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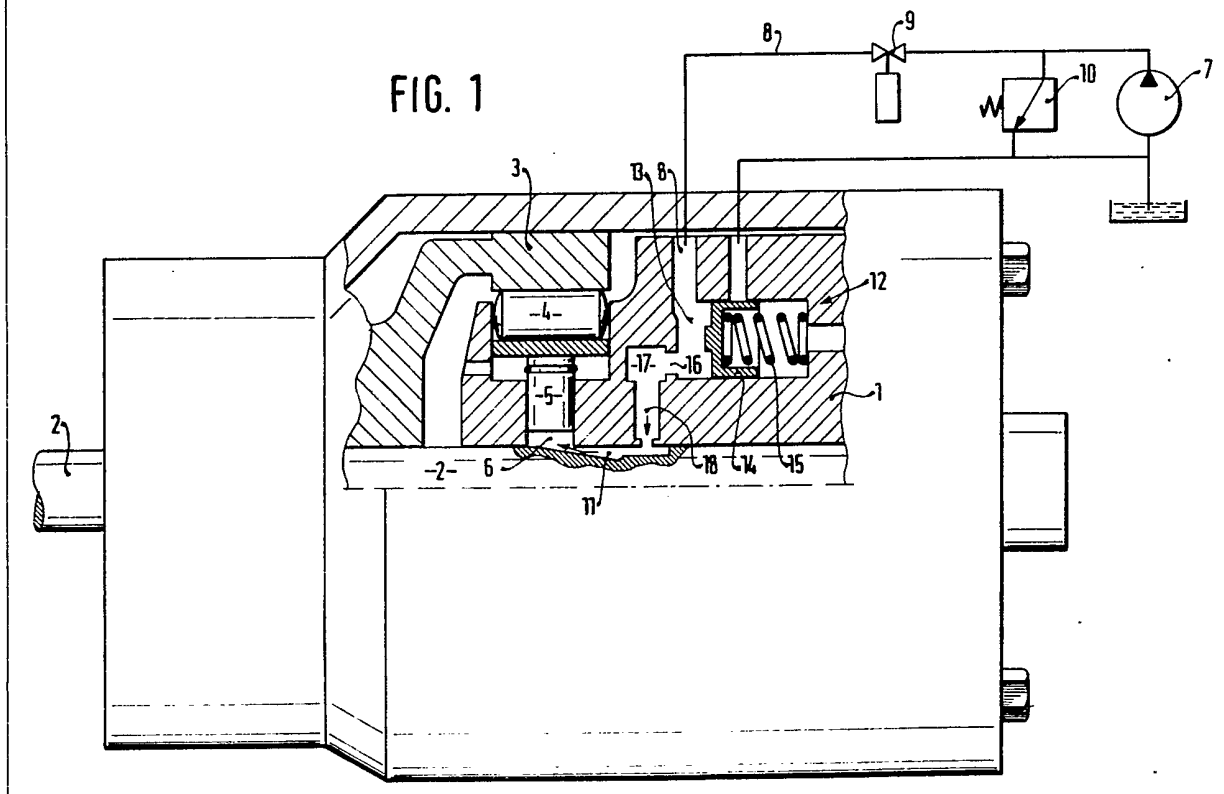
(54) A fuel injection pump

(57) For a fuel injection pump, in particular a radial piston pump (3, 4, 5, 6) with a rotating cam (3), it is proposed to incorporate a fuel storage device (13, 14) in the supply duct (8, 16, 17) leading from the feed pump (7) to the pump chamber (6). Fuel stored under pressure in the device is of sufficient pressure to return the fuel injection pump pistons (5) during the suction stroke and thereby dispense with return springs.

FIG. 1



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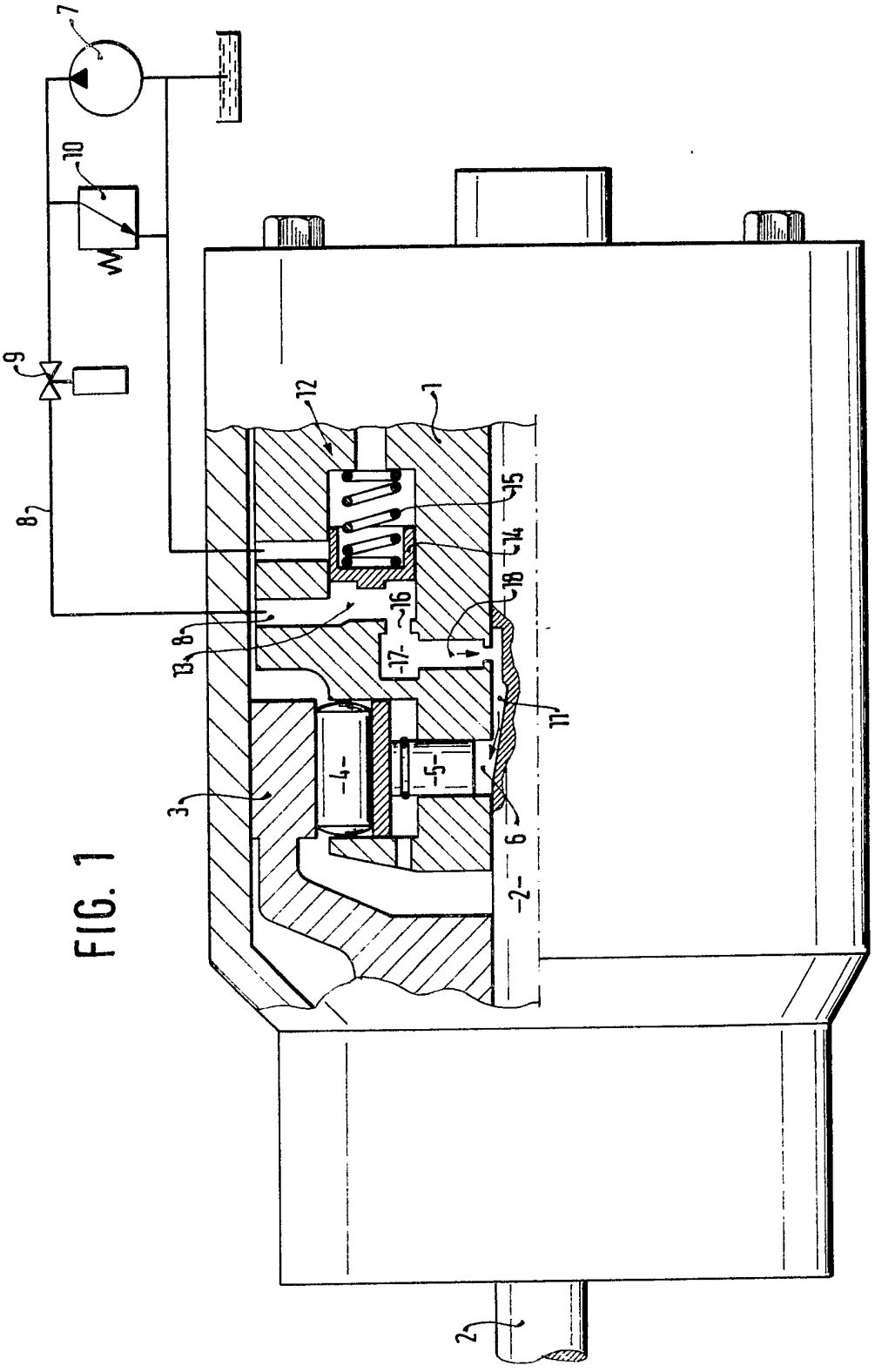

FIG. 1

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FIG.2

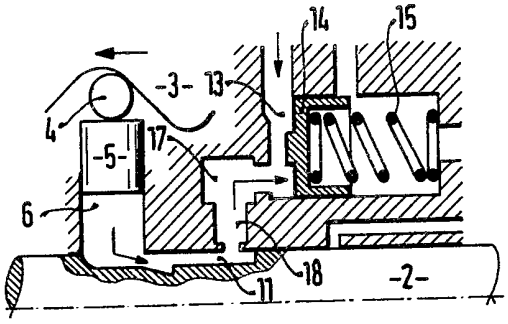


FIG.3

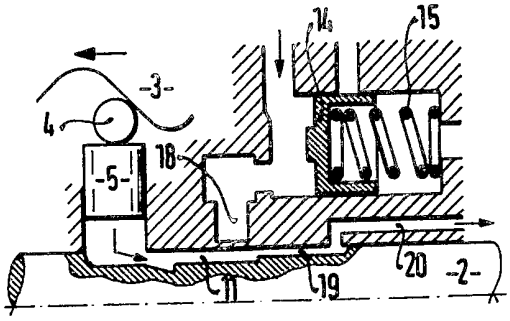


FIG.4

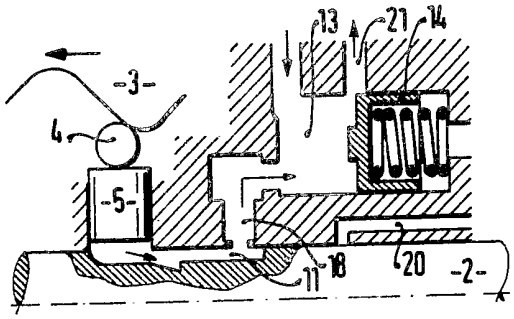
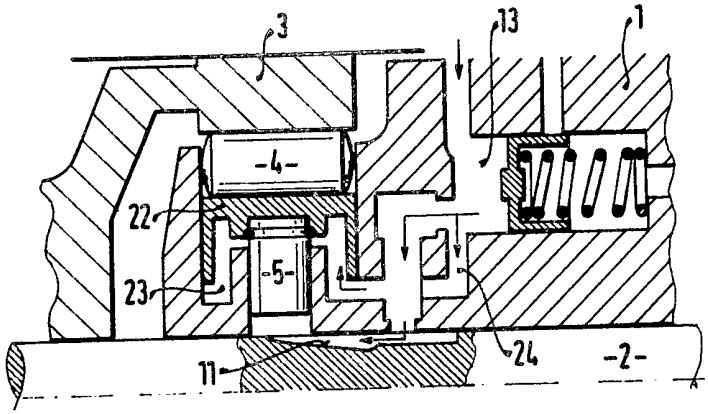


FIG.5



SPECIFICATION

A fuel injection pump

The present invention relates to a fuel injection pump for use in an internal combustion engine.

A known fuel injection pump of this kind is provided with several pump pistons which are urged by springs into their respective initial positions. The relatively large conveying pump must be adapted in its output capacity to the output capacity of the injection pump, namely for the case, in which a maximum volume must flow in shortest time during the suction stroke into the pump working space, i.e. at maximum rotational speed and full load. Particularly disadvantageous in this known construction is the use of the restoring springs which, apart from in diameter, also in axial direction require a considerable amount of space and thereby set the pump makers appreciable problems with the increasing demands of the internal combustion engine manufacturers for physically smaller injection systems.

According to the present invention, there is now provided a fuel injection pump for use in an internal combustion engine, the pump comprising a pump housing, a distributor provided with control channels and rotatably mounted in the housing, at least one pump piston reciprocatably mounted in a respective pump chamber provided within the pump housing, a fuel supply channel provided in the pump housing to provide a connection under the control of the control channels between the or each pump chamber and pump inlet means connectible to a fuel conveying pump, and a fuel storage device connected to the fuel supply channel upstream of the control channels and arranged in use to apply a greater pressure to fuel in the fuel storage device than the driving pressure required for the return stroke of the or each pump piston.

Such a conveying pump may be relatively small, since a relatively large span of time serves as basis of its output capacity, because the conveying pump in the time intervals, during which the pump piston conveys for the injection, fills up the storage device, out of which the fuel then flows into the pump working space for a relatively short time during the suction stroke of the pump piston. Since the pump piston may be pushed by the fuel into its initial position, a restoring spring can be dispensed with, which entails appreciable constructional advantages, in particular with respect to the overall space. In addition, the costs of this precision spring are saved.

Two embodiments of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:–

Figures 1 to 4 show a fuel injection pump in a first embodiment at different stages in its operating cycle, and

Figure 5 shows a fuel injection pump in an embodiment of the present invention.

Referring now to the acompanying drawings, a housing of a fuel injection pump surrounds a rotating distributor 2, which is driven together with a pot-shaped cam 3 at a rotational speed synchronous with the rotational speed of the engine and through rollers 4 drives pump pistons 5, arranged radially of the distributor 2, radially inwards for each pressure stroke. Only one pump piston 5 is illustrated in the drawing, since only that part of the entire fuel injection pump is illustrated, which is required for an explanation of the invention. Actually, preferably two, but also more pump pistons are arranged in one plane around the distributor 2. The pump chamber 6 associated with the pump piston 5 is supplied with fuel from a conveying pump 7 through a supply channel 8, which is blockable by a magnetic valve 9. The conveying pressure of the conveying pump 7 is controlled by a pressure control valve 10. The connection from the supply channel 8 to the pump chamber 6 is controlled in known manner by longitudinal grooves 11 in the circumferential surface of the distributor 2.

Connected to the supply channnel 8 is a fuel store 12, the storage space 13 of which is arranged in the housing 1 and bounded by a storage piston 14. The storage piston 14 is located by a storage spring 15. The injection pump is provided with only one store 13, an outlet 16 of which opens into an annular channel 17, which forms part of the supply channel 8, extends in the pump housing and from which radial bores 18 branch off towards the distributor 2 in order there to be controlled by the longitudinal grooves 11.

The function of this pump shall be explained by reference to the Figs. 1 to 4. In Fig. 1, the suction stroke of the pump piston 5 is just starting, for which reason a connection is produced between the storage space 13 and the pump chamber 6 through the longitudinal groove 11. As illustrated in the partial section, the fuel flows out of the storage space 13 into the annular channel 17 and from there through the radial bore 18 and the longitudinal groove 11 into the pump chamber 6. By reason of the storage pressure, which is determined by the area of the piston 14 and the force of the storage spring 15, the pump piston 5 is urged against its roller 4 and this in turn against the cam ring 3. The conveying of fuel into the pump chamber 6 during this suction stroke is made up partly by a displacement of the storage piston 14 into the storage space 13 and partly by the conveying pump 7. Hereby, a conveying volume per unit time is made possible over a short period, which lies above that of the conveying pump 7 itself. The conveying

pump 7 may therefore be constructed to be correspondingly smaller than would otherwise be the case. However, the storage pressure 13 must be higher than the pressure, which is required for restoration of the piston 5 and the height of which is determined by hysteresis and back-pressure arising in the gear. The supply channel 8 is blockable by the magnetic valve 9 so that the storage piston 14 is pushed by the spring 15 into its initial position and the engine comes rapidly to standstill due to lack of fuel supply.

Different working positions of the device are illustrated in the Figs. 1 to 4, wherein the Figs. 2 to 4 are further simplified for a better understanding and particularly the cam 3 is illustrated as developed cam. Illustrated in Fig. 2 is the start of the pressure stroke of the pump piston 5, for which the roller 4 runs down at the corresponding flank of the cam 3 to effect a pressure stroke. At the start of the pressure stroke, a connection still exists through the groove 11 to the bore 18 and thereby to the annular channel 17 or storage space 13 (according to the illustrated arrows) so that the storage piston 14 is urged by the pressure of the fuel to be displaced against the force of the spring 15. After a further stroke of the pum piston 5, as illustrated in Fig. 3, the groove 11 is separated from the radial bore 18 and connected through a prolonged end portion 19 of the groove 11 with a pressure duct 20, which leads to the fuel injection nozzles mounted on the engine. Further movement of the storage piston 14 takes place against the force of the spring 15 only due to the quantity of fuel flowing from the conveying pump 7. In the end position of the storage piston 14 illustrated in Fig. 4, this drives open a relief bore 21, which leads back to the suction side of the conveying pump 7. According to the set quantity of injection fuel, the radial bore 18 is again driven open by the distributor 2 and the annular groove 11 so that the fuel not getting to the injection nozzles flows back into the storage space 13. After the roller 4 has moved over the here lower crest of the cam 3, the suction stroke of the fuel injection pump then starts again, as illustrated in Fig. 1.

Illustrated in Fig. 5 is a second example of embodiment, in which for the drive of the pump piston during its return stroke (suction stroke), this is coupled with a restoring piston 22 of greater effective working area. The pump chamber 23 of this larger piston 22 is connected through a duct 24, which leads directly to the storage space 13 and is uncontrolled by the distributor 2 or the groove 11. The remaining drive and control functions take place as in the first example of embodiment. The substantial advantage of this direct connection is that no additional throttle effects arise through the distributor 2 and that a lower storage pressure can be chosen for the restoration by reason of the large area of the piston 22.

CLAIMS

1. A fuel injection pump for use in an internal combustion engine, the pump comprising a pump housing, a distributor provided with control channels and rotatably mounted in the housing, at least one pump piston reciprocably mounted in a respective pump chamber provided within the pump housing, a fuel supply channel provided in the pump housing to provide a connection under the control of the control channels between the or each pump chamber and pump inlet means connectible to a fuel conveying pump, and a fuel storage device connected to the fuel supply channel upstream of the control channels and arranged in use to supply a greater pressure to fuel in the fuel storage device than the driving pressure required for the return stroke of the or each pump piston.

2. A fuel injection pump as claimed in claim 1, wherein the or each pump piston is arranged to reciprocate perpendicularly to the rotational axis of the distributor, the or each pump being bounded at the radially inner end thereof by surface portions of the distributor and at the radially outer end thereof by the respective pump piston.

3. A fuel injection pump as claimed in either claim 1 or claim 2, wherein the or each pump piston is coupled to a respective restoring piston operating in a chamber communicating directly with the fuel storage device.

4. A fuel injection pump as claimed in claim 3, wherein the or each pump piston is arranged co-axially with its respective restoring piston.

5. A fuel injection pump as claimed in any one of the preceding claims, wherein the fuel storage device comprises a movable member and means in use acting against the pressure of fuel in the fuel storage device to urge the movable member into a position thereof, in which it substantially blocks the fuel supply channel.

7. A fuel injection pump as claimed in either claim 5 or claim 6, wherein the movable member comprises a spring-loaded piston.

6. A fuel injection pump as claimed in any one of claims 1 to 4, wherein the fuel storage device comprises a movable member urgeable in use by the pressure of fuel in the fuel storage device into an end position, in which the movable member opens a relief channel out of the fuel storage device.

8. A fuel injection pump as claimed in any one of the preceding claims, wherein the distributor comprises means for controlling at least one of injected quantity of fuel and starting time of injection.

9. A fuel injection pump as claimed in any one of the preceding claims, wherein the or

each pump piston is arranged to operate free of control by spring means.

10. A fuel injection pump as claimed in any one of the preceding claims, comprising selectably operable means to block the fuel supply channel.

11. A fuel injection pump as claimed in any one of the preceding claims, in combination with a fuel conveying pump connected to said inlet means, wherein the quantity of fuel receivable by the or each pump chamber during the suction stroke of the respectively associated pump piston is greater than the maximum rate of delivery of fuel by the conveying pump.

12. A fuel injection pump substantially as hereinbefore described with reference to and as illustrated by Figs. 1 to 4 of the accompanying drawings.

13. A fuel injection pump substantially as hereinbefore described with reference to and as illustrated by Fig. 5 of the accompanying drawings.

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