Sept. 13, 1966 F. W. COOK ETAL 3,272,487

CARBURETOR

Filed April 29, 1963 5 Sheets-Sheet 1

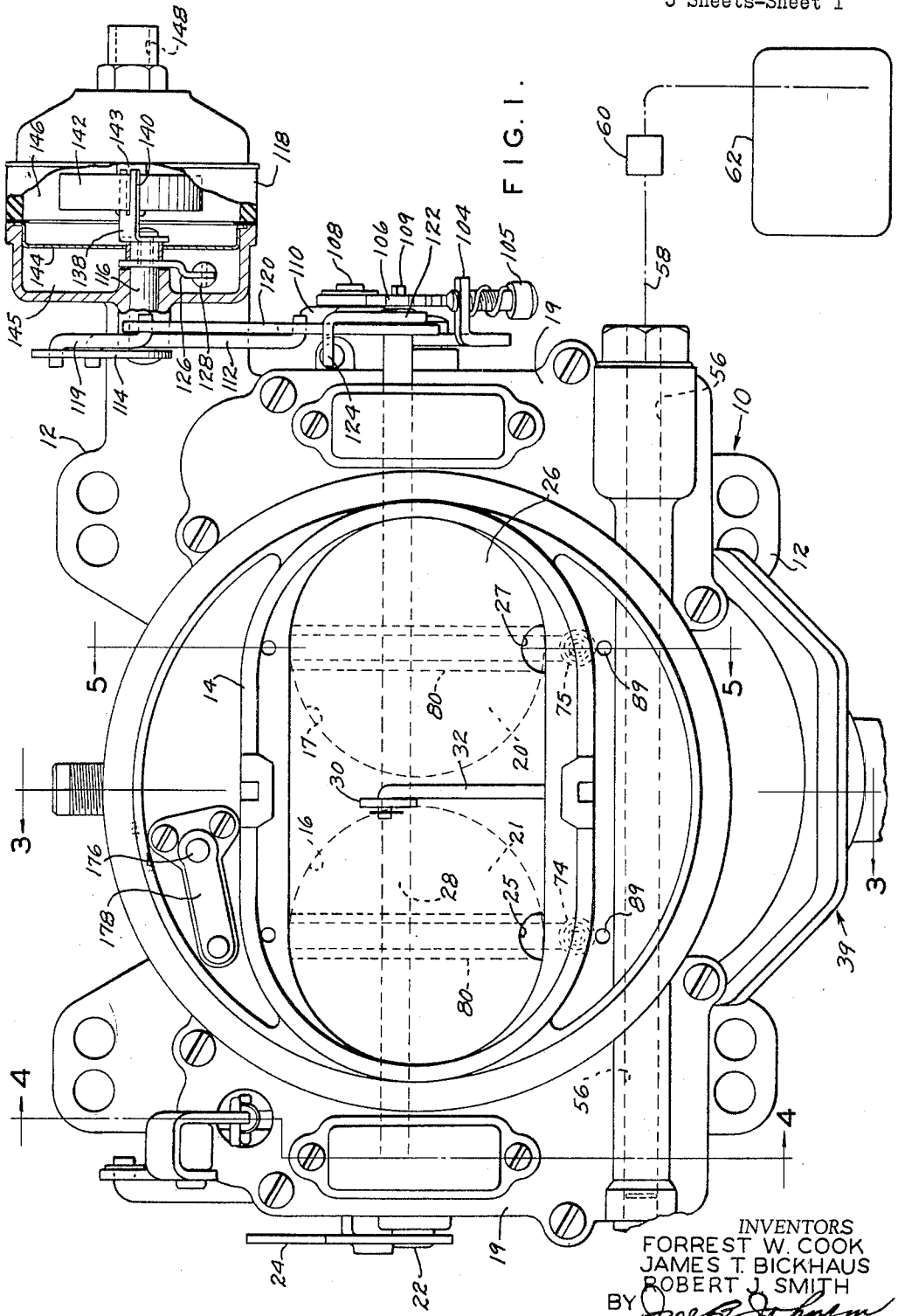


FIG. 1.

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AGENT

Sept. 13, 1966 F. W. COOK ETAL 3,272,487

CARBURETOR

Filed April 29, 1963 5 Sheets-Sheet 2

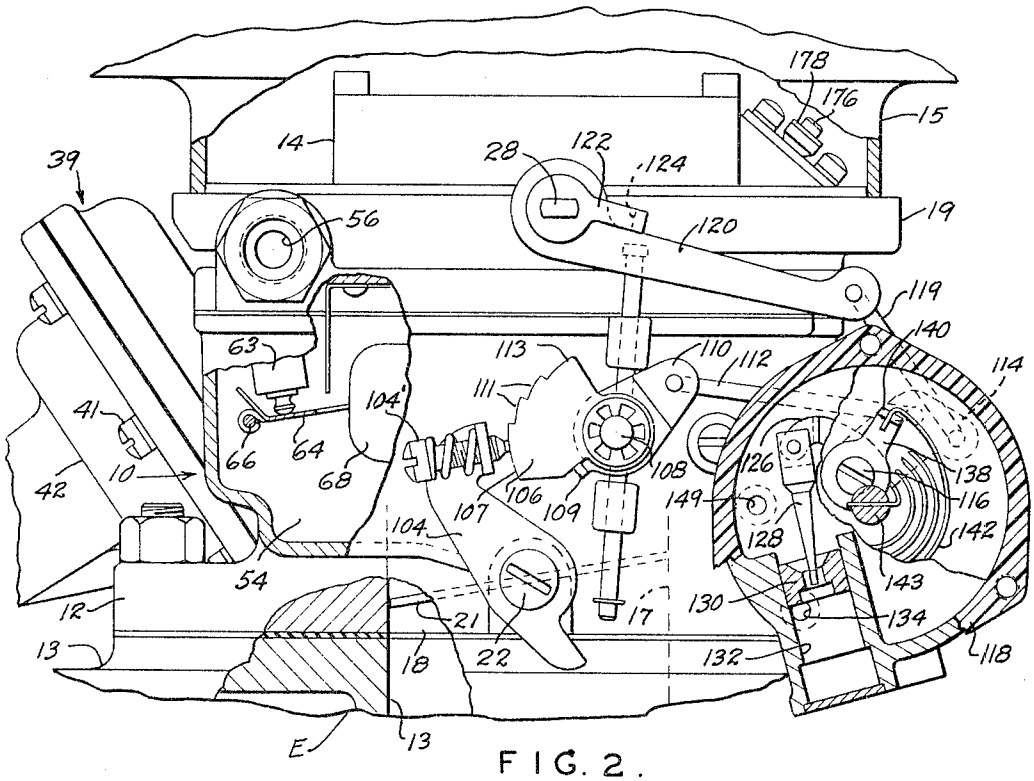


FIG. 2.

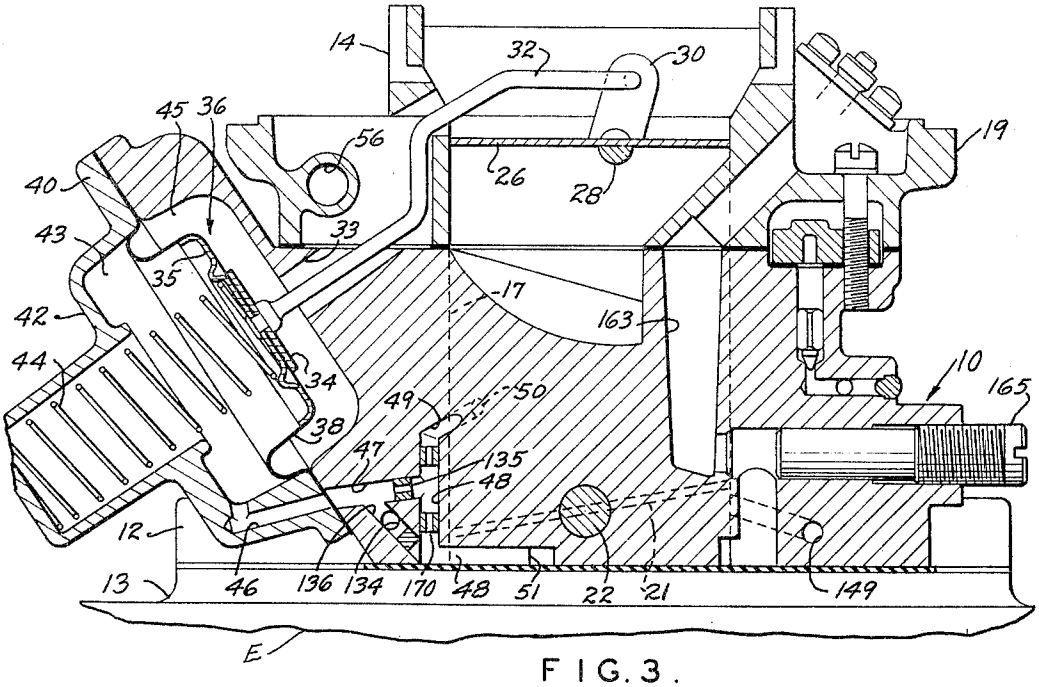


FIG. 3.

Sept. 13, 1966 F. W. COOK ET AL 3,272,487

CARBURETOR

Filed April 29, 1963 5 Sheets-Sheet 3

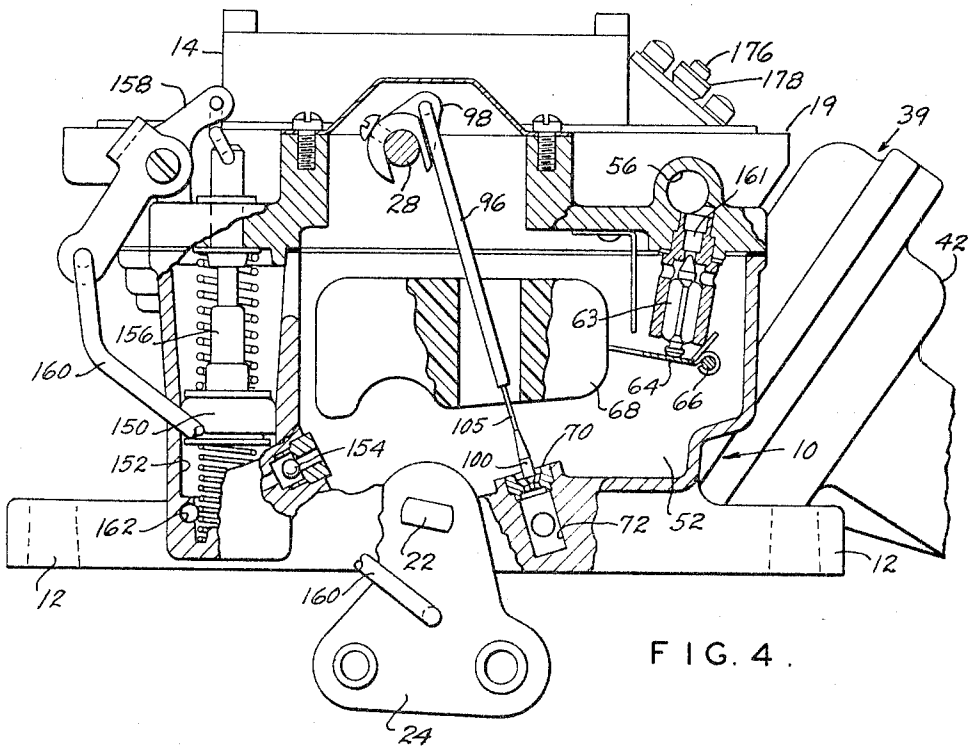


FIG. 4.

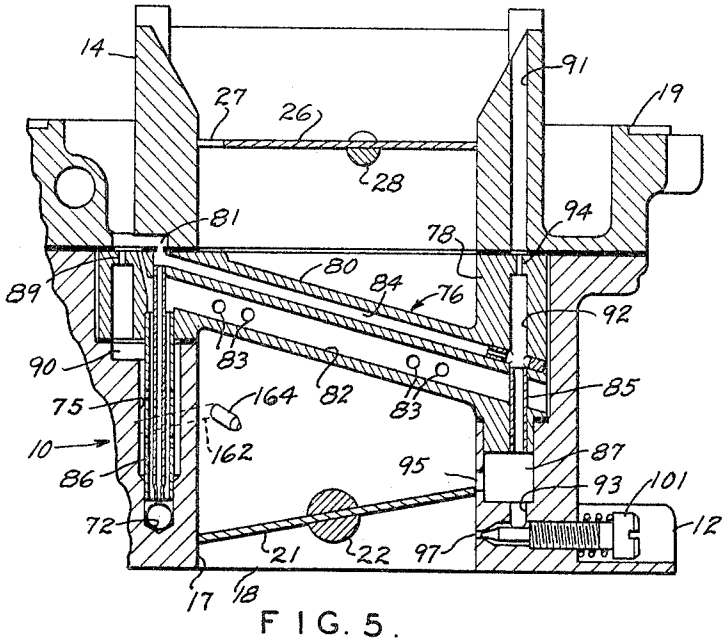


FIG. 5.

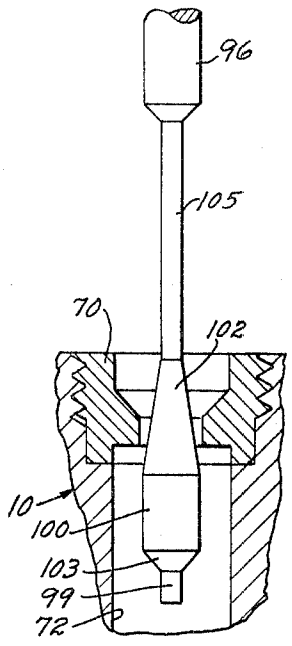


FIG. 4a.

Sept. 13, 1966 F. W. COOK ETAL 3,272,487

CARBURETOR

Filed April 29, 1963 5 Sheets-Sheet 4

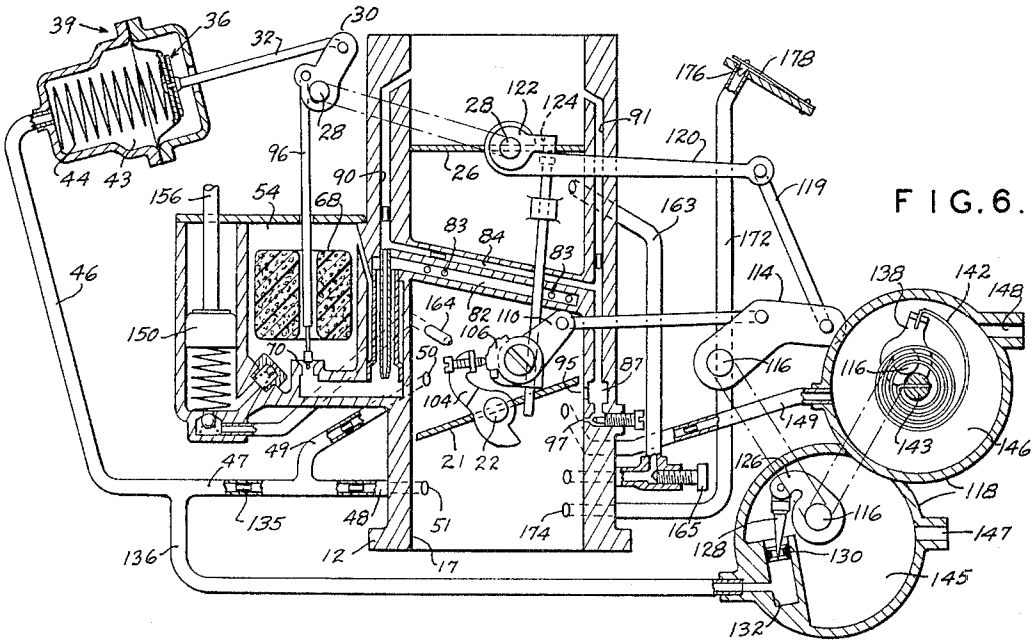


FIG. 6.

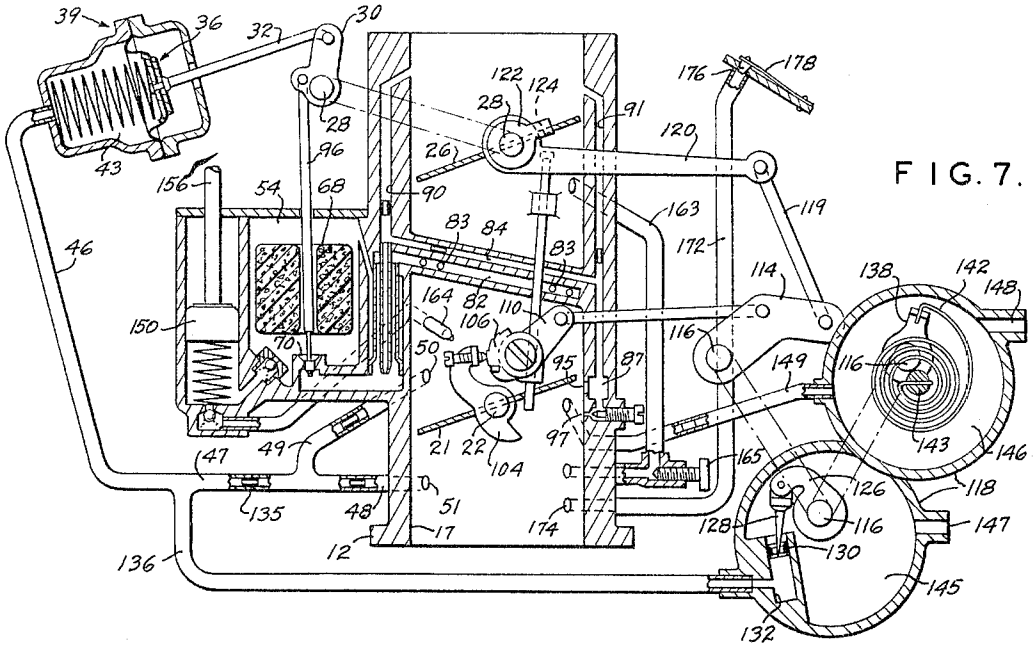


FIG. 7.

Sept. 13, 1966 F. W. COOK ETAL 3,272,487

CARBURETOR

Filed April 29, 1963 5 Sheets-Sheet 5

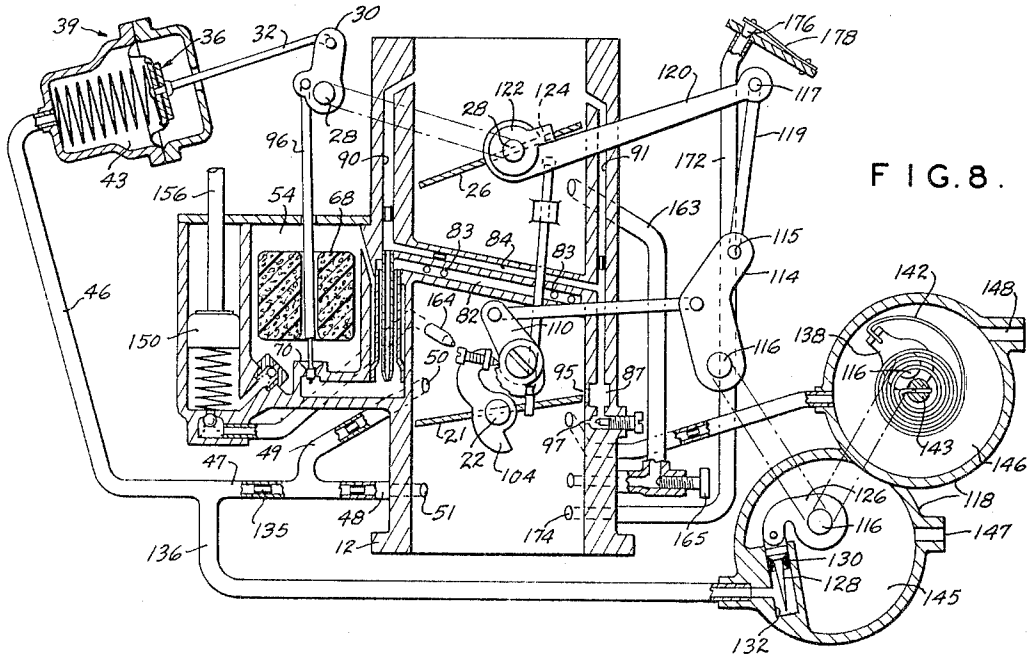


FIG. 8.

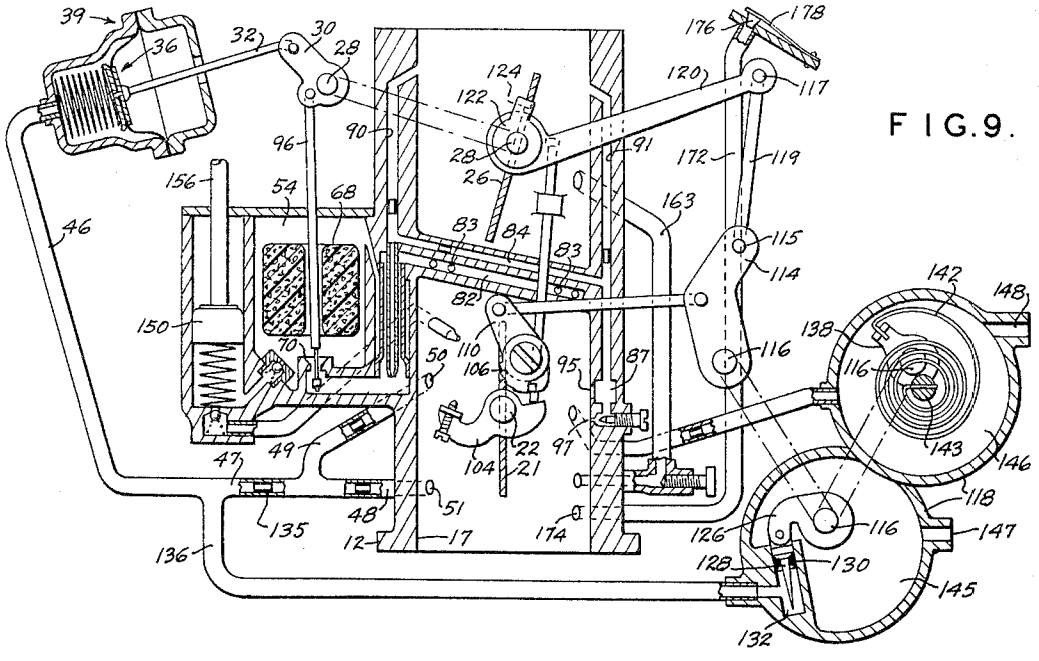


FIG. 9.

United States Patent Office 3,272,487 Patented Sept. 13, 1966

3,272,487

CARBURETOR

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Filed Apr. 29, 1963, Ser. No. 276,472
14 Claims. (Cl. 261—39)

This invention is directed to an air valve carburetor of the type having an air and fuel mixture conduit through the carburetor body. Within the mixture conduit is mounted a manually operated throttle valve for movement between an open and closed position. Upstream from the throttle valve is mounted within the mixture conduit an air valve structure, which measures the flow of air through the carburetor to meter the fuel flowing to the engine. The presence of the air valve also provides a subatmospheric pressure in the region of the fuel nozzles to draw fuel into the mixture conduit.

In some air valve carburetors of this type, a servo motor positions the air valve in response to the air pressure drop across the air valve such that the angular position of the air valve is a measure of the air flow to the engine. The air valve is connected directly to a device for metering fuel to the engine so that fuel flow is provided which is proportional to the air flow to the engine. With the same amount of air flow through the engine, the air valve will assume the same angular position and thus provide the same fuel metering, when the engine is hot as when it is cold. However, for satisfactory engine operation, the engine requires a richer air-fuel mixture when cold than when the engine is warm. It is thus necessary to vary the relationship between the air flow and fuel flow to the engine by providing means to change this relationship in response to engine temperature.

It is therefore an object of this invention to provide a novel air valve carburetor of the type described in which the air valve is responsive to ambient temperatures.

It is a further object of this invention to provide a novel carburetor having an air valve which closely follows changes in ambient temperature to provide an optimum fuel and air mixture during engine operation.

The invention is one in which the position of the air valve of the carburetor determines the fuel flow to the engine in proportion to the amount of air flowing to the engine. The position of the air valve is controlled by a servo motor. To change the relationship between the air flow and fuel flow to the engine, in response to engine temperature, the air pressure within the servo motor is varied by bleeding more or less air to the servo motor in response to changes in the engine temperature. This changes the relationship between fuel flow and air flow to the engine as determined by the angular position of the air valve.

FIGURE 1 is a plan view partly in section of an air valve carburetor including the invention.

FIGURE 2 is a side view in elevation of the carburetor of FIGURE 1 showing a portion of an air filter and an engine manifold to which the carburetor is attached.

FIGURE 3 is a sectional view of the carburetor of FIGURE 1 along the lines 3—3.

FIGURE 4 is a sectional view of the carburetor of FIGURE 1 along section lines 4—4.

FIGURE 4*a* is an enlarged partial view of the fuel control metering rod of FIGURE 4.

FIGURE 5 is a sectional view of the carburetor of FIGURE 1 along lines 5—5.

FIGURE 6 is a schematic view of the carburetor of FIGURES 1 through 5, showing the operation of the carburetor during cranking of the engine in cold weather.

FIGURE 7 is a schematic view of the carburetor of FIGURES 1 through 5, showing the operation of the carburetor under cold ambient conditions.

FIGURE 8 is a schematic view of the carburetor of FIGURES 1 through 5, showing the operation of the carburetor during warm ambient conditions.

FIGURE 9 is a schematic operational view of the carburetor of FIGURES 1 through 5 during wide open throttle operation under normal warm ambient conditions.

The carburetor shown in the figures has a body casting portion **10**, which is connected at a flanged end **12** to an intake manifold structure **13** of engine E shown in FIGURES 2 and 3. The other end of the carburetor body support a cover casting **19** formed with an air horn section **14** mounting an air filter **15**, through which the air passes into the carburetor. Passing through the carburetor body **10** from the air horn **14** are a pair of air and fuel mixture conduits **16** and **17** each opening at one end into the intake manifold **13** at **18** and through which air from the air filter **14** passes to the engine. Mounted in the manifold ends of the mixture conduits **16** and **17** are throttle valves **20** and **21**, respectively, fixed to a common throttle shaft **22** journaled for rotational movement in appropriate bearing surfaces in the carburetor body **10**. Fixed to one end of the throttle shaft **22** is a manually operably lever **24** (FIGURES 1 and 4) for moving the throttles **20** and **21** from a closed to an open position. In the closed position, the throttles are across their respective mixture passages **16** or **17**, as indicated in FIGURES 3 and 5, to prevent the flow of air therethrough. The throttles may be moved from this closed position to a wide open position schematically indicated in FIGURE 9.

Mounted upstream of the throttles **20** and **21** and across the air horn section **14** of the carburetor is an air valve **26**. As indicated in FIGURE 1, valve **26** closes the air horn passage and extends across the two mixture passages **16** and **17**. In this closed position, a flow of air may pass into the two mixture passages **16** and **17** through apertures **25** and **27** in the air valve provided for the clearance of nozzle bars **80** when the air valve opens. Air valve **26** is fixed eccentrically to a shaft **28** journaled in the carburetory body for rotational movement. Shaft **28** extends through the carburetor substantially parallel to the throttle shaft **22**.

A short level arm **30** (FIGURES 1 and 3) is fixed to and extends from the air valve shaft **28**. Lever arm **30** is loosely connected to one end of an actuating rod **32**, the other end of which extends through a passage **33** in body casting **10** and is fixed to a backing plate **34** of a diaphragm assembly **36** of a servo motor **39**. The diaphragm assembly consists of a flexible diaphragm **38** of rubber or appropriate material, which has its center fixed between the pair of plates **34** and **35**. The attached end of operating rod **32** may be spun over to lock the plates tightly together with the diaphragm **38** in-between. The peripheral edge of diaphragm **38** is sandwiched between the flange rim **40** of a spring cup housing **42**. Rim **40** is tightly fastened as by machine screws **41**, for example, extending through the housing flange **40** into the adjacent portion of the carburetor body **10**. A spring **44** is mounted within the housing **42** with one end abutting the closed end of the housing and its other end biased into contact with the center plate **35** of the diaphragm assembly. Spring **44** biases the diaphragm assembly **30** in a direction to close the air valve **26**.

Diaphragm **38** forms a chamber **43** with cup housing **42** and a chamber **45** with body casting **10**. Chamber **43** is sealed except for an air passage **46** extending through the wall and the flange **40** of spring housing **42** to join a second air passage **47** through the carburetor body. Air passage **47** connects into a branch passage **48** leading into the flange **12** of the carburetor and connecting into the intake manifold at opening **51**. Another branch **49** of

passage 47 extends to a port 50 into the mixture conduit 17 between the closed position of throttle valve 21 and the air valve 26.

Formed within the body 10 of the carburetor are a pair of fuel bowls 52 and 54 (FIGURES 2 and 4) positioned on opposite sides of the air horn structure 14. Fuel bowl 52 is adjacent to the mixing conduit 16 and fuel bowl 54 is adjacent to the mixing conduit 17. A fuel inlet passage 56 is formed through the body cover casting 19. As shown in FIGURE 1, the fuel passage 56 extends the length of the carburetor to provide fuel access to the two fuel bowls. The fuel passage 56 is connected in any appropriate manner to an inlet fuel line 58 leading from a fuel pump 60 which provides fuel for the carburetor from the fuel tank 62. The fuel inlet line 58, fuel pump 60 and fuel tank 62 are only schematically shown in FIGURE 1.

Fuel from fuel passage 56 enters each fuel bowl through a short passage 61 having a valve seat, which is controlled by a needle valve 63 operated from a float lever 64 pivoted within the fuel bowl at 66 and having a free end attached to a float 68. The float controlled inlet needles 63 operate in a well-known manner. As the fuel in bowls 52 and 54 reaches a predetermined level, the floats 68 through levers 64 will force the pointed end of needles 63 into the valve seats to prevent additional flow of fuel into the bowls, respectively.

In the bottom of each fuel bowl there is threaded a fuel jet 70 having a calibrated passage therethrough connected to a fuel passage 72 leading to a respective fuel well 74 or 75 (FIGURES 1 and 5) formed in the carburetor body 10 and in the wall of each of the mixing conduits 16 and 17, respectively. For example, in FIGURE 1, well 74 is indicated as being adjacent to the mixing conduit 16, and 75 is adjacent to mixing conduit 17. FIGURE 5 shows the well 75 and main fuel nozzle construction associated with mixing conduit 17, which is identical to similiar structure associated with mixing conduit 16.

Mounted in the top of each one of the mixing conduits 16 and 17 is a separate subassembly insert 76 consisting of a pair of fuel tubes and the main nozzle structure. As shown in FIGURE 5, each subassembly consists of a block 78 having a tubular cross member 80 formed with a main fuel passage 82 and an idle fuel passage 84. Nozzle ports 83 through the wall of main fuel passage 82 allows fuel to pass into the mixture conduits 16 and 17, respectively. Press-fitted into one side of each subassembly block 78 is an apertured fuel tube 86 extending downwardly into the respective well 74 or 75. The upper end of each tube 86 is open and connects with the fuel passage 82 respectively. Coaxially mounted within each fuel tube 86 is an idle fuel tube 88, which is press-fitted in an upper portion of the respective block 78 with its upper open end connecting with the fuel passage 84. Fuel tubes 88 are closed except for small restrictions at their lower ends suspended within the fuel wells 74 and 75, respectively. Short tubes 85 are press-fitted into the opposite side of blocks 78 to form fuel passages leading from passages 84 across passages 82 into respective idle chambers 87. Idle chambers 87 open through ports 95 upstream of throttle 20 and 21, respectively. Short passages 93 connect idle chambers 87 to idle ports 97 opening downstream of throttles 20 and 21, respectively. Idle air and fuel flow through ports 97 is controlled by an idle adjusting screw 101.

Restrictions 89 of predetermined size form air bleed passages from the air horn section into air passages 90 leading into the upper portion of each well 74 and 75 to provide air flow into the main fuel passages. Air passages 91 extend from the upper end of the air horn through the fuel bowl cover casting 19 into air passages 92, each respectively connected to tube 85 and idle fuel passage 84. A restricted portion 94 in each passage 92 and restrictions 81 connecting idle passage 84 to the air horn 14 control the amount of air bled into the idle system.

Within each fuel bowl there is mounted a fuel metering rod 96 which is connected at an upper end to a lever 99 fixed to the portion of air valve shaft 28 extending over the top of the respective fuel bowl. The other end of each metering rod 96 has variations in rod thickness, as shown in FIGURE 4*a*, consisting of an end portion 99 of minimum thickness, a tapered portion 103, an intermediate portion 100 of maximum thickness and a second tapered portion 102 of thickness varying from that of portion 100 to a minimum thickness of portion 105. The connection of metering rods 96 to the air valve shaft 98 provides simultaneous operation of the metering rods with the air valve.

A lever 104 (FIGURE 2) is fixed to the end of throttle shaft 22 opposite to that carrying throttle lever 24. Lever 104 carries a spring biased screw 104' for contacting a fast idle cam 106 freely pivoted on a shaft 108 and in an eccentric manner so that gravity will bias the cam 106 in a counterclockwise direction, as viewed in FIGURE 2. A second lever 110 is also freely mounted for rotation on screw shaft 108 and is connected by a link 112 to a control lever 114 fixed to a shaft 116 journaled for free rotation in a cup housing 118, as shown in FIGURES 1 and 2. Control lever 114 is also connected by a link 119 to a lever 120 loosely mounted for rotation at one end of valve shaft 28. Fixed at the end of the air shaft 28 for rotational movement therewith is a short lever 122 having a portion 124 extending over the lever 120.

In accordance with this invention, there is fixed to an intermediate portion of shaft 116 and for rotation therewith, a second lever 126 carrying at its free end a tapered metering valve 128. The upper end of valve 128 is pivotally mounted on the free end of lever 126 so as to move relative thereto. The tapered end of the metering valve 128 extends into a restriction 130 having a passage therethrough of predetermined size which leads into an air chamber 132 in the housing 118. Air chamber 132 is connected by an air passage 134 to short passage 136 joined to the air passage 47, as shown in FIGURE 3, and schematically indicated in FIGURES 6 through 9. A third lever 138 is fixed at the other end of the shaft 116 for rotation therewith. Lever 138 is forked at its free end 140 to receive one end of a bimetallic thermostatic spring 142 fitted into the fork 140 so as to move lever 138. This connection is schematically shown in FIGURES 6 through 9. The outer end of spring 142 is fixed to a stationary shaft 143 mounted on the cup housing 118.

The cup housing 118 is divided into a pair of chambers 145 and 146 by an imperforate wall structure 144 extending transversely across the housing. This wall 144 prevents the interference of air flow through one chamber with the air flow conditions of the other chamber. Chamber 145 is connected to the atmosphere through a vent schematically indicated at 147 in FIGURES 6 through 9. Chamber 146 is connected to a source of heated air such as a stove connected to the exhaust manifold of the engine. Air from the stove is brought through the hot air conduit and through an inlet fitting 48 into the chamber 146. Chamber 146 is connected by a double branched air passage 149 to the carburetor flange 13 at points downstream of the throttles 20 and 21, respectively. This is schematically shown in FIGURES 6 through 9 and in specific detail in FIGURE 3.

Because of subatmospheric air pressure conditions in the manifold 18 during engine operation, air will flow from the manifold stove through the hot air conduit and fitting 148 into the chamber 146 and from the chamber through passage 149 into the manifold. Also, when the valve 128 is open, atmospheric air will flow through vent 147 into chamber 145 and from chamber 145 through passages 132, 134 and 136 into passage 47.

An accelerating pump piston 150 is mounted within a pump cylinder 152 (FIGURES 4 and 6) formed at the end of the fuel bowl 54. A one way ball check valve

154 permits fuel to flow from the fuel chamber into the pump cylinder 152. The piston rod 156 is connected by a linkage 158 pivoted on the cover casting 19 through a link 160 to the throttle lever 24. The accelerating pump provides additional fuel during the opening of the throttle. When the throttle is opened, the pump piston 150 is pressed downwardly to force fuel through an accelerating fuel passage 162 connected to accelerating nozzles 164 (FIGURES 5 and 6) extending into each of the mixture conduits 16 and 17. This provides additional fuel during throttle operation.

In operation, the engine is cranked to operate the fuel pump and to force fuel into the inlet passage 56 of the carburetor. With the float valves 63 in a lowered position, fuel will flow from fuel passage 56 into each of the fuel bowls 54 and 52. Fuel will continue to flow until the floats 68 are raised to a predetermined position at which point the needle valves 63 are closed to prevent further flow of fuel into the fuel bowls. Fuel will flow from each bowl by gravity through the corresponding metering jet 70 into fuel passages 72 and to a level in each of the fuel wells 74 and 75 equal to the level of fuel in the respective fuel bowl. Fuel will also flow past the check valve 154 to fill the accelerating pump cylinder 152 to the level of fuel in the fuel bowl.

One side of diaphragm 36 of servo motor 39 is exposed to air pressure within chamber 44, which is connected to port 50 in mixture conduit 17 between air valve 26 and throttle valve 21. The other side of diaphragm 36 is exposed through passage 33 to substantially atmospheric air pressure in the air horn 14 upstream of air valve 26.

Starting

During cranking of the engine with the throttle open, the engine turns over to pump air through the carburetor to start the engine. With the engine cold, spring 44 of the servo motor holds air valve 26 closed. Servo motor spring 44 also biases the metering rods 96 through levers 98 to their uppermost position, so that the small diameter starting portions 99 of the metering rods are respectively positioned within the metering jets 70 to enable a sufficient amount of fuel to flow into the fuel nozzles 80. Sufficient air to start the engine passes through apertures 25 and 27 in the air valve 26 and into the mixture passages 16 and 17, respectively. Fuel to start the engine is drawn out of the fuel wells 75 and the nozzle bar passages 82 and 84 by the manifold vacuum extending upstream of the open throttles to the nozzle bars 80. This fuel passes into the mixture conduits through the main nozzle ports 83 and the idle ports 95 and 97.

Engine operation

When the engine is running and the throttles are opened from their closed positions, the air pressure at port 50 drops from atmospheric and the air pressure in motor chamber 43 is reduced until diaphragm 36 is pressed inwardly against the bias of spring 44. The air valve 26 then takes a position determined by servo motor 39, in which the difference in air force on the opposite sides of diaphragm 36 balances the bias of spring 44. As throttles 20 and 21 are moved to change the amount of air flowing to the engine, the servo motor 39 will change the position of air valve 26 to retain substantially the same pressure drop across the air valve. The air valve 26 is thus a device for measuring air flow through the carburetor to the engine.

The value of spring 44 is selected to retain a fixed pressure drop across the air valve at all times. This spring sets the angular position of the air valve relative to the amount of air flowing through the carburetor. This then positions the proper portions of metering rods 96 within jets 70. The shape of metering portions of rods 96 are calibrated to give sufficient fuel flow through jets 70 to provide maximum power at any speed of the engine at wide open throttle up to the full air flow capacity of the carburetor.

The tapered portions 102 of metering rods 96 are shaped to provide an increasing flow of fuel through jets 70 as the air valve opens from a partially open position to full open position, at which opening of the air valve, the rod portions 105 are within jets 70 for maximum fuel flow. The optimum air-fuel ratio is maintained with a full open air valve by the increased depression around the nozzle bars 80 due to increased manifold vacuum at higher speeds. The tapered metering rod and its coaction with the air valve as just described is the invention of James T. Bickhaus and Forrest W. Cook which invention is being claimed in copending application Serial No. 293,411 filed July 8, 1963.

The air valve opening and metering rod position for a given air flow through the carburetor at wide open throttle operation will not provide the proper air-fuel mixture at part open throttle with minimum loads. It is thus necessary to change the relationship between the air flow through the carburetor and the flow of metered fuel to the engine, so that less fuel will flow during part throttle minimum load conditions than during wide open throttle maximum power conditions positioned within the jet. To obtain economy during part throttle operation of the engine, the air bleed passage 48, connecting air passage 47 to a port 51 in the mixture passage 17 downstream of throttle 21, reduces the air pressure in passage 47 and motor chamber 43. This opens the air valve 26 slightly more against spring 44. The air pressure in the region of the nozzle bars 80 is thus increased, which reduces fuel flow from the nozzle apertures 83 to produce a leaner air-fuel mixture to the engine. Although opening of the air valve in this manner increases the open areas between the rod portions 102 and jets 70, the increase of air pressure around the nozzle bars 80 has the controlling effect on fuel flow under the conditions described. Air bleed 48 is only effective under conditions of high manifold vacuum operation of the engine when economy of operation is desirable at low speeds or minimum load conditions. To provide the desired increase in the opening of air valve 26 under these conditions, a restriction 170 is placed in the bleed passage 48. The size of the orifice in restriction 170 is preselected to give the desired effect. In the carburetor mentioned above of the type described, a restriction of 0.035 inch was used. This opening size provided a correction to the position of the air valve proportional to the vacuum changes downstream of the throttles.

Cold engine operation

When ambient conditions are below a temperature of about 75° F., the thermostatic spring 142 biases lever 138, shaft 116 and lever 114 in a clockwise direction to a position shown in FIGURES 2 and 6. In this position, operating lever 114 and link 112 have moved the fast idle cam 106 in a clockwise direction against gravity bias by the aid of a lug 109 fixed to lever 110 in the path of rotation of cam 106. After the engine has started and the throttle lever 24 manually released, the adjustment screw stop 104' on the throttle lever 104 will contact the high portion 107 of the cam 106 and hold the throttles in a slightly open position so that the engine will operate at a fast idle speed (FIGURE 7).

The idle speed of the engine provides a subatmospheric pressure within the intake manifold opening 18 in the order of 18 to 20 inches of mercury negative pressure. This negative pressure will be effective upstream of throttles 20 and 21 to cause a depression below air valve 26. This low pressure will be sensed through port 50 and passage 47 to the servo motor 39, which will operate to partially open the air valve 26 and permit flow of sufficient air past throttles 20 and 21 for the cold idle operation.

Idle fuel is drawn from the nozzle ports 83. Also,

air passing through apertures 25 and 27 will sweep around the upper edges of the slightly opened throttles 20 and 21 and will draw air and fuel from the idle ports 95. Idle fuel from idle fuel passage 84 mixes with air bled through passages 90, 91 and 92 and passes through tubes 85 into idle chambers 87 and is drawn out through idle ports 97. Additional air flows through the bypass passages 163 to enter the mixture conduits below the throttles. The metering rod portions 103 are positioned within jets 70 during this cold engine idling operation.

For satisfactory operation, the engine requires a richer air-fuel mixture than when the engine is warm. In accordance with our invention, the air pressure in servo motor 39 is changed in response to engine temperature to provide a richer air-fuel mixture ratio for cold engine operation. When the engine is cold, shaft 116 is biased by spring 142 to a position shown in FIGURES 2 and 6. In this position the metering valve pin 128 is moved out of the restriction 130 to permit a bleeding of air through passage 134 to passage 47 and through passage 49 to the mixture conduit. This air bleed slightly increases the pressure within the servo motor chamber 43 which, with the spring 44, closes the air valve 26 slightly from a position it would otherwise have. This results in a higher depression in the area between the air valve and throttles 20 and 21, which induces a richer fuel flow from the nozzle ports 83 and optimum engine performance for cold engine operation. The amount that valve 26 is closed by the air bled through passages 134 and 136 may be adjustably controlled by the size of a restriction 135 placed in passage 47 between passages 134 and passage 49. This restriction may be in the range of 0.025" to 0.040" in diameter in a carburetor of the type described to provide the desired effect.

During engine operation, because of the subatmospheric pressure in the manifold inlet 18, there is a continuous flow of air from the exhaust manifold stove through the housing chamber 146 and passages 149 which is directed upwardly against throttles 20 and 21, respectively. When the engine begins to run, the air in the exhaust manifold stove becomes heated and the flow of air into the housing chamber 146 becomes warm. The heated air in housing chamber 146 warms the thermostatic coil 142 and causes it to relax and to move the lever 138 in a counterclockwise direction from the position of FIGURE 6. This rotates shaft 116 and lever 126 so as to move the metering valve pin 128 into the passage of restriction 130.

As coil 142 is increasingly heated, the valve 128 progressively cuts down bleeding of air through passage 134 so that pressure in motor chamber 43 decreases and motor 139 slowly moves air valve 26 farther open from its position determined by the air flow through the carburetor. This lowers the depression of air pressure in the region of the nozzle bars 80 and lessens the flow of fuel from the nozzle apertures 83 to provide a leaner air-fuel mixture. Further heating of the coil 142 provides an additional counterclockwise movement of the metering pin 128 until it seats within the passage of restriction 130 to prevent all flow of air through passage 134 to passage 147, at which time the engine has reached a normal operating temperature. With air passage 134 closed, pressure within servo motor 43 drops to a value sensed by ports 50 and 51 alone. Air valve 26 now takes a part open position determined by a predetermined pressure drop across the air valve. This pressure drop can be preselected to retain the optimum flow of fuel from nozzle apertures 83 during warm engine operation with a part open throttle. In the carburetor mentioned above, of the type described, spring 44 is selected to provide a constant pressure drop of 0.3 inch of mercury across the air valve.

When the engine has warmed to a normal operating temperature as described, thermostatic spring 142 rotates shaft 116 and levers 114 and 110 to their positions indicated in FIGURE 8. When the throttles are now operated, the idle stop screw 105 releases the fast idle cam 106 and permits it to drop by gravity. If the throttles are subsequently released for idling conditions, the screw 105 will contact the lowest cam position 113 (FIGURE 2) and allow the throttles to take a substantially closed position. Idle fuel is now drawn by manifold vacuum mainly from the idle chambers 87 through the idle ports 97 and in the manner described above. Air flows through idle bleeds 81 and 91 and the bypass passage 163, controlled by the adjustment screw 165.

The rotation of shaft 116 counterclockwise by spring 142 rotates operating lever 114 to its fullest extent in the counterclockwise direction (FIGURE 8). In this position, the pivot 115 between levers 114 and 119 has passed over center of a straight line between shaft 116 and the pivot 117 between levers 119 and 120. A toggle link is formed by levers 114 and 119. This over-center toggle condition retains the lever 120 in an uppermost position, as viewed in FIGURE 8, where lever arm 124 will strike lever 120. This blocks open the air valve 26 and prevents it from closing as long as the engine is hot. Thus, the engine can be started without an over-rich condition which would be provided with air valve 26 closed. An optimum opening for valve 26 for hot engine starting conditions is from 25 to 30 degrees from its closed position. Also, holding the valve 26 in this open condition allows the engine when warm to function properly during idle operation when warm without an over-rich fuel mixture. In this blocked open position of the air valve, metering rod portions 100 are positioned within jets 70 to provide a sufficient flow of fuel to the engine, during low speed or idling operation.

As the engine cools when not running and the thermostatic spring 142 tensions, the lever 114 will be rotated clockwise and will break the toggle stop. The air valve is then closed slowly as lever 120 is slowly rotated clockwise by the cooling spring 142. When cold, the air valve 26 is closed and in position for a cold start, as described above. The toggle mechanism and associated linkage just described is further disclosed and claimed in copending application Serial No. 281,175, filed May 17, 1963 for Robert J. Smith.

An additional bypass passage 172 may be used extending from the air horn 14 to a port 174 in the mixture conduit 17 downstream of the throttle 21. In cold engine operation passage 172 is closed, as shown in FIGURE 6, by a valve 176 controlled by a bimetal, temperature responsive spring 178. During hot ambient conditions spring 178 opens valve 176 and air can flow through passage 172 to lean out the idle mixture in the manifold.

We claim:

1. A carburetor for an internal combustion engine, said carburetor comprising a body structure having an air and fuel mixture conduit therethrough, a throttle valve mounted across said mixture conduit for movement from an open to a position closing said mixture conduit, means for operating said throttle valve, an air valve mounted within said mixture conduit anteriorly of said throttle valve for movement from an open to a position closing said mixture conduit, said body structure having a fuel chamber therein and a fuel passage extending from said fuel chamber to said mixture conduit for supplying fuel thereto, said passage having a metering restriction, a metering rod operatively connected to said air valve, said metering rod having a portion of varying thickness within said metering restriction to vary fuel flow through said fuel passage, a servo motor responsive to ambient air pressure connected to said air valve to control said air valve, means forming a first air passage to said servo motor from said mixture conduit downstream of said air valve to expose said servo motor to changes in air pressure in said mixture conduit in response to operation of said throttle, means forming a second air passage from ambient air to said first air passage, and

temperature responsive valve means in said second air passage for controlling the flow of air through said second passage whereby to modify the operation of said servo motor in response to engine temperatures.

2. The invention of claim 1 wherein said temperature responsive valve means includes a valve seat in said second passage, a valve member mounted for movement onto said valve seat to close said second passage and a bimetallic element connected to said valve member to move said valve member in response to ambient temperature.

3. The invention of claim 2 including means for directing engine heat around said bimetallic element.

4. The invention of claim 2 including a housing enclosing said bimetallic element, and a conduit means connecting said housing to said mixture conduit downstream of said throttle, said housing including a portion having an air passage opening into said housing and adapted to be connected to a source of engine heated air.

5. A carburetor comprising a body structure having an air and fuel mixture conduit therethrough, a throttle valve mounted across said mixture conduit for movement from an open to a position closing said mixture conduit, means for operating said throttle valve, an air valve eccentrically mounted within said mixture conduit anteriorly of said throttle valve for movement from an open to a position closing said mixture conduit, biasing means for biasing said air valve toward a closed position, an air motor connected to said air valve to move said air valve, said body structure including a first air passage from said mixture conduit downstream of said throttle valve to said air motor and a branch passage communicating with said mixture conduit above said throttle valve whereby to control said air valve in response to pressure drop across said throttle valve, means forming a second air passage connected at one end to said first air passage and open at the other end thereof to ambient air, valve means for controlling flow of air through said second air passage to said first passage, said valve means including a valve seat within said second passage and a valve structure for closing said valve seat, temperature responsive means for operating said valve structure and including a housing, a shaft rotatably mounted in said housing, said valve structure fixed to said shaft for rotation therewith, and a bimetallic thermal sensitive spring having one end fixed within said housing and the other end thereof fixed to said shaft to operate said valve member in response to changes in ambient temperature.

6. The invention of claim 5 including means for heating said bimetallic spring relative to engine operation to close said second air passage.

7. The invention of claim 5 including means for heating said bimetallic spring with engine heat.

8. The invention of claim 5 including means for conducting engine heated air through said housing to heat said bimetallic spring.

9. A carburetor for an internal combustion engine, said carburetor comprising a body structure having an air and fuel mixture conduit therethrough, a throttle valve mounted across said mixture conduit for movement from an open to a position closing said mixture conduit, means for operating said throttle valve, said body structure having a fuel chamber therein and a fuel passage extending from said fuel chamber to said mixture conduit for supplying fuel thereto, said passage having a metering restriction, a metering rod having a portion of differing thickness within said metering restriction to vary fuel flow through said fuel passage, an air valve mounted within said mixture conduit anteriorly of said throttle valve for movement from an open to a position closing said mixture conduit, an air motor responsive to air pressure connected to said metering rod and said air valve to move said metering rod portion and said air valve simultaneously, means forming an air passage to said air motor from said mixture conduit to expose said air motor to changes in air pressure in said mixture conduit in response to operation of said throttle, and temperature responsive means for modifying the air pressure in said passage to vary the position of said metering rod within said metering restriction in accordance with temperature changes.

10. A carburetor comprising a body structure having an air and fuel mixture conduit therethrough, a throttle valve mounted across said mixture conduit for movement from an open to a position closing said mixture conduit, means for operating said throttle valve, an unbalanced air valve mounted within said mixture conduit anteriorly of said throttle valve for movement in response to air flow from a position closing said mixture conduit to an open position, a spring connected to said air valve and biasing said air valve toward a closed position, said body structure having a fuel chamber therein and a fuel passage extending from said fuel chamber to said mixture conduit for supplying fuel thereto, said passage having a metering restriction, a metering rod operatively connected to said air valve, said metering rod having a portion of varying thickness within said metering restriction to vary fuel flow through said fuel passage, an air motor connected to said air valve, means forming air passages from said mixture conduit on both sides of the closed position of said throttle valve to said air motor to position said air valve against the bias of said spring in response to pressure drop across said throttle valve, and temperature responsive means to modifying the air pressure effective on said air motor to position said air valve in accordance with temperature changes.

11. A carburetor comprising a body structure having an air and fuel mixture conduit therethrough, a throttle valve mounted across said mixture conduit for movement from an open to a position closing said mixture conduit, a lever connected to said throttle valve for movement therewith, an air valve mounted within said mixture conduit anteriorly of said throttle valve for movement from an open to a position closing said mixture conduit, an air motor connected to said air valve to move said air valve, said body structure including a first air passage from said mixture conduit downstream of said throttle valve to said air motor to control said air valve in response to pressure drop across said throttle valve, means forming a second air passage connected at one end to said first air passage and open at the other end thereof to ambient air, valve means for controlling flow of air through said second air passage to said first passage, said valve means including a valve seat within said second passage and a valve movable onto and off said valve seat, engine temperature responsive means for operating said valve whereby to modify the action of said air motor, a housing, a shaft rotatably mounted in said housing, said valve fixed to said shaft for rotation therewith, a bimetallic thermal sensitive spring having one end fixed within said housing and the other end thereof fixed to said shaft to move said valve onto said valve seat in response to changes in engine temperature, a fast idle lever rotatably mounted on said carburetor in the path of movement of said throttle lever, said fast idle lever having a plurality of stop portions of successively increasing heights to hold said throttle at correspondingly more open positions for varying the speed of engine idle operation, and linkage means connecting said fast idle lever with said shaft for movement therewith in response to engine temperature.

12. The invention of claim 11 wherein said shaft positions said fast idle lever with a low stop portion thereof in the path of said throttle lever when said valve is on said valve seat.

13. The invention of claim 11 wherein said shaft positions said fast idle lever with a high stop portion thereof in the path of said throttle lever when said valve is off said valve seat.

14. A carburetor comprising a body structure having an air and fuel mixture conduit therethrough

(1) a throttle valve mounted across said mixture con-

duit for movement from an open to a position closing said mixture conduit,

(2) means for operating said throttle valve

(3) an air valve eccentrically mounted within said mixture conduit anteriorly of said throttle valve for movement from an open to a position closing said mixture conduit

(4) an air motor connected to said air valve

(5) biasing means for biasing said air valve toward a closed position

(6) said body structure having a fuel chamber therein and a fuel passage extending from said fuel chamber to said mixture conduit for supplying fuel thereto

(7) said fuel passage having a metering restriction

(8) a metering rod connected to said air valve for movement therewith, said metering rod having a portion of differing thickness within said metering restriction to vary fuel through said fuel passage

(9) said body structure further including a first air passage from said mixture conduit downstream of said throttle valve to said air motor and a branch passage communicating with said mixture conduit above said throttle valve whereby to control said air valve in response to pressure drop across said throttle valve

(10) means forming a second passage connected at one end to said first air passage and open at the other end thereof to ambient air

(11) valve means for controlling flow of air through said second passage to said first passage whereby to modify the action of said motor

(12) said valve means including a valve seat within said second passage and a valve member for closing said valve seat

(13) temperature responsive means for operating said valve member and including a housing

(14) a shaft rotatably mounted in said housing

(15) said valve member fitted to said shaft for rotation therewith

(16) and a bimetallic thermo-sensitive spring having one end fixed within said housing and the other end thereof fixed to said shaft to operate said valve member in response to changes in ambient temperature.

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