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(54) Fuel pump group with variable flow rate

(57) The present invention concerns a mechanical pump group (1) for a fuel feeding system for four-stroke injection engines, mounted at the power unit (100) to carry out feeding with variable flow rate according to the revolutions of the engine.

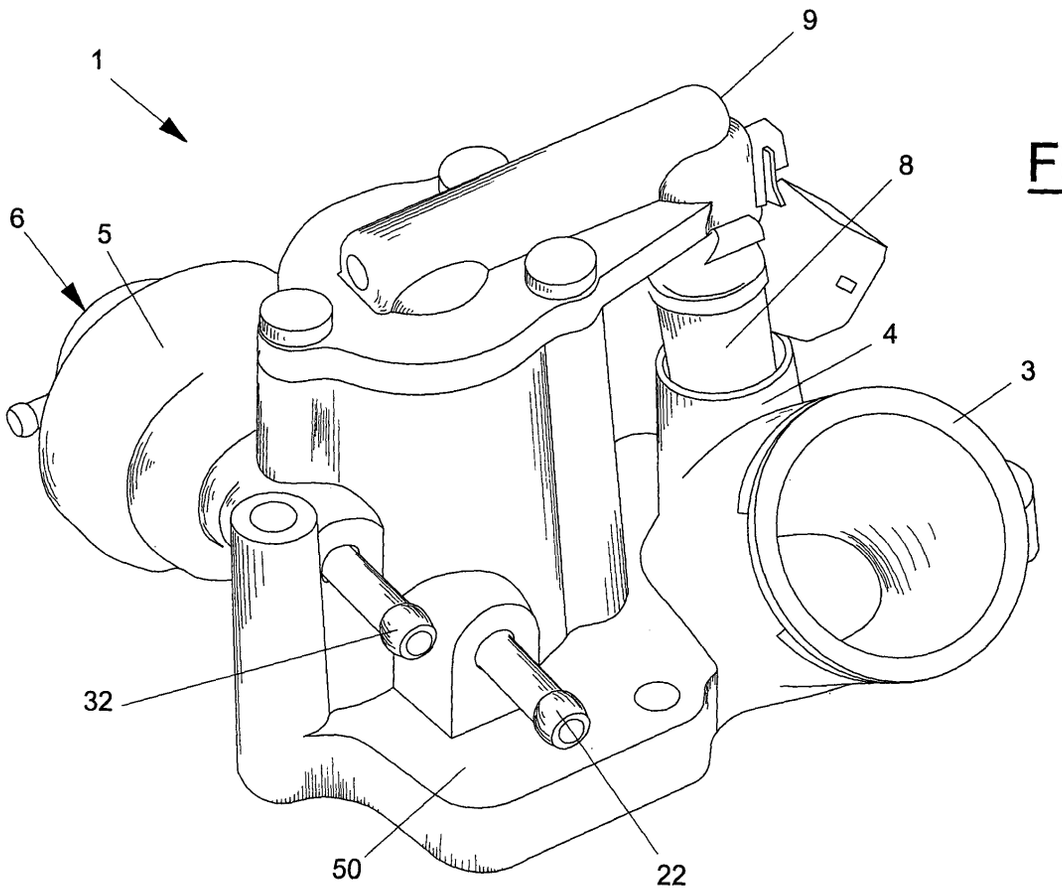

Fig. 2

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Description

[0001] The present invention concerns a fuel pump group with variable flow rate and in particular a fuel pump group with variable flow rate for application on four-stroke engines.

[0002] In the field of four-wheeled vehicles it is known to use 4-stroke engines equipped with direct or indirect injection feeding systems in order to reduce harmful emissions whilst obtaining the same yield.

[0003] Direct injection systems are those in which the fuel is injected, in the form of one or more accurately directed jets, inside the cylinder (or else directly in the combustion chamber), whereas indirect injection systems are those that foresee the injection of the fuel, in the form of a duly atomised jet, into the suction duct upstream of the combustion chamber.

[0004] In this second type of systems the feeding of petrol to the injector takes place by means of an electric pump group positioned inside the reservoir.

[0005] Such a pump group, although it is an applicable solution, is not the best for feeding injectors of two-wheeled vehicles, both due to the high cost of an electric pump that would not make its use advantageous on two wheels and because such pumps, in order to work, require a certain absorption of current, which motorcycle batteries, above all those of low cylinder capacity, are unable to supply.

[0006] In light of the above, it is clear that there is a need to be able to have a pump group, like the one according to the present invention, that minimises costs and electricity consumption.

[0007] Therefore, the purpose of the present invention is that of solving the problems of the prior art by providing pump group that does without the absorption of electricity and that at the same time is reliable and safe.

[0008] Another purpose of the present invention is that of providing a pump group that allows the risks of contamination by impurities that can penetrate into the ducts during the connection operations of the various pipes that form part of the feeding system to be eliminated or at least reduced.

[0009] Another purpose of the present invention is that of providing a pump group that allows the limitation of recirculation, reheating of petrol and the formation of a so-called vapour lock, a phenomenon that can occur in the presence of high temperatures under the bonnet that consists of the formation of bubbles of vapour in the piping of the feeding system.

[0010] Finally, a further purpose of the present invention is that of making a pump group that is easy and cost-effective to produce.

[0011] These and other purposes are accomplished by the feeding system according to the present invention that has the characteristics of the attached claim 1.

[0012] Further characteristics of the invention are highlighted by the subsequent claims.

[0013] Substantially, a pump group for a fuel feeding system for four-stroke injection engines according to the present invention is a mechanical pump group arranged at the engine.

[0014] According to an advantageous aspect of the present invention, the pump group is mounted directly on the head of the power unit.

[0015] Further characteristics and advantages of the present invention shall become clearer from the present description, given for illustrating and not limiting purposes, with reference to the attached drawings, in which:

figure 1 is a partial section side view of the pump group according to the present invention installed directly on the head of the power unit of an indirect injection four-stroke engine;
Figure 2 shows an axonometric view of the pump group according to the present invention;
Figure 3 is an enlarged partial section side view of the pump group according to the present invention;
Figure 4 is a plan view from above of the pump group according to the present invention; and
Figure 5 is a plan view from above of the pump group according to the present invention, partially in section.

[0016] With reference to the figures, a fuel pump group 1 according to the present invention, for fuel feeding systems for four-stroke injection engines, is shown.

[0017] As can be seen in figure 1, the pump group 1 is mechanical and according to a preferred embodiment, it is mounted at the power unit 100 and in particular on the head 51 of the power unit itself.

[0018] The pump group 1, again according to the preferred embodiment shown in figures 1-5, has a containment body 50 made by die casting, a mechanical feeding pump 2, an injector 8 positioned inside a relative housing 4 and a pressure regulator 6 positioned inside the relative housing 5.

[0019] The pump 2 and the injector 8 are placed in communication by means of a connection duct 7 made inside a support 9 for the injector screwed onto the containment body 50.

[0020] The containment body 50, as stated previously, is mounted directly on the head 51 of the power unit 100.

[0021] In detail, the containment body 50 is mounted on the head 51 of the power unit 100 by means of screws 52, placing a heat insulation header 10 between the head 51 of the power unit 100 and the containment body 50.

[0022] The pump 2, as can be seen better in figure 1, takes the alternating movement from a desmodromic system 11 formed from an eccentric 12, arranged on the cam axis of the engine, and from a forked lever 13 engaged with the eccentric 12, as shall be illustrated hereafter.

[0023] The forked lever 13, again as can be seen in

the figures, is rotatably pivoted, at 14, through a suitable clamping screw, to the head 51 of the power unit 100.

[0024] The pump 2 consists of a cylinder 16 - piston 15 group , in which the piston 15 is actuated by a shaft 18 activated by the forked lever 13.

[0025] In detail, the forked lever 13 has a projection that abuts against the base of the shaft 18 to guide the stroke of the shaft 18 and, consequently, of the piston 15 with respect to the cylinder 16. The contact between the shaft 18 and the fork 13 is ensured by suitable elastic means, such as a helical spring 19.

[0026] The lubrication of the coupling between cylinder 16 and piston 15 is ensured by a suitable oil circuit that sends pressurised oil into a throat 17 made, for such a purpose, in the lower portion of the cylinder 16.

[0027] The pump 2, as can be seen more clearly in figure 3, also comprises, at the top, a delivery chamber 28 connected, at the top, to the connection duct 7 and, at the bottom, to the cylinder 16 - piston 15 group .

[0028] Through the connection duct 7, the delivery chamber 28 is placed in communication with the injector 8.

[0029] In particular, an automatic cylindrical valve 40 is arranged between the cylinder 16 - piston 15 group and the delivery chamber 28. This valve is made up of a fixed part 26 and a mobile part 25.

[0030] The valve 40 and in particular its mobile part 25 is able to lift up under the action of the piston 15 to make the fuel flow through suitable holes 33 to the delivery chamber 28 and from here to the injector 8.

[0031] The number, position and arrangement of the holes 33 can vary according to the delivery curve that one wishes to obtain.

[0032] During the downward stroke of the piston 15, suitable elastic means, such as a counter spring 27, ensure that the valve 40 closes.

[0033] The feeding of the fuel to the pump 2 is obtained through the holes 20 made in the high part of the cylinder 16.

[0034] Such holes 20, which interface with the chamber 21 of the pump body 2, are connected to the fuel reservoir, not shown, through the duct 22.

[0035] The positioning of the holes 20 with respect to the piston 15 determines the suction-delivery diagram of the pump 2.

[0036] The delivery chamber 28, as can be seen more clearly in figure 5, through the opening 35, the throat 30 and suitable holes 29, also communicates with a pressure regulator 6 suitable for ensuring the correct pressure of the fuel going into the injector 8.

[0037] The pump group 1 outlined above allows an automatic variation of the impulse flow rate to be carried out according to the number of revolutions of the engine.

[0038] The stroke of the piston and in particular its speed, all other things being equal, is indeed directly connected to the drive shaft and therefore to its number of revolutions. This characteristic is used to have the maximum impulse flow rate at low operating speeds, in order to pressurise the unit quickly during the starting step, and optimal impulse flow rate values, in other words lower values, when the engine works at normal operating speed. The pump group according to the present invention may or may not foresee a fuel recirculation circuit, made by means of the throat 23, formed on the cylinder 16, with the purpose of recovering the pressurised petrol that drips from the cylinder 16 - piston 15 coupling during the delivery step and injecting it through the suitable hole 24 into the suction chamber 21.

[0039] In the case of recirculation being present, as shown in figures 1-5, it should be noted that the amount of petrol necessary for recirculation must not be excessive in order to avoid overheating that would cause the deterioration of the fuel still present in the reservoir.

[0040] In such a case, in line with the pressure regulator there is an outlet fitting 32 (figure 1) of the fuel necessary for the return of the petrol into the reservoir during recirculation.

[0041] In an alternative embodiment that is not shown and that is not equipped with recirculation, the outlet fitting 32 is not present, therefore the feeding unit is provided with just one pipe for feeding from the reservoir to the pump 2, without the return branch.

[0042] In such a case, the outlet of the regulator 6 must be connected, directly or indirectly, with the chamber 21 through a duct that can be outside or inside the pump 2.

[0043] In the case of a feeding system for an indirect injection four-stroke engine the containment group 50 also comprises an air intake duct 3 on which it is foreseen to mount an elastic fitting 34 for the attachment of the throttled body, see figures 1 and 2.

[0044] Although in the present description a pump group has been illustrated installed on the head of the engine group, it should however be understood that the pump group could also be installed in another area of the power unit, possibly replacing or integrating the desmodromic actuation system with another system suitable for the purpose.

[0045] The pump group according to the present invention allows most of the components to be grouped together close to the throttled body of the engine, and also, unlike analogous systems adopted on four-wheeled vehicles, it has zero absorption of electricity and low cost and is small in size and, therefore, it has low impact upon the lay-out of the vehicle and finally it does not have high pressure pipes.

[0046] The present invention has been described for illustrating but not limiting purposes according to its preferred embodiments, but it should be understood that variations and/or modifications can be made by men skilled in the art without for this reason departing from the relative scope of protection, as defined by the attached claims.

Claims

1. Pump group (1) for fuel feeding systems for four-stroke injection engines **characterised in that** said pump group (1) is mechanical and is mounted at the power unit (100) to carry out feeding with variable flow rate according to the revolutions of the engine.

2. Pump group (1) according to claim 1, **characterised in that** it is mounted on the head (51) of the power unit (100).

3. Pump group (1) according to claim 1 or 2, **characterised in that** it comprises a containment body (50) comprising at least one injector (8), positioned inside a relative housing (4), a mechanical feeding pump (2) and a connection duct (7) between said pump (2) and said injector (8).

4. Pump group (1) according to claim 3, **characterised in that** said containment body (50) comprises reversible fastening means (52) to the head (51) of the power unit (100).

5. Pump group (1) according to claim 3 or 4, **characterised in that** said pump (2) is actuated in an alternating manner by a desmodromic system (11).

6. Pump group (1) according to claim 5, **characterised in that** said desmodromic system (11) comprises an eccentric (12), arranged on the cam axis of the power unit, engaged with a forked lever (13) hinged to the head (51) of said power unit (100).

7. Pump group (1) according to claim 6, **characterised in that** said pump (2) comprises a cylinder (16) - piston (15) group actuated by a shaft (18) activated by said forked lever (13).

8. Pump group (1) according to any one of claims 3 to 7, **characterised in that** said pump (2) comprises a delivery chamber (28) connected to said connection duct (7) and to an automatic valve (40) suitable for lifting up under the thrust of said piston (15) to make the fuel flow to said delivery chamber (28) and for going back down into position under the action of elastic means (27).

9. Pump group (1) according to claims 8 and 7, **characterised in that** said pump (2) also comprises at least one hole for filling said pump (2) in communication with a feeding duct (22) coming from the reservoir.

10. Pump group (1) according to any one of the previous claims from 3 to 9, **characterised in that** said containment body (50) comprises a fitting (34) for a throttled body.

Fig. 1

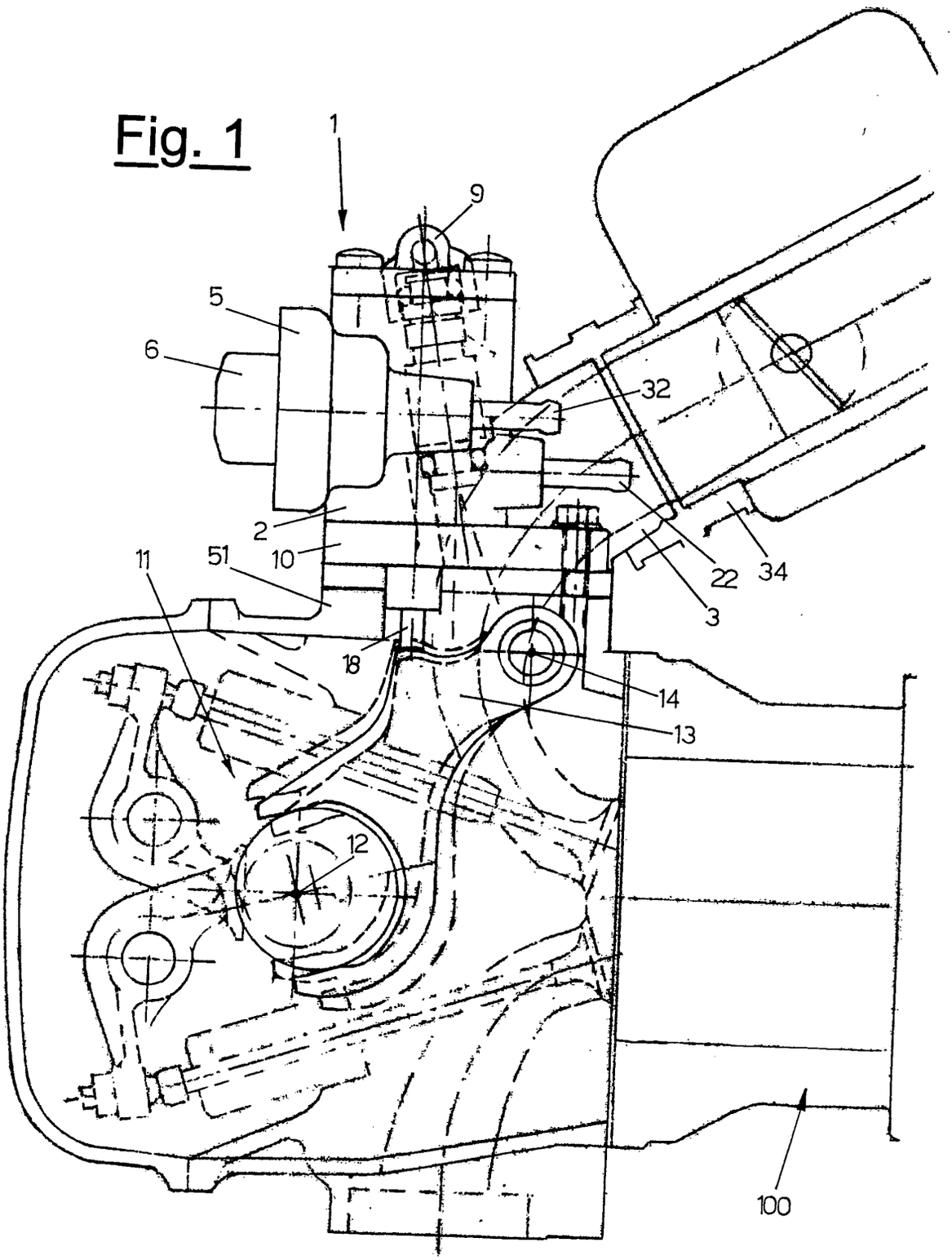

Fig. 2

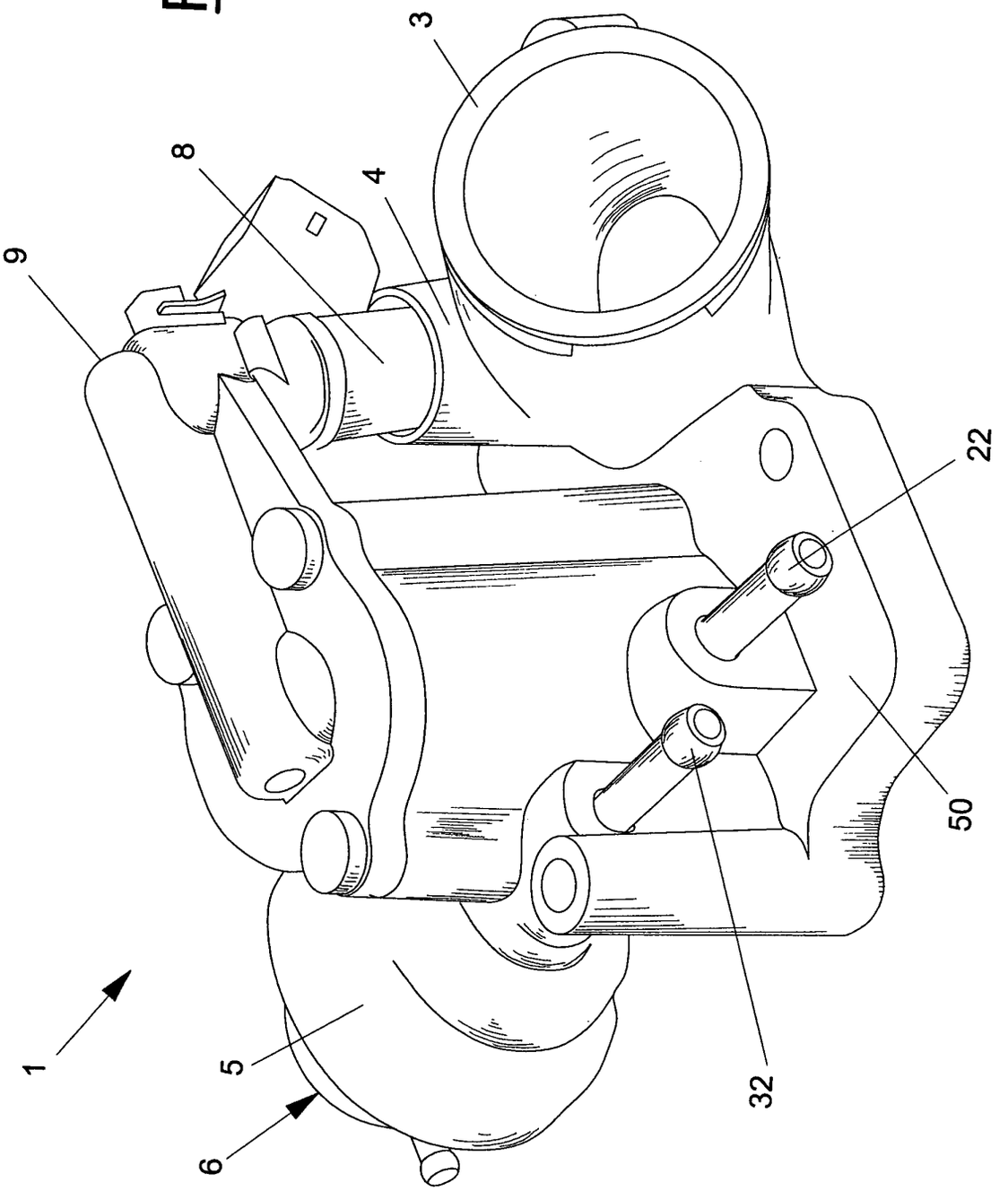

Fig. 3

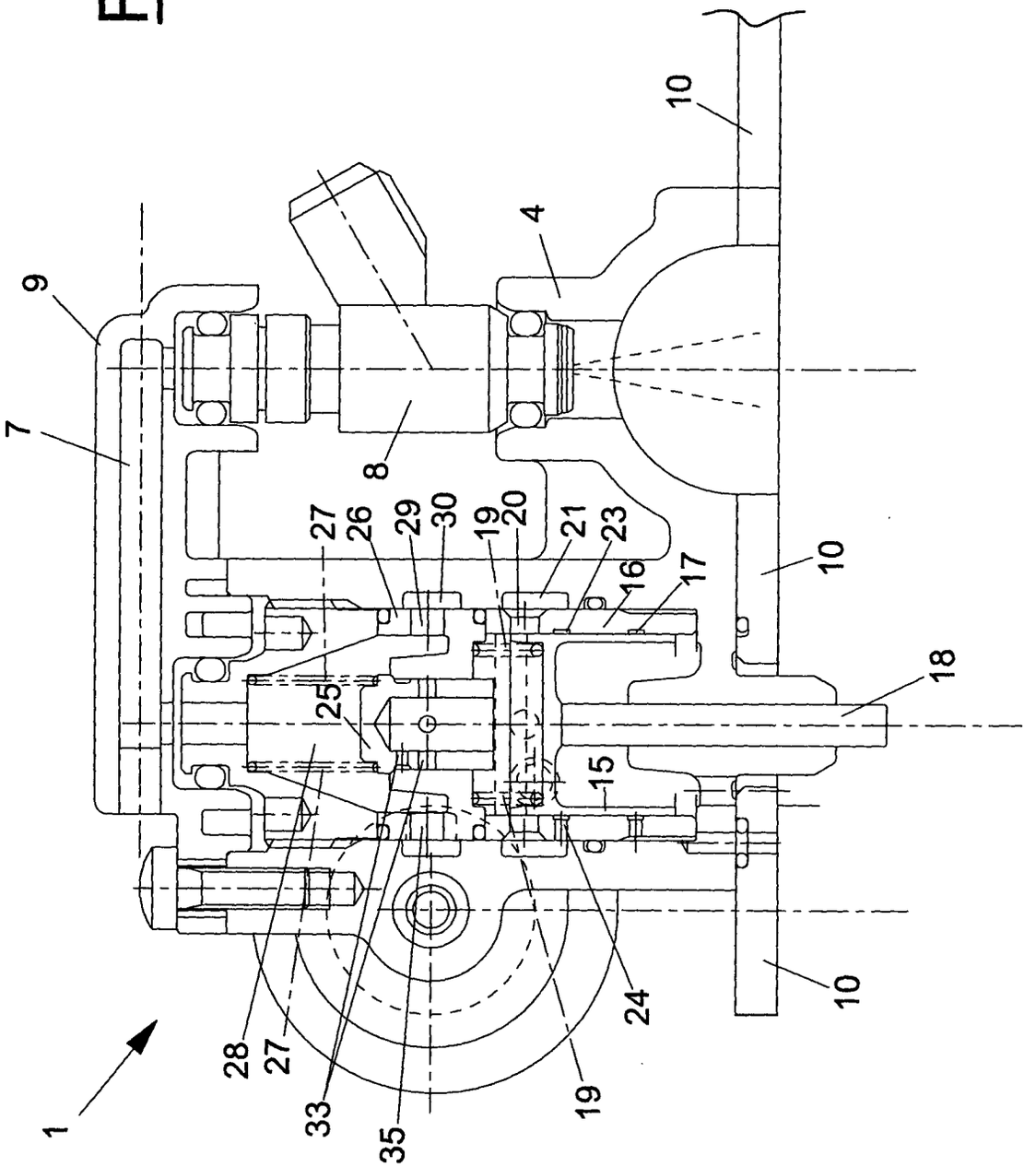

Fig. 4

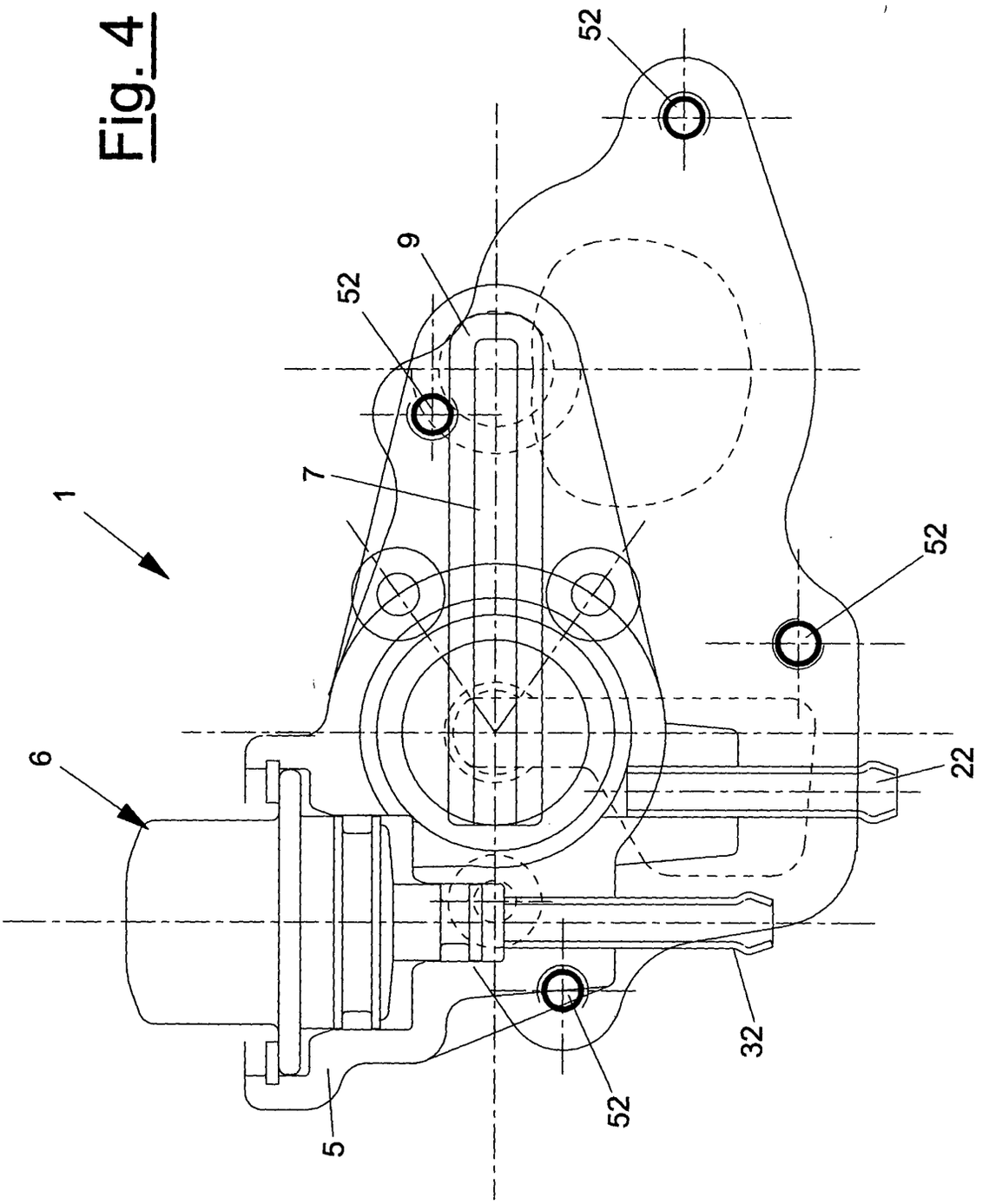

Fig. 5