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PUMP WITH DRY RUNNING PROTECTION

The invention relates to a pump, in particular a centrifugal pump according to claim 1.

Such a pump comprises a pump housing with an inlet and an outlet, wherein a motor shaft, which is non-rotatably connected to an impeller arranged in the pump housing, is rotatablv mounted in a rear wall of the pump housing by means of a primary mechanical seal arrangement, wherein a dry-running protection system is associated with the primary mechanical seal arrangement.

Centrifugal pumps are in particular used for pumping fluid pump media such as, for example, swimming pool water. In this case, the pump medium is sucked in through the inlet and is dispensed under pressure through the outlet. For this purpose, an impeller is rotatably arranged in the pump housing of centrifugal pumps, which impeller is connected to a motor via a motor shaft and is set into rotation by said motor. In this case, a substantially radial flow is generated in the pump medium, as a result of which pressure is increased within the pump and the pump medium is pushed out of the outlet.

Mounting the motor shaft in the pump housing or in the rear wall of the pump housing is usually carried out via a mechanical seal arrangement which comprises a mechanical sealing ring and a counter ring, wherein the mechanical sealing ring is connected stationarily in the pump housing, and the counter ring is connected stationarily to the motor shaft. During rotation of the motor shaft, the mechanical sealing ring and the counter ring then slide on each other. To increase tightness, an additional sealing ring can be provided between the mechanical sealing ring and the counter ring.

In order to keep friction losses low and to prevent an additional temperature from being exceeded, the mechanical seal arrangement has to be cooled or lubricated. This lubrication is usually carried out by the pump medium, which wets the mechanical seal arrangement. Since an inside surface of the mechanical seal arrangement is usually connected with a pressure chamber of the pump, the pump medium can come into contact with the mechanical seal arrangement. It is also known to specifically guide the pressurised pump medium to the mechanical seal arrangement through special channels.

With this approach, dry running of the mechanical seal arrangement cannot be completely prevented. An air bubble forms around the mechanical seal arrangement and prevents the pump medium from cooling and lubricating between the mechanical sealing

ring and the counter ring. This can result in overheating and finally in failure of the mechanical seal arrangement. The mechanical seal arrangement is then no longer capable of sufficiently sealing the pump housing. As a result, the pump medium can escape from the pressure chamber through the mechanical seal arrangement.

From DE 20 313 289 U1, dry-running protection for a pump is known, wherein a filling level of the pump medium within the pump housing is monitored with a fluid detector. It is ensured here that operating the pump is only possible if the pump medium flows around the mechanical seal arrangement. For this purpose, an additional bypass channel is provided.

Such dry-running protection is passive protection that works relatively reliably. However, when an error is detected, the pump is always shut down, which can result in long downtimes and therefore entails increased maintenance costs. A complete stop of the pumps is also problematic for many applications, such that the range of use of such dry-running protection is limited.

EP 1 222 393 A1 discloses the preamble of claim 1. JP 2004 245134A, US 3 741 679 A , US 6 422 822 B1 and GB 2 078 878 A disclose further relevant pumps.

It is thus an object of the invention to eliminate the disadvantages of the prior art and in particular to provide a pump that has a high degree of operational reliability and requires little maintenance.

This object is achieved by a pump having the features of claim 1. Embodiments are subject matter of claims 2 to 6.

The dry-running protection system thus has a fluid volume that is connected with a side of the primary mechanical seal arrangement facing away from the impeller. This can be achieved due to the fact that the fluid volume directly adjoins an outside of the primary mechanical seal arrangement. The fluid volume can be filled, for example, with white oil or another fluid. Lubricating and cooling of the primary mechanical seal arrangement is carried out by this fluid if the lubrication by the pump medium is interrupted. As a result, inadmissible heating of the mechanical seal arrangement is reliably prevented. This ensures that the mechanical sealing ring and the counter ring always slide on a thin film. Thus, active protection of the mechanical seal arrangement is provided by the dry-running protection system, wherein an emergency lubrication is obtained so that a shutdown of the pump in case of a lack of lubrication of the primary mechanical seal arrangement by the pump medium does not have to lead to a shutdown of the pump. Rather, the primary

mechanical seal arrangement is protected by the fluid in the fluid volume against temperature-induced failures. Moreover, in the case of a leak in the mechanical seal arrangement, the fluid volume prevents the pump medium from penetrating into the drive of the pump. Instead, the pump medium is in this case retained in the fluid volume. Thus, the dry-running protection system reduces downtimes of the pump and increases operational reliability. Here, active protection is provided which allows continued operation of the pump even in cases of insufficient lubrication by the pump medium. Overall, this results in an extremely low-maintenance, reliable operation of the pump with a low failure probability.

According to the invention, the fluid volume is formed between the rear wall of the pump and a cover of the pump housing. Thus, the fluid volume is formed by a chamber that is formed between the rear wall and the cover. Optionally, a modified standard rear wall can be used so as to provide a sufficient volume. The dry-running protection system can in this case be implemented with relatively little effort.

It is most preferred here for the motor shaft to be rotatably mounted in the cover by means of a secondary mechanical seal arrangement. This mechanical seal arrangement is in this case also cooled by the fluid in the fluid volume.

A particularly simple embodiment is achieved due to the fact that the cover is connected in a fluid-tight manner with the rear wall, in particular being screwed or clamped thereto or pressed therein. Optionally, an additional sealing means can be provided between the cover and the rear wall so as to securely seal the fluid volume with respect to the outside. A screw connection between the cover and the rear wall has the advantage that the cover can be removed with relatively little effort so as to carry out maintenance work, for example.

According to the invention, the dry-running protection system has a reservoir which is connected with the fluid volume via an access port formed in the pump housing, in particular in the rear wall. The reservoir is thus arranged outside of the pump housing and is connected to the access port via pipes. The reservoir is used, on the one hand, for storing a sufficient amount of fluid so that complete filling of the fluid volume is always ensured and, on the other, it is used as a pressure compensation container so that, for example, heating of the fluid in the fluid volume and resulting volume increase is not a problem.

According to the invention, the reservoir is arranged geodetically higher than the primary mechanical seal arrangement. As a result, on the one hand, automatic refilling of the fluid volume takes place and, on the other, it is ensured in this manner that the mechanical seal arrangement is always covered by the fluid in the fluid volume. An outlet of the reservoir should be formed at a position on the reservoir that is geodetically as low as possible so that all the fluid in the reservoir can be transferred into the fluid volume. In order to enable a vertical and horizontal arrangement of the pump, according to the invention the reservoir is connected to the access port via pipes angled at 90°, which have sufficient mechanical stability to support the reservoir. Thus, the overall construction is kept simple.

Preferably, a filling level of the reservoir can be monitored. When the fluid rises in the reservoir, a signal can then be output. Thus, a leak can be detected relatively quickly.

An advantageous embodiment provides for this purpose that the reservoir is at least partially transparent. A fluid level in the reservoir is then relatively easily identifiable with the naked eye. Checking the dry-running protection system is therefore possible with little effort. A transparent embodiment of the reservoir is possible without any problems through an appropriate selection of material such as glass or plastics.

In order to improve the operational reliability, it is provided according to the invention that the pump housing has a bleeding device for bleeding a pressure chamber. The pressure chamber is located between the rear wall and the impeller. Air in the pressure chamber can cause a malfunction in the lubrication of the mechanical seal arrangement by the pump medium. Accordingly, it is expedient if the air can escape from the pump. For this purpose, the bleeding device can have, for example, a bleed screw or a bleed valve that is manually or automatically operated.

In a preferred embodiment, the pump housing is made of grey cast iron. Thus, the pump can be produced in a very cost-effective manner. For use with corrosive fluids, the pump housing can have a corrosion-resistant coating so as to prevent corrosion of the pump housing.

Further advantages of the invention, the scope of protection of which is exclusively determined by the following claims, are given in the following description of exemplary embodiments based on the drawings.

Figure 1 shows a pump in a spatial illustration,

Figure 2 shows a cut-out of the pump in a partial sectional view, and

Figure 3 shows components of a dry-running protection system.

Figure 1 shows a centrifugal pump 1 with a pump housing 2 in a spatial illustration. The pump housing 2 has an inlet 3 and an outlet 4 for a pump medium, in particular for fluids. The pump housing 2 is of multi-piece design and has, among other things, a rear wall 5 that seals off a pressure chamber, and a cover 6 that is fastened to the rear wall 5. A motor 7 that serves for driving an impeller is fixed to the cover 6.

A reservoir 10 is connected to the pressure chamber of the pump 1 via an access port 8 and a pipe 9, wherein the access port is formed as one piece with the rear wall 5. The reservoir 10 is formed from a transparent material such as glass so that the level of a fluid in the reservoir 10 is visible from the outside.

The reservoir 10 is part of a dry-running protection system, which is explained in more detail in connection with Figure 2, which shows a cut-out of a detail of the pump 1. The motor 7 is non-rotatably connected to an impeller 12 via a motor shaft 11 and can set the impeller 12 into rotation. As a result, a pump medium is acted on substantially in a radial direction, such that a radial flow forms, and the pump medium is sucked in through the inlet 3 and is dispensed under pressure through the outlet 4. Accordingly, as pressure chamber 13 is located between the impeller 12 and the rear wall 5.

The motor shaft 11 is mounted in the rear wall 5 by means of a primary mechanical seal arrangement 14 that comprises at least one mechanical sealing ring 15, 23 and one counter ring 16. The mechanical seal arrangement 14, on the one hand, serves for mounting the shaft 11 in the rear wall 5 and, on the other, for sealing off the pressure chamber 13. The pump medium contained in the pressure chamber 13 serves for lubricating the mechanical seal arrangement 14 so that normally a thin film of pump medium is formed between the mechanical sealing ring 15, 23 and the counter ring 16.

On a side of the rear wall 5 facing away from the pressure wall 13, a fluid volume 17 is formed in which a lubricating fluid such as, for example, white oil is received. The fluid volume 17 takes up space between the rear wall 5 and the cover 6, which, for this purpose, are connected to each other in a fluid-tight manner. For this purpose, a seal 18 is arranged between the cover 6 and the rear wall 5, and the cover 6 is fastened by means of screws 19.

The motor shaft 11 is mounted in the cover 6 via a secondary mechanical seal arrangement 20. The secondary mechanical seal arrangement 20 seals off the passage of the motor shaft 6 from the fluid volume 17.

The fluid volume 17 should always be completely filled with fluid, if possible, so as to be in contact not only with the primary mechanical seal arrangement 14, but also with the secondary mechanical seal arrangement 20. The fluid volume 17 is connected via the access port 8 to the reservoir 10, which is arranged geodetically higher than the primary mechanical seal arrangement 14 and the secondary mechanical seal arrangement 20, so that in particular as long as fluid is contained in the reservoir 10, it is always ensured that the primary mechanical seal arrangement 14 and the secondary mechanical seal arrangement 20 are covered by the fluid in the fluid volume 17. This ensures that the fluid volume 17 is automatically refilled from the reservoir 10. The reservoir 10 serves at the same time as a pressure compensation container which, for example, is able to compensate temperature-induced fluctuations of the fluid.

The fluid in the fluid volume 17 takes on a plurality of tasks. On the one hand, when the lubrication by the pump medium is interrupted, the fluid ensures sufficient cooling and lubrication of the primary mechanical seal arrangement 14. On the other hand, the pump medium is prevented from escaping in the region of the mechanical seal arrangement 14. Thus, the operational reliability of the pump is increased. In particular, dry running of the primary mechanical seal arrangement 14 is reliably avoided and continued operation of the pump is enabled even in cases where sufficient lubrication by the pump medium is not ensured. Lubrication and cooling of the secondary mechanical seal arrangement 20 can also be carried out by the fluid in the fluid volume.

For bleeding the pressure chamber 13, a bleeding device 21 is provided in the pump housing 2, which bleeding device is arranged at the geodetically highest point of the pressure chamber 13 and enables manual bleeding of the pressure chamber 13.

Figure 3 shows an exploded view of the substantial elements of the dry-running protection system. In addition to the rear wall 5, which is in any case present in such pumps, the cover 6 is provided so as to be able to form the fluid volume 17 between the rear wall 5 and the cover 6. For this purpose, the rear wall 5 is additionally shaped so that a chamber of sufficient size for receiving the fluid is created. The cover 6 can in this case be screwed to the rear wall 5 in a fluid-tight manner by means of the screws 19.

The motor shaft 11 is mounted in the cover 6 by means of a secondary mechanical seal arrangement 20.

In order to always ensure a sufficient filling level in the fluid volume 17, the fluid volume 17 is connected via the access port 8 and the pipe 9 to the reservoir 10, from

which fluid is automatically refilled. The reservoir can have an atmospheric connection 24, for example a hole. For bleeding the pressure chamber 13, a bleeding device 21 with a bleed screw 22 is formed in the rear wall 5. Thus, the dry run protection according the invention requires relatively few additional elements. At the same time, the dry run protection provides active safeguarding and thus enables continued operation of the pump even if the lubrication by the pump medium is not sufficient. Rather, the primary mechanical seal arrangement is lubricated and cooled at the same time by fluid in the fluid volume so that it is protected against burns. In the event of a lack of pump medium at the primary mechanical seal, it is therefore not required to shut down the pump, nor is there the danger of damage to the primary mechanical seal. Rather, lubrication and cooling is carried out by the fluid in the fluid volume until sufficient pump medium is available on the pressure side. In this manner, the pump does not become damaged at all and the operation can be continued without malfunctions. Thus, effective and active protection of the mechanical seal and therefore of the pump is provided.

Therefore, according to the invention, a pump is provided which offers high operational reliability while requiring little maintenance, and which is relatively unlikely to malfunction. At the same, additional protection against pump media escaping is obtained.

Optionally, the pump housing can be provided with an additional coating, which makes particular sense in cases where the pump housing is made of grey cast iron.

List of reference signs

1	Centrifugal pump
2	Pump housing
3	Inlet
4	Outlet
5	Rear wall
6	Cover
7	Motor
8	Access port
9	Pipe
10	Reservoir
11	Motor shaft
12	Impeller
13	Pressure chamber
14	Primary mechanical seal arrangement
15	Mechanical sealing ring
16	Counter ring
17	Fluid volume
18	Seal
19	Screws
20	Secondary mechanical seal arrangement
21	Bleeding device
22	Bleed screw
23	Mechanical sealing ring
24	Atmospheric connection

Patentkrav

1. Pumpe, især en centrifugalpumpe (1), som har et pumpehus (2) med et indløb (3) og et udløb (4), idet en motoraksel (11), som er ikke-drejeligt forbundet med et løbehjul (12) indrettet i pumpehuset (2), er drejeligt monteret i en bagvæg (5) af pumpehuset (2) med en primær glideringstætningsanordning (14), idet den primære glideringstætningsanordning (14) er tildelt et tørløbsbeskyttelsessystem, idet tørløbsbeskyttelsessystemet har en væskevolumen (17), som er forbundet med en side af den primære glideringstætningsanordning (14), som vender væk fra løbehjulet (12), idet væskevolumenen (17) er dannet mellem bagvæggen (5) og et dæksel (6) af pumpehuset (2), idet pumpehuset (2) har en udluftningsindretning (21) til udluftning af et trykkammer (13), hvilken udluftningsindretning er indrettet ved den geodætisk højeste position i trykkammeret (13), idet trykkammeret (13) er placeret mellem bagvæggen (5) og løbehjulet (12), idet tørløbsbeskyttelsessystem har et reservoir (10), som er forbundet med væskevolumenen (17) via en adgang (8) udformet i pumpehuset (2), især i bagvæggen (5) eller i dækslet (6), og idet reservoiret (10) er indrettet geodætisk højere end den primære glideringstætningsanordning (14), **kendetegnet ved, at** en vertikal og horisontal anordning af pumpen gøres mulig ved at forbinde reservoiret (10) med adgangen via 90° vinklede ledninger, som har en tilstrækkelige mekanisk stabilitet til at bære reservoiret (10).

2. Pumpe ifølge krav 1, **kendetegnet ved, at** motorakslen (11) er monteret drejeligt i dækslet (6) med en sekundær glideringstætningsanordning (20).

3. Pumpe ifølge kravene 1 eller 2, **kendetegnet ved, at** dækslet (6) er forbundet på en fluidtæt måde med bagvæggen (5), især skruet fast eller fastklemt.

4. Pumpe ifølge et af de foregående krav, **kendetegnet ved, at** et opfyldningsniveau af reservoiret (10) kan overvåges.

5. Pumpe ifølge et af de foregående krav, **kendetegnet ved, at** reservoiret (10) er mindst delvist transparent.

6. Pumpe ifølge et af de foregående krav, **kendetegnet ved, at** pumpehuset (2) er fremstillet af gråt støbejern og især har en belægning.

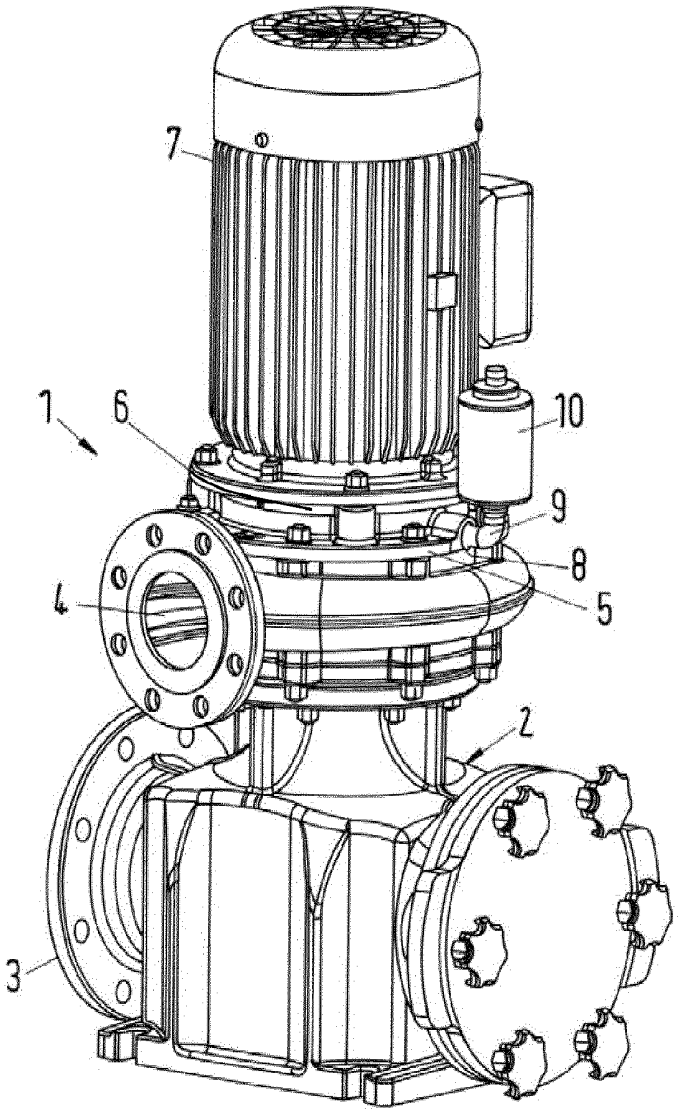

Fig.1

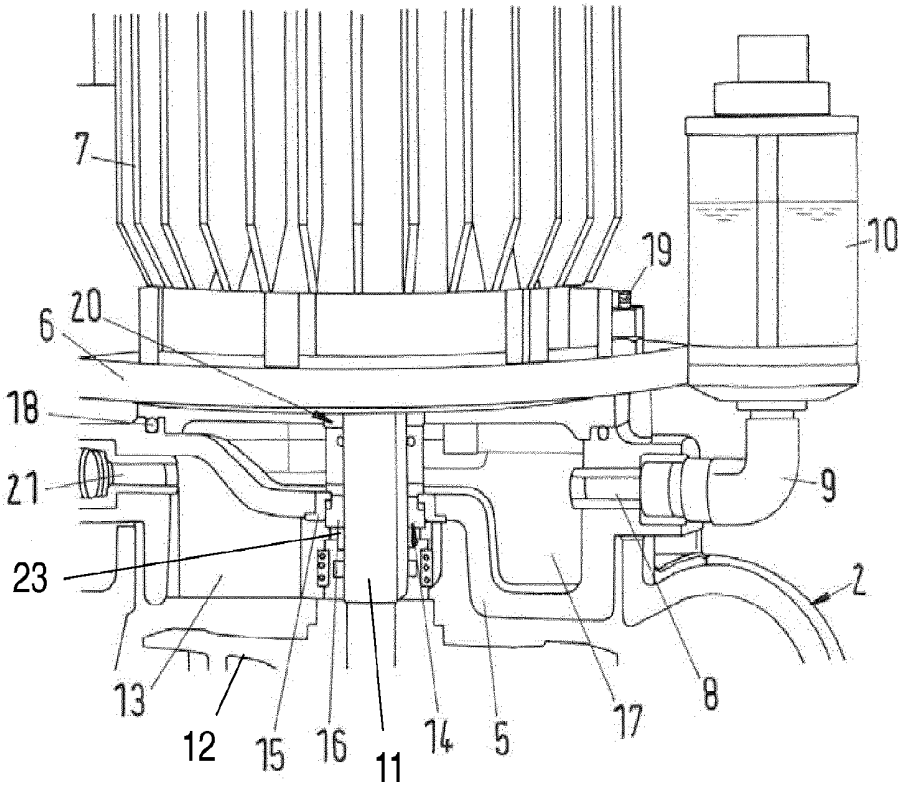

Fig.2

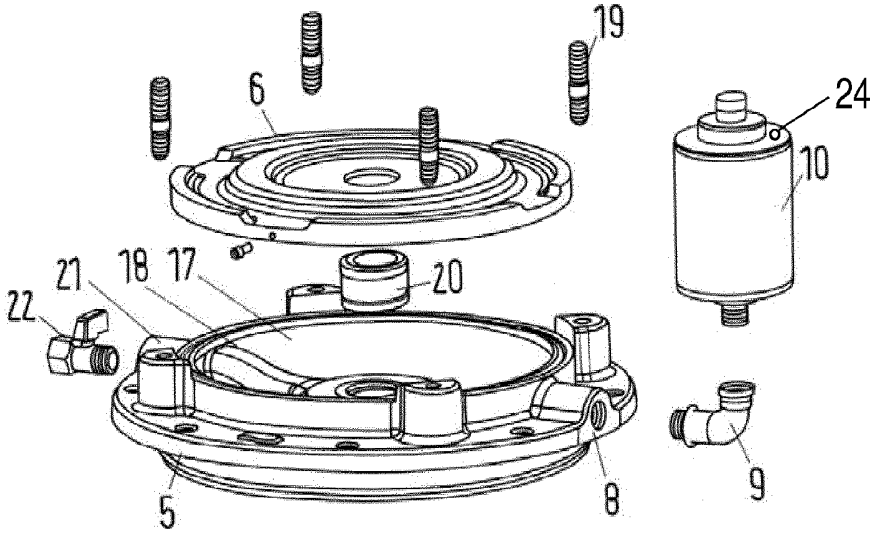

Fig.3