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G. E. LIARDET
FUEL INJECTION PUMP

2,831,473

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2 Sheets-Sheet 1

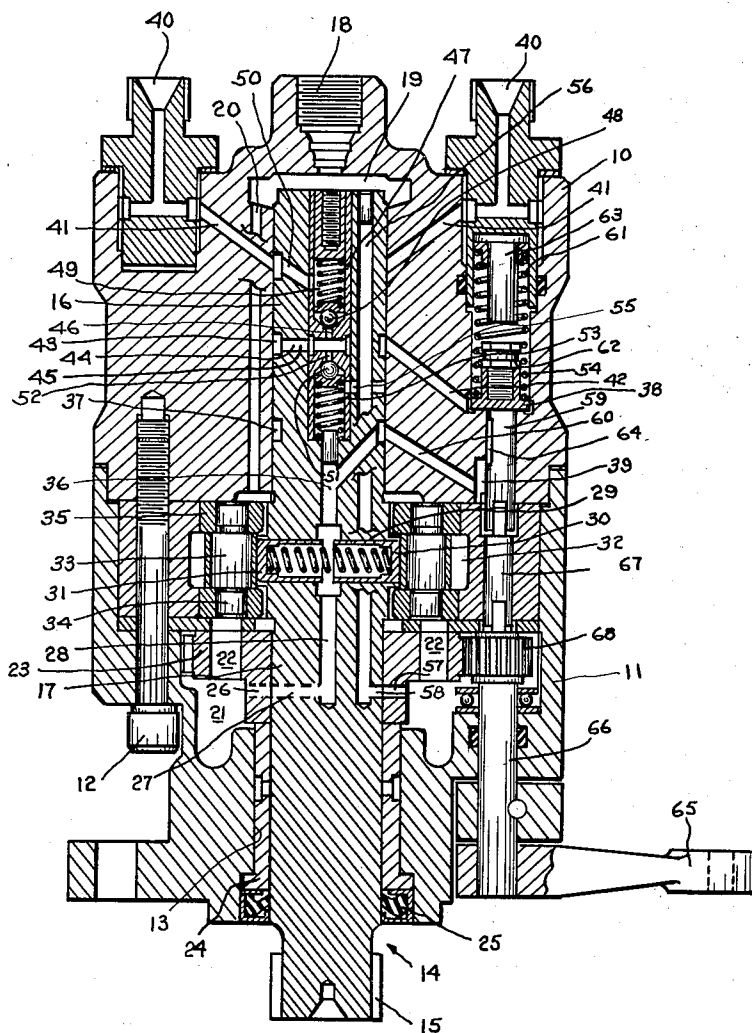


Fig. 1.

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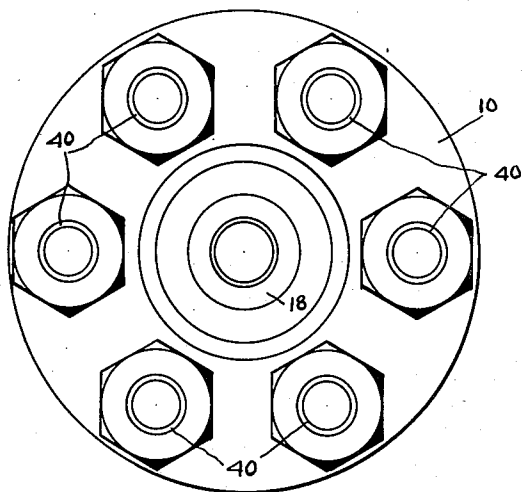


Fig. 2.

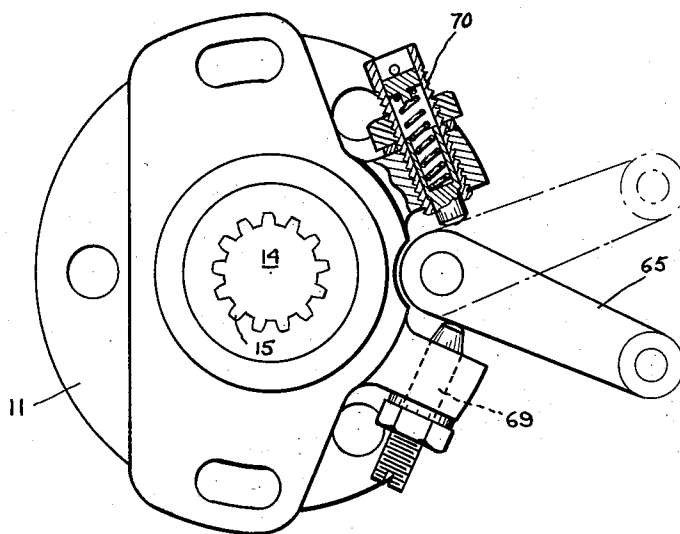


Fig. 3.

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FUEL INJECTION PUMP

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8 Claims. (Cl. 123—140)

This invention relates to fuel injection apparatus and has particular reference to a new and improved device which is relatively simple, compact and economical.

An object of the invention is to provide a new and improved fuel injection apparatus which embodies a distributor type fuel injection pump combined with a hydraulic governor, thereby producing a much more simple, compact and inexpensive apparatus which eliminates a large part of the size, weight and bulk, and which is further enhanced by the absence of mechanical linkages and parts usually found in distributor type fuel injection apparatus.

Another object is to provide such an apparatus wherein the governing means is entirely hydraulic and operates directly on the fluid being injected into the engine and requires no separate hydraulic fluid supply and which does not require a drive, thereby allowing much greater freedom in positioning the fuel injection apparatus relative to the engine.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings and it will be understood that changes may be made in the details of construction and arrangement of parts shown and described without departing from the spirit of the invention as expressed in the accompanying claims as the preferred form of the invention has been given 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 an end view thereof taken from the drive end; and

Fig. 3 is an end view thereof taken from the opposite end.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout, the device shown embodying the invention comprises a housing formed of two sections 10 and 11, secured in assembled relation by bolts or the like 12.

The housing sections 10 and 11 are provided with an aligned bore 13 in which is positioned the rotor designated generally at 14 and which has the spline drive 15 at one end, the distributing portion 16 adjacent its opposite end and the intermediate pumping portion 17.

In housing section 10 is provided the fuel inlet 18 adapted to be connected by a fluid line to a source of fuel under pressure such as a supply or transfer pump or to a fuel tank and in this case, the supply pump may be located within the injection pump housing and driven by rotor 14. Within housing section 10 is fuel chamber 19 from which fuel passes through duct 20 to annular inlet chamber or sump 21 through openings in the tappet housing and openings 22 in timing gear 23.

The rotor 14 is mounted for rotation in bearing bushing 24 and oil seal 25 is provided to prevent leakage.

Timing gear 23 is also provided with spaced fuel inlet ports 26, one of which is provided for each pump outlet

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and which communicate with fuel inlet port 27 in rotor 14 and said port 27 communicates with longitudinal duct or bore 28 for supplying fuel to injection pumping portion 17, which has a plurality, preferably two, opposed radial pumping bores 29 in each of which is positioned a piston or plunger 30 which preferably have bores, as shown, in which is positioned a spring 31 for effecting the suction stroke of said plungers and allowing the complete filling of the bore with fuel for each pumping stroke.

Surrounding said pumping portion 17 is provided the internal cam 32 having opposed lobes for simultaneously effecting the pumping stroke of opposed pistons or plungers 29. Between the ends of each of the plungers 29 and cam 32 is provided a double roller tappet 33 each of which has guide rollers 34 mounted for rotation in shoe 35 whereby, when rollers 33 engage the cam lobes, the rollers and shoes are forced toward its piston or plunger and, thereby, effecting the pumping stroke of said piston which is thereafter returned to pumping position by spring 31.

Pumping portion 17 communicates through duct or passage 36 with annular or peripheral grooves 37 in rotor 14 which in turn communicates with duct 60 which allows the passage of fuel to governor chamber 39.

Housing section 10 is provided with the fuel outlets 40, each of which is adapted to be connected to its respective engine cylinder by a fluid line which is not shown and each of said outlets 40 communicates with bore 13 by means of a discharge passage or duct 41.

The distributing portion 16 of rotor 14 communicates with governor chamber 39 through duct 42 and said distributing portion 16 is provided with the annular peripheral groove 43 which registers with duct 42 and supplies fuel through port 44 to chamber 45 from which fuel passes through passage 46 when fuel pressure is sufficient to overcome the force of spring 47 against ball check or delivery valve 48 and fuel then passes into distributor chamber 49 from which fuel passes through distributing port 50 to one of three ducts 41 connected to its respective high pressure or discharge outlets 40 and on rotation of rotor 14, fuel is delivered to each of the outlets 40 and its respective engine cylinder successively.

In opposed relation to delivery valve 48 is provided a spill valve consisting of ball check valve 51 which normally is retained in position to close passage 52 from chamber 45 by spring 53 in spill chamber 54 from which fuel passes through port 55 from which fuel passes into spill duct 56 and spill port 58, which communicates with each of the spaced spill ports 57 successively, one of which spill ports is provided in timing gear 23 for each pump outlet and are adapted to spill fuel into inlet chamber 21.

The hydraulic governor arrangement is similar to that shown and described in Patent No. 2,582,539 and comprises the governor metering valve 59 in governor chamber 39. Metering valve 59 is mounted for rotatable and slidable movement and the head or top portion 38 of this valve is normally held in engagement with housing 10 surrounding valve chamber 39 by spring 61 and said head or top portion 60 has the adjustable portion 62 which may be adjusted to adjust the maximum fuel delivered by the apparatus and when valve member 59 is lifted by fuel pressure, the head engages stop 63 to limit the upward movement of valve 59 and, thereby, limit the maximum fuel delivery.

Metering valve member 59 or the adjacent wall of chamber 39 are provided with at least one lateral or helical channel 64 or other passage whereby relative adjustment of valve 59 and chamber 39 will control the quantity of fuel passing through the hydraulic governor.

Metering valve 59 is adapted to be pivotally adjusted by adjustment of governor speed control lever 65 which

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is operatively connected to shaft 66 which is operatively connected to shaft member 67 which in turn is operatively connected to metering valve member 59 by any suitable connection such as the tongue and groove connection shown which allows the longitudinal adjustment of metering valve 59 by fuel pressure and still allows pivotal adjustment of said metering valve.

On shaft 66 is provided speed control pinion 68 which meshes with a gear sector on the periphery of timing gear 23 for rotatably adjusting said timing gear to adjust the timing of injection.

As will be seen in Fig. 3, the housing is provided with the adjustable maximum speed stop 69 adapted to adjustably limit the movement of governor speed control lever 65 and opposite stop 69 is provided adjustable spring loaded idling stop 70 which may be adjusted to control the engine idling speed.

The operation of the apparatus is as follows:

Fuel enters inlet 18 to chamber 19 from which it flows through duct 20 and openings in the cam housing and openings 22 to annular sump or inlet chamber 21 and as inlet port 27 is aligned with each of the inlet ports 26 successively, upon rotation of rotor 14, during each suction stroke of the plungers, fuel enters through port 27 to bore 28 to the pumping chamber.

On each pumping stroke of the plungers, during which time port 27 is out of registry with all of the ports 26, fuel is forced under injection pressure through duct 36, annular groove 37 and duct 38 to governor chamber 39 and metering valve 59 controls the fuel quantity as previously described.

From the hydraulic governor, the fuel flows through duct 42 and annular groove 43 and port 44 to chamber 45. Fuel then passes check valve 48 to distributing chamber 49 from which it is distributed by distributing port 50 to each of the outlet ports 41, which communicate with their respective outlets 40, as rotor 14 is rotated.

Injection by the apparatus is terminated when spill port 58 is in communication with one of the spill ports 57 and upon such spilling of fuel, injection is terminated.

It is only necessary to have one set of ports 26 or 58 in timing gear 23 which ports then function both as inlet and spill ports.

It is also pointed out that with inlet port 45 positioned as shown and a port on the opposite side of rotor 14 and in alignment with spill port 55, that hydraulic balance of rotor 14 will be obtained.

It is also pointed out that the hydraulic governor arrangement could be provided in other locations such as in alignment with rotor 14 but such arrangement would not allow the obtaining of as compact and small size of apparatus as with the arrangement shown.

From the foregoing, it will be seen that I have provided new and improved means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a housing having a bore, a rotor in said bore in said housing, said rotor having a pumping portion and a distributing portion, a plurality of outlets communicating with said bore, said pumping portion having a longitudinal bore in said rotor and a plurality of radial bores communicating with said longitudinal bore, piston means mounted for reciprocation in said radial bores, cam means for effecting reciprocation of said piston means, an inlet port communicating with said longitudinal bore, said distributing portion having a fuel passage and a distributing port communicating with said fuel passage and adapted to deliver fuel to each of said outlets successively, and hydraulically operated governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion and said governor being spaced from said rotor and having its inlet communicating with said

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pumping portion, an outlet communicating with said distributing portion, a spill passage in said rotor, means for controlling the spilling of fuel through said spill passage and means for simultaneously adjusting said spill control means and said governor.

2. In a device of the character described, a housing having a bore, a rotor in said bore in said housing, said rotor having a pumping portion and a distributing portion, a plurality of outlets communicating with said bore, said pumping portion having a longitudinal bore in said rotor and a plurality of radial bores communicating with said longitudinal bore, piston means mounted for reciprocation in said radial bores, cam means for effecting reciprocation of said piston means, an inlet port communicating with said longitudinal bore, said distributing portion having a fuel passage and a distributing port communicating with said fuel passage and adapted to deliver fuel to each of said outlets successively, and hydraulically operated governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, a spill port communicating with said distributing portion, a spill passage in said rotor, means for controlling the spilling of fuel through said spill passage and means for simultaneously adjusting said spill control means and said governor and a check valve in said spill passage.

3. In a device of the character described, a housing having a bore, a rotor in said bore in said housing, said rotor having a pumping portion and a distributing portion, a plurality of outlets communicating with said bore, said pumping portion having a longitudinal bore in said rotor and a plurality of radial bores communicating with said longitudinal bore, piston means mounted for reciprocation in said radial bores, cam means for effecting reciprocation of said piston means, an inlet port communicating with said longitudinal bore, said distributing portion having a fuel passage and a distributing port communicating with said fuel passage and adapted to deliver fuel to each of said outlets successively, and hydraulically operated governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, said governor having a metering valve in a bore in said fuel path, said valve being pivotally adjustable and adapted to be adjusted longitudinally by fuel pressure whereby the quantity of fuel delivered to the distributing portion is controlled, and a spill passage communicating with said distributing portion, an adjustable sleeve having a port for controlling the spilling of fuel through said spill passage and a check valve in said spill passage.

4. In a device of the character described, a housing having a bore, a rotor in said bore, said rotor having a pumping portion and a distributing portion, said pumping portion comprising a longitudinal bore and radial bore means communicating therewith, piston means in said radial bore means and cam means adjacent the periphery of said radial bore means and effecting reciprocation of said piston means, an inlet port communicating with said longitudinal bore, an adjustable member having port means adapted to communicate with said port means in said rotor, the relative position of said rotor and said port means being adjustable, said distributing portion comprising a fuel passage communicating with said pumping portion, a distributing port communicating with said fuel passage and adapted to distribute fuel to each of said outlets successively, governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, a spill passage in said rotor, a

check valve in the fuel passage to said distributing port and a check valve in said spill passage.

5. In a device of the character described, a housing having a bore, a rotor in said bore, said rotor having a pumping portion and a distributing portion, said pumping portion comprising a longitudinal bore and radial bore means communicating therewith, piston means in said radial bore means and cam means adjacent the periphery of said radial bore means and effecting reciprocation of said piston means, an inlet port in said rotor communicating with said longitudinal bore, an adjustable member surrounding said rotor and having fill and spill port means adapted to communicate with said port means in said rotor, the relative position of said port means in said adjustable member and rotor being adjustable, said distributing portion comprising a fuel passage having a portion externally of said rotor and communicating with said pumping portion and a distributing port in said rotor communicating with said fuel passage and adapted to distribute fuel to each of a plurality of outlets successively, and governing means having a variable area portion and a hydraulically actuated portion in said external portion of said fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, said governing means operating directly on the fluid being injected by the pump.

6. In a device of the character described, a housing having a bore, a rotor in said bore, said rotor having a pumping portion and a distributing portion, said pumping portion comprising a longitudinal bore and radial bore means communicating therewith, piston means in said radial bore means and cam means adjacent the periphery of said radial bore means and effecting reciprocation of said piston means, an inlet port communicating with said longitudinal bore, an adjustable member having port means adapted to communicate with said port means in said rotor, the relative position of said port means being adjustable, said distributing portion comprising a fuel passage communicating with said pumping portion and a distributing port communicating with said fuel passage and adapted to distribute fuel to each of said outlets successively, and governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, said governing means operating directly on the fluid being injected by the pump, a spill port communicating with said distributing portion and a check valve for controlling the passage of fuel to said spill port.

7. In a device of the character described, a housing having a bore, a rotor in said bore, said rotor having a pumping portion and a distributing portion, said pumping portion comprising a longitudinal bore and radial bore means communicating therewith, piston means in said radial bore means and cam means adjacent the periphery of said radial bore means and effecting reciprocation of said piston means, an inlet port in said rotor communi-

cating with said longitudinal bore, an adjustable member surrounding said rotor and having port means adapted to communicate with said port means in said rotor, the relative position of said port means in said rotor and adjustable member being adjustable, said distributing portion comprising a fuel passage communicating with said pumping portion and a distributing port communicating with said fuel passage and adapted to distribute fuel to each of said outlets successively, and governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion whereby the quantity of fuel delivered to the distributing portion is controlled, said governing means operating directly on the fluid being injected by the pump, said governor having a metering valve portion in a bore and pivotally adjustable for controlling the passage of fuel therethrough and adapted to be longitudinally adjusted by fuel pressure, spill port means in said adjustable member and said rotor and means for simultaneously adjusting the relative positions of said ports and pivoting said governor valve.

8. In a device of the character described, a housing having a bore, a rotor in said bore, said rotor having a pumping portion and a distributing portion, said pumping portion comprising a longitudinal bore and radial bore means communicating therewith, piston means in said radial bore means and cam means adjacent the periphery of said radial bore means and effecting reciprocation of said piston means, an inlet port in said rotor communicating with said longitudinal bore, an adjustable member surrounding said rotor and having port means adapted to communicate with said port means in said rotor, the relative position of said port means in said rotor and adjustable member being adjustable, said distributing portion comprising a fuel passage communicating with said pumping portion and a distributing port communicating with said fuel passage and adapted to distribute fuel to each of said outlets successively, and governing means having a variable area portion and a hydraulically actuated portion in the fuel path and subjected to the pressure of fuel from the pumping portion between said pumping portion and said distributing portion, said governing means operating directly on the fluid being injected by the pump and a longitudinal spill passage and a spill port in said rotor and communicating with said distributing portion, spill port means in said adjustable member and means for simultaneously adjusting the relative positions of said fill and spill ports in said rotor and adjustable member and adjusting said governor valve.

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