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W. C. SUTTLE
FUEL SUPPLY SYSTEM

2,910,057

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3 Sheets-Sheet 1

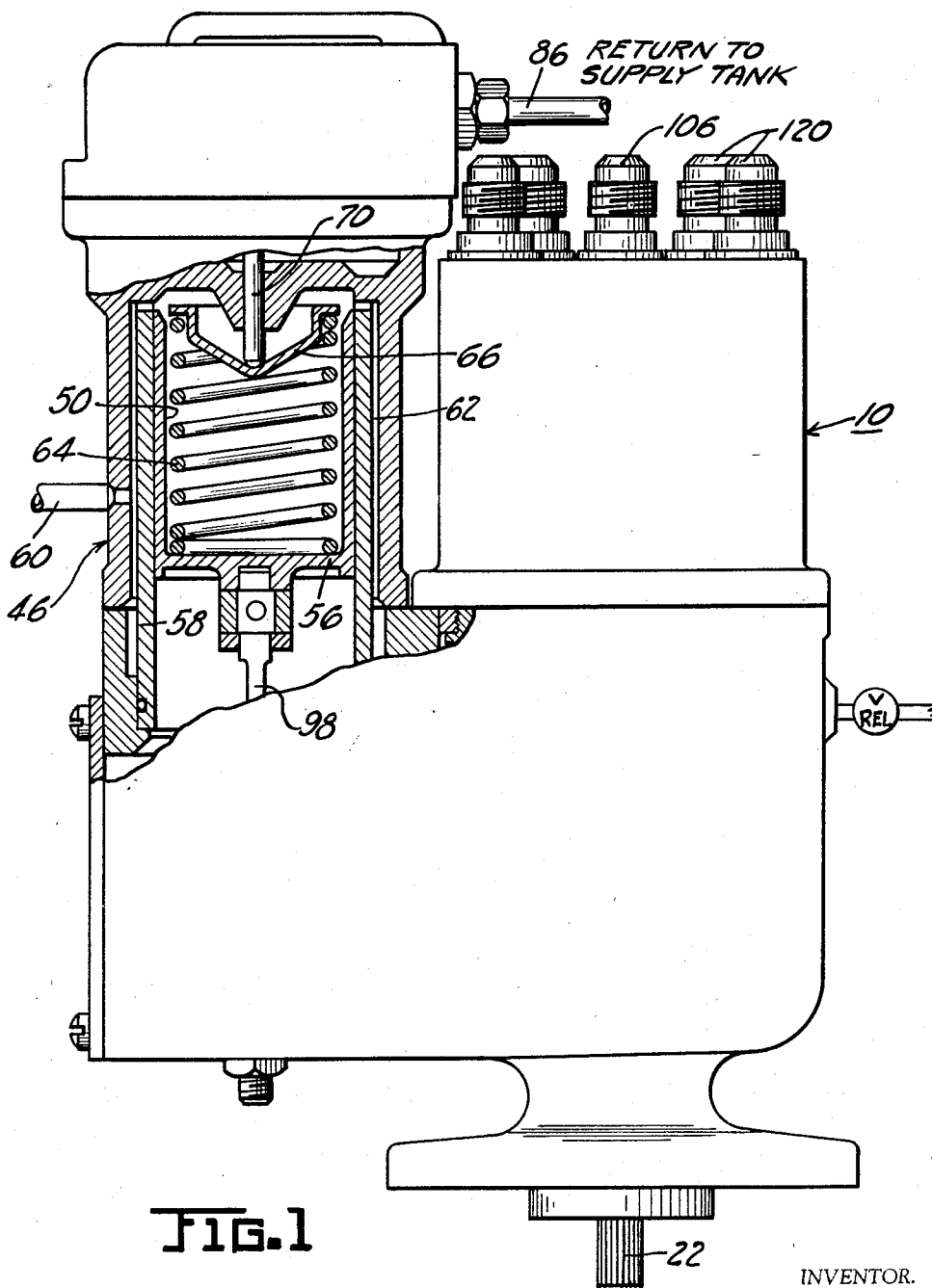


FIG. 1

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3 Sheets-Sheet 2

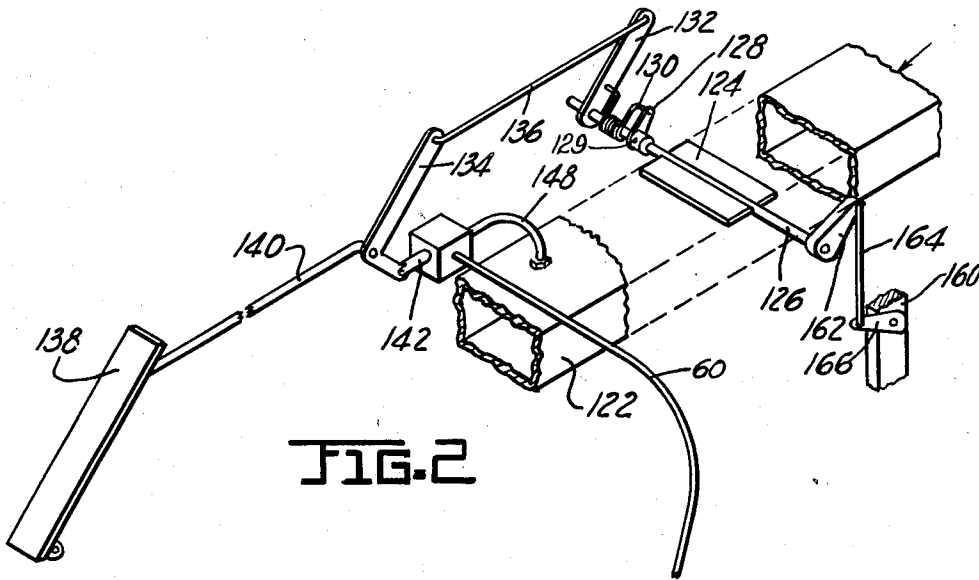


FIG. 2

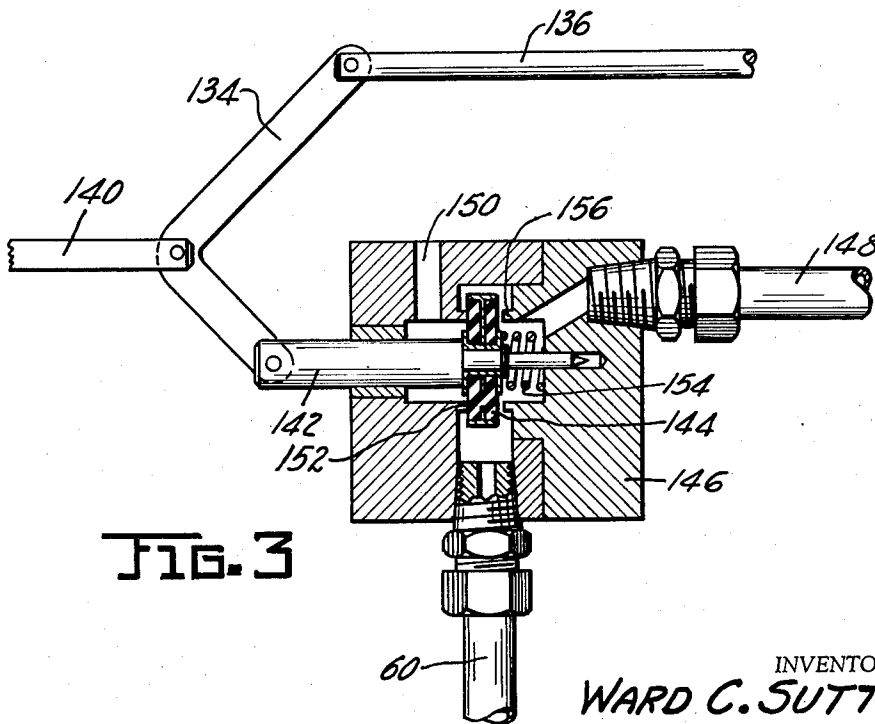


FIG. 3

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3 Sheets-Sheet 3

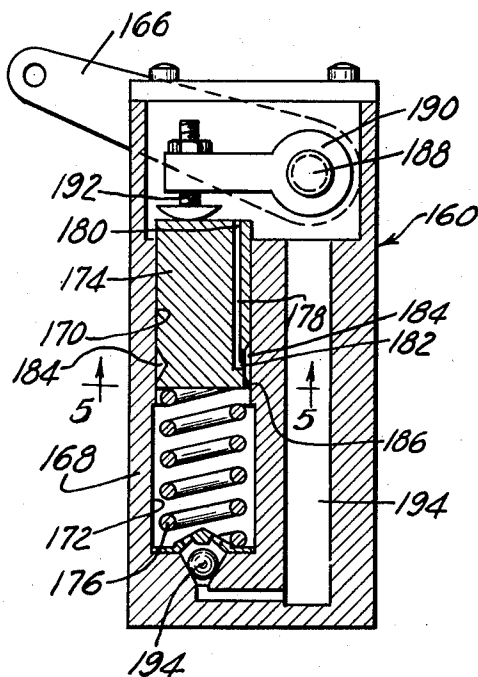


FIG. 4

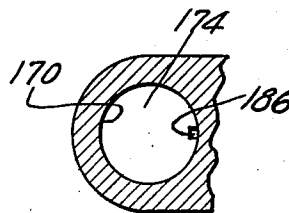


FIG. 5

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1

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FUEL SUPPLY SYSTEM

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6 Claims. (Cl. 123—140)

The present invention relates generally to a fuel supply system for an internal combustion engine and more particularly to an acceleration control for such a system.

A fuel supply system for which the present invention is particularly adapted utilizes a variable displacement pump having an induction passage pressure responsive control member for varying the displacement thereof. The pump is connected to the engine to inject fuel into the induction passage thereof. The induction passage is provided with a throttle to control the supply of air to the engine. When the throttle is opened rapidly it is difficult to obtain a sufficiently rapid response from the pump control member to increase the fuel supply in proportion to the increase in air supply.

It is an object of the present invention to provide in a fuel supply system a control to produce a desired fuel air mixture during acceleration.

Other objects and advantages of the present invention will become apparent during the course of the following description, reference being had therein to the accompanying drawings, in which:

Figure 1 is a view partly in section of a fuel injection device;

Figure 2 is a schematic view of the control members for the device;

Figure 3 is a schematic view partially in section of the valve shown in Figure 2;

Figure 4 is a schematic view partially in section of the dashpot shown in Figure 2; and

Figure 5 is a sectional view taken along line 5—5 of Figure 4.

Referring now to the drawings and more particularly to Figure 1, there is shown a variable displacement fuel injection pump 10 having a control device 46 including a control member 98 operatively connected to the pump for varying the displacement thereof and induction pressure responsive means or piston 50 operatively connected to member 98 for actuating same. Pressure responsive means 50 includes a piston or movable wall 56 mounted in a cylinder 58. Piston 56 is subjected to induction passage or manifold pressure through conduits 60 and 62 which open into cylinder 58. A spring or resilient member 64 located in cylinder 58 exerts a force on piston 56 in opposition to the force of manifold pressure.

Pump 10 is supplied with fuel from a suitable source (not shown) through inlet 106 and is discharged under pressure through outlets 120 which are adapted for connection with appropriate fuel nozzles (not shown) which may be located in the induction passage or cylinders of the engine to which the fuel injection system is adapted to supply fuel.

As best seen in Figure 2, the internal combustion engine to which the present fuel injection system is adapted to supply fuel is provided with an induction passage 122 containing a throttle 124 mounted on a shaft 126 therein. A throttle lever 128 is fixed to throttle shaft 126 by a pin 129 and is secured by means of torsion spring 130 to a loose lever 132 which is rotatably mounted on the

2

throttle shaft. Loose lever 132 is connected to one end of a floating lever 134 by means of a rod 136. An accelerating pedal or control member 138 is connected to the floating lever 134 intermediate its ends by an actuating member 140. The other end of floating lever 134 is pivotally connected to stem 142 of valve 144 which is mounted in a housing 146. The interior of housing 146 is connected to the pump pressure responsive control 50 by means of conduit 60. Conduit 148 connects the interior of housing 146 with the induction passage 122 downstream of throttle valve 124. A vent 150 normally exposed to substantially atmospheric pressure is provided with a seat 152 against which valve 144 is urged by means of spring 154. Conduit 148 is provided with a seat 156 which is adapted to receive the valve member 144.

Throttle 124 is connected to a dashpot 160 by means of throttle shaft 126, lever 162, rod 164 and crank 166. As best shown in Figure 4 dashpot 160 is provided with a stepped cylinder 168 having a first diameter portion 170 and a second larger diameter portion 172. A piston 174 is reciprocally mounted in cylinder 168 and is urged to normally assume a position within the first diameter portion 170 by a spring 176. A passage 178 is formed in the piston and opens at one end 180 in an end of piston 174 and opens at the other end 182 into a groove 184 formed in the side wall of piston 174 and spaced from the end thereof. A restricted passageway 186 connects the groove 184 with the end of the piston.

Crank 166 is provided with a one-way connection with piston 174 through shaft 188, lever 190 and adjustable abutment 192. The cylinder 168 is filled with a liquid which when the piston 174 is moved downwardly may pass through restricted passageway 186, passage 178 to a conduit 194 for return to the cylinder through check valve 196. The piston 174 is positioned in cylinder 168 by means of the adjustable abutment 192 so that a predetermined throttle opening is required to move the piston 174 from the first diameter portion 170 to a position wherein the groove 184 is in communication with the second larger diameter portion 172 of the cylinder 168. By this arrangement a two stage damping action is provided. The first stage producing the greatest retarding action on throttle opening when the piston is wholly within the first diameter portion 170; and the second stage producing a smaller retarding action when the groove 184 in piston 174 enters into communication with the second larger diameter portion of cylinder 168.

In operation the displacement or effective volume discharge of the pump 10 is varied by means of cam or control member 98 which is actuated by the induction passage pressure responsive means 50. Spring 64 urges the pressure responsive piston 56 to move cam 98 toward its extreme position for producing maximum displacement or volume discharge. Induction passage pressure acting on piston 56 urges the piston in a direction to move control member 98 toward the other of its extreme positions of minimum displacement or volume discharge. Thus when the induction passage absolute pressure is high the pump will be positioned in the full stroke or maximum displacement position.

In the present invention when the throttle is opened to accelerate the engine the pump is positioned in or near its full stroke position in advance of throttle movement. The time duration that the pump remains in the full stroke position for acceleration depends on the position of the throttle when the accelerator pedal is actuated, the amount of travel of the accelerating pedal, and the velocity of accelerator pedal travel. When the accelerator pedal 138 is depressed the floating lever 134 is moved to the right as shown in Figure 3 whereby the valve 144 is seated on seat 156 and vent 150 is connected to the pressure responsive means 50 through conduit 60. Spring 64

3

in pressure responsive means 50 then moves the piston 56 to move the pump towards its maximum stroke position. Floating lever 134 also actuates loose lever 132 to urge the throttle 124 toward open position through the torsion spring connection 130 with throttle lever 128. Dashpot 160 resists the opening of throttle 124 and causing the spring 130 to wind up. The spring 130 gradually unwinds moving throttle 124 toward the selected open position in opposition to dashpot 160. When the spring 130 has unwound and throttle 124 has been open to the selected position the spring 154 is effected to move valve 144 to seat on the vent seat 152 whereby the pressure responsive means 50 is again connected to the induction passage through conduits 60 and 148.

Although only one embodiment of my invention has been described, it will be understood by those skilled in the art that the objects of the invention may be attained by the use of other constructions different in certain respects from that disclosed without departing from the underlying principles of the invention.

I claim:

1. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein on a shaft, a variable displacement fuel supply pump adapted to be connected to said engine, a control member operatively connected to said pump for varying the displacement thereof, means responsive to induction passage pressure operatively connected to said member for urging said member in a direction to decrease the displacement of said pump, resilient means operatively connected to said member for urging said member in a direction to increase the displacement of said pump, a throttle lever fixed to said shaft, a loose lever rotatably mounted on said shaft, a resilient connection between said levers, a floating lever, a housing, means connecting one end of said floating lever to said loose lever, a conduit adapted to connect said pressure responsive means to said induction housing, means connecting said housing to said passage, an atmospheric vent means in said housing, a valve in said housing movable to first and second positions to respectively connect said pressure responsive means to said vent means and said conduit, means connecting said valve to the other end of said floating lever, an actuating member connected to said floating lever intermediate its ends, a cylinder having a first diameter and a second larger diameter, a piston in said cylinder, a passage in said piston opening in one end of said piston and in the side wall of said piston spaced from the other end thereof, a passageway connecting said passage with the other end of said piston, a restriction in said passageway adjacent said other end, resilient means in said cylinder urging said piston to a position normally within said first diameter portion of said cylinder, and means operatively connecting said throttle shaft with said piston.

2. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein, a variable volume discharge pump; an outlet for said pump; means adapted to connect said outlet to said engine; control means operatively connected to said pump for varying the discharge therefrom; induction passage pressure responsive means operatively connected to said control means for urging said control means towards one of its extreme positions; a housing; a conduit adapted to connect said housing to said induction passage; a vent in said housing exposed to substantially atmospheric pressure; means for selectively connecting said pressure responsive means to said conduit and vent; a spring normally urging said last mentioned means in direction to connect said pressure responsive means to said conduit; an actuating member; means connecting said member, said last mentioned means and said throttle to move said last mentioned means to momentarily connect said pressure responsive means to said vent when said

4

actuating member is moved in a throttle opening direction.

3. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein, a variable volume discharge pump, an outlet for said pump, means adapted to connect said outlet to said engine, control means operatively connected to said pump for varying the discharge therefrom, induction passage pressure responsive means operatively connected to said control means for urging said control means towards one of its extreme positions, a housing, means connecting said housing to said pressure responsive means, a conduit adapted to connect said housing to said induction passage, a vent in said housing exposed to substantially atmospheric pressure, a valve for selectively connecting said pressure responsive means to said conduit and vent, a throttle lever operatively connected to said throttle, a floating lever operatively connected to said valve and throttle lever, an actuating member operatively connected to said floating lever for moving said valve to a position to connect said pressure responsive means to said vent when said actuating member is moved in a throttle opening direction.

4. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein, a variable volume discharge pump; an outlet for said pump; means adapted to connect said outlet to said engine, control means operatively connected to said pump for varying the discharge therefrom; induction passage pressure responsive means operatively connected to said control means for urging said control means towards one of its extreme positions; resilient means urging said control means toward the other of its extreme positions; a housing; means connecting said housing to said pressure responsive means; a conduit adapted to connect said housing to said induction passage; vent in said housing means exposed to substantially atmospheric pressure; a valve movable to alternatively connect said pressure responsive means to said conduit and vent means; an actuating member; means connecting said member, said valve and said throttle to move said valve in a direction to connect said pressure responsive means with said vent means in advance of throttle movement when said actuating member is moved in a throttle opening direction.

5. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein; a variable volume discharge pump; an outlet for said pump; means adapted to connect said outlet to said engine; control means operatively connected to said pump for varying the discharge therefrom; induction passage pressure responsive means operatively connected to said control means for urging said control means toward one of its extreme positions; a housing; means connecting said housing to said pressure responsive means; a conduit adapted to connect said housing to said induction passage; vent in said housing means exposed to substantially atmospheric pressure; a valve for selectively connecting said pressure responsive means to said conduit and vent means; resilient means normally urging said valve in a direction to connect said pressure responsive means to said conduit; a throttle lever; resilient means operatively connecting said throttle lever with said throttle; a dashpot having a first stage and a second stage, said second stage being less effective than said first stage; means operatively connecting said throttle with said dashpot for actuating said dashpot in said first stage until said throttle is opened a predetermined amount; an actuating member; means operatively connecting said actuating member, said throttle and said throttle lever to move said valve to at least momentarily connect said pressure responsive means to said vent in advance of throttle movement when said actuating member is moved in a throttle opening direction.

5

6. In a fuel supply system for an internal combustion engine having an induction passage with a throttle mounted therein; a variable volume discharge pump; an outlet for said pump; means adapted to connect said outlet to said engine; control means operatively connected to said pump for varying the discharge therefrom; induction passage pressure responsive means operatively connected to said control means for urging said control means toward one of its extreme positions; a housing; means connecting said pressure responsive means to said housing; a conduit adapted to connect said housing to said induction passage; vent in said housing means exposed to substantially atmospheric pressure; a valve for selectively connecting said pressure responsive means to said conduit and vent means; a throttle lever; resilient

6

means operatively connecting said throttle lever with said throttle; a dashpot operatively connected to said throttle for retarding the opening movement thereof during at least a predetermined range of throttle movement; an actuating member; and means operatively connecting said actuating member, said valve and said throttle lever to move said valve to connect said pressure responsive means to said vent means when said actuating member is moved in a throttle opening direction.

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