Nov. 7, 1933. A. S. WALKER 1,934,108

FUEL OIL INJECTION PUMP

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Fig. 1.

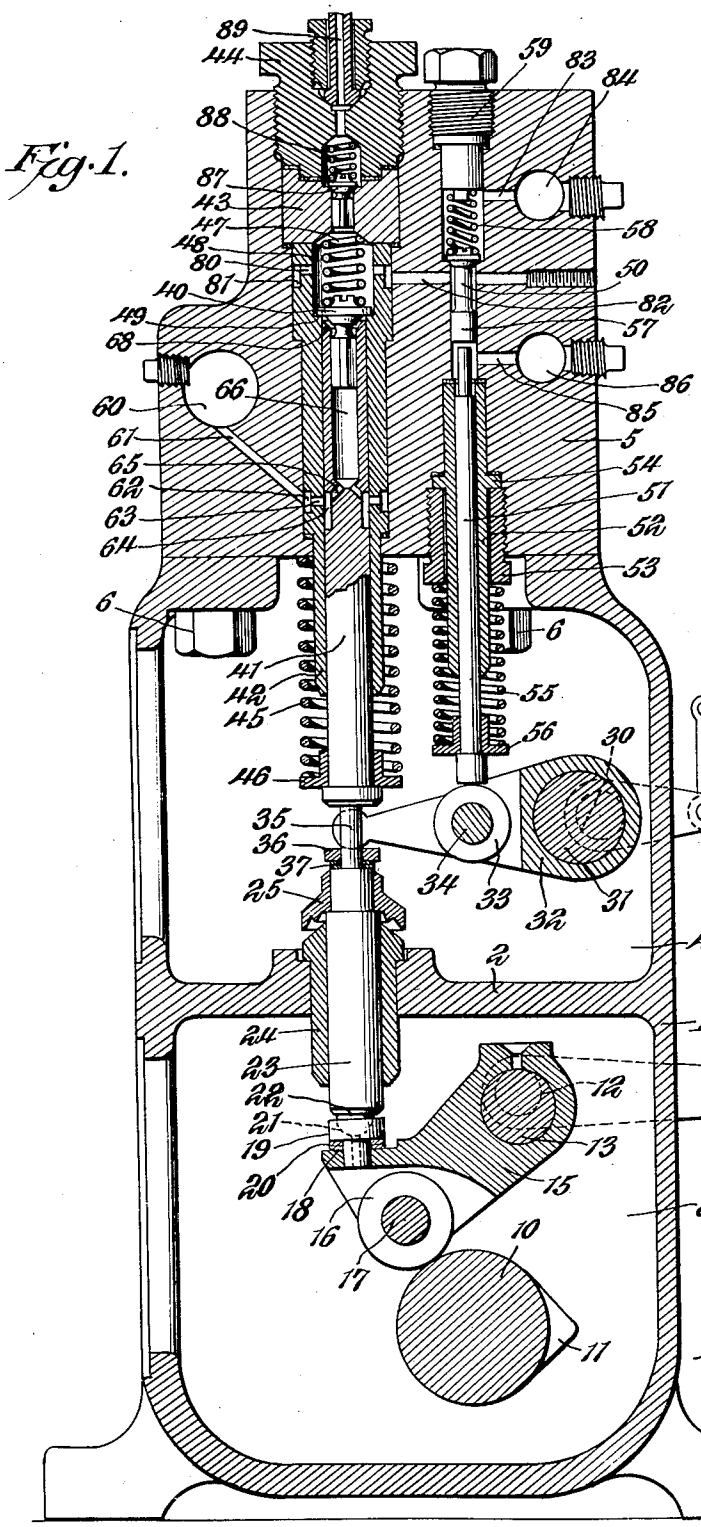
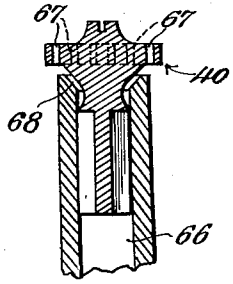
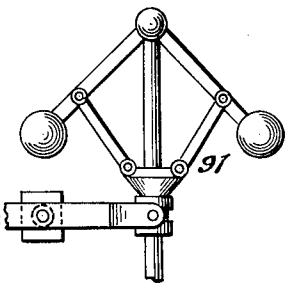


Fig. 2.





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FUEL OIL INJECTION PUMP

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12 Claims. (Cl. 123—139)

The invention relates to fuel oil injection pumps for internal combustion engines, particularly engines of the self ignition type.

In engines of this character, a pump is required for each cylinder, and the injection of the oil takes place just at the end of the compression stroke when the pressure in the cylinder is at the highest point; therefore the oil must be injected into the cylinder against the high pressure existing at that time. And good practice requires that the oil be injected quickly, and under good conditions which may be controlled, both as to the time of the beginning of the injection and as to the time of termination thereof.

These pumps usually employ a suction or supply valve, which controls the flow of oil from the source of supply; a discharge valve, through which the oil flows to the engine cylinder; and a control valve, which governs the termination of the supply of oil to the cylinder. These three valves will hereafter be referred to as the "supply" valve, the "discharge" valve, and the "control" valve.

The principal object of the invention is to so actuate the supply valve that it shall seat certainly and quickly, thus securing the delivery of oil to the engine at the exact time intended and in definite but controllable quantities.

Other objects are to actuate the supply and control valves in unison and in a definite relation to each other; to vary the time of movement of these valves at the will of the operator, to vary the operation of the control valve in accordance with the requirements of the engine, and to vary the time when injection of fuel starts relative to the angular rotation of the cam shaft.

Other objects will appear more fully from the drawing and description.

Fig. 1 is a general sectional view of the pump showing the valves and operating parts.

Fig. 2 is a view of the supply valve on an enlarged scale, and showing perforations thereon through which the oil flows.

Referring to the attached drawing and particularly to Fig. 1 wherein the pump is shown in section, the numeral 1 represents the casing of the pump. A partition 2 divides this casing into two chambers, a lower chamber 3, which contains the main operating elements, and an upper chamber 4, in which certain of the operating elements are mounted. A pump block 5 is secured to the casing by any suitable means as by bolts 6.

Mounted in the lower chamber 3 is an operating shaft 10 having an actuating cam 11 on the periphery thereof. This shaft is to be rotated from the engine in any convenient way. This shaft and cam actuate the pump elements, as will be described later. Adjacent the shaft 10, and likewise mounted in the chamber 3, is another shaft 12, carrying an eccentric 13. This shaft is manually adjustable, as by the lever 14, or other suitable means, so that the position of the eccentric may be varied at the will of the operator.

A rocker arm 15 has one of its ends loosely mounted upon the eccentric 13; and carries at the other end a roller 16 mounted for rotation upon a pin 17 secured in the rocker arm. The rocker arm 15 is provided at the end remote from the eccentric with a seat 18 upon which is mounted a socket 19. Shims 20, or other adjusting devices, lie between the seat 18 and the socket 19. A hemispherical rest 21 is positioned in the socket 19, and upon the upper surface 22 thereof stands a push rod 23, which actuates the pump plunger. This push rod is movable within a closely fitting sleeve 24 which is pressed tightly in an opening in the partition 2. A drip cap 25, secured near the top of the push rod prevents fuel oil passing down the push rod into the lower chamber.

In the chamber 4 there is mounted for rotation a control shaft 30, having mounted thereon or formed therewith an eccentric 31. This shaft and its attached eccentric are adapted to be oscillated under the control of a governor operated by the engine itself.

Another rocker 32, termed herein the "control" rocker, operates the control valve. This rocker has one end thereof mounted upon the eccentric 31, and the other, which is bifurcated to accommodate the reduced end 35 of the push rod 23, resting upon a hardened collar 36 on the push rod. Adjusting devices as shims 37 may be used between the hardened collar and the end of the push rod.

The supply valve is designated 40. This valve cooperates with and is actuated by the main pump plunger 41. This plunger moves with a close fit in a sleeve 42 secured in the pump housing, and held in place therein by a block 43 and screw plug 44. A spring 45 surrounding the sleeve rests at its upper end against the bottom of the pump housing and at its lower end upon a collar 46 on the plunger 41. This holds the plunger down on to the top of the push rod 23 with a yielding pressure. A spring 47 in the valve chamber 48 holds the supply valve 40 upon a shoulder or stop 49 in the sleeve 42.

The control valve 50 is operated by plunger 51 movable with a tight fit in a sleeve 52 fastened

in the pump housing by any suitable means, as by the nut 53 screwed into the housing against the flange 54. The plunger 51 rests on the roller 33 carried by the rocker 32, and is shifted as the rocker is moved either by the cam 11 and push rod 23, or by the governor through the shaft 30 and eccentric 31. A spring 55 having one end resting against the nut 53 and the other upon a flange 56 on the plunger, serves to keep the plunger in contact with the roller 33. The upper end of the plunger 51 cooperates with the lower end 57 of the control valve 50 and lifts the same from off its seat. A spring 58 above the valve 50 and resting against the plug 59 keeps the valve upon its seat.

The supply valve 40 normally rests upon the stop 49 under the pressure of its spring 47, but this stop is not the seat for the valve; its seat is at 68 in the top of the pump plunger 41. Therefore when the pump plunger is in its lower position, the valve 40 rests upon the stop 49 and not upon its seat. As the plunger 41 rises, it first moves the seat 68 into contact with the valve 40 and then lifts the valve from off its stop; it picks up the valve, lifts it, and upon its return again places it upon its stop. Therefore, when the pump plunger is in its lowest position, there is always a gap between the valve and its seat; and the width of this gap will vary somewhat with the position of the eccentric 13, which, as before described, may be manually adjusted.

The oil supply is illustrated diagrammatically at 60. Leading therefrom is a channel 61 running to an annular recess 62 in the sleeve 42. This sleeve is provided with orifices 63, which in turn lead to an annular channel 64 formed in the periphery of the pump plunger 41. This channel 64 is made considerably wider than the diameter of the orifices 63, so that the channel will be in communication with these openings whatever may be the position of the plunger as it moves up and down. Openings 65 formed in the plunger lead from the annular channel 64 to a chamber 66 formed in the pump plunger 41. Openings 67 (Fig. 2) in the flange of the valve 40 form passageways for the oil from chamber 66 in the plunger to the chamber 48 of the valve 40.

As the plunger 41 withdraws a suction effect is produced within the chambers 48 and 66, and oil from the supply 60 enters through the passages 61, 62, 63, 64 and 65 filling the chambers. The valve 40 does not follow the plunger for the spring 47 cannot move the valve against the inrushing oil, but as soon as the chambers are full of oil, the valve 40 will be seated by its spring on its stop 49.

Ports 80 lead from the chamber 48 to an annular recess 81 in the top of the sleeve 42; and from this channel through the passage 82 to the chamber of the control valve 50. An outlet 83 leads to a discharge chamber 84, from which any oil that may be discharged through the control valve 50 is carried back to the supply. A drain passage 85 is connected to the valve chamber below the lower part of the valve, and leads to a discharge or drain pipe 86.

The discharge valve 87 is arranged above the supply valve 40, and this valve is held to its seat by a spring 88 placed in the channel above the valve. Any suitable connection, as the pipe 89, leads to the engine cylinder.

While the shaft 30 which carries the eccentric 31 is intended to be adjusted under the control of the engine, the particular means for effecting this control do not form a part of this invention. But a governor adapted to be driven by the engine is shown diagrammatically, and so connected to the pump as to indicate the manner in which the control is effected. A lever 90 attached to the shaft 30 is connected by suitable links and lever to the governor 91. With these connections the governor will shift the shaft 30 and its eccentric 31 so as to cause the discharge valve to open earlier or later as the demands on the engine require.

The use of the partition 2 and the drip cap 25 prevents the passage of fuel oil from the chamber 4 to the chamber 3, thus preventing contamination of the oil for the bearings in chamber 3 by fuel oil from chamber 4.

The shims 20 between the face 18 of the rocker 15 and the socket 19 are used to effect adjustment of the individual pumps. Where the pumps are used with multiple cylinder engines, some means for adjusting the individual pumps is necessary. This is effected by means of these shims, more or less of them being used as circumstances require. Similar shims 37 are inserted between the top of the push rod 23 and the collar 36 for timing the movement of the control valve 50 with repect to the supply valve 40.

The operation will now be given. Assuming that the shaft 10 is so connected as to be rotated in timed relations with the main shaft of the engine, and that the governor 91 is likewise driven by the engine, as the shaft 10 rotates the cam 11 carried thereby strikes the roller 16 on the rocker 15, thus lifting the rocker. This in turn raises the push rod 23 which lifts the pump plunger 41, and at the same time shifts the rocker 32 around its eccentric 31. The pump plunger first closes the gap between the valve seat 68 and the supply valve 40. As soon as the valve seat strikes the valve it will close the oil channel from the chamber 66 to the chamber 48 which normally is maintained through the openings 67 in the flange of the valve 40. As soon as the valve seat strikes the valve 40 it will lift the latter and force the oil that is in the chamber 48 up through the discharge valve 87 and out the pipe 89 to the engine cylinder.

This movement of the pump plunger and its valve seat 68 causes the seat to strike the valve while it is moving with considerable rapidity. This not only causes the valve to seat firmly and certainly upon the seat, but it also causes a quick discharge of the oil into the engine, thus producing the rapid injection of the fuel which is so important in engines of the character for which this pump is intended.

While the pump plunger 41 is still rising the rocker 32 lifts the plunger 51 of the control valve 50 from its seat and thus relieves the pressure by opening the by-pass 80, 81 and 82, thus quickly checking the discharge of oil into the engine.

The point in the cycle at which the control valve is opened will depend upon two factors. First, it will depend on the position of the eccentric 13, which, as before explained, is manually adjustable by means of the lever 14. If the shaft 12 be turned clockwise the roller 16 will be shifted to the left in its angular relation to the cam 11, and will therefore be struck by the cam earlier in the cycle if the shaft turns clockwise, or later if it turns counter clockwise; or if the shaft 12 is moved counter clockwise, the roller 16 will be moved to the right and its angular relation to the cam 11 again changed, it will be operated by the cam later in the cycle if the

shaft 10 is turning clockwise, or earlier if it is turning counter clockwise. Thus the push rod 23 and the pump plunger may be caused to operate sooner or later, as the case may be. This control of the push rod 23 will also control the rocker 32 and its roller 33, thereby causing the control valve to be actuated sooner or later in the cycle, as may be desired.

The supply valve plunger 41 and control valve plunger 51 have a fixed and definite relation to each other. This is due to the yoke 32, which is actuated by the plunger 23, and which in turn operates the plungers 41 and 51. Because of the manner in which the yoke or lever 32 is pivoted, and because the plunger 51 rests thereon between the plunger 41 and the fulcrum, the movement of the plunger 51 will always be a definite and fixed fraction of that of plunger 41. This relationship is always maintained, except as it is modified by the engine governor 91 shifting the eccentric 31.

If the eccentric 13 is so set that the plunger 41 is operated by cam 11 early in its cycle, the relief valve 50 will also be operated at a corresponding early time; and if the supply valve plunger 41 is operated by cam 11 later in the cycle, then the relief valve 50 also will be correspondingly retarded. So while the time of the beginning of the effective operation of these valves may be varied by shifting the eccentric 13, the relative movements of the two plungers is not changed thereby. If the supply valve is closed at an earlier time then the control valve will be opened at an earlier time, except as its operation may be modified by the engine governor; and if the supply valve is closed later, then the control valve will be operated at a correspondingly later time, except as its operation may be modified by the engine governor.

Moreover, inasmuch as the shaft 30 and eccentric 31 are movable under the control of the governor 91, these elements will be shifted to cause the roller 33 to lift the push rod 51 and open the discharge valve in accordance with the demands of the engine itself. If the engine slows down, it will rotate the eccentric to lower the rocker 32 and its roller 33, so that the discharge valve will not be opened until later in the cycle, thus causing the introduction of a large fuel charge into the cylinder; on the other hand, if the engine speeds up, the governor will rotate the eccentric 31 so as to cause the pump plunger 51 to open the discharge valve earlier in the cycle, thus reducing the fuel charge.

What I claim is:—

1. In a fuel injection pump, a pump casing, an oil supply valve in the casing, a stop for limiting the movement of the supply valve in one direction, a pump plunger having an oil channel therethrough and a seat for the supply valve in the end thereof, and means for moving the plunger so that the seat in the end thereof shall cooperate with the supply valve to prevent the back flow of oil from the pump casing and to force the oil into the engine.

2. In a fuel injection pump, a pump casing having an oil channel therethrough, a supply valve in the channel, a stop for limiting the movement of the valve in one direction, a hollow pump plunger through which the oil flows the plunger having a seat for the supply valve in the end thereof, and means for moving the plunger into contact with the valve to close the passage through the channel and to force the oil into the engine.

3. In a fuel injection pump, a pump casing having an oil channel therethrough, a supply valve in the channel past which the oil may flow, a stop for limiting the movement of the valve in one direction, a control valve, a hollow pump plunger having a seat for the supply valve in the outer end thereof, means for moving the plunger toward the supply valve to seat the latter on the valve seat, means for operating the control valve, means for varying the time of operation of the pump plunger, and means for maintaining the same operating relation between the pump plunger and the means for operating the control valve irrespective of the timing of the pump plunger.

4. In a fuel injection pump, the combination of a pump casing, a supply valve, a discharge valve and control valve in the pump casing, a hollow pump plunger having a valve seat in the end thereof for cooperating with the supply valve, a plunger for operating the control valve, a cam shaft adapted to operate in timed relation with the engine, means actuated from the cam shaft for operating the two plungers in a definite relation with respect to each other, and means under the control of the operator for varying the time of operation of the supply and control valves with respect to the angular position of the cam shaft.

5. In a fuel injection pump, the combination of a pump chamber having a channel therein through which the oil flows to the engine and a by-pass through which excess oil may flow after the engine has been supplied, a supply valve opening into the pump chamber, a discharge valve in the channel, and a control valve in the by-pass, a hollow plunger through which the oil flows to the pump chamber, a plunger cooperating with the control valve, means for operating the plungers in unison, and means under the control of the operator for varying the time in the engine cycle at which the supply valve and the control valve shall operate.

6. In a fuel injection pump, a pump casing, a supply valve and a control valve, a partition in the casing for dividing the same into lower and upper operating chambers, a pump plunger for operating the supply valve, a cam shaft in the lower chamber for operating the plunger, means in the upper chamber for operating the control valve in timed relation with the supply valve, and means for deflecting fuel oil from passing along the plunger from the upper chamber to the lower chamber.

7. In a fuel injection pump, the combination of a pump casing, a supply valve in the casing, a control valve in the casing, a stop for limiting the movement of the supply valve, a pump plunger for operating the supply valve having a seat in its outer end for the supply valve and having a greater range of movement than the valve, a plunger for operating the control valve, a cam shaft for operating the plunger for the supply valve so as to bring the seat therein in contact with the valve at a relatively high velocity after the beginning of the pressure stroke so as to completely seat the valve in the plunger, and means for maintaining a definite operating relation between the supply valve and the control valve.

8. In a fuel injection pump, the combination of a pump casing, a supply valve therein, a pump plunger for operating the supply valve, a rocker for operating the plunger, a shaft having an eccentric upon which the rocker is mounted, a cam shaft for operating the rocker, shims between the rocker and the pump plunger by

which the relation of this plunger to the supply valve may be adjusted, a plunger for operating the control valve, a rocker pivoted at one end and cooperating with the pump plunger for operating the control valve so as to maintain a timed relationship between the supply valve and the control valve, and shims between the plunger and the control valve rocker for adjusting the time of operation of the control valve with respect to the supply valve.

9. In a fuel injection pump, a pump casing, a supply valve, a plunger for operating the supply valve, a control valve, a plunger for operating the control valve, a lever for operating the two plungers, a cam rotatable with the engine shaft for operating the lever so as to move the plungers and their respective valves, and means under the control of the engine for varying the fulcrum of the lever.

10. In a fuel injection pump, a pump casing, a supply valve, a plunger for operating the supply valve, a control valve, a plunger for operating the control valve, a lever p voted at one side of the plungers and adapted to operate the same, a cam rotatable with the engine shaft for operating the lever so as to move the plungers and their respective valves, an eccentric upon which the lever is fulcrumed, and means under the control of the engine for shifting the eccentric so as to vary the fulcrum of the lever.

11. In a fuel injection pump, a pump casing, a supply valve, a plunger for operating the supply valve, a control valve, a plunger for operating the control valve, a lever pivoted at one side of the plungers and so positioned with respect thereto that the supply valve plunger shall be operated by the end of the lever and the control valve plunger by an intermediate portion of the lever so that the movement of the control plunger shall be definitely related to the movement of the supply valve plunger, a cam rotatable with the eng ne shaft for operating the lever so as to move the plungers and their respective valves, and an eccentric upon which the lever is fulcrumed.

12. In a fuel injection pump, a pump casing, a supply valve, a plunger for operating the supply valve, a control valve, a plunger for operating the control valve, a lever pivoted at one side of the plungers and so positioned with respect thereto that the supply valve plunger shall be operated by the end of the lever and the control valve plunger by an intermediate portion of the lever so that the movement of the control plunger shall be definitely related to the movement of the supply valve plunger, a cam rotatable with the engine shaft for operating the lever so as to move the plungers and their respective valves, an eccentric upon which the lever is fulcrumed, and means under the control of the eng ne for shifting the eccentric so as to vary the fulcrum of the lever.

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