changes and modifications may be made without departing from the spirit and scope of the invention, as defined by the appended claims.

We claim:

1. A carburetor for an internal combustion engine comprising an induction passage, a throttle valve for controlling the flow of combustible mixture through said induction passage, air valve means in said induction passage anterior to said throttle valve, said air valve means being movable in response to pressure variations in said induction passage for maintaining a substantially constant pressure between said air valve means and the said throttle valve, a fuel source, a fuel discharge circuit for discharging fuel from said fuel source into the portion of said induction passage between said air valve means and said throttle valve, a fuel metering valve for controlling the rate of fuel flow through said fuel discharge circuit, a metering cam, means interconnecting said metering cam and said air valve means for simultaneous movement of said air valve means and said metering cam, a lever supported for pivotal movement, a follower on said lever engaging a cam surface of said metering cam for pivotal movement of said lever upon movement of said air valve means, means interconnecting said lever and said fuel metering valve for operation of said fuel metering valve upon pivotal movement of said lever, means responsive to engine operating characteristics, and means intercon-

6

necting said last-named means with said lever for varying the pivotal axis of said lever in response to variations in the engine operating characteristics to alter the relationship between said air valve means and said fuel metering valve.

2. A carburetor as defined by claim 1 wherein the means responsive to engine operating characteristics is responsive to engine intake manifold vacuum and temperature.

3. A carburetor for an internal combustion engine comprising an induction passage, a throttle valve for controlling the flow of combustible mixture through said induction passage, air valve means in said induction passage anterior to said throttle valve, said air valve means being movable in response to pressure variations in said induction passage for maintaining a substantially constant pressure between said air valve means and the said throttle valve, a fuel source, a fuel discharge circuit for discharging fuel from said fuel source into the portion of said induction passage between said air valve means and said throttle valve, a fuel metering valve for controlling the rate of fuel flow through said fuel discharge circuit, a metering cam, means interconnecting said metering cam and said air valve means for simultaneous movement of said air valve means and said metering cam, a first lever, a second lever pivotally supporting said first lever for pivotal movement about a first pivot axis, follower means upon said first lever coacting with a cam surface of said metering cam for pivotal movement of said first lever about said first pivot axis upon movement of said air valve means, means interconnecting said first lever with said fuel metering valve for operation of said fuel metering valve upon pivotal movement of said first lever, means supporting said second lever for pivotal movement about a second pivot axis, means responsive to an engine operating characteristic, and means interconnecting said last-named means with said second lever for pivotal movement of said second lever about said second pivot axis and for moving said first pivot axis upon a variation in the engine operating characteristic to alter the relationship between said air valve and said fuel metering valve.

4. A carburetor as defined by claim 3 wherein the means responsive to an engine operating characteristic is responsive to temperature.

5. A carburetor as defined by claim 3 wherein the means responsive to an engine operating characteristic is responsive to engine intake manifold vacuum.

6. A carburetor for an internal combustion engine comprising an induction passage, a throttle valve for controlling the flow of combustible mixture through said induction passage, air valve means in said induction passage anterior to said throttle valve, said air valve means being movable in response to pressure variations in said induction passage for maintaining a substantially constant pressure between said air valve means and the said throttle valve, a fuel source, a fuel discharge circuit for discharging fuel from said fuel source into the portion of said induction passage between said air valve means and said throttle valve, a fuel metering valve for controlling the rate of fuel flow through said fuel discharge circuit, a metering cam, means interconnecting said metering cam and said air valve means for simultaneous movement of said air valve means and said metering cam, a first lever, a second lever pivotally supporting said first lever for pivotal movement about a first pivot axis, follower means upon said first lever coacting with a cam surface of said metering cam for pivotal movement of said first lever about said first pivot axis upon movement of said air valve means, means interconnecting said first lever with said fuel metering valve for operation of said fuel metering valve upon pivotal movement of said first lever, means supporting said second lever for pivotal movement about a second pivot axis, temperature responsive means operatively connected to said second lever for pivotal movement of said second lever about said second pivot axis

7

upon variations in temperature for altering the location of said first pivot axis and the relationship between said fuel metering valve and said air valve means, a vacuum motor, a vacuum passage extending from said vacuum motor to said induction passage posterior to said throttle valve for operating said vacuum motor in response to variations in engine intake manifold vacuum, and means operatively connecting said vacuum motor to said second lever for moving said second pivot axis upon variations in intake manifold vacuum for altering the location of said first pivot axis and the relationship between said air valve means and said fuel metering valve.

5

10

8

References Cited by the Examiner

UNITED STATES PATENTS

1,693,095	11/1928	Ritchie et al. -----	251—229 X
1,838,421	12/1931	Linkert -----	261—50
2,365,910	12/1944	Shaft.	
2,457,570	12/1948	Leibing.	
2,989,950	6/1961	Lockman -----	137—85 X
2,996,051	8/1961	Mick.	
3,023,744	3/1962	Mick.	

HARRY B. THORNTON, *Primary Examiner*.
T. R. MILES, *Assistant Examiner*.