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(54) **PUMP INSTALLATION WITH DETACHABLE MUFFLER**

(57) The invention relates to a pump installation comprising a liquid pump (10), a vacuum pump (60) for withdrawing air from the liquid pump, and a muffler (80) for the vacuum pump, wherein the vacuum pump comprises an air outlet (74) for exhausting air from the diaphragm chamber, and the muffler comprises a muffler cap (81) that is detachably mounted to the vacuum pump to receive air from the air outlet, and a muffler outlet (87) for exhausting the air that is received, wherein the muffler cap comprises a free end edge along which the muffler is mounted to the vacuum pump, wherein in the mounted condition the muffler cap and the vacuum pump together bound a muffler chamber (92), wherein the muffler comprises muffler baffles (93) in the muffler chamber, wherein in the dismounted condition of the muffler the free end edge bounds an access opening of the muffler cap and the muffler baffles extend towards the access opening.

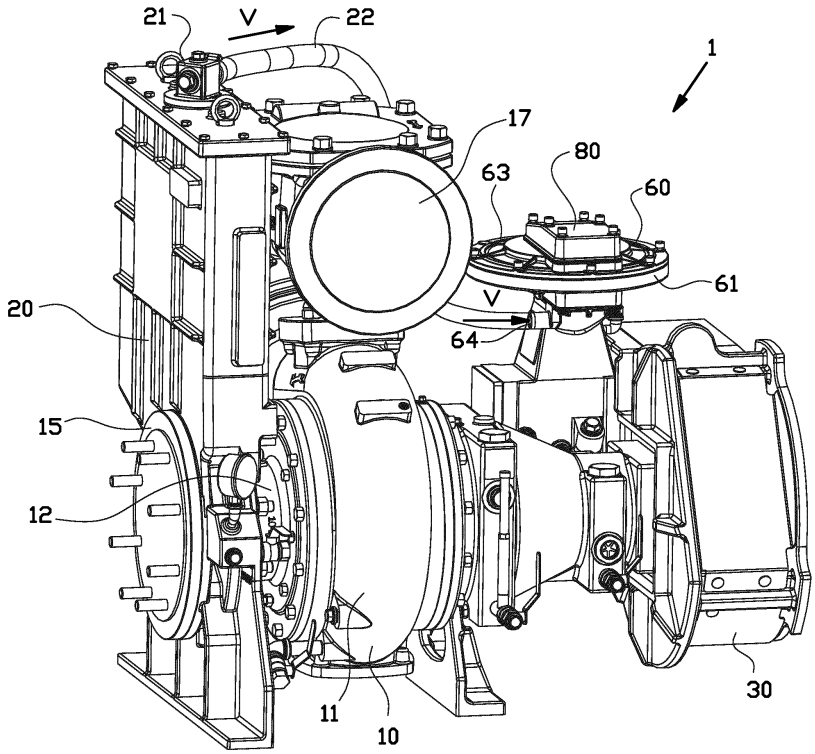

FIG. 1A

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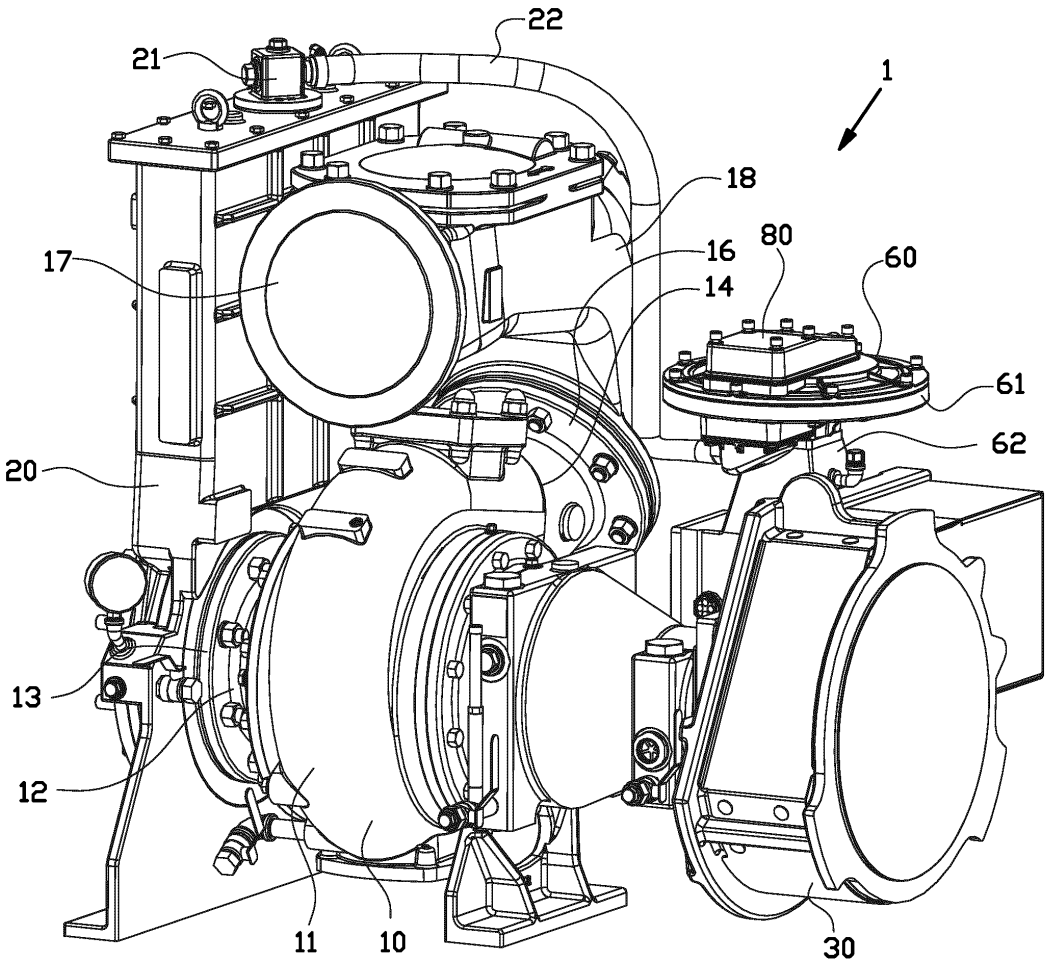

FIG. 1B

Description

BACKGROUND

[0001] The invention relates to a pump installation comprising a liquid pump, a vacuum pump for withdrawing air from the liquid pump, and a muffler for the vacuum pump. The vacuum pump is required for starting and re-starting the liquid pump.

[0002] A known pump installation of this type comprises a muffler that is mounted against the air outlet of the vacuum pump for muffling the sound of the vacuum pump. With prolonged operation dirt may accumulate inside the muffler.

SUMMARY OF THE INVENTION

[0003] A disadvantage of the known muffler for the vacuum pump is that it is embodied as a disposable part. When in the interior dirt has accumulated to such an extent that the muffler does not function properly anymore, or got clogged, it is replaced in its entirety. At the moment that this is established, a replacement needs to be present already on site. This is impractical from a logistic point of view, in particular for pump installations that are operational autonomously in the field. The liquid pump cannot start or re-start when the muffler got clogged.

[0004] It is an object of the present invention to provide a pump installation of the abovementioned type of which the operational reliability of the muffler can be easily maintained at the desired level.

[0005] According to a first aspect, the invention provides a pump installation comprising a liquid pump, a vacuum pump for withdrawing air from the liquid pump, and a muffler for the vacuum pump, wherein the vacuum pump comprises a diaphragm chamber in which a pumping diaphragm is contained, and an air outlet for exhausting air from the diaphragm chamber, wherein the muffler comprises a muffler cap that is detachably mounted to the vacuum pump to receive air from the air outlet, and a muffler outlet for exhausting the air that is received, wherein the muffler cap comprises a cover wall that merges into a circumferential wall, wherein the circumferential wall comprises a free end edge along which the muffler is mounted to the vacuum pump, wherein in the mounted condition the muffler cap and the vacuum pump together bound a muffler chamber, wherein the muffler comprises muffler baffles in the muffler chamber, wherein in the dismounted condition of the muffler the free end edge bounds an access opening of the muffler cap and the muffler baffles extend towards the access opening.

[0006] The pump installation according to the invention comprises a muffler whereof the detachable muffler cap bounds together with the vacuum pump a muffler chamber in which the muffler baffles are located. The muffler baffles become directly accessible via the access opening when the muffler cap is taken off. As a result, dirt that has accumulated between the muffler baffles can be removed on site and the cleaned muffler cap can be put back in place. This can be performed at any necessary moment, without the need of keeping a local stock of spare mufflers.

[0007] In an embodiment the muffler baffles have free edges at the side opposite to the cover wall that extend in the access opening, whereby the space between the muffler baffles is directly accessible as from the access opening to remove dirt out of there.

[0008] In an embodiment thereof are in the mounted condition of the muffler the free end edges of the muffler baffles in contact with, or at just a short distance to the vacuum pump, whereby they seal off or substantially seal off against the vacuum pump. In this manner the air to be muffled is forced to pass along the muffler baffles.

[0009] In an embodiment the muffler baffles are have a straight plated shape.

[0010] In an embodiment the muffler baffles extend parallel to each other.

[0011] In an embodiment the muffler baffles extend transverse to the direction from the air outlet to the muffler outlet.

[0012] In an embodiment the muffler baffles merge into the cover wall.

[0013] In an embodiment the muffler baffles merge at one side into the circumferential wall, and extend at an opposite side spaced apart from the circumferential wall to bound a passage therewith.

[0014] In an embodiment thereof the passages that are bound by subsequent muffler baffles alternate in the direction from the air outlet to the muffler outlet transverse to that direction to form a meandering muffler channel between the air outlet and the muffler outlet.

[0015] In an embodiment the muffler cap and the vacuum pump together bound a receiving chamber in which the air outlet debouches, wherein the receiving chamber, the muffler chamber and the muffler outlet are fluently in series with each other. The muffler cap then directly connects with the air outlet of the vacuum pump from which the noise to be muffled originates. This air is fed via the muffler chamber with the muffler baffles to the muffler outlet.

[0016] In an embodiment the muffler cap is detachably mounted to the vacuum pump by means of bolts or screws, whereby it can be dismounted and mounted back to the vacuum pump with simple tools.

[0017] In an embodiment the vacuum pump comprises a diaphragm housing onto which a pump cover is placed, wherein the air outlet is located in the pump cover and the muffler cap is detachably mounted against the pump cover.

[0018] In an embodiment the pump diaphragm is mounted between the diaphragm housing and the pump cover.

[0019] In an embodiment the vacuum pump comprises an air inlet that is connected with the liquid pump.

[0020] In an embodiment the liquid pump is a centrifugal pump.

[0021] According to a second aspect, the invention provides a method for performing maintenance of the pump installation according to any one of the preceding claims, wherein the method comprising dismounting the muffler cap whereby the muffler baffles become directly accessible via the access opening, via the access opening removing dirt that is positioned between the muffler baffles, and mounting the muffler cap to the vacuum pump.

[0022] It is observed that DE 10 2012 000 980 A1 discloses an installation having a liquid pump and a vacuum pump wherein the vacuum pump can supply gas to the liquid pump to form a foam therein.

[0023] The various aspects and features described and shown in the specification can be applied, individually, wherever possible. These individual aspects, in particular the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The invention will be elucidated on the basis of an exemplary embodiment shown in the attached drawings, in which:

Figures 1A and 1B are two isometric side views of a pump installation comprising a liquid pump, a vacuum pump and a muffler therefore acceding to the invention;

Figures 2A and 2B are an isometric top view and a straight side view of the vacuum pump and the muffler of figure 1;

Figure 3 is an isometric top view of the vacuum pump according to figures 2A and 2B, wherein a muffler cap of the muffler has been dismounted; and

Figure 4 is a straight bottom view of the dismounted muffler cap of figure 3.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Figures 2A and 2B show a pump installation 1 for pumping large volumes of liquid, like sewage or excessive rain water. The pump installation 1 comprises a liquid pump 10, a motor 30 for driving the liquid pump 10, and a vacuum pump 60 by means of which the pump installation 1 is designed to be self-priming. The pump installation 1 can be of mobile design for temporary deployment, for instance at a construction site.

[0026] The liquid pump 10 in this example is embodied as a centrifugal water pump, and comprises a centrifugal pump housing 11 which merges into a concentric inlet 12 and a tangential outlet 14. The concentric inlet 12 merges into an inlet flange 13 secured around an opening of a float tank 20. The float tank 20 is also provided on the right opposite side with an opening where a suction flange 15 is fixed for connecting a not shown suction hose to the pump installation 1. The tangential outlet 14 merges into an outlet flange 16 on which a pressure nozzle 18 is secured, the opposite end of which is provided with a pressure flange 17 for connecting a not shown pressure hose to the pump installation 1.

[0027] The float tank 20 is provided at the top with a hose connection 21 to which a vacuum hose 22 is connected. The float tank 20 is hollow inside and airtight. The internal cavity of the float tank 20 is in fluid communication with the concentric inlet 12 so that air can be withdrawn therefrom only via the vacuum hose 22 . In the inner cavity of the float tank 20 is a float located that can float on liquid that has been taken in. When the liquid level therein is above the height of the pressure nozzle 18, the float closes the supply to the hose connection 21.

[0028] In this example, the vacuum pump 60 is directly driven by the motor 30, which in this example is designed as a combustion engine. The vacuum pump 60 may also be driven by its own motor, such as an electric motor. The vacuum pump 60 is shown in more detail in Figures 2A, 2B and 3, and comprises a diaphragm housing 61 on a hollow pedestal 62 with which the vacuum pump 60 is secured to the motor 30. The diaphragm housing 61 is closed at the top with a pump cover 63 and is provided at the bottom with an air inlet 64 to which the vacuum hose 22 is connected. The vacuum pump 60 is shown in more detail in Figures 2A, 2B, 3 and 4.

[0029] The diaphragm housing 61 and the pump cover 63 together define a dome-shaped internal diaphragm chamber of the vacuum pump 60. The diaphragm housing 61 and the pump cover 63 together clamp a flexible pump diaphragm 65. The dome-shaped diaphragm chamber and the pump diaphragm 65 have a circular diameter along the restraint. The diaphragm chamber has sufficient height to allow the pump diaphragm 65 to move elastically up and down as from the center. For this purpose, the pump diaphragm 65 is connected in the middle to a not shown connecting rod which extends below the pump diaphragm 65 through the base 62 to the motor 30 and which is guided in a slide bearing 66 above the pump diaphragm 65. The connecting rod is reciprocally driven in its longitudinal direction by the motor 30 via a not further shown camshaft in order for the pump diaphragm 65 to alternately increase and decrease the volume of the diaphragm chamber above the pump diaphragm 65.

[0030] The pump cover 63 includes a dome-shaped cover wall 70 which merges into a mounting flange 71 extending therearound. The mounting flange 71 is secured to the pump diaphragm 65 circumferentially by bolts 75 to the diaphragm housing 61 with the pump diaphragm 65 clamped therebetween. As shown in Figure 3, the cover wall 70 comprises a straight center plane 72 in which a circumferential seal chamber 73 is formed. Within the seal chamber 73 an air outlet 74 is situated which contacts the volume of the diaphragm chamber located above the pump diaphragm 65. A non-return valve 75 is included in the air outlet 74 which allows only an outgoing air flow in direction W. The air inlet 64 communicates internally with the volume of the diaphragm

chamber that is located above the pump diaphragm 65. In this connection a not shown non-return valve is included, which allows only an ingoing air flow in direction V.

[0031] The vacuum pump 60 is provided with a muffler 80 to muffle or dampen the noise produced by the moving pump diaphragm 65 and by the check valve 75. The muffler 60 comprises a muffler cap 81 which is provided with a first cover wall 82 which merges into a second cover wall 83 which is inclined thereon. The cover walls 82, 83 merge all around into two parallel side walls 84, a rear wall 85 and a front wall 86 which merge into a muffler outlet 87. The side walls 84, the rear wall 85 and the front wall 86 define a free end edge 89 which extends in a straight plane. The first cover wall 82, the rear wall 85 and the adjacent parts of the side walls 84 jointly define an internal receiving chamber 90 for the air outlet 74 with the non-return valve 75. The second cover wall 83, the front wall 86 and the parts of the side walls 84 connecting thereto together define an internal muffler chamber 92. In the muffler chamber 92 there are several parallel, straight muffler baffles 93 with a free end edge 96. The muffler baffles 93 all merge into the second cover wall 83 and on one side merge into one of the side walls 84. The muffler baffles 93 are directed transversely to the direction from the receiving chamber 90 to the muffler outlet 87 and each leave a passage 94 with the opposite side wall 84 free. The passages 94 are staggered or alternate so that the muffler baffles 94 form a meandering muffler channel 95 between the receiving chamber 90 and the muffler outlet 87. These muffler baffles 94 dampen the sound in the airflow from the air outlet 74 to the muffler outlet 87.

[0032] Within the periphery of the seal chamber 73, the pump cover 63 is provided with a plurality of screw bushings 76 projecting from the cover wall 70, with which the muffler cap 81 is secured with bolts 88. The circumferential free edge 89 coincides with the seal chamber 73 and a not shown seal is received therebetween to seal of airtight. The cover wall 70 therefore forms an additional part of the boundary of the receiving chamber 90 and the muffler chamber 92 in the muffler cap 81.

[0033] When the pump installation 1 is started or restarted, the internal volume of the liquid pump 10 and the suction hose and pressure hose connected thereto must be completely filled with liquid. To this end, the vacuum pump 60 is driven by the motor 30, so that air is withdrawn from the float chamber of the float tank 20 via the vacuum hose 22 in direction V until the liquid level of the liquid that has been taken in extends above the height of the pressure nozzle 18. The float then closes off the hose connection 21. The liquid pumping can then be started.

[0034] After a number of start-up cycles, debris may build up in the receiving chamber 90 and the muffler chamber 92 of the muffler 80, particularly between the muffler baffles 94. The muffler cap 81 can then be dismounted in its entirety allowing free access to the muffler baffles 94 from the access opening that is bound by the end edge 89. The muffler 80, in particular the interspaces between the muffler baffles 94 thereof, can then be cleaned at a distance from the pump installation 1, for instance in a workshop, and then mounted back again.

[0035] It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the scope of the present invention.

Claims

1. Pump installation (1) comprising a liquid pump (10), a vacuum pump (60) for withdrawing air from the liquid pump, and a muffler (80) for the vacuum pump, wherein the vacuum pump comprises a diaphragm chamber in which a pumping diaphragm (65) is contained, and an air outlet (74) for exhausting air from the diaphragm chamber, wherein the muffler comprises a muffler cap (81) that is detachably mounted to the vacuum pump to receive air from the air outlet, and a muffler outlet (87) for exhausting the air that is received, wherein the muffler cap comprises a cover wall (82, 83) that merges into a circumferential wall (84, 85, 86), wherein the circumferential wall comprises a free end edge (89) along which the muffler is mounted to the vacuum pump, wherein in the mounted condition the muffler cap and the vacuum pump together bound a muffler chamber (92), wherein the muffler comprises muffler baffles (93) in the muffler chamber, wherein in the dismounted condition of the muffler the free end edge bounds an access opening of the muffler cap and the muffler baffles extend towards the access opening.

2. Pump installation (1) according to claim 1, wherein the muffler baffles (93) have free edges (96) at the side opposite to the cover wall (82, 83) that extend in the access opening.

3. Pump installation (1) according to claim 2, wherein in the mounted condition of the muffler the free end edges (96) of the muffler baffles (93) are in contact with, or at just a short distance to the vacuum pump.

4. Pump installation (1) according to any one of the preceding claims, wherein the muffler baffles (93) are have a straight plated shape.

5. Pump installation (1) according to any one of the preceding claims, wherein the muffler baffles (96) extend parallel to each other.

6. Pump installation (1) according to any one of the preceding claims, wherein the muffler baffles (93) extend transverse to the direction from the air outlet (74) to the muffler outlet (87).

7. Pump installation (1) according to any one of the preceding claims, wherein the muffler baffles (93) merge into the cover wall (82, 83).

8. Pump installation (1) according to any one of the preceding claims, wherein the muffler baffles (93) merge at one side into the circumferential wall (84, 85, 86), and extend at an opposite side spaced apart from the circumferential wall to bound a passage (94) therewith.

9. Pump installation (1) according to claim 8, wherein in the direction from the air outlet (74) to the muffler outlet (87) the passages that are bound by subsequent muffler baffles alternate transverse to that direction to form a meandering muffler channel between the air outlet and the muffler outlet.

10. Pump installation (1) according to any one of the preceding claims, wherein the muffler cap (81) and the vacuum pump (60) together bound a receiving chamber (90) in which the air outlet (74) debouches, wherein the receiving chamber (90), the muffler chamber (92) and the muffler outlet (87) are fluently in series with each other.

11. Pump installation (1) according to any one of the preceding claims, wherein the muffler cap (81) is detachably mounted to the vacuum pump (60) by means of bolts (88) or screws.

12. Pump installation (1) according to any one of the preceding claims, wherein the vacuum pump (60) comprises a diaphragm housing (61) onto which a pump cover (63) is placed, wherein the air outlet (74) is located in the pump cover and the muffler cap (81) is detachably mounted against the pump cover.

13. Pump installation (1) according to claim 12, wherein the pump diaphragm (65) is mounted between the diaphragm housing (61) and the pump cover (63).

14. Pump installation (1) according to any one of the preceding claims, wherein the vacuum pump (60) comprises an air inlet (64) that is connected with the liquid pump (10).

15. Pump installation (1) according to any one of the preceding claims, wherein the liquid pump (10) is a centrifugal pump.

16. Method for performing maintenance of the pump installation (1) according to any one of the preceding claims, wherein the method comprising dismounting the muffler cap (81) whereby the muffler baffles (93) become directly accessible via the access opening, via the access opening removing dirt that is positioned between the muffler baffles, and mounting the muffler cap (81) to the vacuum pump.

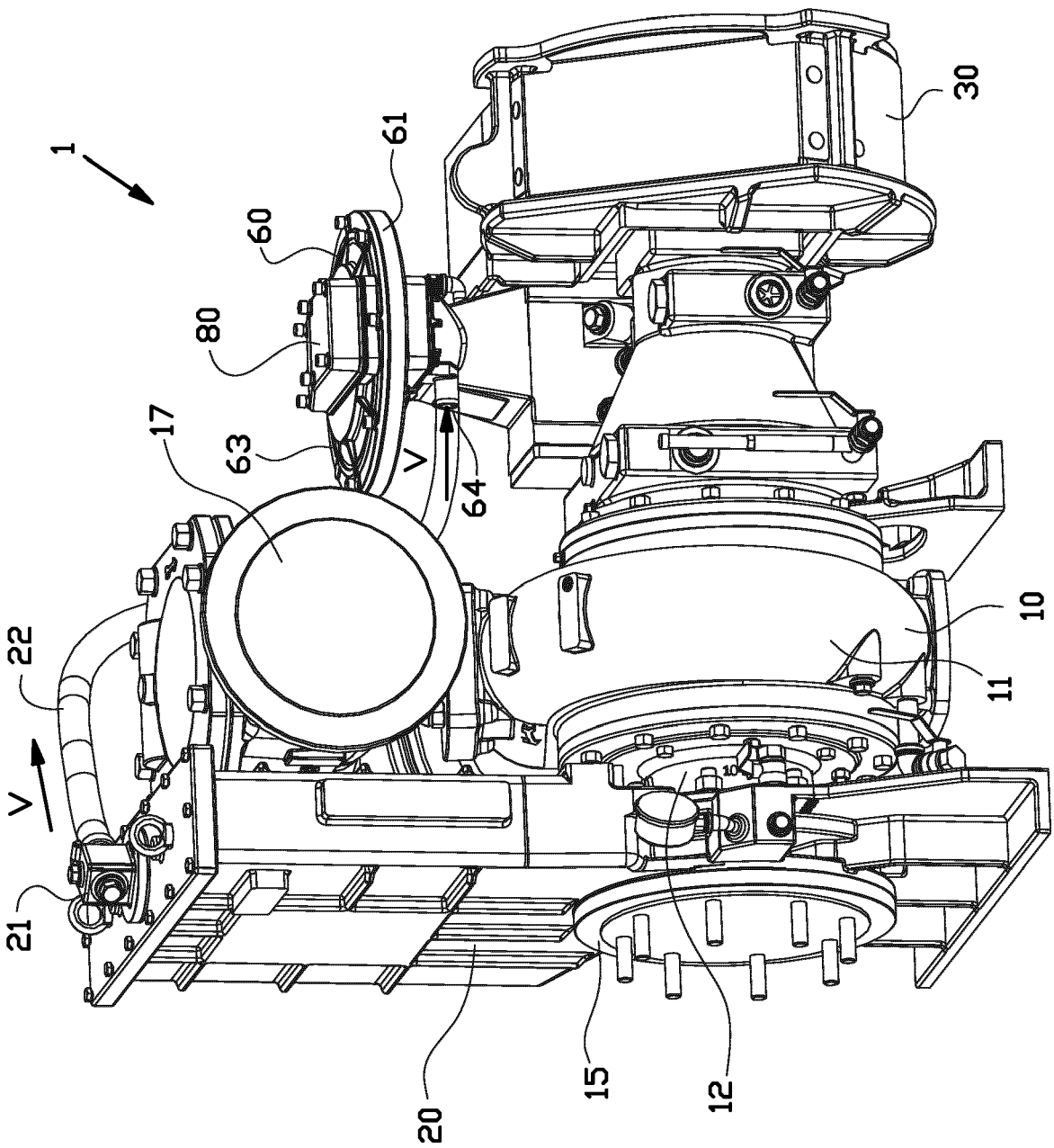

FIG. 1A

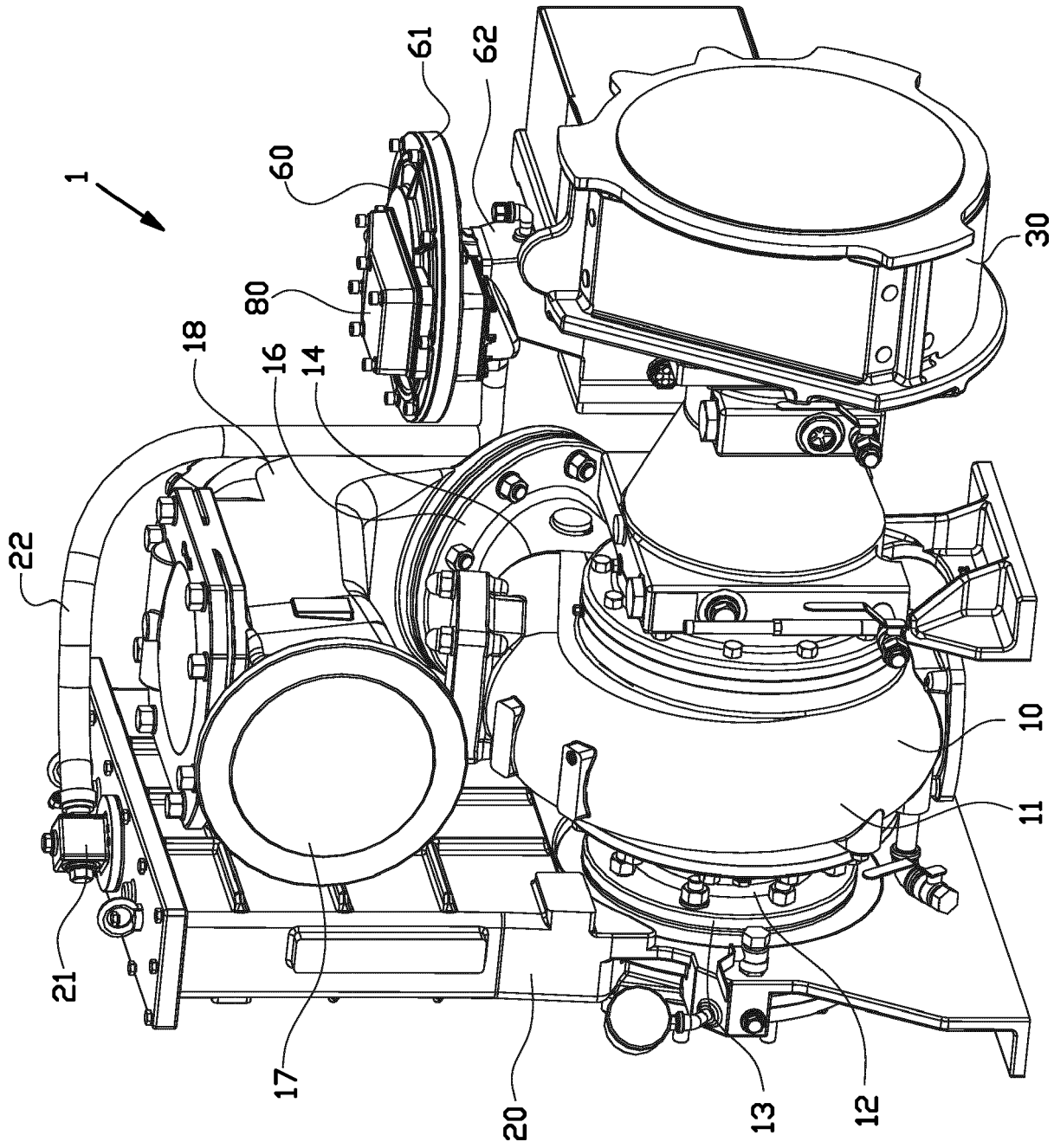

FIG. 1B

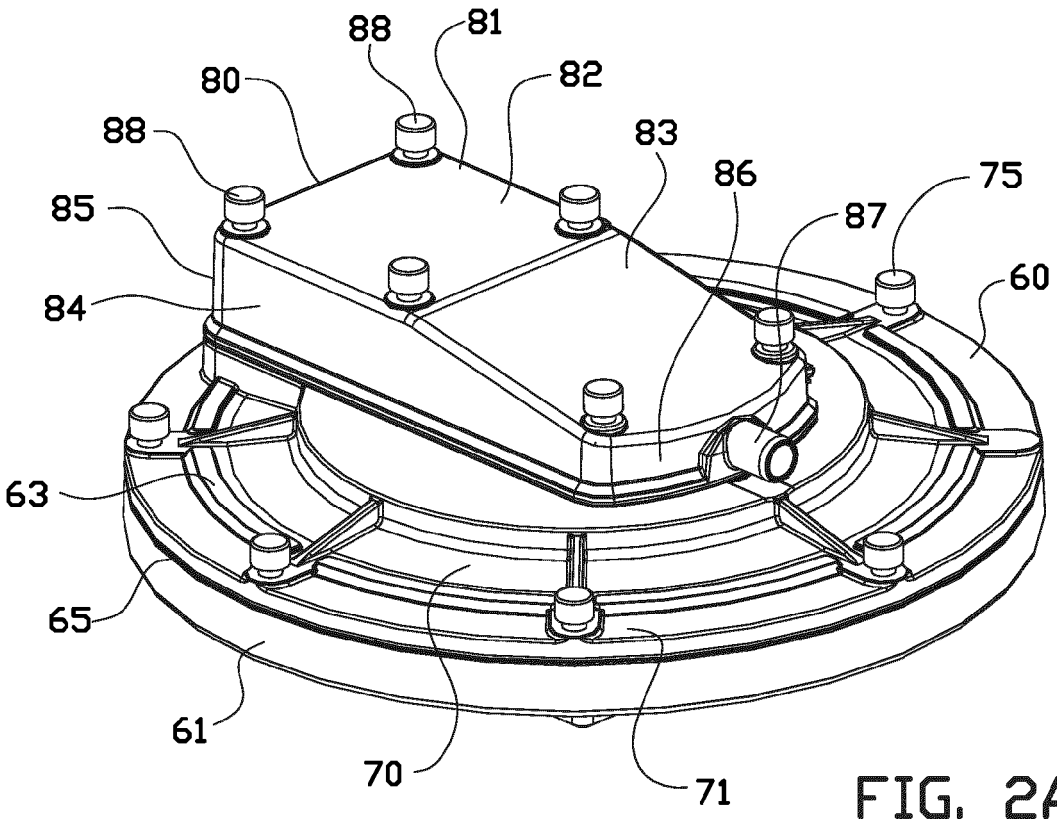
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FIG. 2A

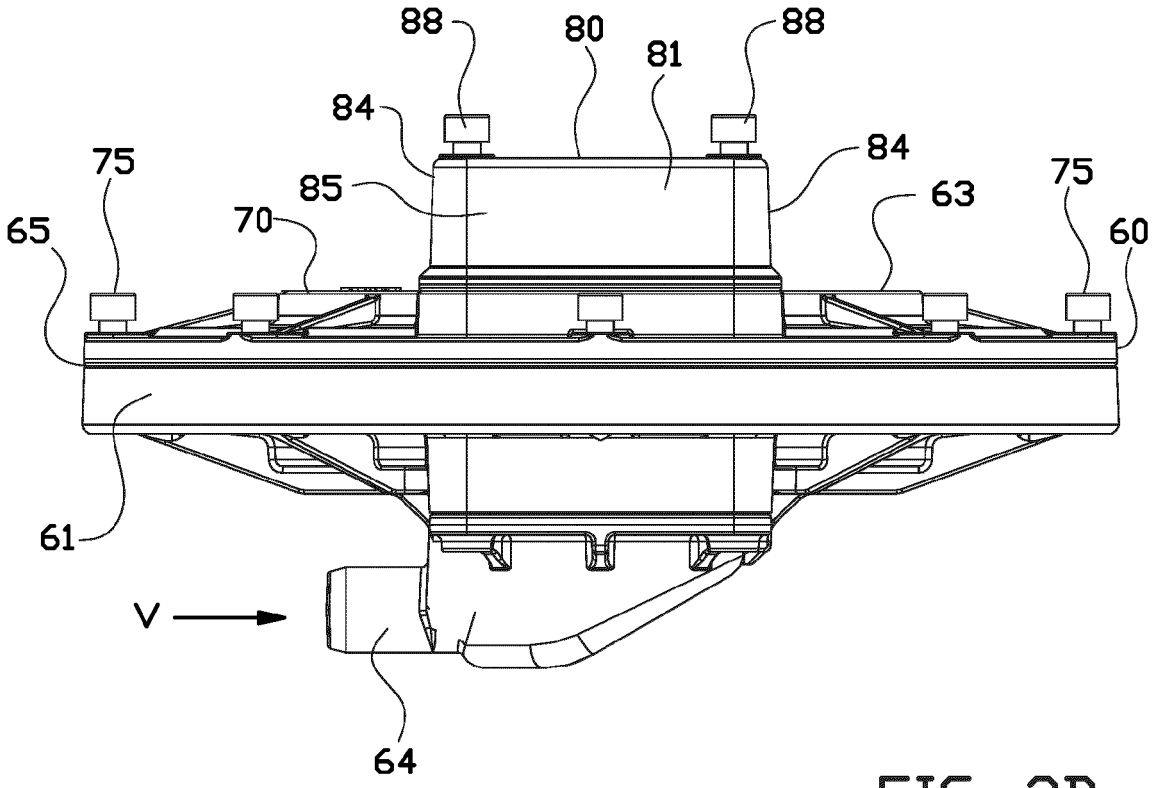
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FIG. 2B

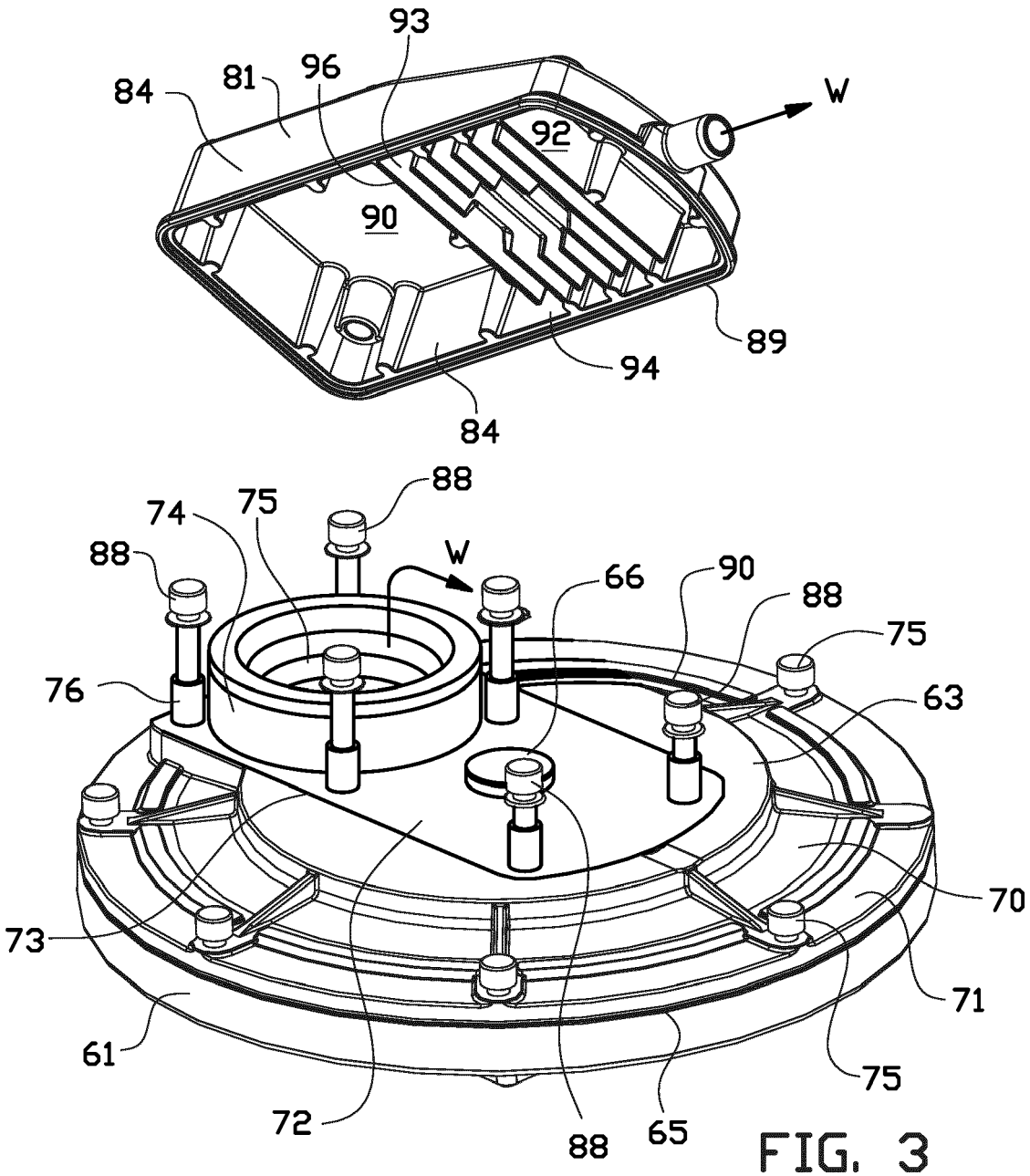
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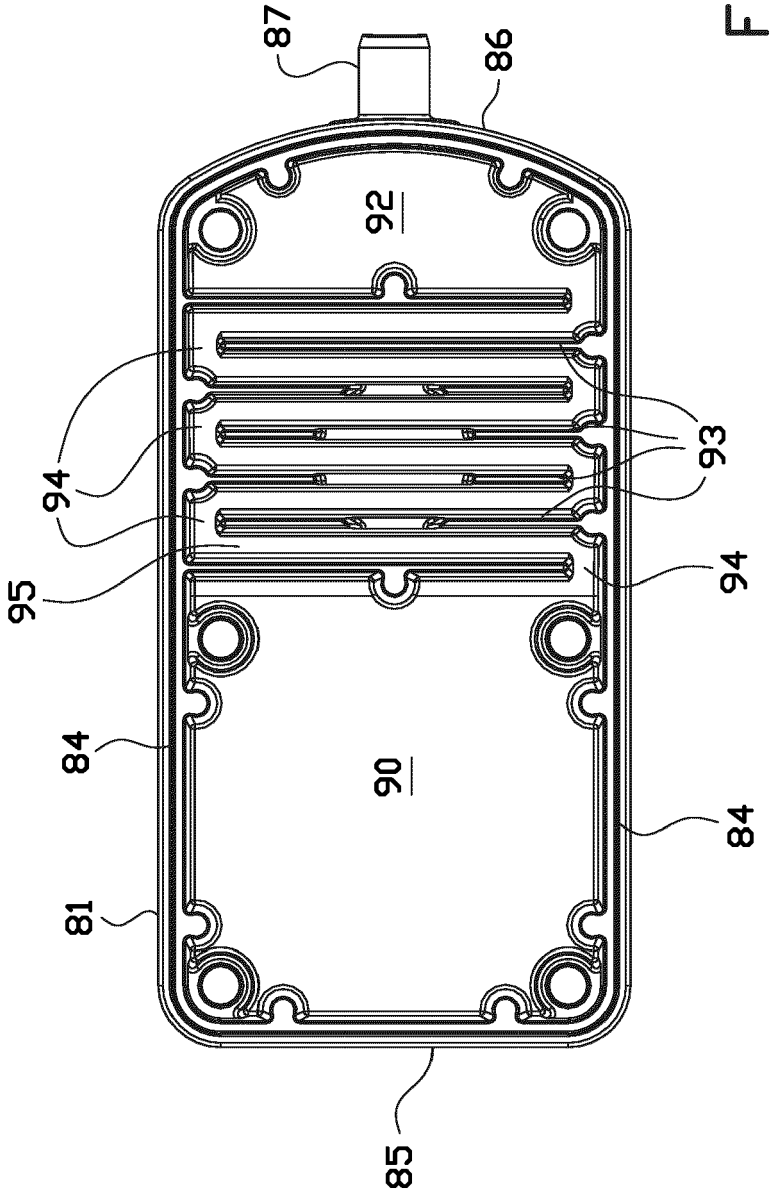
FIG. 3

FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
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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	20 June 2022	Lange, Christian

CATEGORY OF CITED DOCUMENTS

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