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(54) Injection assembly with pressure booster for pressure die-casting machines, and pressure die-casting machine provided with the injection assembly

(57) An injection assembly with pressure booster for pressure die-casting machines, which includes a main injection piston (7) that is actuated by a pressurized liquid that is allowed to flow by a check valve (13), and a booster piston (17), which is arranged so that it can slide axially with respect to the main piston (7), wherein the multiplier piston (17) is separated from the check valve (13) and is arranged downstream thereof along the advancement direction of the main injection piston (7).

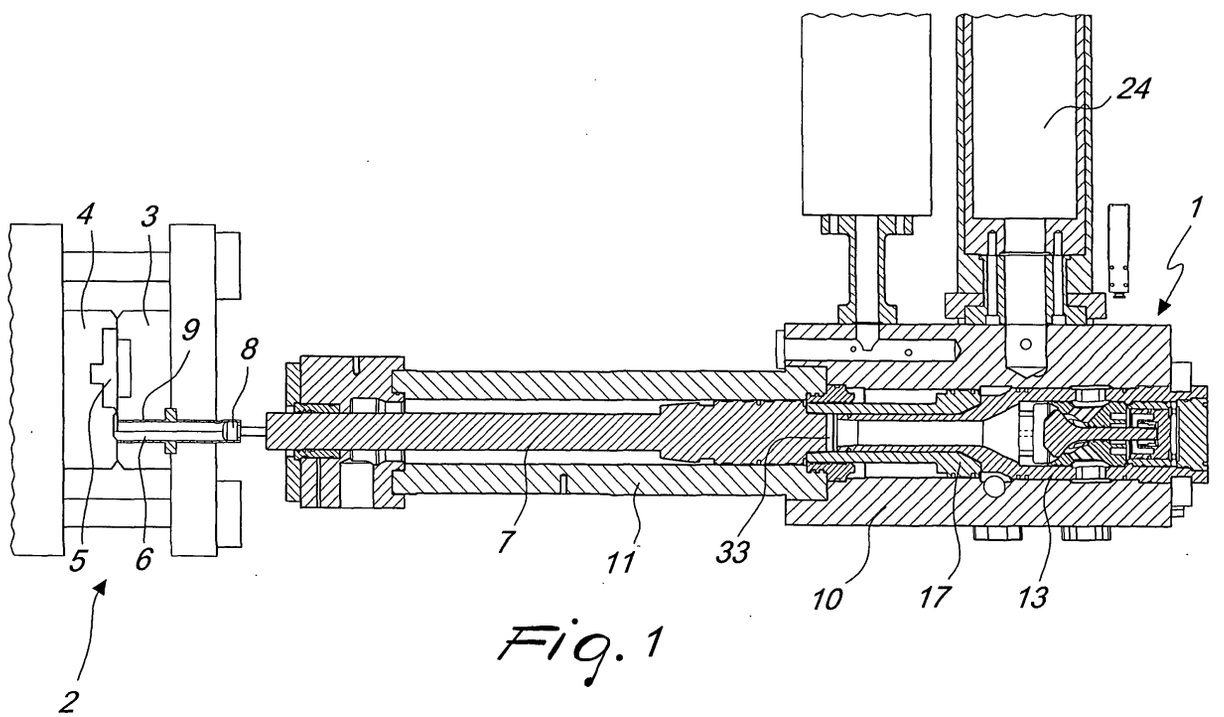

Fig. 1

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Description

[0001] The present invention relates to an injection assembly with pressure booster for pressure die-casting machines. The invention also relates to a pressure die-casting machine provided with the injection assembly.

[0002] The field of the invention relates to machines for pressure die-casting of aluminum alloys or magnesium alloys.

[0003] In general, these machines are presses that have a horizontal axis for the injection of the alloy into the die and are constituted by two main assemblies:

- a closure assembly, which is designed to close the two parts that constitute the die, so as to form a cavity (whose shape can vary depending on the part to be obtained), within which the injected molten alloy is to be contained, withstanding the action of the pressure that would tend to open the two parts of the die; this assembly, after hardening has occurred, allows to open the die so as to allow to remove the die-cast part, and by subsequently closing it allows the start of a new injection cycle;
- an injection assembly, which is designed to act on the molten alloy cast through an appropriately provided opening in a cylindrical container, which is connected to the die and is arranged on a horizontal axis that is perpendicular to the fixed plane of the closure assembly; the injection is performed by a piston, which is arranged inside the cylindrical container and is connected axially to a stem, with cooling channels for the piston, which in turn is attached to a support that is rigidly coupled to the stem of the so-called injection piston.

[0004] The operation for injecting the molten alloy into the die occurs practically in three steps:

- a first low-speed step, in which, by way of the action of the injection piston, the piston inside the cylindrical container pushes the molten alloy, which normally fills the container only partially, beyond the opening that allowed to pour the molten alloy into the container;
- a second high-speed step, which causes the alloy to fill quickly the cavity of the die so that during this time no solidification that prevents complete filling of the die begins;
- a third step, in which, after a sudden reduction in the injection speed, which delimits the second step with respect to the third step, action is taken, by applying high pressure to the alloy, which is by then solidifying due to the cooling that it undergoes in the die, so as to compact the alloy and minimize the porosities inside the die-cast part.

[0005] During the third injection step, in order to increase the pressure that acts on the injection piston, a booster piston is generally used which, being pushed on the piston side by the line pressure, acts on the stem side on the liquid that is contained in the injection chamber, increasing the injection pressure up to a maximum of the injection pressure that is generally equal to approximately three times the line pressure (hence the name "booster piston" or simply "booster").

[0006] In general, the pressure of the third step is in any case adjustable between the line pressure and three times its value, by acting on the ring on the stem side of the booster with a variable counterpressure that can attenuate the action of the booster in a chosen manner.

[0007] Currently, it is known to arrange the booster piston of the injection assembly, with respect to the axis of the injection piston, in the following manners:

1) the booster piston acts with its stem at right angles to the direction of motion of the injection piston;
2) the booster piston acts with its stem coaxially to the movement of the injection piston; in this solution, the check valve, through which the liquid passes in the first two injection steps and which is closed during the third step to allow the boosting action by keeping the liquid enclosed within the injection chamber, is contained within the main injection block and is rigidly coupled to the booster piston, increasing its overall mass.

[0008] The known art in which the booster piston is arranged at right angles to the axis of the injection piston entails considerable space occupation problems (and therefore problems in terms of inertia of the booster) and cost problems.

[0009] Conventional injection assemblies with a booster that is coaxial to the injection piston instead have the drawback that since they form a monolithic assembly with the check valve (which enables the inflow of liquid during the first and second injection steps), they entail the simultaneous movement of the booster piston together with the check valve, consequently producing high inertia. Accordingly, the mass of the booster is increased with respect to the strictly useful mass, and this reduces the speed of execution of the third injection step or boosting step.

[0010] The aim of the present invention is to provide a new injection assembly with pressure booster of the coaxial type which, with respect to the background art that has been considered, offers lower inertia and therefore faster action.

[0011] Another object of the invention is to provide a pressure die-casting machine that is provided with the pressure booster.

[0012] This aim and this and other objects that will become better apparent hereinafter, are achieved by the injection assembly and the pressure die-casting machine of claims 1 and 12 respectively. Preferred embodiments of the invention are given in the dependent

claims.

[0013] With respect to the cited background art, the injection assembly according to the invention allows to provide a booster piston that has a smaller mass and accordingly allows to achieve faster execution of the third injection or boosting step.

[0014] In particular, it should be stressed that this speed is important, since the compaction that one wishes to obtain on the alloy that is solidifying must be as quick as possible in order to achieve the effect of reducing the porosities in the die-cast part before complete solidification. Usually, this compaction must occur in a time comprised between 15 and 30 ms, a result that is fully achieved and can even be exceeded according to the invention.

[0015] This aim and this and other objects, advantages and characteristics will become apparent from the description that follows of a preferred embodiment of the injection assembly, illustrated by way of non-limiting example in the figures of the accompanying drawings, wherein:

Figure 1 is a longitudinal sectional view of an injection assembly according to the invention, operating with the closure assembly and with the booster piston in the fully retracted position;

Figure 2 is a view of the injection assembly of Figure 1 with a booster piston in an advanced intermediate boosting step;

Figure 3 is a view of the injection assembly of Figure 1 with the booster piston in a fully extended position.

[0016] Figure 1 illustrates the essential components of interest for the invention of a pressure die-casting machine that includes an injection assembly 1 and a closure assembly 2. In particular, the closure assembly 2 substantially provides two die parts 3 and 4, between which there is a casting cavity 5 into which a molten metallic alloy 6 is propelled under pressure. This propulsion is determined by a main injection piston 7, by way of a piston 8 that is inserted in a container 9 of the alloy 6.

[0017] The injection assembly 1 includes a main injection block 10, which is rigidly coupled to an injection cylinder 11, inside which the main injection piston 7 is accommodated so that it can slide axially. The injection piston is moved by the inflow of pressurized liquid that enters through an annular input circuit 12 and acts on the main piston 7 after opening a flow control member 30 of a check or one-way valve 13. The valve 13 is in turn rigidly coupled to the main injection block 10 and is held in the closed position by means of springs 14 and kept in its open position by a single-action piston 15, which in turn is pushed by an actuation liquid that enters a cavity 16 of the cover of the valve 13 (Figure 3).

[0018] More precisely, the liquid that enters the annular circuit 12 flows inside a channel 31 formed by an extension 32 of the valve body 13. Further, a booster piston 17 forms a portion of a duct 33 for feeding the actuation liquid of the main injection piston 7.

[0019] The booster piston 17, provided with a stem 20, is arranged coaxially with respect to the main injection piston 7. The booster piston has a fully separate and independent structure with respect to the valve 13 and is arranged downstream thereof along the direction of motion of the main injection piston 7. In particular, the booster piston 17 is arranged coaxially to the main injection piston 7 and to the extension 32 of the valve body 13 and is fitted so that it is superimposed with respect to the extension 32.

[0020] The movements of the booster piston 17 are guided by means of an external surface 18 thereof having a larger diameter, which is engaged in a cylindrical cavity 19 of the main injection block 10, and by way of an outer cylindrical surface 21 of the stem 20, which in turn is engaged so that it can slide on a surface 22 of a guiding bush 23. According to the invention, therefore, the movements of the booster piston 17 are independent of the check valve 13, which is physically separate from the body of the piston 17 and remains motionless during the motion of the piston.

[0021] During the first injection step, or low-speed step, the liquid that enters the annular cavity 12 after opening the check valve 13 flows axially in the advancement direction of the main injection piston 7.

[0022] Then, in the second step or high-speed step, the flowrate of the liquid is increased (by using an appropriately provided accumulation device 24), allowing to achieve a higher advancement speed of the injection piston 7.

[0023] In the third step, shown in Figure 2, the advancement of the booster piston 17 is actuated by the inflow of an actuation liquid into a hole 25 and a ring 26, which are provided upstream of the booster piston 17 on the main injection block 10. The action of the liquid is applied to the annular surface 28 of the piston 17.

[0024] The illustrated embodiment allows to use a counterpressure on the booster piston 17, so as to control and adjust the final boosting force thereof, provided by way of a flow of liquid that enters a ring 27 that lies inside the main block 10 and acts on an annular surface 29 of the piston 17.

Claims

1. An injection assembly with pressure booster for pressure die-casting machines, comprising a main injection piston (7) that is actuated by a pressurized liquid, which is allowed to flow by a check valve (13), and a booster piston (17), which is arranged so that it can slide axially with respect to said main piston (7), **characterized in that** said booster piston (17) is separated from said check valve (13), so as to move independently thereof and thus reduce the inertia of said booster piston.

2. The injection assembly according to claim 1, **characterized in that** said booster piston (17) is arranged downstream of said valve (13) in the direction of advancement of the main injection piston (7).

3. The injection assembly according to claim 1 or 2, **characterized in that** said valve (13) is fitted so that it is rigidly coupled to said main injection block (10).

4. The injection assembly according to claim 3, **characterized in that** said valve (13) is provided with springs (14) for closing the flow control member (30) thereof and has a piston (15) for opening said flow control member and an annular circuit (12) for feeding the actuation liquid of said main injection piston (7).

5. The injection assembly according to claim 3, **characterized in that** said valve (13) has an extension (32) inside which there is a channel (31) for the passage of the liquid for actuating said main injection piston (7).

6. The injection assembly according to claim 3, **characterized in that** said booster piston (17) further forms a portion of a duct (33) for feeding the actuation liquid of said main injection piston (7).

7. The injection assembly according to claim 3, **characterized in that** said main injection block (10) is provided with a hole (25) for feeding liquid to said booster piston (17).

8. The injection assembly according to claim 7, **characterized in that** it is further provided with a ring at an annular surface (28) of said piston (17).

9. The injection assembly according to claims 3, 7 or 8, **characterized in that** said booster piston (17) is provided with an external surface that has a larger diameter (18) and is engaged in a cylindrical cavity (19) of said main block (10), and a stem (20) that is provided with an external cylindrical surface (21), said external and external cylindrical surfaces (18, 21) guiding the axial movement of said booster piston (17).

10. The injection assembly according to claim 9, **characterized in that** it comprises a guiding bush (23) provided with a surface (22) for the sliding of said surface (21) of said booster piston (17).

11. The injection assembly according to one or more of the preceding claims, **characterized in that** it is provided with a ring (27) that is arranged inside said main block (10) for the inflow of a counterpressure liquid, which is suitable to act on an annular surface (29) of said piston (17).

12. A pressure die-casting machine of the type comprising a closure assembly (2) that is provided with die parts (3, 4) that form between them a casting cavity (5) for containing a molten metallic alloy (6) that is made to advance by pressure within the die by way of a pusher piston (8), which can slide within a container (9) of said metallic alloy (6), **characterized in that** it is provided with at least one injection assembly (1) with a pressure booster according to one or more of the preceding claims.

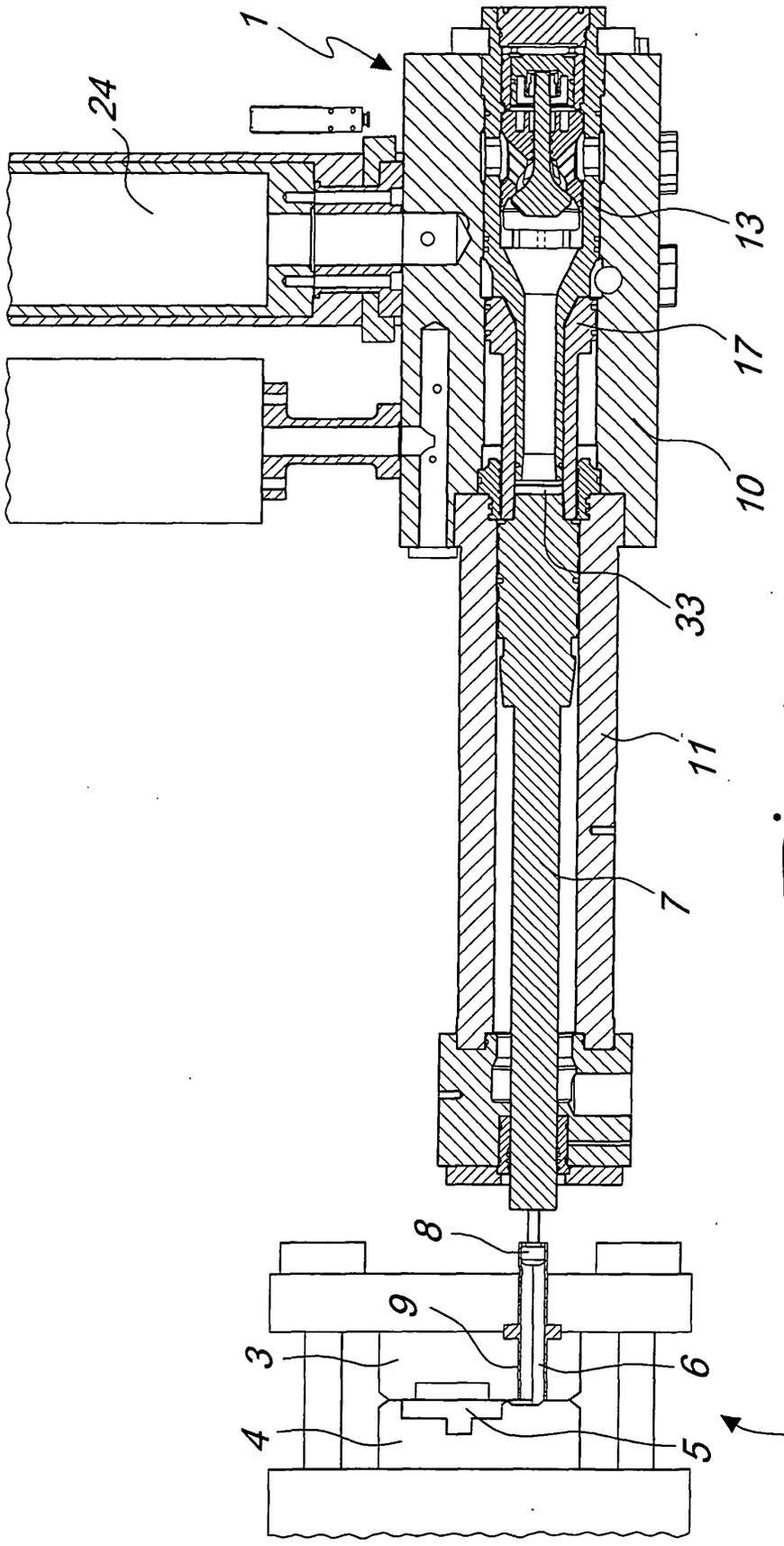

Fig. 1

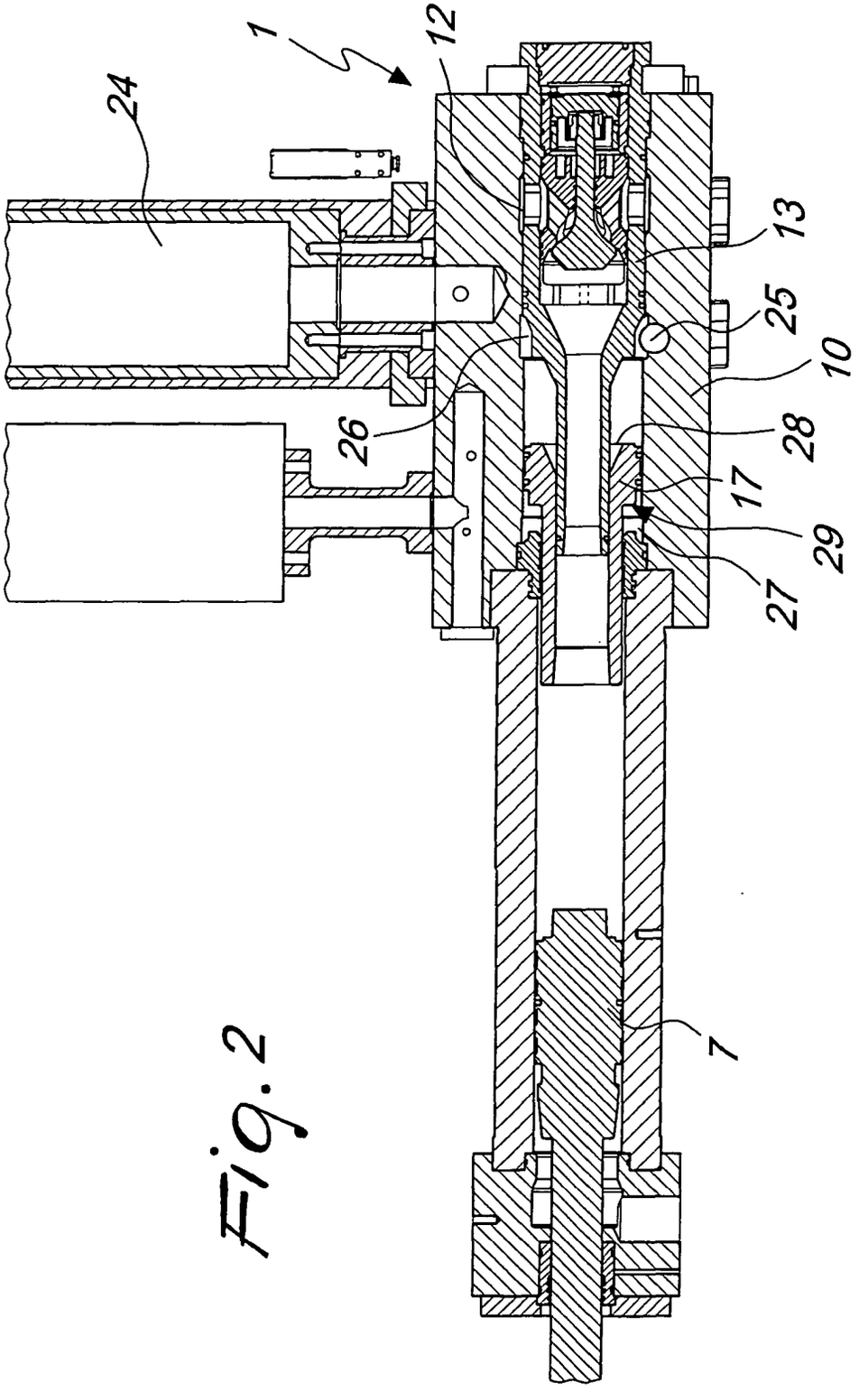

Fig. 2

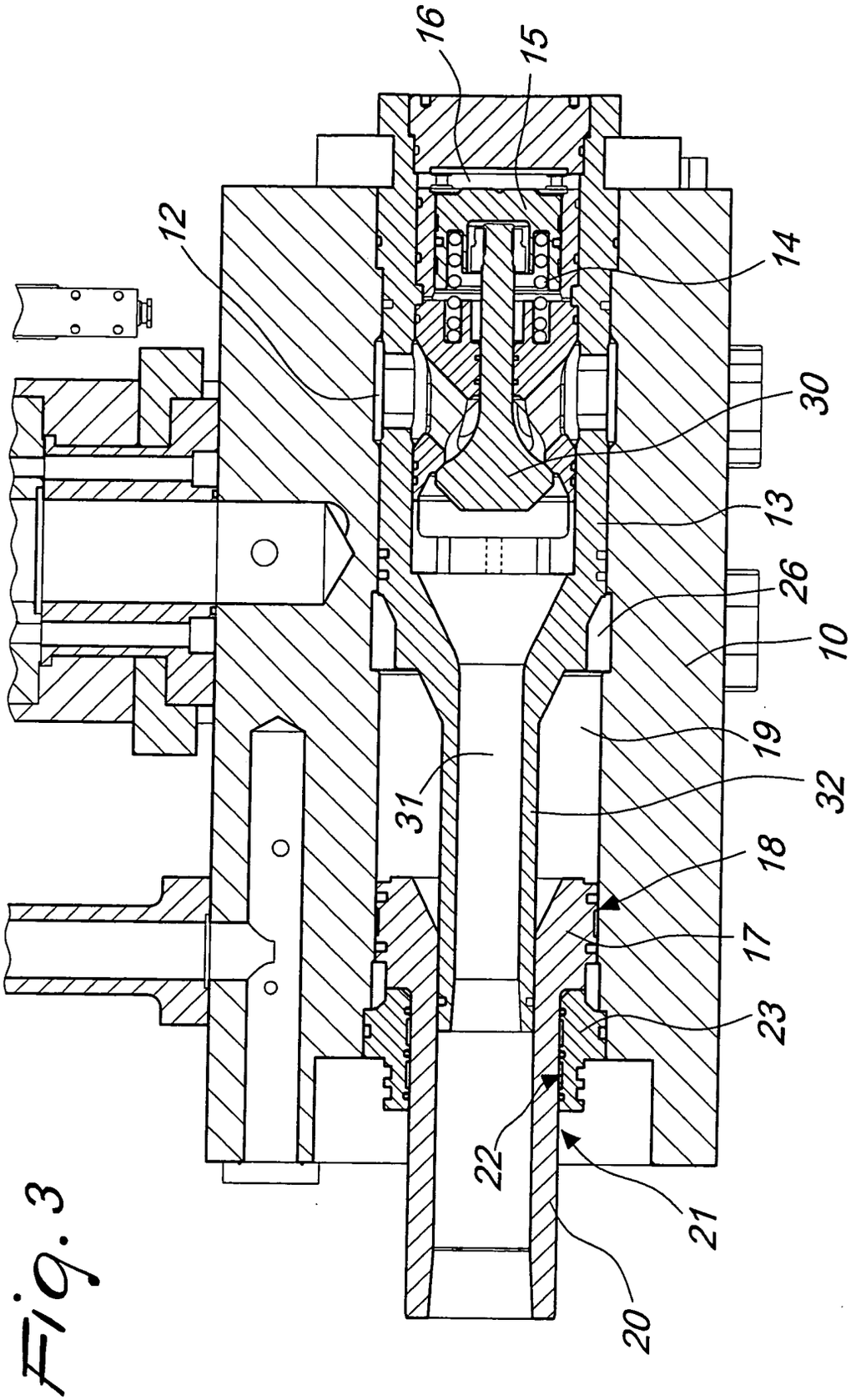

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 00 5109

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 June 2005	Lombois, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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