Nov. 20, 1956 W. O. BISCHOFF 2,771,066

FUEL INJECTION PUMP

Filed Jan. 30, 1953 3 Sheets-Sheet 1

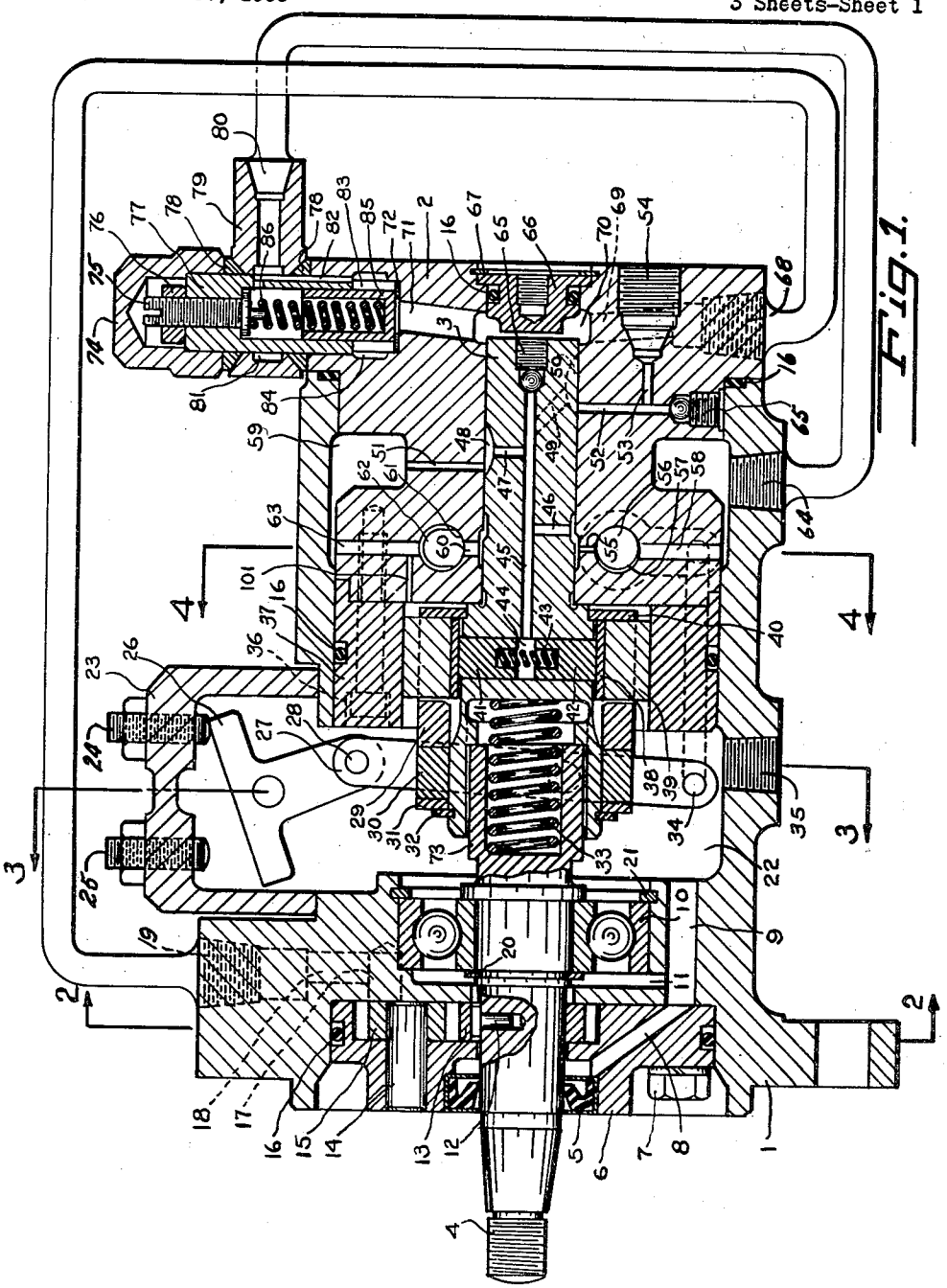


Fig. 1.

INVENTOR.
WALDEMAR O. BISCHOFF
BY
Raymond A. Paquin
ATTORNEY.

Nov. 20, 1956 W. O. BISCHOFF 2,771,066

FUEL INJECTION PUMP

Filed Jan. 30, 1953 3 Sheets-Sheet 2

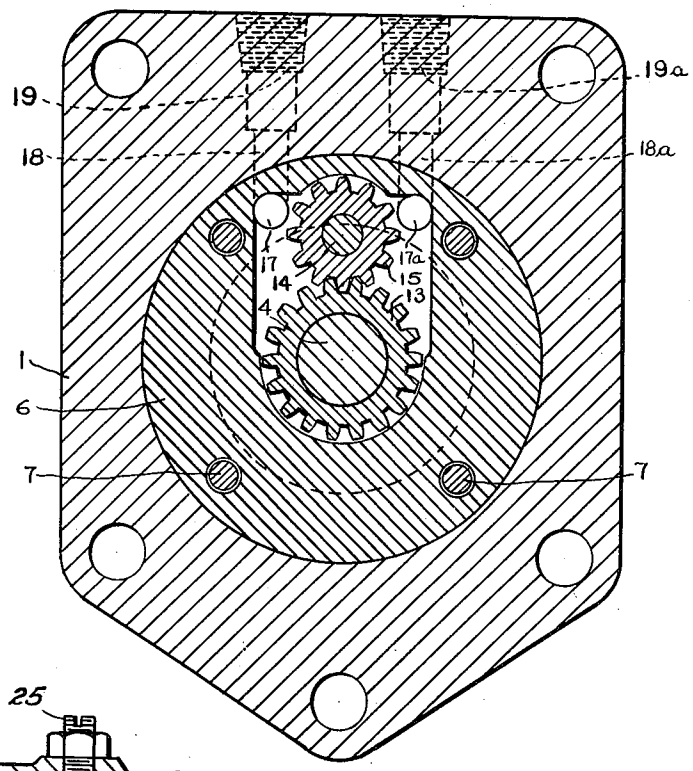


Fig. 2.

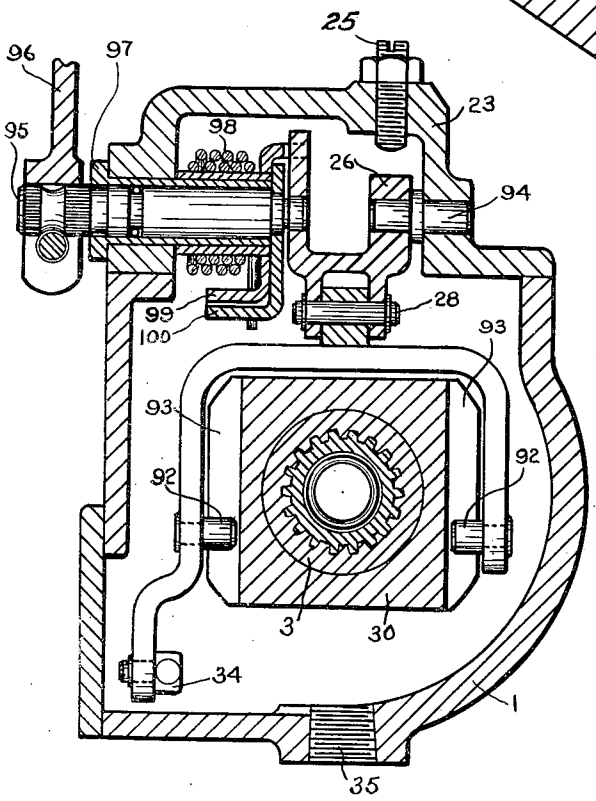


Fig. 3.

INVENTOR.
WALDEMAR O. BISCHOFF
BY
Raymond A. Paquin
ATTORNEY.

Nov. 20, 1956 W. O. BISCHOFF 2,771,066

FUEL INJECTION PUMP

Filed Jan. 30, 1953 3 Sheets-Sheet 3

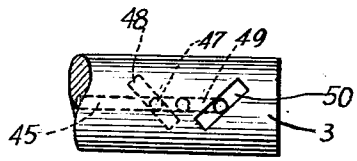


Fig. 6.

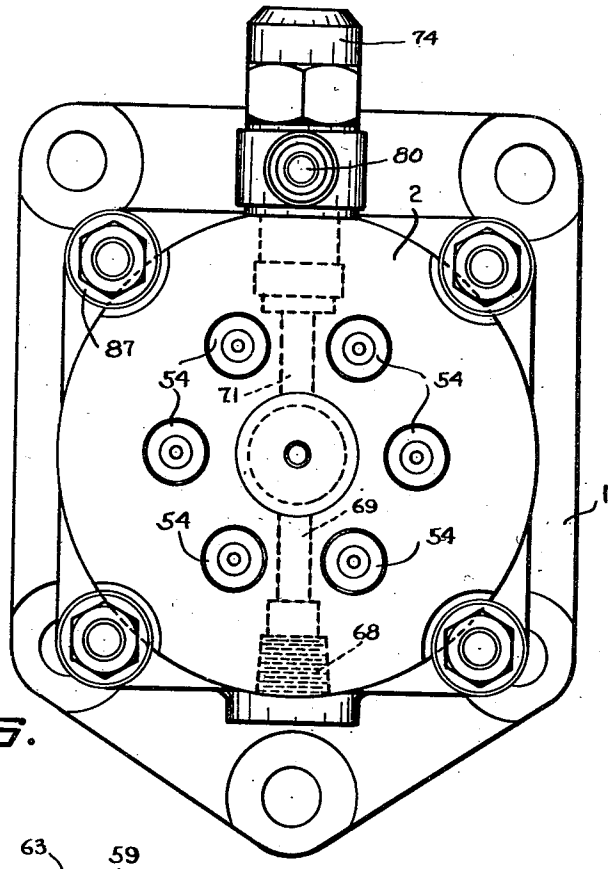


Fig. 5.

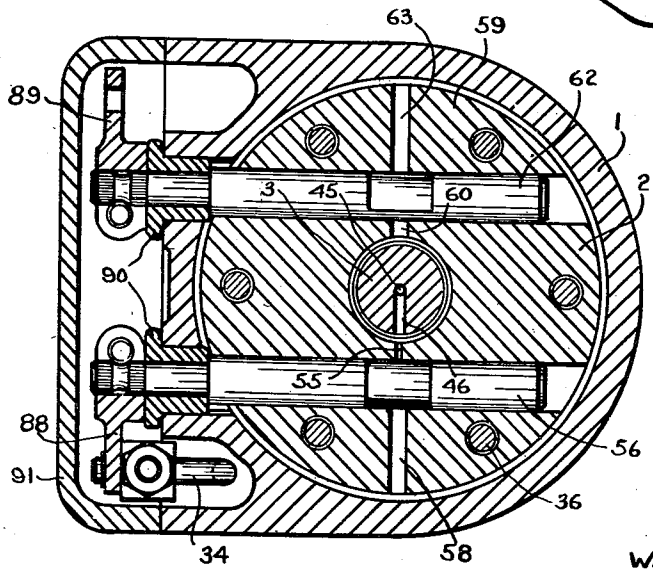


Fig. 4.

INVENTOR.
WALDEMAR O. BISCHOFF
BY
Raymond A. Paquin
ATTORNEY.

United States Patent Office 2,771,066 Patented Nov. 20, 1956

2,771,066

FUEL INJECTION PUMP

Waldemar O. Bischoff, South Hadley Falls, Mass., assignor to American Bosch Arma Corporation, a corporation of New York

Application January 30, 1953, Serial No. 334,330

4 Claims. (Cl. 123—139)

This invention relates to fuel injection apparatus and has particular reference to a new and improved apparatus of the type set forth which is relatively simple and compact in construction and efficient in operation.

An object of the invention is to provide new and improved fuel quantity control means for an apparatus of the type set forth.

Another object is to provide new and improved governing means for such a device.

Another object is to provide new and improved automatic timing means for fuel injection apparatus.

Another object is to provide new and improved shutoff valve means for such an apparatus.

Another object is to provide an apparatus of the type set forth having governor means operated by hydraulic pressure and wherein the pressure is controlled in direct proportion to the engine speed.

Another object is to provide an apparatus of the type set forth which does not require delivery or suction valves and wherein the distributor oscillates with variations in speed.

Another object is to provide such an apparatus wherein the distributor controls the opening and closing of both the suction and discharge ports.

Another object is to provide a new and improved automatic timing control for such an apparatus wherein the timing control is obtained through the oscillation of the distributor shaft.

Another object is to provide such an apparatus wherein the fuel quantity is controlled through a throttled discharge arrangement.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details of construction and arrangement of parts without departing from the scope of the invention as set forth in the accompanying claims, as the preferred form has been shown and described by way of illustration only.

Referring to the drawings:

Fig. 1 is a longitudinal sectional view of a fuel injection apparatus embodying the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 is an end view of the distributor end of the apparatus; and

Fig. 6 is a fragmentary side view of the distributor.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the form of invention shown comprises a housing 1 which is shown constructed for flange mounting to the engine, but could be made for various mounting conditions. The hydraulic head 2 is

secured to the housing 1 by dogs and screws 87 or some other suitable means. Leakage through the flanged joint is prevented by O ring 16. The distributor 3 is lapped to fit the bore of head 2 and is driven by the drive shaft 4 through the splines 73 or some other suitable means. The drive shaft 4 is driven by the engine through gears or coupling. In the cover 6 is provided an oil seal 5 to prevent leakage of fuel along the shaft. Fuel is drained from the seal through passage 8 to passage 9 into drain sump 22. The drive shaft 4 is supported by bearing 10 which is positioned in housing 1 by snap rings 20 and 21. Fuel can circulate through the bearing and is drained back through passage 11 into passage 9 to the sump. A suitable connection can be made at drain hole 35 to pipe the drain sump back to the fuel tank.

The fuel supply pump consists of gears 13 and 15 in the cover 6. Gear 13 is conected to drive shaft 4 through key 12 and drives gear 15 which is mounted on shaft 14. Suitable passages are made in cover 6 for the fuel flow to and from the gear pump. Cover 6 is fastened to housing 1 by screws 7 and leakage of fuel is prevented by O ring 16. If the drive shaft 4 is rotated clockwise fuel is brought in through port 19*a*, passage 18*a* and port 17*a* to the gears and is discharged through port 17, passage 18 to port 19. If the drive shaft is rotated counter-clockwise, the fuel flows in the opposite direction through the gear pump.

The control unit cover 23 is fastened to the housing 1 by screws (not shown). In this cover are adjustable idle stop screw 24 and full speed stop screw 25 which limit the rotation of connecting link 26, which pivots on pin 94 and is connected to fulcrum bar 27 through pin 28. In the fulcrum bar 27 are fulcrum pins 92 which slide in slot 93 of sleeve 30. Sleeve 30 does not rotate but is loosely fitted to distributor shaft 3, being properly located by spacers 29 and 31 and snap ring 32. The other governor linkage parts are shaft 95, lever 96, sleeve 97, spring 98 and tangs 99 and 100. A torque control can be incorporated if desired. The governor spring 33 is contained in the space provided in drive shaft 4 and distributor shaft 3. The control rod 34 is connected to the fulcrum bar 27 and to the control valve lever 88. At its connection at lever 88 the rod 34 can be provided with an adjustment for calibration purposes.

An internal cam 37 is supported by housing 1 and fastened to head 2 by screws 36. Excessive leakage between the cam and the housing is prevented by an O ring 16. Roller slippers 38 support cam rollers 39 which ride on cam 37. End plate 40 locates the slippers and rollers. Pistons 41 and 42 are moved by the cam 37 and returned by the spring 43 and centrifugal action combined with fuel pressure. Fuel chamber 44 is connected through passage 45 to bypass port 46, suction ports 47, suction port slots 48, discharge port 49 and discharge port slot 50 all in distributor 3. In head 2 are six suction passages 51 connected to suction sump 59, six discharge passages 52 connected to passages 53 to discharge connections 54 and closed by suitable plugs 65. Also in the head are a bypass orifice 55, bypass valve 56 with its eccentric portion 57 and bypass passage 58 connected to sump 59. Shutoff port 60 is closed by shufoff valve 61 with an eccentric section 62. Shutoff passage 63 connects to sump 59. Fuel is brought into sump 59 through connection 64 from the filter. Fuel for lubricating purposes flows from sump 59 through passage 63 through orifice 101 into the cam and roller compartment. Orifice 101 also provides the "through flow" passage for the fuel.

Plug 66 is held in place by snap ring 67 in the head 2.

Fuel from the fuel supply pump enters the head through port 68 and passage 69 to chamber 70, thence through passage 71 up to the variable orifice valve. The valve

parts consist of gasket 72, cap nut 74, adjusting screw 75, lock nut 76, body 77, sealing gaskets 78, banjo fitting 79, piston 85 and spring 86. Fuel flows from passage 71 through slots 83 to passage 82 into pocket 81 and out through port 80. Port 80 is connected to the final filter.

In Fig. 4 collars 90 which are threaded into housing 1 retain the bypass valve 56 and the shutoff valve 62 in their respective bores in head 2. Fastened to the valve 56 is its operating lever 88 and to the valve 62 is its operating lever 89. Cover 91 encloses the levers.

When the injection pump is suitably connected to an engine and is rotated in a clockwise rotation, fuel is brought in through port 19*a*, passage 18*a* and port 17*a* to the fuel supply pump gears 13 and 15. Fuel is discharged through port 17, passage 18 and port 19 which is connected to port 63 through tubing. Fuel passes through passage 69 to sump 70 and passage 71 to the variable orifice valve. Fuel exerts a pressure against piston 85 which is resisted by spring 86. The piston lifts from its seat and meters the fuel through the narrow slots 83 in valve body 77 until the load on the piston and the spring force balance each other. As the gear pump is a positive displacement unit, it will deliver more fuel as its speed increases. The proportions of spring 86, piston 85 and slots 83 can be arranged to operate with any one size of gear pump to provide a definite relationship between fuel pressure in sump 70 and pump speed. This relationship can be established by the designer to suit his needs. Fuel pressure in sump 70 varies in direct proportion to the pump speed in this application.

Fuel passing the piston 85 continues through passages 83, 82 and 81 to port 80. From port 80 it is piped to a filter and from the filter to port 64 into supply sump 59. Pressure in the supply sump is maintained reasonably constant through a regulating valve (not shown) and/or the orifice 101.

When the cam 37 permits the pistons 41 and 42 to move outward under the influence of the spring 43, centrifugal force and fuel supply pressure, and the suction passages 51 are properly lined up with suction port 47 in distributor 3, fuel will flow from sump 59 through passages 51, slot 48, port 47, passage 45 into chamber 44. During this time the discharge ports are closed by the distributor. Further rotation of the distributor closes the suction ports and lets passage 49 communicate with passages 52 and 53 to discharge port 54. This rotation also moves the pistons 41 and 42 to another part of the cam 37 so that they are forced inward causing fuel to be discharged through passage 45, port 49, slot 50, passages 52 and 53 to port 54. Further rotation will open and close the suction and discharge ports in sequence.

Fuel quantity discharged through ports 54 is regulated by the action of bypass valve 56. Orifice 55 is in communication with passage 45 at all times through passage 46. When the maximum amount of fuel is required to be discharged at port 54, the valve 56 is rotated so that it seals orifice 55 from passage 58. Then all fuel pumped by the pistons will be discharged through port 54 and none can go through 55 to passage 58. If no fuel delivery is required at port 54 the eccentric portion 57 of valve 56 is rotated so that orifice 55 opens to passage 58 allowing all fuel pumped by the pistons to be bypassed to the suction sump 59. The eccentric portion 57 of valve 56 can be arranged in such a manner that part of the fuel can be delivered to the discharge port 54 and the remainder can be bypassed through orifice 55. The amount bypassed can be regulated as desired by rotating the valve 56 the required amount.

Passage 46 also communicates directly with passage 60 to shutoff valve 61.

Under normal operating conditions the valve 61 is in the position shown and the lapped fit between the valve 61 and the head 2 effectively seals the passage 60 from the passage 63. When it is desired to stop all delivery of fuel to the discharge ports 54 under emergency conditions the valve 61 is rotated so eccentric portion 62 opens the passage between port 60 and passage 63 to the sump 59 permitting all fuel to be returned to the suction sump.

Lubrication is accomplished through fuel discharging through orifice 101 into the cam and roller area and then splashed by centrifugal action over the remainder of the operating parts. Excess fuel is drained back to the tank through port 35.

Governing is accomplished through the action of the fuel pressure on the end of the distributor 3 in chamber 70. The pressure of the fuel in chamber 70 is varied and regulated by the variable orifice valve in direct proportion to the pump speed. This pressure applied to the distributor is opposed by the action of spring 33. The distributor is slidably connected to the drive shaft 4. Mounted on the distributor shaft is a governor sleeve 30 which does not rotate with the shaft . As the pressure changes in the chamber 70 the distributor moves carrying the sleeve 30 with it. Attached to the sleeve is the governing linkage to the bypass valve 56 and to the operating lever 96. Governing action is the same as in a centrifugal governor except that the force operating the governor is developed by hydraulic pressure instead of flyweights.

Timing control is obtained through utilization of the longitudinal movement of the distributor shaft due to the hydraulic pressure. Slots 48 and 50 are helical grooves or some other suitable shape in the surface of distributor 3. As the fuel pressure increases with increase in speed, the distributor shaft moves to the left, opposed by spring 33. The edge of slot 50 which communicates with discharge passage 52 opens earlier with an increase in speed causing an advance in the timing of the beginning of injection.

As the speed decreases, the spring 33 forces the distributor 3 back to the right towards its original position and causes the slot 50 to open later in relation to passage 52. This retards the injection. The timing advance curve can be altered to suit the engine requirements by altering the shape and angle of the slot 50. Slots 48 are the same shape as slot 50 but connects the suction ports to the distributor, so the relationship between opening and closing of suction and discharge ports will remain the same regardless of the speed or the position of the distributor.

From the foregoing it will be seen that I have provided relatively simple and economical means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a positive pressure supply pump, an injection pump, said supply pump being driven in direct ratio to the speed of said injection pump, a fuel path between said supply pump and said injection pump, an automatic variable pressure regulating valve in the fuel path between the supply pump and injection pump, a plurality of outlets and means for distributing fuel pumped by said injection pump to said outlets in desired sequence, means for controlling the quantity of fuel delivered by said injection pump, said means comprising a fuel bypass passage communicating with said fuel distributing means, a fuel control valve for controlling the quantity of fuel bypassed through said bypass passage, a linkage connected to said fuel control valve, a hydraulically actuated governor lever connected to said linkage for actuating said linkage according to the pressure regulated by said pressure regulating valve and resilient means opposing said actuating of said linkage by said hydraulic means.

2. In a device of the character described, a drive shaft, a supply pump and an injection pump operatively connected to said drive shaft whereby said supply pump will be driven in direct ratio to the speed of the injection pump, a fuel path between said supply and injtction pumps, an automatically variable pressure regulating valve in said fuel path, a plurality of outlets and means for distributing fuel pumped by said injection pump to said outlets in desired sequence, means for controlling the quantity of fuel delivered

by said injection pump, said means comprising a fuel bypass passage communicating with said fuel distributing means, a fuel control valve for controlling the quantity of fuel bypassed through said bypass passage, a linkage connected to said fuel control valve, hydraulically actuated means connected to said linkage for actuating said linkage according to the pressure regulated by said pressure regulating valve and resilient means opposing said actuation of said linkage by said hydraulic means.

3. In a device of the character described, a drive shaft, a supply pump operatively connected to said drive shaft, a combined fuel pumping and distributing means in alignment with said drive shaft, said means comprising a pumping portion having reciprocable plunger means and cam means for actuating said plunger means in one direction, said pumping and distributing means having a rotary distributing portion communicating with said pumping portion, a fuel path between said supply pump and said injection pump and an automatically variable pressure regulating valve in said fuel path between said supply and injection pumps, and means for controlling the quantity of fuel passing to said injection pump, said means comprising a fuel bypass passage communicating with said fuel distributing means, a control valve for controlling the quantity of fuel bypassed through said bypass passage and linkage means connected to said control valve, a surface of said pumping and distributing means communicating with hydraulic pressure whereby said pressure will actuate said linkage according to the pressure regulated by said pressure regulating valve and thereby adjust said control valve.

4. In a device of the character described, a drive shaft, a supply pump operatively connected to said drive shaft, a combined fuel pumping and distributing means in alignment with said drive shaft, said means comprising a pumping portion having reciprocable plunger means and cam means for actuating said plunger means in one direction, said pumping and distributing means having a rotary distributing portion communicating with said pumping portion, a fuel path between said supply pump and said injection pump and an automatically variable pressure regulating valve in said fuel path between said supply and injection pumps, and means for controlling the quantity of fuel passing to said injection pump, said means comprising a fuel bypass passage communicating with said fuel distributing means, a control valve for controlling the quantity of fuel bypassed through said bypass passage and linkage means connected to said control valve, a surface of said pumping and distributing means communicating with hydraulic pressure whereby said pressure will actuate said linkage and thereby adjust said control valve, and automatic timing control means automatically actuated by said hydraulic pressure, said hydraulic pressure actuating said injection pump and distributor axially to vary the timing of injection by the pump.

References Cited in the file of this patent

UNITED STATES PATENTS

2,243,861	Hautzeuroeder	June 3, 1941
2,295,833	Deschamps	Sept. 15, 1942
2,356,101	Temple	Aug. 15, 1944
2,478,528	Edwards	Aug. 9, 1949
2,518,473	Hogeman	Aug. 15, 1950
2,593,788	Parsons	Apr. 22, 1952
2,641,238	Roosa	June 9, 1953
2,674,236	Humber	Apr. 6, 1954