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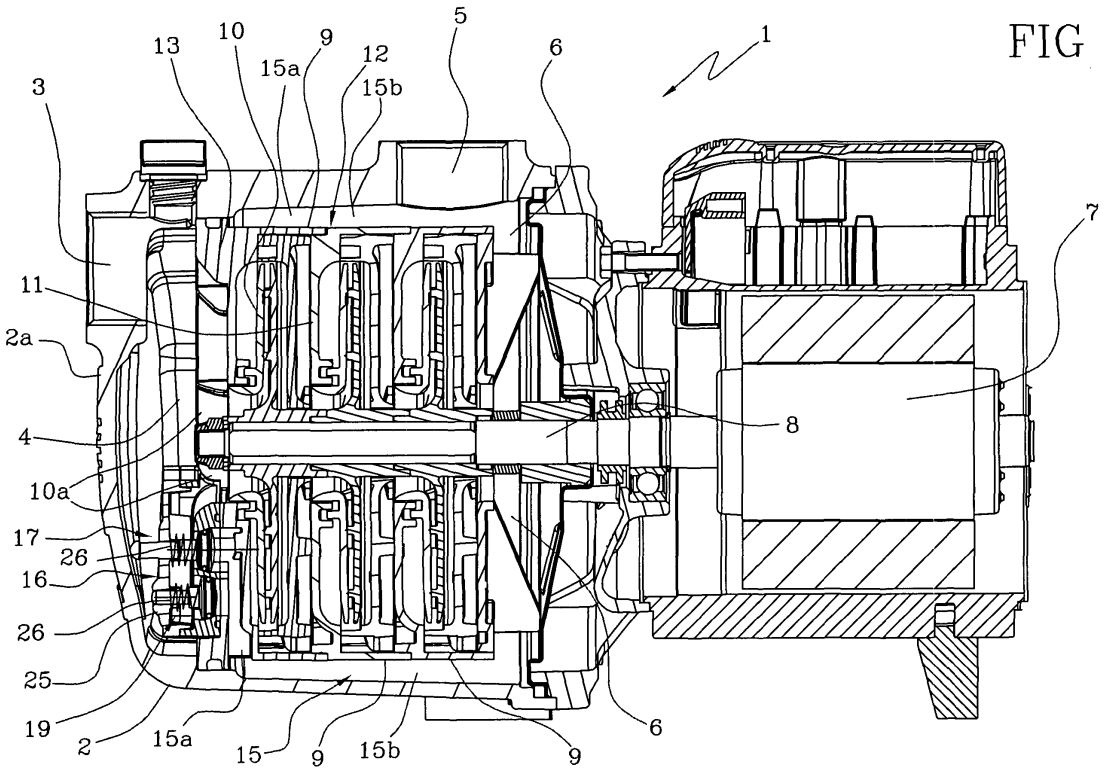
Amended claims in accordance with Rule 86 (2) EPC.

(54) Centrifugal pump

(57) A centrifugal pump comprises a containment body (2) with an infeed pipe (4) and an outfeed pipe (6); at least one intake stage (9) located in the containment body (2) between the pipes (4, 6), and having at least one impeller (10) for sucking a fluid from the infeed pipe (4) and conveying it towards the outfeed pipe (6); and impeller (10) drive means (7). The pump also has a safety valve (19) located in the containment body (2) and able to switch between an open condition in which it allows fluid to pass from the outfeed pipe (6) to the infeed pipe (4), and a closed condition in which it does not allow the passage of the fluid. The pump also comprises safety valve (19) locking means (26) for keeping the valve (19) in the closed position until the pressure of the fluid in the outfeed pipe (6) exceeds a predetermined pressure value P.

FIG 1



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Description

[0001] The present invention relates to a centrifugal pump, in particular a multi-stage self-priming centrifugal pump used in hydraulic systems.

[0002] As is known, various types of centrifugal hydraulic pumps are marketed which are suitable for sucking a fluid through an infeed (intake) pipe and conveying the fluid towards an outfeed (delivery) pipe.

[0003] Such centrifugal pumps consist of a containment body in which there extend in succession a plurality of coaxial stages with special impellers. The impellers are keyed to a rotary shaft whose rotation is driven by an electric motor. In particular, each impeller has a set of blades shaped in such a way as to suck the fluid, usually water, from a central zone of the impeller and conveyor it towards a peripheral zone.

[0004] Moreover, each stage is equipped with a fixed ring-shaped element (diffuser) inserted between two impellers. Each ring-shaped element has a set of deflectors suitable for conveying the flow out of the peripheral zone of the previous impeller and towards the central zone of the next impeller.

[0005] Some centrifugal pumps also have a self-priming mechanism so that they can expel the air present in the infeed pipe by recirculating water, so as to guarantee a constant supply of liquid to the impellers.

[0006] Indeed, it is known that centrifugal impellers must always operate with water in the pump, otherwise it will be unprimed and there will be a sudden drop in the head.

[0007] For this reason, the self-priming device supplies the water in the impellers in such a way as to keep water in the pump even when the infeed pipe contains a quantity of air to be expelled.

[0008] Generally speaking, the self-priming device has a valve inserted between the outfeed pipe and the infeed pipe, which can be switched between a position in which it does not allow water to pass from the outfeed pipe to the infeed pipe and a position in which it allows the water to pass from the outfeed pipe to the infeed pipe. In detail, during pump operation, the water pressure in the outfeed pipe keeps the valve closed. When the pump stops, the pressure in the outfeed pipe is reduced, allowing the valve to switch to the open position, in which it allows water to pass from the delivery pipe to the infeed pipe. The valve remains open even during the pump initial restart step, that is to say, until the pressure in the outfeed pipe reaches a predetermined value able to switch the valve to the closed condition.

[0009] In this way, during the pump initial restart step, the impellers initially encounter the water returned into circulation by the self-priming device, preventing the pump from operating dry and its consequent unpriming.

[0010] However, the known centrifugal pumps briefly described above have an important disadvantage chiefly linked to the fatigue failure conditions of the parts subject to pulsing pressure and to water hammering.

[0011] It should be noticed that, during operation, the pressure of the water delivered in the pump may vary depending on the conditions of use. In this situation, high pressure conditions may be created in the pump, which damage the containment body. Consequently, the high pressure water may flow out of the containment body or even interfere with correct operation of the pump.

[0012] To overcome this disadvantage in some cases use is currently made of a solution in which a safety valve is inserted on the delivery pipe downstream of the pump which, when the pressure exceeds a predetermined threshold, discharges water to the outside until the pressure is returned within the values tolerated.

[0013] In this situation, the technical need which forms the basis of the present invention is to provide a centrifugal pump which substantially overcomes the above-mentioned disadvantage.

[0014] Within the technical need, an important aim of the invention is to provide a centrifugal pump which during operation can maintain a level of pressure in the pump not higher than a predetermined level.

[0015] Another aim of the present invention is to provide a centrifugal pump able to always keep the water in the pump, avoiding the use of safety valves on the delivery pipe.

[0016] The technical need indicated and the aim specified are substantially achieved by a centrifugal pump characterised in that it comprises the technical solution set out in the claims herein.

[0017] A preferred, non-limiting embodiment of a centrifugal pump in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

- Figure 1 is a longitudinal section of the centrifugal pump in accordance with the invention;
- Figure 2 is a view of a construction detail of the pump illustrated in Figure 1 in a first operating condition;
- Figure 3 is a view of a construction detail of the pump illustrated in Figure 1 in a second operating condition;
- Figure 4 is a view of a construction detail of the pump illustrated in Figure 1 in a third operating condition;
- Figure 5 is an exploded perspective view of part of the centrifugal pump in accordance with the invention.

[0018] With reference to the accompanying drawings, the numeral 1 denotes as a whole the centrifugal pump in accordance with the invention.

[0019] As Figure 1 shows, the pump 1 has a containment body 2 with mainly cylindrical extension, having a first end 2a which extends transversally to the longitudinal extension of the containment body 2. The first end 2a has a hole 3 which is part of an infeed pipe 4 for the water sucked in by the pump.

[0020] It should be noticed that this description refers specifically to a centrifugal pump 1 suitable for sucking

up water. Such pumps are widely used in various types of hydraulic systems. However, the pump 1 may be used to suck up any other type of fluid in the liquid state.

[0021] The containment body 2 also has a side surface in which there is a hole 5, which is part of an outfeed pipe 6 for the water sucked up by the pump 1. The holes 3, 5 of the infeed pipe 4 and the outfeed pipe 6 can advantageously be connected to respective pipes of a water system to which the pump 1 is connected. However, in other embodiments the two holes 3, 5 are positioned in other points.

[0022] The containment body 2 also has a second end 2b, opposite the first end 2a, to which the drive means 7 are connected. The drive means, illustrated only in Figure 1, preferably consist of a known type of electric motor, having a rotary shaft 8 which extends along the longitudinal extension of the body 2 and inside the body 2.

[0023] Inside the containment body 2 there also extends at least one intake stage 9 consisting of at least one impeller 10 keyed to the shaft 8 to suck water from the infeed pipe 4 and convey it to the outfeed pipe 6.

[0024] As is better illustrated in the exploded view in Figure 5, the pump 1 may have a plurality of intake stages 9, consecutive and connected to one another along the longitudinal extension of the body 2.

[0025] In detail, each stage 9 consists of an impeller 10 and a diffuser 11, the latter coaxial with and alongside the respective impeller 10.

[0026] In particular, in the embodiment illustrated, the impeller 10 substantially consists of two disks alongside one another and between which special blades are housed, for conveying the water in rotation from a central water passage zone 10a to a peripheral outfeed zone 10b. The diffuser 11 consists of a ring-shaped deflector 11a coaxially inserted, with the relative impeller, in a tubular body 11b. The deflector 11a is designed to convey the water out of the peripheral zone 10b of the impeller 10 and towards the central zone 10a of the next stage 9. The tubular bodies 11b are alongside one another in such a way that they form a closed cylindrical body 12.

[0027] In other words, the tubular bodies 11b are coaxially connected to one another to form a single cylindrical body 12 located in the containment body 2 and housing the impellers 10.

[0028] As illustrated in the exploded view in Figure 5, the pump 1 also has a connecting collar 13, inside the body 2 at the infeed pipe 4 hole 3.

[0029] In particular, the collar 13 substantially consists of a ring-shaped element which can be connected between the stage 9 next to the infeed pipe 4 and the inner surface of the body 2 (see Figure 1). Moreover, the pump 1 has an end diffuser 14, connected to the stage 9 next to the outfeed pipe 6 and having a set of deflectors suitable for eliminating any water turbulence at the outfeed of the impeller 10 closest to the outfeed pipe 6. Moreover, the end diffuser 14 has an axial fluid infeed hole and radial outfeed holes.

[0030] As is better illustrated in Figure 1, the cylindrical body 12 is detached from the inner surface of the containment body 2 to form both the outfeed pipe 6 and an auxiliary pipe 15.

[0031] In greater detail, in the embodiment illustrated, the auxiliary pipe 15 extends inside the pump 1 from the outfeed pipe 6 towards the infeed pipe 4. In even more detail, the auxiliary pipe 15 has a substantially cylindrical shape surrounding the cylindrical body 12 and forms a first end 15a at the connecting collar 13, and a second end 15b opposite the first end 15a, located at the outfeed pipe 6.

[0032] The pump 1 also comprises a recirculation part 16 inserted between the outfeed pipe 6 and the infeed pipe 4 to allow the passage of water from the outfeed pipe 6 to the infeed pipe 4 in an initial pump starting step.

[0033] In particular, the recirculation part 16 is located at the first end 15a of the auxiliary pipe 15, next to a central zone 10a of the impeller 10 near the infeed pipe 4.

[0034] In detail, the recirculation part 16 has a primary self-priming valve 17 which can be switched between an open condition in which it allows water to pass from the auxiliary pipe 15 to the infeed pipe 4 (see Figure 3), and a closed position in which it blocks the auxiliary pipe 15 and prevents the passage of water (see Figures 2 and 4).

[0035] In particular, the recirculation part 16 comprises a connecting plate 18 located between the infeed pipe and the auxiliary pipe. The plate 18 advantageously engages with the collar 13 and substantially has the shape of a parallelepiped. The primary valve 17 is housed in an opening 18a made in the plate, forming the section which allows the passage of water when the primary valve 17 is open.

[0036] There are also primary valve 17 locking means 26, to keep the valve 17 open until the pressure of the fluid in the outfeed pipe 6 exceeds a predetermined pressure value corresponding to pump steady state operation (transient operation during self-priming).

[0037] The pump 1 also comprises a safety valve 19 which can switch between an open condition in which it allows water to pass from the outfeed pipe 6 to the infeed pipe 4 (Figure 4), and a closed condition in which it does not allow the passage of water (Figures 2 and 3).

[0038] Again, there are safety valve 19 locking means 26 to keep the valve 19 closed until the pressure of the fluid in the outfeed pipe 6 exceeds a predetermined pressure value P corresponding to the maximum delivery pressure value allowed.

[0039] Advantageously, the safety valve 19 is connected to the recirculation part 16 and in particular is alongside the primary valve 17. When the pressure of the water in the auxiliary pipe 15 is greater than a predetermined pressure value P, the valve 19 is switched to the open condition.

[0040] In particular, the safety valve 19 is also housed in an opening 18b made in the plate 18 and forming the section which allows the passage of water when the safety valve 19 is open. Therefore, in the embodiment illustrated, the two openings 18a, 18b are alongside one an-

other and both communicate between the outfeed pipe 6 (by means of the auxiliary pipe 15) and the infeed pipe 4.

[0041] As is better illustrated in Figures 2 - 4, each valve 17, 19 has a cylindrical portion 20 which slides in the respective opening 18a 18b, having a first end 20a located towards the auxiliary pipe 15 and a second end 20b opposite the first end 20a located at the infeed pipe 4.

[0042] Each valve 17, 19 also has a head 21 connected to the respective first end 20a. The head 21 is disk-shaped, extending flat transversally to the longitudinal extension of the cylindrical portion 20. It should be noticed that the head 20 may be inserted in the opening 18a, 18b in such a way that it blocks in the respective valve 17, 19 closed position; whilst in the valve 19, 17 open position the head 21 is detached from the opening 18a, 18b.

[0043] In further detail, it should be noticed that the head 21 in the valve 17, 19 closed position engages at a narrowing in each opening 18a, 18b. Advantageously, each head 21 has a special O-ring 21a in contact with the narrowing and guaranteeing the valve hydraulic seal.

[0044] It should also be noticed that the narrowing of the opening 18a housing the primary valve 17 is achieved in the part towards the infeed pipe 4. In this way, when the primary valve 17 is open, the head is moved towards the auxiliary pipe 15 (see Figure 3).

[0045] The narrowing of the opening 18b housing the safety valve 19 is achieved in the part towards the auxiliary pipe 15. In this way, when the safety valve 19 is open, the head 21 is moved towards the infeed pipe 4 (see Figure 4).

[0046] Moreover, the recirculation part 16 has a supporting element 22 connected to the plate 18 and having respective sliding seats 23 housing the second ends 20b of each cylindrical portion 20.

[0047] In particular, the supporting element 22 consists of a flat element connected to the plate 18 and detached from it to form a passage 24 for the water from the openings 18a, 18b to the infeed pipe 4.

[0048] In greater detail, in the accompanying drawings the supporting element 22 is housed in the infeed pipe 4 and is connected to the plate 18 by respective peripheral edges which can engage with one another to form a box-shaped body 25 in which the passage 24 for the water is made.

[0049] Returning to the elastic element 26a connected to each valve 17, 19, as illustrated in Figures 2 - 4, this consists of a helical spring fitted to the respective cylindrical portion 20 and having a first end 26b connected to the supporting element 22 and a second end 26c opposite the first end 26b, connected to the respective head 21 to push the relative valve 17, 19. In this situation, and thanks to the shape of each opening 18a, 18b, it should be noticed that the elastic element 26a connected to the primary valve 17 pushes the valve 17 towards the open condition. In other words, the elastic element 26a pushes the head 21 of the primary valve 17 towards the auxiliary pipe 15 outside the opening 18a.

[0050] The elastic element 26a connected to the safety valve 19 pushes the head 21 towards the narrowing in the opening 18b, keeping the safety valve 19 closed.

[0051] Pump 1 operation, described mainly in structural terms, is as follows.

[0052] The drive means 7 cause the impellers 10 to rotate which, as described above, suck the water from the infeed pipe 4 and convey it towards the outfeed pipe 6. During pump 1 steady state operation part of the water flowing out of the pipe 6 also passes through the auxiliary pipe 15. During this operating step both of the valves 17, 19 are in the closed condition in which they do not allow water to pass from the auxiliary pipe 15 to the infeed pipe 4 (Figure 2) .

[0053] Advantageously, if the water pressure in the outfeed pipe 6 and as a result in the auxiliary pipe 15 goes above a predetermined pressure value P, the safety valve 19 switches, overcoming the resistance of the elastic element 26a, to the open position, allowing water to pass from the delivery pipe 6 to the infeed pipe 4 (Figure 4). It should be noticed that the pressurised water in the auxiliary pipe 15 pushes against the head 21 of the safety valve 19. The elastic element 26a of the safety valve 19 keeps the valve locked in the closed condition. If the water pressure increases, the action of the elastic element 26a is overcome and the head 21 of the valve 19 is moved out of the opening 18b, allowing water to pass through the opening 18b, thus returning the water to the infeed pipe 4. In this way, the safety valve 19 is opened when the pressure of the water flowing out rises above the limit value P. As a result, said pressure is always kept below a predetermined pressure value P.

[0054] It should also be noticed that during pump 1 operation, the water pressure in the auxiliary pipe 15 keeps the primary self-priming valve 17 closed, because the action of the counteracting element 26a is overcome by the water pressure.

[0055] When the drive mans 7 are stopped and the impellers no longer suck in water, the residual water pressure in the outfeed pipe 6 and in the auxiliary pipe 15 falls. In this situation, the counteracting element 26a connected to the primary valve 17 pushes the valve 17 into the open position, allowing the residual water in the auxiliary pipe 15 to enter the primary pipe 4.

[0056] Advantageously, when the pump 1 is started up again, the impellers suck in the water returned into circulation by the primary valve 17 until the pressure in the auxiliary pipe 15 again pushes the valve 17 into the closed position (as happens when the pump is primed with a consequent absence of air in the intake pipe).

[0057] The invention brings important advantages.

[0058] It should be noticed that, if the pressure in the pump 1 increases above the predetermined pressure value P, the safety valve 19 allows the water delivered to be recirculated, re-establishing an optimum pressure value.

[0059] Advantageously, it should be noticed that the safety valve 19 returns the water into circulation in the infeed pipe 4, preventing the water from flowing out of

the pump 1 body 2, unlike the safety devices known today which discharge the water to the outside of the system delivery pipe. The solution provided by the present invention is also advantageous compared with solutions involving the creation of a by-pass outside the pump, since such solutions are significantly more expensive and bulky.

[0060] It should also be noticed that the pressure value P which causes the safety valve 19 to open may be set by acting on the counteracting element 26. In other words, the physical characteristics of the counteracting element 26 (number of coils, spring cross-section) can be used to define the value P above which the spring allows water to pass towards the infeed pipe 4.

[0061] Another advantage of the present invention is that both valves 17, 19 are contained in a single box-shaped body 25 inserted in the pump, thus limiting the pump 1 overall dimensions. Both the primary valve 17 which allows pump self-priming, and the safety valve 19 for maintaining the predetermined pressure value P are connected to the box-shaped body 25. Advantageously, any maintenance work on both valves may be carried out by simply substituting only the box-shaped body 25.

Claims

1. A centrifugal pump, comprising:

- a containment body (2) with an infeed pipe (4) and an outfeed pipe (6);
- at least one intake stage (9) located in the containment body (2) between the pipes (4, 6), and having at least one impeller (10) for sucking a fluid from the infeed pipe (4) and conveying it towards the outfeed pipe (6);
- drive means (7) for the impeller (10);

the pump being **characterised in that** it also comprises a safety valve (19) located in the containment body (2) and able to switch between an open condition in which it allows fluid to pass from the outfeed pipe (6) to the infeed pipe (4), and a closed condition in which it does not allow the passage of the fluid; and safety valve (19) locking means (26) for keeping the valve (19) closed until the pressure of the fluid in the outfeed pipe (6) exceeds a predetermined pressure value P.

2. The pump according to the foregoing claim, also comprising a recirculation part (16) inserted between the outfeed pipe (6) and the infeed pipe (4), allowing fluid to pass from the outfeed pipe (6) to the infeed pipe (4); the safety valve (19) being part of the recirculation part (16).

3. The pump according to either of the foregoing claims, also comprising an auxiliary pipe (15) in fluid communication with the outfeed pipe (6), the recirculation part (16) being inserted between the auxiliary pipe (15) and the infeed pipe (4).

4. The pump according to claim 2 or 3 when dependent on 2, **characterised in that** the recirculation part (16) comprises a primary valve (17) that can switch between an open condition in which it allows fluid to pass from the outfeed pipe (6) to the infeed pipe (4) and a closed condition in which it does not allow the passage of fluid; and primary valve (17) locking means (26) for keeping the valve (17) open until the pressure of the fluid in the outfeed pipe (6) is lower than a predetermined pressure value.

5. The pump according to the foregoing claim, **characterised in that** the recirculation part (16) also comprises a connecting plate (18) located between the infeed pipe (4) and the outfeed pipe (6); the primary valve (17) and the safety valve (19) being housed in respective openings (18a, 18b) made in the plate (18) forming sections for the passage of the fluid in the valve (17, 19) open condition.

6. The pump according to the foregoing claim, **characterised in that** each valve (17, 19) has a cylindrical portion (20) which slides in the respective opening (18a, 18b), and a head (21) connected to a first end (20a) of the cylindrical portion (20) and extending transversally to the longitudinal extension of the cylindrical portion (20); the head (21) in the closed position blocking the opening (18a, 18b), and in the open position being detached from the respective opening (18a, 18b).

7. The pump according to the foregoing claim, **characterised in that** the recirculation part (16) also comprises a supporting element (22) connected to the plate (18) and having respective sliding seats (23) for a second end (20b) of each cylindrical portion (20) opposite the first end (20a); the supporting element (22) being detached from the plate (18) to form a passage (24) for the fluid from the openings (18) to the infeed pipe (4).

8. The pump according to claim 7, **characterised in that** the supporting element (22) and the plate (18) have respective peripheral edges which can be connected to one another to form a box-shaped body (25) in which the passage (24) for the fluid is created.

9. The pump according to any of the claims from 4 to 8, **characterised in that** the primary valve (17) locking means (26) comprise an elastic counteracting element (26a) connected to the valve (17).

10. The pump according to any of the foregoing claims, **characterised in that** the safety valve (19) locking

means (26) comprise an elastic counteracting element (26a) connected to the valve (19).

11. The pump according to claim 9 or 10, **characterised in that** the elastic element (26a) comprises a helical spring fitted to the respective cylindrical portion (20).

12. The pump according to claims 9 and 10, or 9, 10 and 11, **characterised in that** the elastic element (26a) connected to the primary valve (17) has a first end (26b) connected to the supporting element (22) and a second end (26c), opposite the first end (26b), connected to the respective head (21) for pushing the valve (17) into the open condition; and also being **characterised in that** the elastic element (26a) connected to the safety valve (19) has a first end (26b) connected to the supporting element (22) and a second end (26c), opposite the first end (26b), connected to the respective head (21) for pushing the valve (19) into the closed condition.

13. The pump according to any of the foregoing claims, comprising a plurality of intake stages (9); each stage (9) also having a diffuser (11), coaxial with and downstream alongside the respective impeller (10).

14. The pump according to the foregoing claim, **characterised in that** each diffuser (11) is connected to an impeller (10) for conveying the fluid out of a peripheral outfeed portion (10b) of the impeller (10) towards a central infeed portion (10a) of a subsequent stage (9).

15. The pump according to claims 3 and 13, **characterised in that** the stages (9) are alongside one another, forming a closed cylindrical body (12) housed in the containment body (2); the auxiliary pipe (15) being between the cylindrical body (12) and the containment body (2).

Amended claims in accordance with Rule 86(2) EPC.

1. A centrifugal pump, comprising:

- a containment body (2) with an infeed pipe (4) and an outfeed pipe (6);
- at least one intake stage (9) located in the containment body (2) between the pipes (4, 6), and having at least one impeller (10) for sucking a fluid from the infeed pipe (4) and conveying it towards the outfeed pipe (6);
- drive means (7) for the impeller (10);

wherein the pump
also comprises a safety valve (19) located in the containment body (2) and able to switch between an open condition in which it allows fluid to pass from the outfeed pipe (6) to the infeed pipe (4), and a closed condition in which it does not allow the passage of the fluid; and safety valve (19) locking means (26) for keeping the valve (19) closed until the pressure of the fluid in the outfeed pipe (6) exceeds a predetermined pressure value P;
the pump also comprising a recirculation part (16) inserted between the outfeed pipe (6) and the infeed pipe (4), allowing fluid to pass from the outfeed pipe (6) to the infeed pipe (4); the safety valve (19) being part of the recirculation part (16);
characterized in that the recirculation part (16) further comprises a primary valve (17) that can switch between an open condition in which it allows fluid to pass from the outfeed pipe (6) to the infeed pipe (4) and a closed condition in which it does not allow the passage of fluid; and primary valve (17) locking means (26) for keeping the valve (17) open until the pressure of the fluid in the outfeed pipe (6) is lower than a predetermined pressure value.

2. The pump according to claim 1, also comprising an auxiliary pipe (15) in fluid communication with the outfeed pipe (6), the recirculation part (16) being inserted between the auxiliary pipe (15) and the infeed pipe (4).

3. The pump according to claim 1, **characterised in that** the recirculation part (16) also comprises a connecting plate (18) located between the infeed pipe (4) and the outfeed pipe (6); the primary valve (17) and the safety valve (19) being housed in respective openings (18a, 18b) made in the plate (18) forming sections for the passage of the fluid in the valve (17, 19) open condition.

4. The pump according to the foregoing claim, **characterised in that** each valve (17, 19) has a cylindrical portion (20) which slides in the respective opening (18a, 18b), and a head (21) connected to a first end (20a) of the cylindrical portion (20) and extending transversally to the longitudinal extension of the cylindrical portion (20); the head (21) in the closed position blocking the opening (18a, 18b), and in the open position being detached from the respective opening (18a, 18b).

5. The pump according to the foregoing claim, **characterised in that** the recirculation part (16) also comprises a supporting element (22) connected to the plate (18) and having respective sliding seats (23) for a second end (20b) of each cylindrical portion (20) opposite the first end (20a); the supporting element (22) being detached from the plate (18) to form a passage (24) for the fluid from the openings (18) to the infeed pipe (4).

6. The pump according to claim 5, **characterised in**

that the supporting element (22) and the plate (18) have respective peripheral edges which can be connected to one another to form a box-shaped body (25) in which the passage (24) for the fluid is created.

7. The pump according to any of the claims, **characterised in that** the primary valve (17) locking means (26) comprise an elastic counteracting element (26a) connected to the valve (17).

8. The pump according to any of the foregoing claims, **characterised in that** the safety valve (19) locking means (26) comprise an elastic counteracting element (26a) connected to the valve (19).

9. The pump according to claim 7 or 8, **characterised in that** the elastic element (26a) comprises a helical spring fitted to the respective cylindrical portion (20).

10. The pump according to claims 7 and 8, or 7, 8 and 9, **characterised in that** the elastic element (26a) connected to the primary valve (17) has a first end (26b) connected to the supporting element (22) and a second end (26c), opposite the first end (26b), connected to the respective head (21) for pushing the valve (17) into the open condition; and also being **characterised in that** the elastic element (26a) connected to the safety valve (19) has a first end (26b) connected to the supporting element (22) and a second end (26c), opposite the first end (26b), connected to the respective head (21) for pushing the valve (19) into the closed condition.

11. The pump according to any of the foregoing claims, comprising a plurality of intake stages (9); each stage (9) also having a diffuser (11), coaxial with and downstream alongside the respective impeller (10).

12. The pump according to the foregoing claim, **characterised in that** each diffuser (11) is connected to an impeller (10) for conveying the fluid out of a peripheral outfeed portion (10b) of the impeller (10) towards a central infeed portion (10a) of a subsequent stage (9).

13. The pump according to claims 2 and 11, **characterised in that** the stages (9) are alongside one another, forming a closed cylindrical body (12) housed in the containment body (2); the auxiliary pipe (15) being between the cylindrical body (12) and the containment body (2).

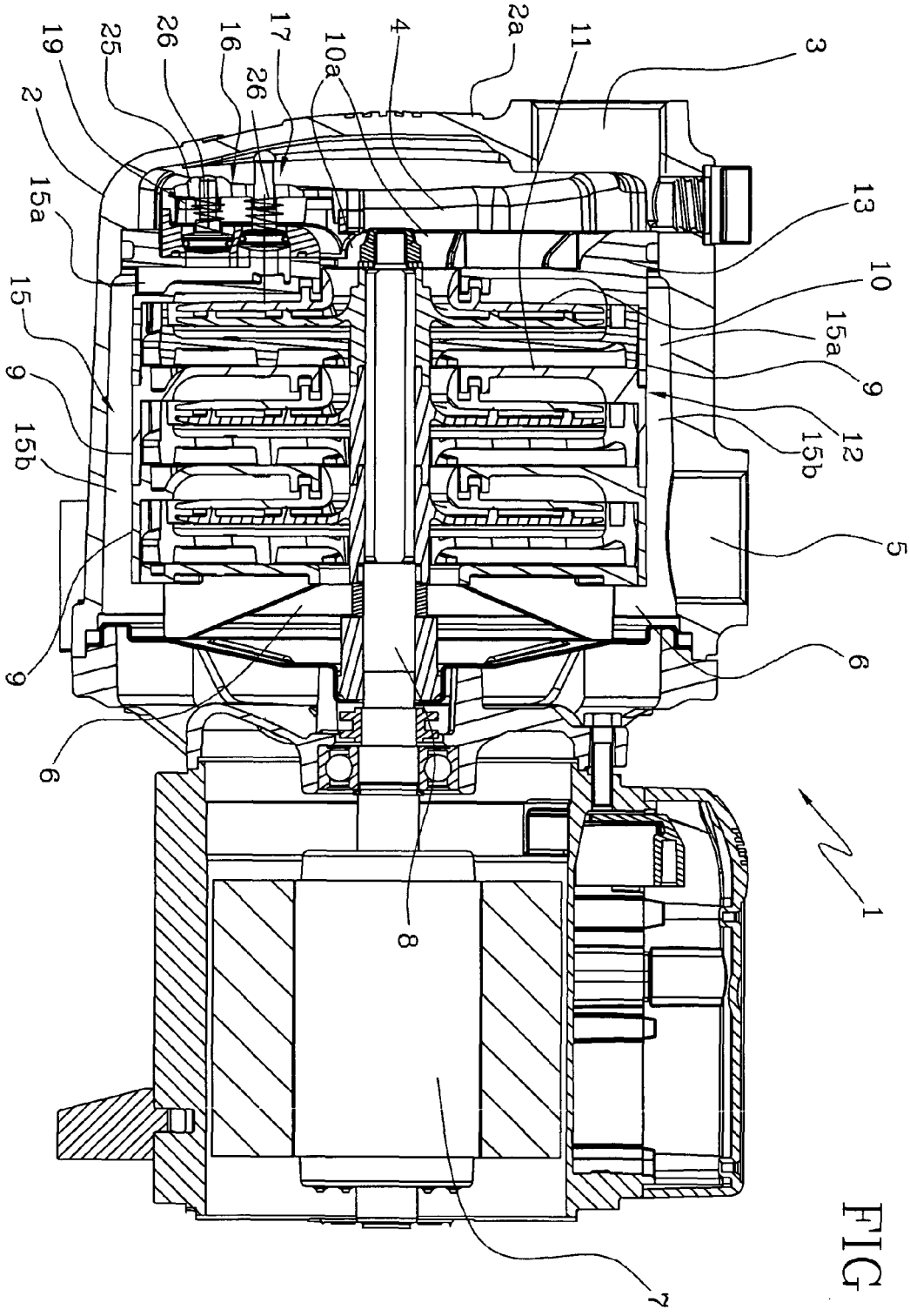
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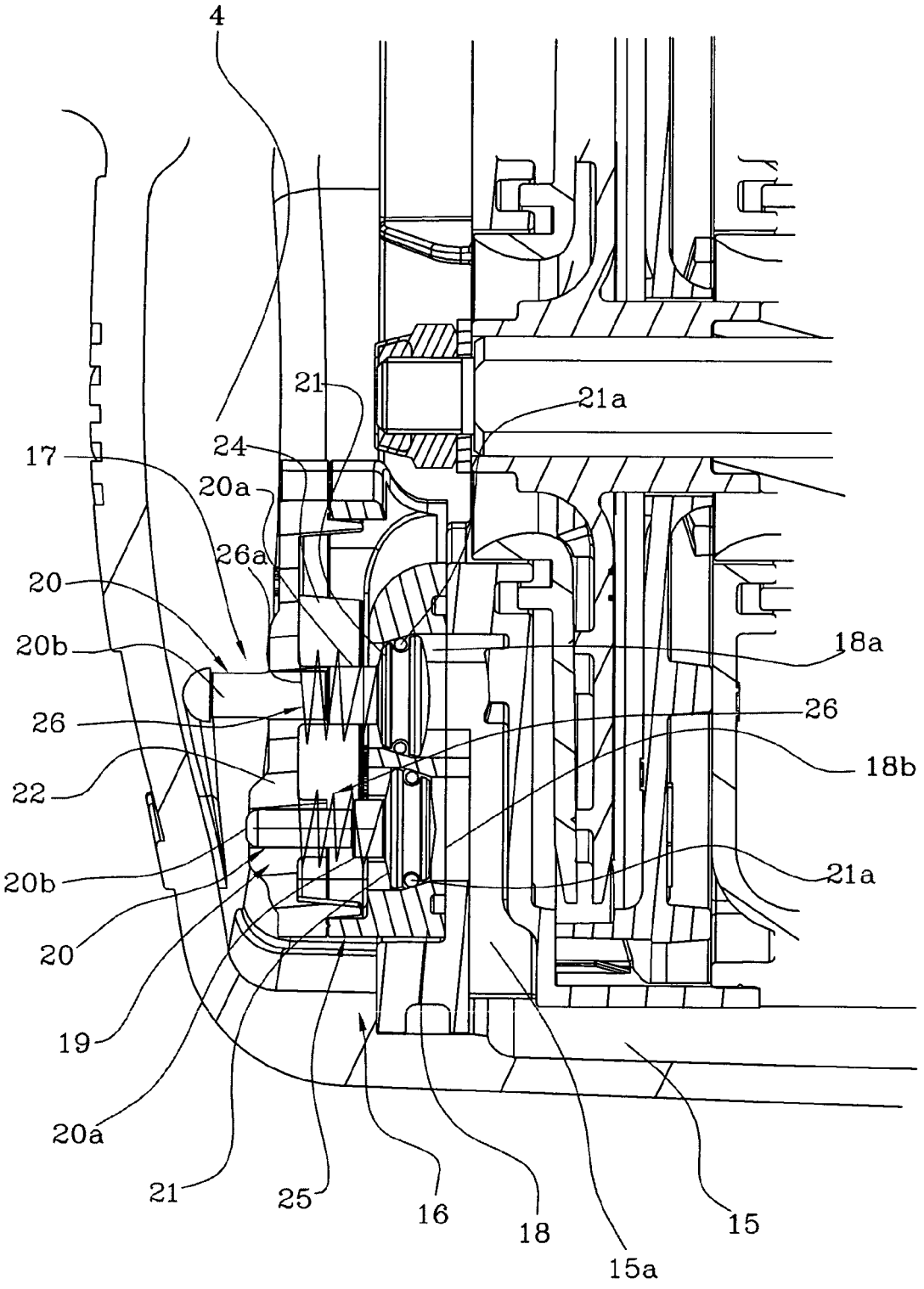
FIG 1

FIG 2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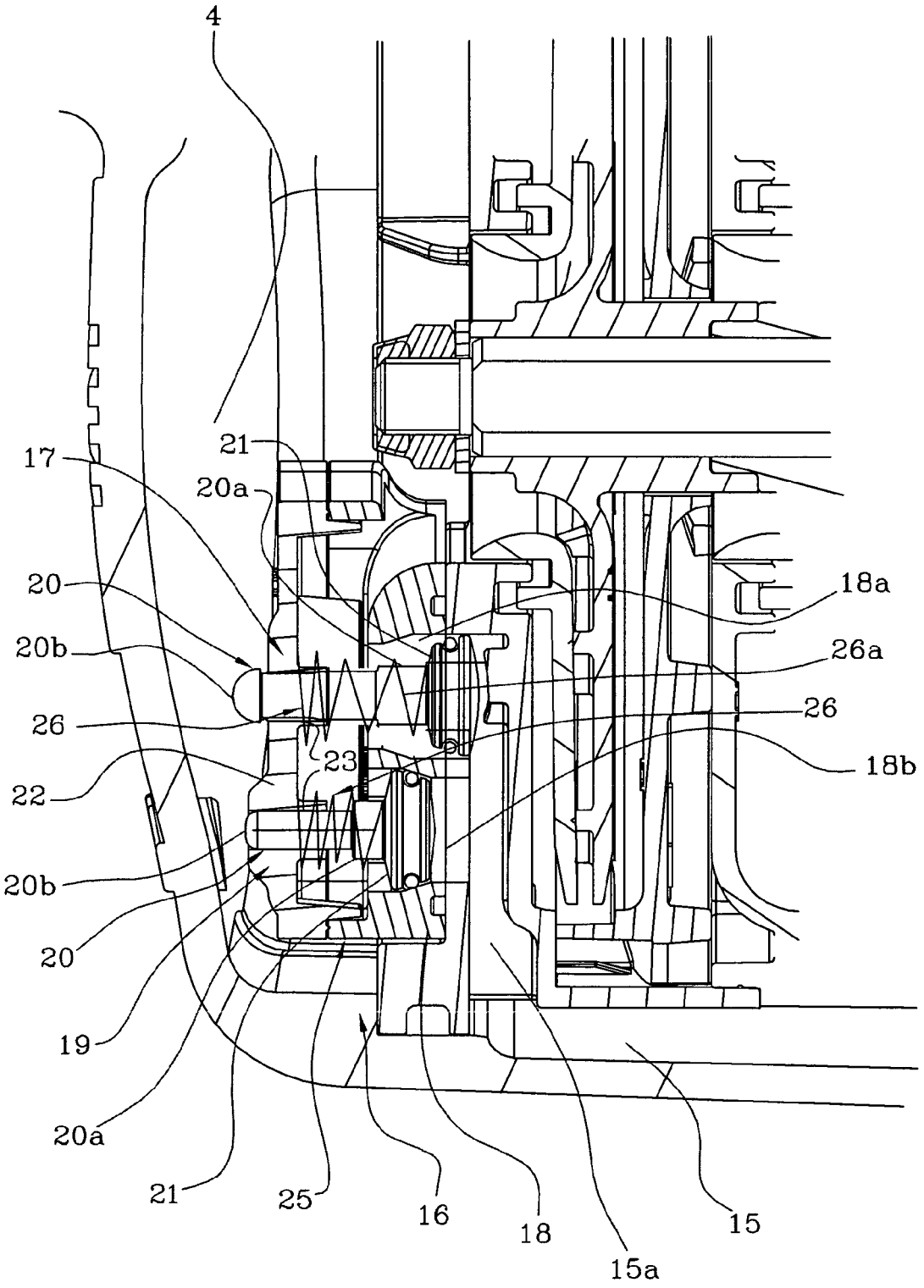
15a

FIG 3


4
17
21
20a
20
18a
20b
26a
26
26
23
18b
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20b
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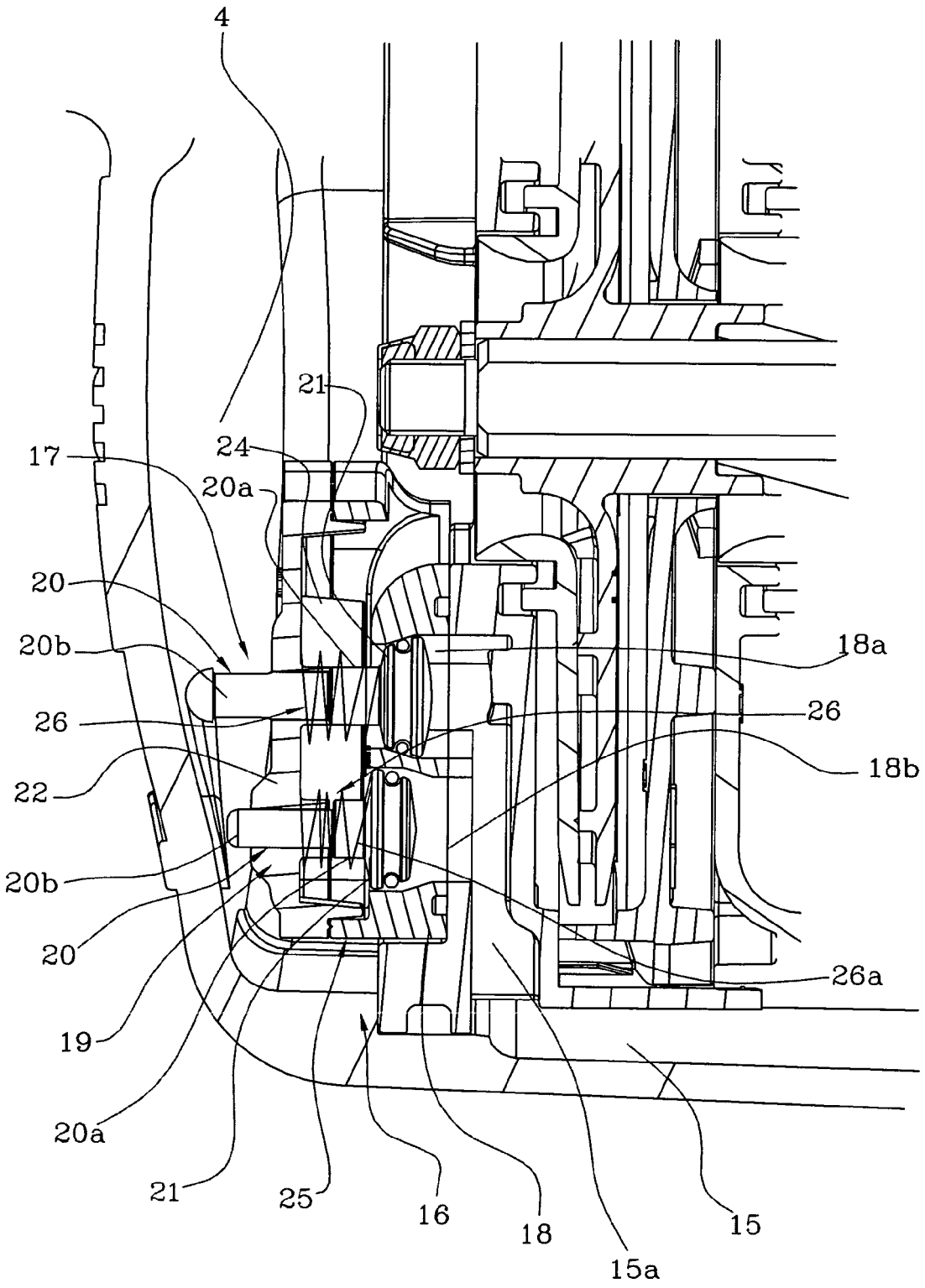
19
20a
21
25
16
18
15a
15

FIG 4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21
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20a
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20b
18a
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22
18b
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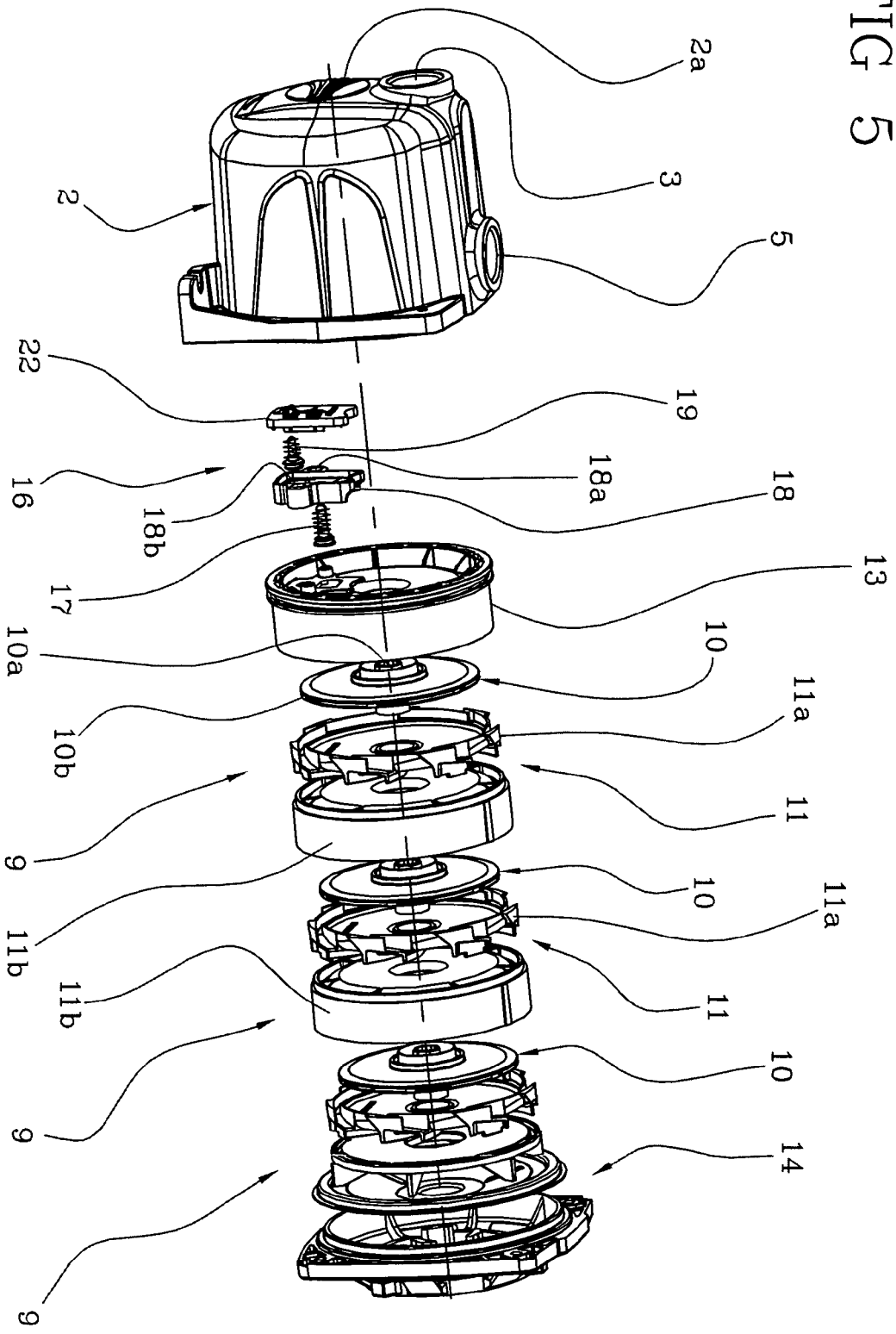
26a
19
20a
21
25
16
18
15
15a

FIG 5


2a
3
2
5
22
19
16
18a
18
18b
17
13
10a
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10b
11a
11
9
11b
10
11a
11b
11
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10
14
9

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EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5397

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	WO 93/11360 A (NOCCHI POMPE S.P.A) 10 June 1993 (1993-06-10) * page 3, line 23 - page 4, line 19; figure 1 * * page 5, line 9 - page 6, line 1; figure 3 * * claims 1,4,5 * -----	1-3,10, 11,13-15 12	F04D15/00
X A	DE 19 13 242 A1 (NIEMES,WILFRIED) 24 September 1970 (1970-09-24) * page 1, paragraphs A.1,B * * page 3, paragraph F.1.1; figure 1 * -----	1-3,10, 11 13-15	
X A	DE 197 09 484 A1 (HELLA KG HUECK & CO, 59557 LIPPSTADT, DE) 10 September 1998 (1998-09-10) * column 3, line 11 - line 34; figure 1 * -----	1-3,10, 11 12-15	
A	DE 21 06 852 A1 (SUEDDEUTSCHE KUEHLER BEHR) 14 September 1972 (1972-09-14) * page 2, last paragraph - page 3, paragraph 3; figure 1 * -----	1-3,10, 11	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F04D
F01P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 September 2005	Di Giorgio, F

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EPO FORM 1503 03.82 (P04C01)

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22-09-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9311360 A	10-06-1993	AT 150137 T	15-03-1997
		DE 69218250 D1	17-04-1997
		EP 0619001 A1	12-10-1994
		IT 1257704 B	01-02-1996
		US 5718564 A	17-02-1998
DE 1913242 A1	24-09-1970	NONE	
DE 19709484 A1	10-09-1998	NONE	
DE 2106852 A1	14-09-1972	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82