

(12)

EUROPEAN PATENT APPLICATION

(43)

Date of publication:

(51)

Int Cl.7: F04D 9/06

02.03.2005 Bulletin 2005/09

(21)

Application number: 03425564.6

(22)

Date of filing: 29.08.2003

(84) Designated Contracting States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR Designated Extension States: AL LT LV MK	(74) Representative: Ponchiroli, Simone Bugnion S.p.A. Via Garibaldi, 19 37121 Verona (IT)
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(54)

A self-priming centrifugal pump

(57) A self-priming centrifugal pump comprising a pump body (2), a motorised impeller (8) mounted internally to the pump body (2) and a diffuser (13) positioned downstream of the impeller (8), with reference to the direction of flow of a liquid in the pump (1). The diffuser (13) has a first and a second wall (14), (15) defining between them an annular diffusion chamber (16). The diffusion chamber (16) has a first segment (18) and a second segment (19), the one being the continuation of the other, the first segment (18) corresponding, in use, to

an upper portion of the diffusion chamber (16). The first wall (14) has a plurality of openings (17) positioned along its own outer circumferential periphery to allow the entry of the flow of liquid exiting the impeller (8) into the diffusion chamber (16), whilst the second wall (15) is substantially closed in correspondence with the first segment (18), and it has at least a through hole (20) in correspondence with the second segment (19), to put in communication the second segment (19) of the diffusion chamber (16) with the delivery chamber (5).

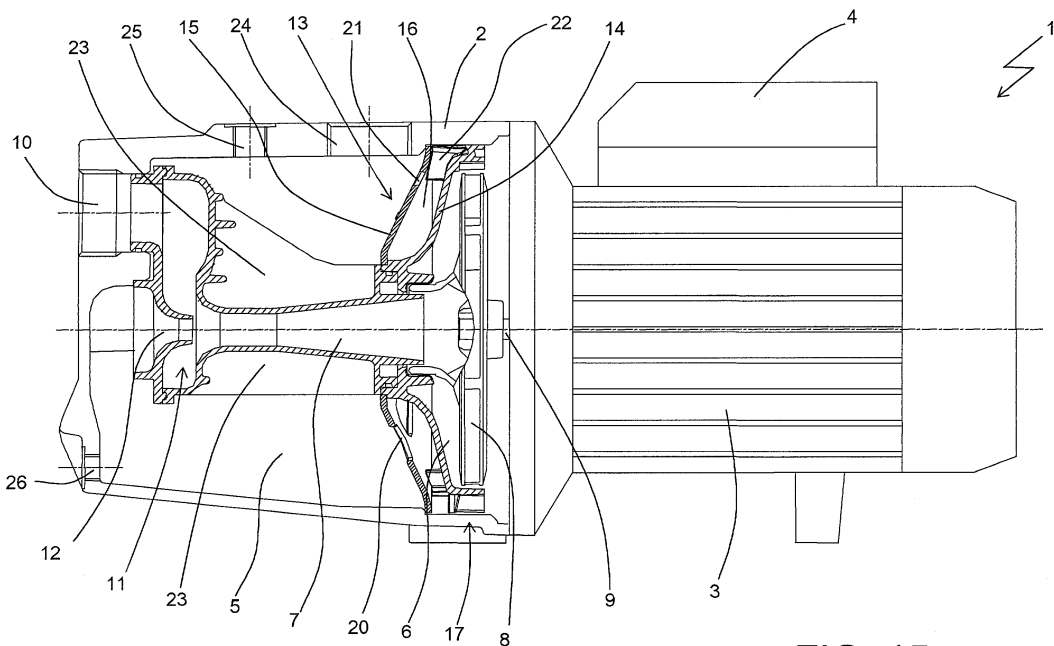


FIG. 15

Description

[0001] The present invention relates to a self-priming centrifugal pump of the kind described in the preamble to claim 1.

[0002] Currently known self-priming centrifugal pumps have an intake conduit axially facing the impeller, downstream of which a diffuser, coaxial to the impeller itself, guides the pumped liquid into a delivery chamber which in many practical applications surrounds the intake conduit. An opening obtained in the intake conduit in correspondence with an area thereof, shaped as a Venturi tube, causes the liquid present in the delivery chamber, when the pump is started, to be thrust through the opening, thereby creating a vacuum at the start of the Venturi tube, which allows to aspirate from the inlet of the pump body any air present therein.

[0003] Currently known diffusers have a diffusion chamber that is delimited by two opposite walls, whereof one is oriented towards the impeller and another one towards the delivery chamber. Through the outer circumferential periphery of the wall oriented towards the impeller a plurality of openings are obtained, which allow the entry of the flow of liquid exiting the impeller into the diffusion chamber.

[0004] Also through the wall oriented towards the delivery chamber are generally obtained one or more holes which put the diffusion chamber in communication with the delivery chamber.

[0005] In a first known embodiment, described in US Patent 2 934 021, through the wall oriented towards the delivery chamber are obtained four groups of small holes. The four groups are then positioned above, below, and at the two sides of the axis of the impeller.

[0006] A second known embodiment of the diffuser is instead described in the patent EP 361 328.

[0007] In this embodiment, the diffuser has a single annular hole extending between the wall oriented towards the delivery chamber and the part of the intake conduit that is inserted internally to the delivery chamber itself (Figures 1 and 2).

[0008] Both known solutions described above, however, have the considerable drawback of a relatively high, and anyway not optimal, self-priming time of the pump.

[0009] As is well known, upon starting, in the pump starts to re-circulate the liquid present in the delivery chamber through the intake conduit. In this way, thanks to the Venturi tube conformation of the intake conduit, the pump gradually sucks in the air (or the gaseous fluid) present in the intake conduit upstream of the point shaped as a Venturi tube. The air which becomes mixed with the liquid in the intake conduit must subsequently be separated therefrom in correspondence with the delivery chamber to be ejected from the delivery conduit.

[0010] The self-priming time, for an equal length of the intake conduit (construed both as a conduit within the pump, and as a pipeline outside the pump, such as the

suction pipe of a well), thus depends on the ability of the pump to suck in the air present in the intake conduit, to separated from the liquid and to eject it through the delivery conduit.

[0011] As stated, currently known pumps have a relatively high self-priming pump, due to their mediocre ability to separate the air from the liquid inside the delivery chamber.

[0012] In this situation, the technical task constituting the basis of the present invention is to provide a self-priming centrifugal pump that overcomes the aforementioned drawbacks.

[0013] In particular, the technical task of the present invention is to provide a self-priming centrifugal pump that has a reduced self-priming time relative to currently known pumps.

[0014] The specified technical task and the objects set out herein are substantially achieved by a self-priming centrifugal pump as described in the accompanying claims.

[0015] Further features and the advantages of the present invention shall become more readily apparent from the detailed description of some preferred, but not exclusive, embodiments of a self-priming pump illustrated in the accompanying drawings, in which:

- Figure 1 shows a front view of a detail of a diffuser of a self-priming centrifugal pump in accordance with the prior art;
- Figure 2 shows a section view of the detail of Figure 1 according to the line II-II;
- Figure 3 shows a front view of a detail of a diffuser of a self-priming centrifugal pump constructed according to a first embodiment of the present invention;
- Figure 4 shows a top view of the detail of Figure 3;
- Figure 5 shows a front view of a detail of a diffuser of a self-priming centrifugal pump constructed according to a second embodiment of the present invention;
- Figure 6 shows a top view of the detail of Figure 5;
- Figure 7 shows a front view of the diffuser of Figure 3 with an additional element highlighted;
- Figure 8 shows a top view of the diffuser of Figure 7;
- Figure 9 shows a front view of the diffuser of Figure 5 with an additional element highlighted;
- Figure 10 shows a top view of the diffuser of Figure 9;
- Figure 11 shows a front view of a detail of the diffuser of Figure 9;
- Figure 12 shows a section view of the detail of Figure 11 according to the line XII-XII;
- Figure 13 shows a front view of the detail of the diffuser of Figure 7;
- Figure 14 shows a sectioned view of the detail of Figure 13 according to the line XIV-XIV; and
- Figure 15 shows a schematic and partially sectioned side view of a self-priming centrifugal pump

according to the present invention.

[0016] With reference to the aforementioned figures, the reference number 1 globally designates a self-priming centrifugal pump according to the present invention (Figure 15).

[0017] The pump 1, shown in Figure 15, comprises a pump body 2 set horizontally side by side with an electric motor 3 provided with its own connection box 4.

[0018] Inside the pump body 2 are identified a delivery chamber 5, a pumping chamber 6 and an intake conduit 7.

[0019] In the pumping chamber 6 is mounted a motorised centrifugal impeller 8 (of a known type) rigidly connected to the shaft 9 of the electric motor 3.

[0020] The intake conduit 7 extends between an intake hole 10, obtained in an upper part of the pump body 2, and the pumping chamber 6 into which it opens in alignment with the axis of the impeller 8.

[0021] In its own intermediate portion shaped as a Venturi tube 11, the intake conduit 7 has a branch 12 open towards the delivery chamber 5.

[0022] The pumping chamber 6 is also peripherally in communication with the delivery chamber 5 through a diffuser 13 (Figures 7-10).

[0023] In the illustrated embodiment, the intake conduit 7 and the delivery chamber 5 are positioned on the same side of the impeller 8 (but this solution is not mandatory), and the diffuser 13 is rigidly mounted between the inner wall of the pump body 2 and the outer wall of the intake conduit 7.

[0024] The diffuser 13, which is positioned downstream of the impeller 8 with reference to the flow of the liquid in the pump 1, is constituted mainly by a first and by a second wall 14, 15, substantially shaped as annuli, which identify between them a diffusion chamber 16 having, at least mainly, continuous annular development.

[0025] The first wall 14 (Figures 3-6) is oriented towards the impeller 8 whilst the second wall 15 (Figures 11-14) faces the delivery chamber 5 of the pump 1.

[0026] The communication between the pumping chamber 6 and the diffusion chamber 16 is assured by a plurality of openings 17 positioned along the outer circumferential periphery of the first wall 14, which allow the entry of the flow of liquid exiting the impeller 8 into the diffusion chamber 16.

[0027] In the diffusion 16 can be identified a first segment 18 and a second segment 19, one being a continuation of the other, in which the first segment 18 corresponds, in use, to the central upper portion of the ring defined by the diffusion chamber 16. In particular, in the illustrated embodiments, the diffuser 13 has, viewed frontally, annulus shape, and the first segment 18 can be frontally identified as the upper sector of said circular crown (Figures 7 and 9).

[0028] The second wall 15 is substantially closed in correspondence with the first segment 18 of the diffu-

sion chamber 16, whilst it has one or more through holes 20 in correspondence with the second segment 19. Said through holes 20 have the purpose of putting in communication the second segment 19 of the diffusion chamber 16 with the delivery chamber 5, thus allowing the passage of the liquid in substantially axial direction.

[0029] Depending on the embodiments, in correspondence with the first segment 18 of the diffusion chamber 16, the second wall 15 can be either completely closed (Figures 9-12), or it can have, in correspondence with the summit part of the first segment 18 of the diffusion chamber 16, a small vent hole 21 to allow the exit of any air present in the diffusion chamber 16 towards the delivery chamber 5 (figures 7, 8, 13, 14).

[0030] The presence or absence of the vent hole 21 depends on the dimensioning of the diffuser 13. In particular when the extension of the first segment 18 is relatively high (Figure 13), the vent hole 21 is necessary to prevent air from accumulating in the upper part of the diffusion chamber 16. On the contrary, if the extension of the first segment 18 of the diffusion chamber 16 is relatively reduced (Figure 11), the presence of the hole 21 is not indispensable since any air accumulated in the upper part of the diffusion chamber 16 would in any case be driven towards the delivery chamber 5 by the liquid in swirling motion which flows inside the diffuser 13.

[0031] Advantageously, the through hole 20 (or the through holes 20 as the case may be) positioned in correspondence with the second segment 19 of the diffusion chamber 16 has elongated shape along the development of the second segment 19 itself, and covers most of the development thereof in order to maximise the flow of liquid from the diffusion chamber 16 to the delivery chamber 5.

[0032] The illustrated embodiments comprise a plurality of through holes 20, distributed in succession along an arc of circumference having for its centre the axis of the impeller 8, but other embodiments may also comprise a single through hole 20 with equivalent size and shape.

[0033] As shown in particular in Figures 3 through 6 which show the diffuser 13 without the second wall 15, in the illustrated embodiments, the diffuser 13 further comprises a plurality of spacers 22 interposed between the first and the second wall 14, 15, integral to the first wall 14 and positioned in correspondence with the external periphery of the diffusion chamber 16.

[0034] Since said spacers 22 intercept the flow of the liquid entering tangentially into the diffusion chamber 16, they can be shaped slightly arched in order to facilitate the commencement in the diffusion chamber of a motion with rotational component about the axis of the impeller 8.

[0035] As shown in Figures 8, 10 and 15, the diffusion chamber 16 in addition to developing in annular fashion about the axis of rotation of the impeller 8, also has a development component parallel to said axis in the direction of the delivery chamber 5. In essence the cham-

ber therefore develops mainly along the lateral surface of a cone frustum with its conicity oriented towards the delivery chamber 5.

[0036] In the delivery chamber 5 are also present two vertical stiffening bulkheads 23 which contrast the swirling motion of the liquid about the intake conduit.

[0037] As regards the pump body 2, in the illustrated embodiment it has, in addition to the intake hole 10, also a delivery hole 24 and a filling hole 25 obtained in the upper part, and a discharge hole 26 obtained in the lower part, all in communication with the delivery chamber 5.

[0038] At the time of installation, the pump 1 is mounted with the axis of the impeller 8 preferably in horizontal position, although slightly inclined positions are admissible provided they do not compromise the self-priming operation. Moreover, the first segment 18 of the diffusion chamber 16 is in the highest position.

[0039] In this way, at the time the pump 1 is started, the liquid present inside the pump body 2 is made to flow cyclically between the delivery chamber 5, the intake conduit 7, the pumping chamber 6 and the diffusion chamber 16.

[0040] In correspondence with the Venturi tube 11, air coming from the intake conduit 7 is mixed with the liquid. Once the liquid reaches the delivery chamber 5, the air is released and reaches the delivery hole 24 to exit the pump 1.

[0041] The presence of a substantially closed segment of the second wall 15 in correspondence with the first segment 18 of the diffusion chamber 16 (the possible presence of the vent hole 21 has nearly no influence) causes, at the time the pump 1 is started (with liquid present only inside the pump body 2), the surface of the liquid inside the pump body 2 not to be directly involved by the flow of the liquid exiting the diffuser 13.

[0042] In this way the air bubbles which are separated from the liquid which exits the diffuser 13 through the through holes 20 do not find fluid flow to hinder their upward travel towards the delivery hole 24.

[0043] On the contrary, in currently known pumps the surface of the liquid is always involved by a flow of liquid in swirling motion exiting the diffuser 13, parallel to the axis of the impeller 8. In this way, any air bubbles separating from the flow exiting the diffuser 13 in the low part of the delivery chamber 5 are intercepted by the swirling flow and brought into circulation again and again by the flow of liquid.

[0044] The present invention thus achieves important advantages.

[0045] The pump of the present invention assures a considerably shorter self-priming time than known pumps, thanks to its own ability to separate the air bubbles from the flow of liquid.

[0046] It should also be noted that the present invention is relatively easy to construct and that also the cost connected with the construction of the invention is not high.

[0047] The invention thus conceived can be subject to numerous modifications and variations, without thereby departing from the scope of the inventive concept that characterises it.

[0048] All details can be replaced by other, technically equivalent elements and in practice all materials employed, as well as the shapes and dimensions of the various components, may be any depending on requirements.

Claims

1. A self-priming centrifugal pump comprising

- a pump body (2);
- a motorised impeller (8) mounted internally to the pump body (2); and
- a diffuser (13) positioned downstream of the impeller (8), with reference to the direction of flow of a liquid in the pump (1), and having a first and a second wall (14), (15) defining between each other a diffusion chamber (16) having, at least mainly, continuous annular development, said first wall (14) being oriented towards said impeller (8) and said second wall (15) being oriented towards the delivery chamber (5) of the pump (1), said first wall (14) having a plurality of openings (17) positioned along its own outer circumferential periphery to allow the entry of the flow of liquid exiting the impeller (8) into the diffusion chamber (16), and said second wall (15) having at least a through hole (20) to put in communication the diffusion chamber (16) with the delivery chamber (5);

characterised in that said annular diffusion chamber (16) has a first segment (18) and a second segment (19), the once being a continuation of the other, said first segment (18) corresponding, in use, to an upper portion of said diffusion chamber (16), and **in that** said second wall (15) is substantially closed in correspondence with said first segment (18), said through hole (20) being obtained in correspondence with the second segment (19), to put in communication said second segment (19) of the diffusion chamber (16) with the delivery chamber (5).

2. A self-priming centrifugal pump as claimed in claim 1 **characterised in that** said through hole (20) has elongated shape along the development of the second segment (19) of the diffusion chamber (16).
3. A self-priming centrifugal pump as claimed in claim 1 or 2 **characterised in that** it has a single through hole (20) extending along most of the development of the second segment (19) of the diffusion chamber (16).

4. A self-priming centrifugal pump as claimed in claim 1 or 2 **characterised in that** said second wall (15) has a plurality of through holes (20) distributed along the development of said second segment (19) of the diffusion chamber (16). 5
5. A self-priming centrifugal pump as claimed in claim 4 **characterised in that** said plurality of holes is distributed along circumference arc. 10
6. A self-priming centrifugal pump as claimed in claim 1 **characterised in that** said diffuser (13) further comprises a plurality of spacers (22) interposed between the first and the second wall (14), (15) and positioned in correspondence with the outer periphery of the diffusion chamber (16). 15
7. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said diffusion chamber (16) develops mainly along the lateral surface of a cone frustum with conicity oriented towards the delivery chamber (5). 20
8. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said first segment (18) of the diffusion chamber (16) corresponds, in use, to a central upper portion of said diffusion chamber (16). 25
9. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said second wall (15) has, in correspondence with the summit part of the first segment (18) of the diffusion chamber (16), a small vent hole (21) to allow the escape of any air present in the diffusion chamber (16) towards the delivery chamber (5). 30 35

Amended claims in accordance with Rule 86(2) EPC. 40

1. A self-priming centrifugal pump comprising
 - a pump body (2);
 - a motorised impeller (8) mounted internally to the pump body (2); and 45
 - a diffuser (13) positioned downstream of the impeller (8), with reference to the direction of flow of a liquid in the pump (1), and having a first and a second wall (14), (15) defining between each other a diffusion chamber (16) having, at least mainly, continuous annular development, said first wall (14) being oriented towards said impeller (8) and said second wall (15) being oriented towards the delivery chamber (5) of the pump (1), said first wall (14) having a plurality of openings (17) positioned along its own outer circumferential periphery to allow the entry of the flow of liquid exiting the impeller (8) into the 50 55

diffusion chamber (16), and said second wall (15) having at least a through hole (20) to put in communication the diffusion chamber (16) with the delivery chamber (5);

characterised in that said annular diffusion chamber (16) has a first section (18) and a second section (19), the one being a continuation of the other along the ring defined by the diffusion chamber (16), said first section (18) corresponding, in use, to an upper portion of said diffusion chamber (16), and **in that** said second wall (15) is substantially closed in correspondence with said first section (18), said through hole (20) being obtained in correspondence with the second section (19), to put in communication said second section (19) of the diffusion chamber (16) with the delivery chamber (5).

2. A self-priming centrifugal pump as claimed in claim 1 **characterised in that** said through hole (20) has elongated shape along the development of the second section (19) of the diffusion chamber (16).

3. A self-priming centrifugal pump as claimed in claim 1 or 2 **characterised in that** it has a single through hole (20) extending along most of the development of the second section (19) of the diffusion chamber (16).

4. A self-priming centrifugal pump as claimed in claim 1 or 2 **characterised in that** said second wall (15) has a plurality of through holes (20) distributed along the development of said second section (19) of the diffusion chamber (16).

5. A self-priming centrifugal pump as claimed in claim 4 **characterised in that** said plurality of holes is distributed along circumference arc.

6. A self-priming centrifugal pump as claimed in claim 1 **characterised in that** said diffuser (13) further comprises a plurality of spacers (22) interposed between the first and the second wall (14), (15) and positioned in correspondence with the outer periphery of the diffusion chamber (16).

7. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said diffusion chamber (16) develops mainly along the lateral surface of a cone frustum with conicity oriented towards the delivery chamber (5).

8. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said first section (18) of the diffusion chamber (16) corresponds, in use, to a central upper portion of said diffusion chamber (16).

9. A self-priming centrifugal pump as claimed in any of the previous claims, **characterised in that** said second wall (15) has, in correspondence with the summit part of the first section (18) of the diffusion chamber (16), a small vent hole (21) to allow the escape of any air present in the diffusion chamber (16) towards the delivery chamber (5).

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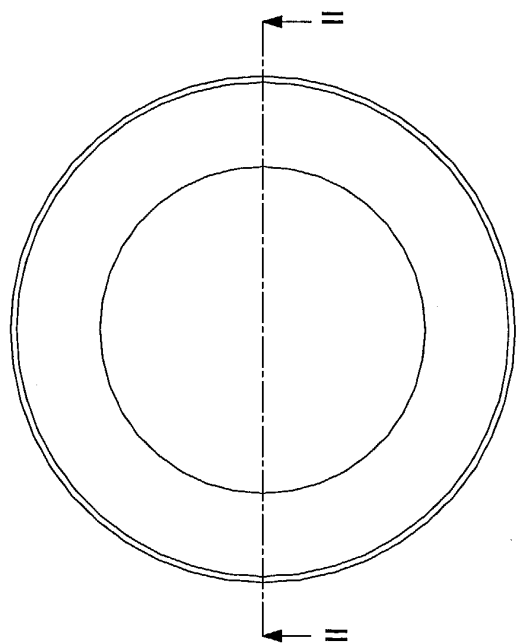


FIG. 1

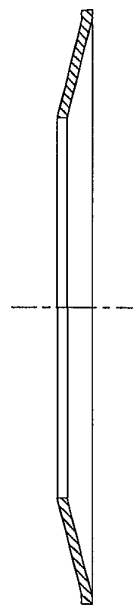


FIG. 2

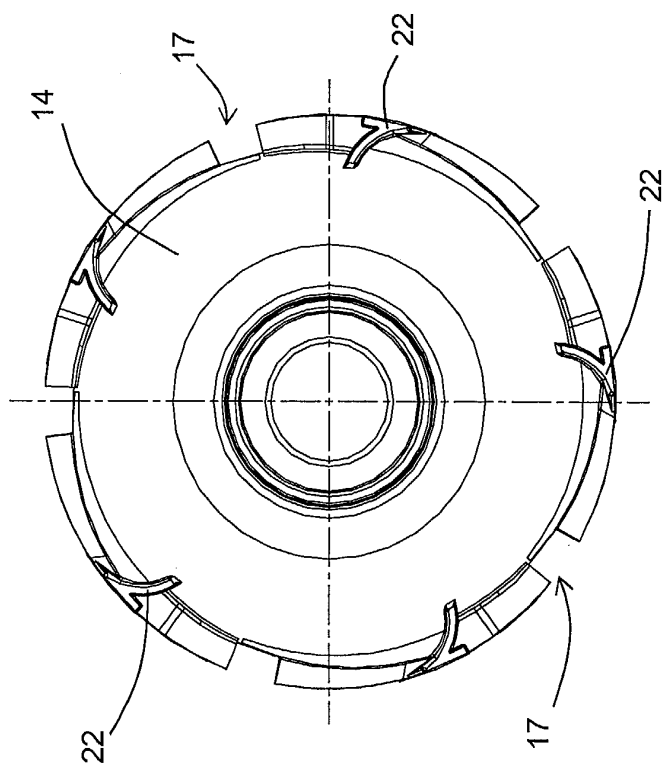


FIG. 3

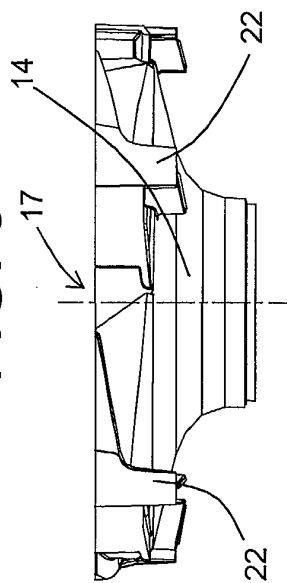
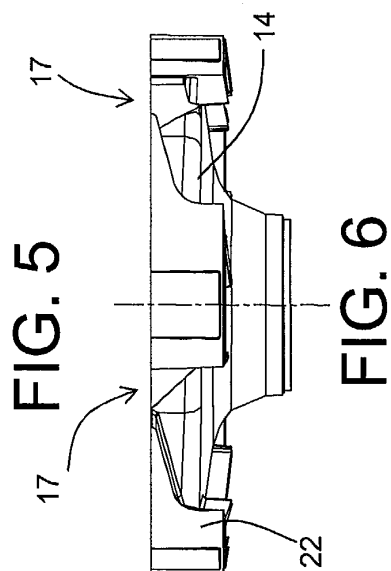
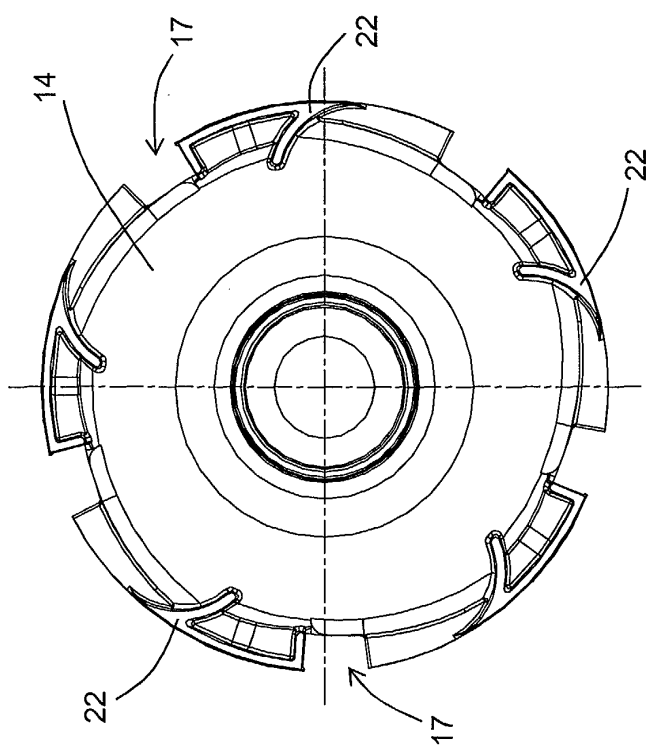
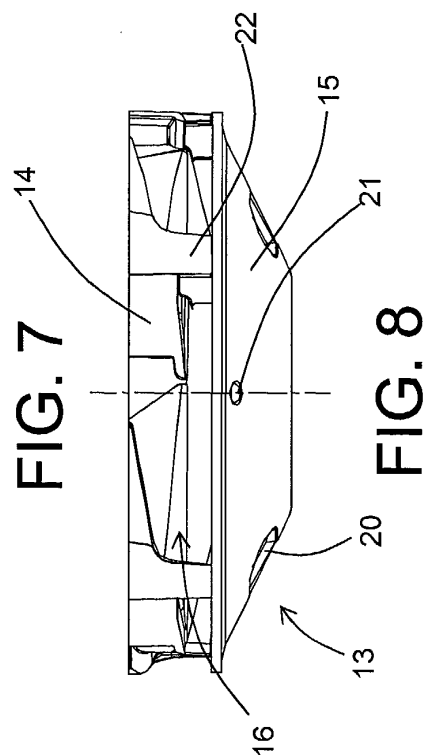
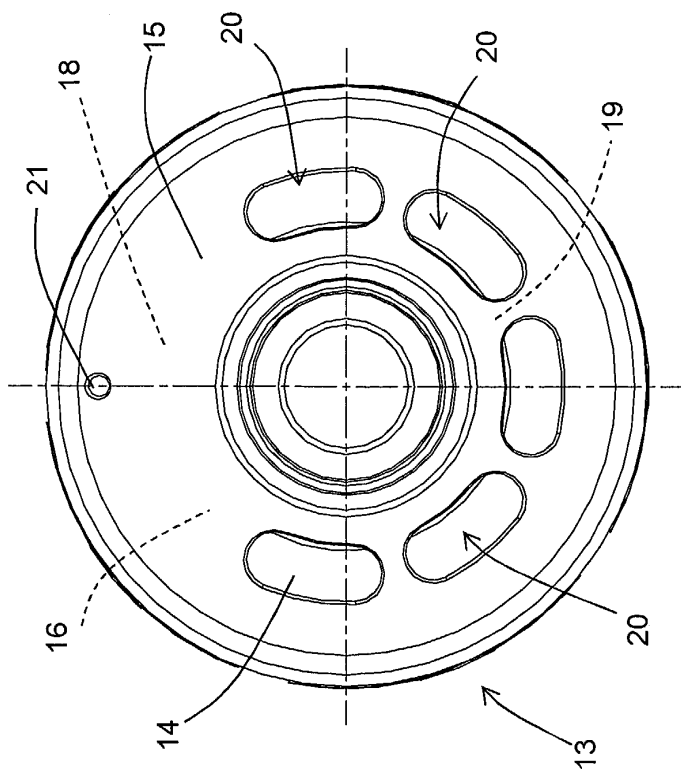


FIG. 4



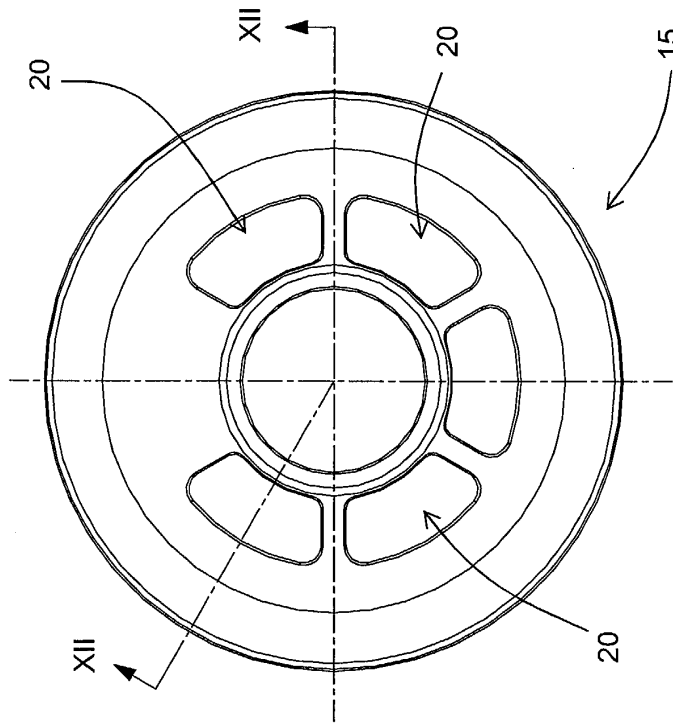


FIG. 11

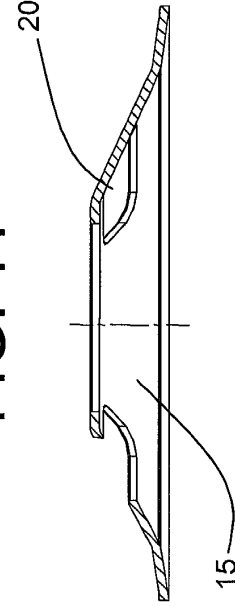


FIG. 12

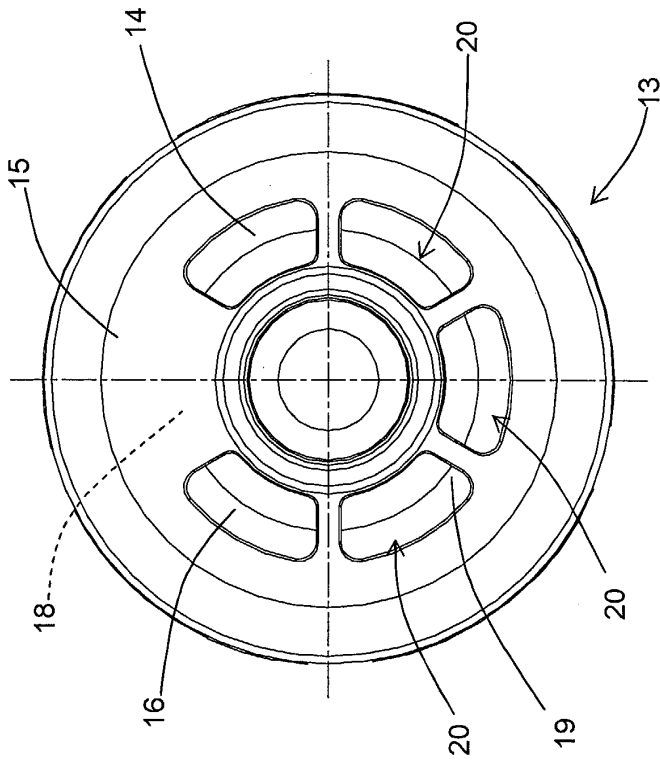


FIG. 9

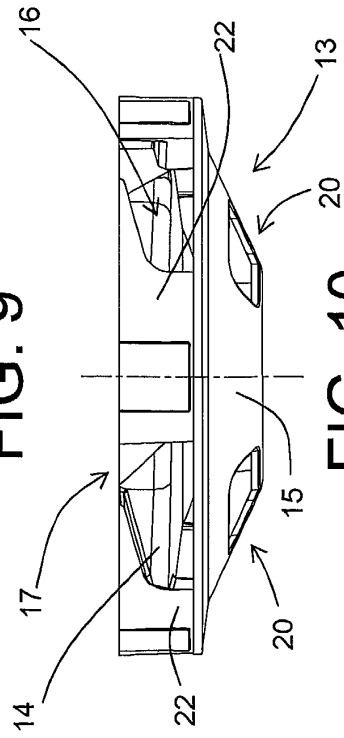


FIG. 10

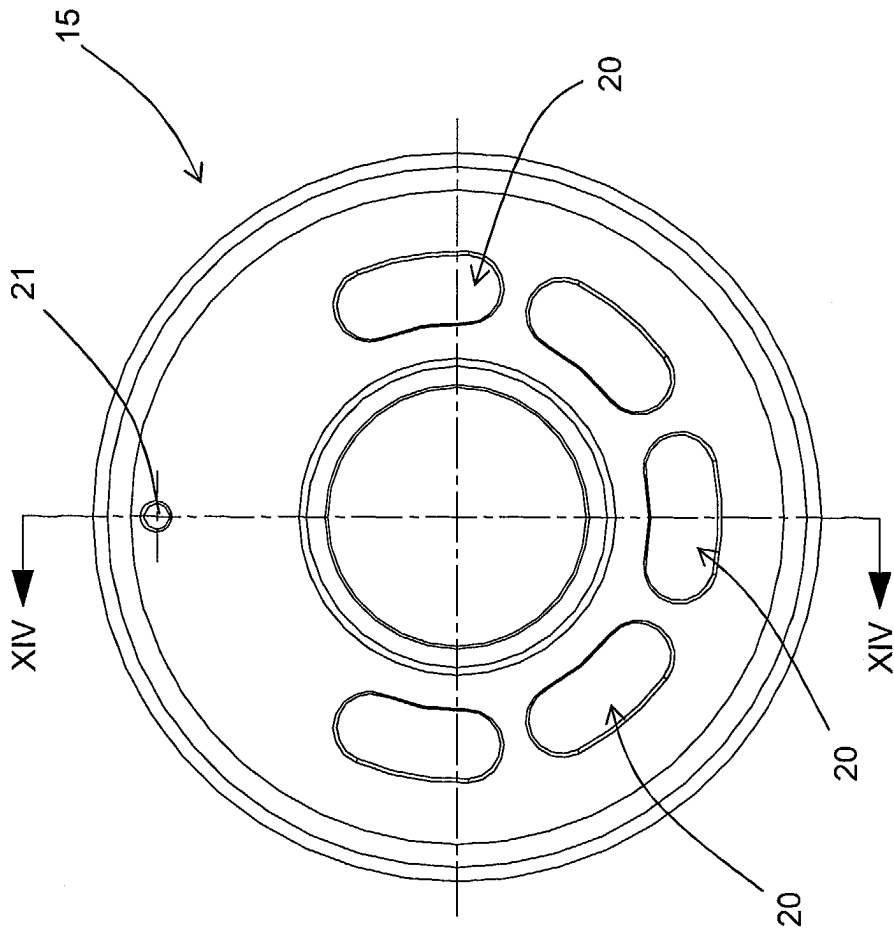


FIG. 13

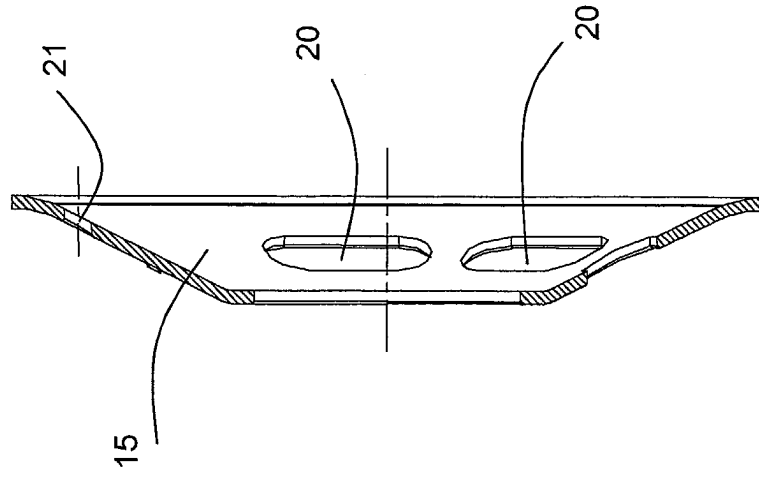


FIG. 14

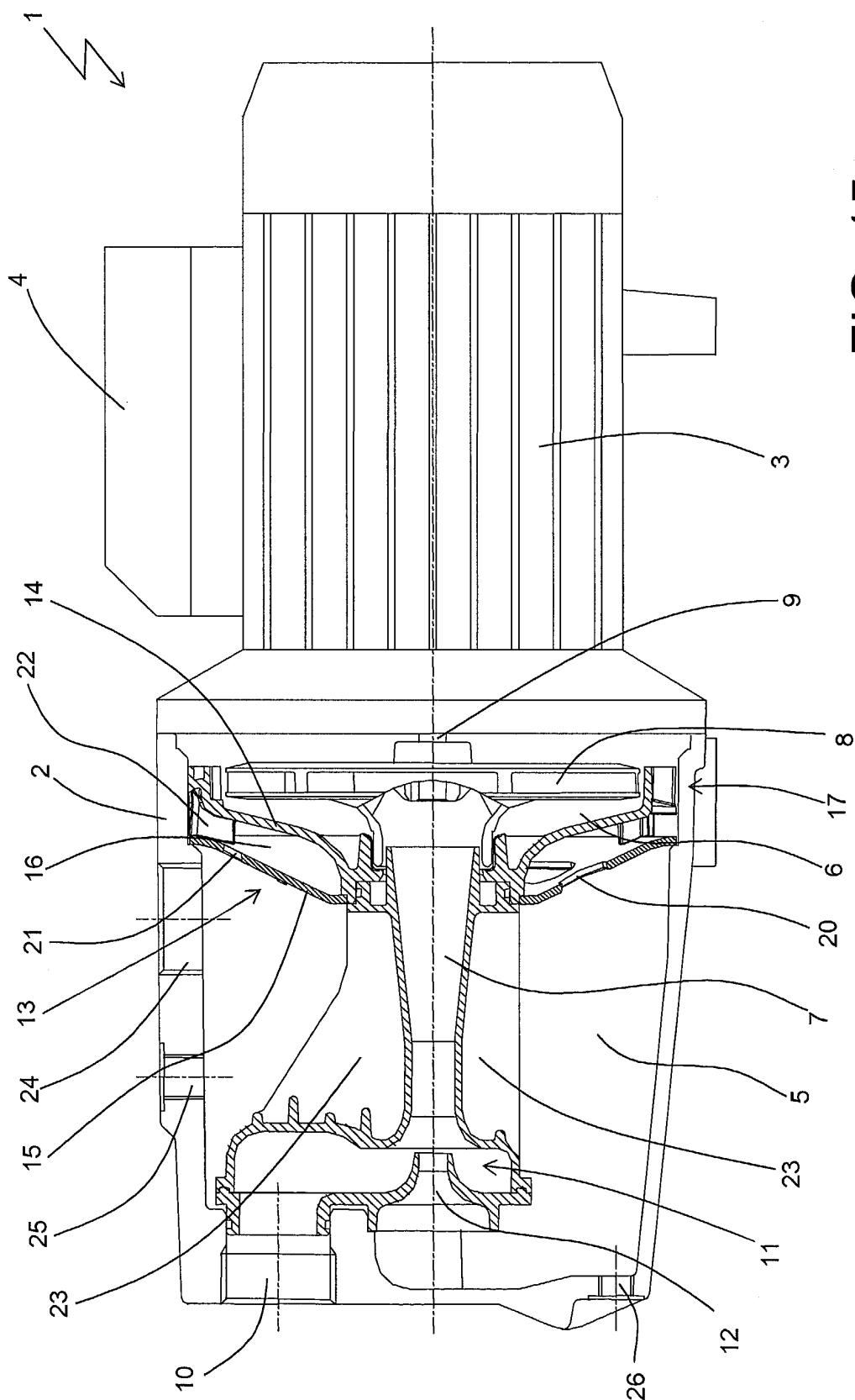


FIG. 15



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5564

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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F04D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 3 February 2004	Examiner Ingelbrecht, P
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 42 5564

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03-02-2004

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