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Dahlgren

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[54] **PUMPING DEVICE WITH SELF CENTERING SPHERICAL SEATING SURFACES**

[75] Inventor: **Jens Karl Adolf Dahlgren,** Stockholm, Sweden

[73] Assignee: **Stenberg-Flygt AB,** Solna, Sweden

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[51] **Int. Cl.** **B67d 5/40**

[58] **Field of Search** 417/360; 222/180, 385, 380, 222/383, 74, 334, 333, 567; 285/18

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—Stanley H. Tollberg
Assistant Examiner—James M. Slattery
Attorney—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A pump unit immersible in the liquid of a well, comprising a liquidtight motor, a pump housing with an outlet connection and guiding means which, on lowering of the pump unit, guide the outlet connection into the vicinity of a fixed coupling unit of the outlet pipe. The pump unit having a seating while the outlet connection has a tapered aperture fitting thereto, so that the connection, after the unit has been essentially lowered, can be brought up against the coupling unit, into sealing engagement with the seating, essentially in the axial direction of the coupling unit. The seating surfaces being spherical to allow for slight misalignment.

3 Claims, 2 Drawing Figures

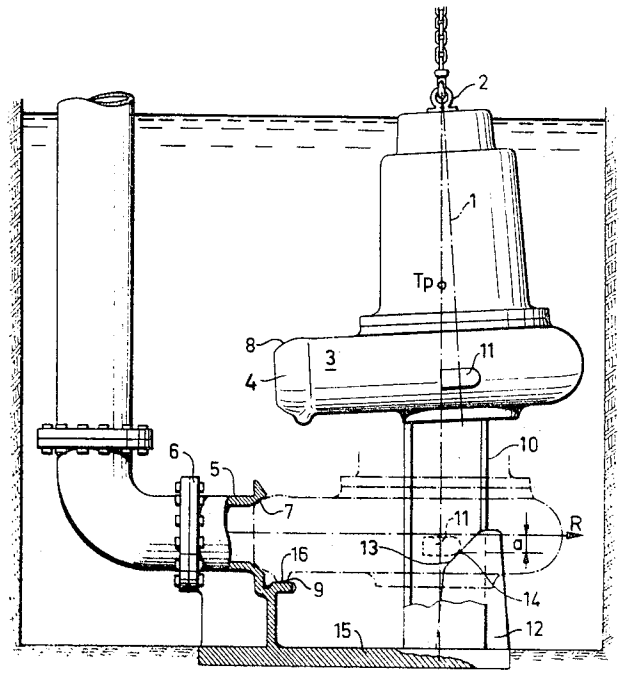


Fig. 1

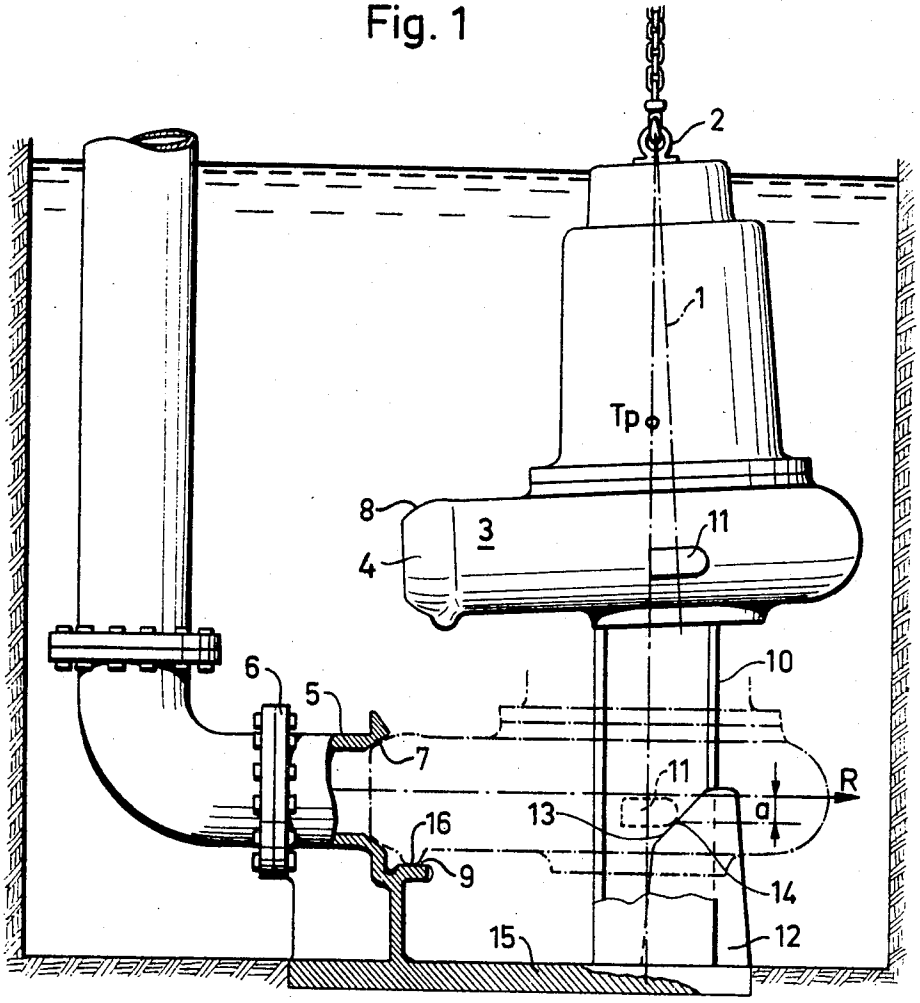
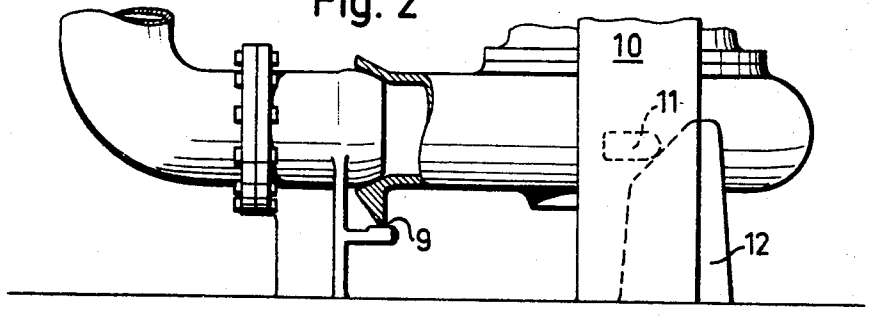


Fig. 2



PUMPING DEVICE WITH SELF CENTERING SPHERICAL SEATING SURFACES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a pumping device with a pump unit immersible in a liquid in a well or the like and consisting of a liquidtight-enclosed motor and a centrifugal pump with outlet device leading from the pump housing, the pump unit having a guide which, on lowering and raising of the pump unit, guides the pump connection to and from the vicinity of the coupling unit of a permanently fitted outlet pipe.

2. Descripition of the Prior Art

In pump units intended for operation wholly or partially immersed in the pumped liquid there is great inconvenience in maintenance work if the pump units are permanently installed. To avoid these inconveniences it is a known practice to arrange for the pump units to be lowered into the pumped liquid, guided along guides and, in their lowered position, bearing against a coupling unit on an outlet pipe for the liquid. The connection of the pump unit must in this position close tightly against the outlet pipe without needing to be attached to it by means, for example, of screws.

These known devices admittedly enable the pump unit to be relatively easily raised out of the pump liquid for maintenance work, but the difficulty is to get the connection of the pump unit to close tightly against the coupling unit of the outlet pipe after the pump unit has been lowered and during its operation.

The U.S. Pat. No. 3,018,925 describes a device of this kind, in which the flanges which connect the pump unit to the outlet pipe form an angle with a vertical plane, a catch on the connecting flange gripping across the flange of the coupling unit and so pressing the two flanges together. The advantage of this is that the pump unit, in its lowered position, seals against the connecting pipe under the influence of the gravity of at least part of the pump unit. This provides a relatively good seal between pump and outlet pipe.

Devices are also known in which the slide-pieces which run along the guides are articulated to the pump unit, which, after immersion in the pumped liquid, is turned slightly round an essentially horizontal axis, the connecting flange of the pump unit being thereby lowered in the direction of the connecting flange of the outlet pipe. In such devices as well, the weight of the pump unit is used to achieve a seal between the coupling flange of the outlet pipe and the connecting flange on the pump housing, in that a certain torque arises around the axis around which the slide-shoes are rotatably arranged. In these devices, accordingly, the seal between the pump unit connection and the coupling flanges is obtained only through the torque produced by the weight of the pump unit.

A disadvantage of these devices, however, is that they require very narrow tolerances for clearances and angles between the flange of the outlet pipe and the axis of rotation of the pump.

Furthermore a force of reaction, which counteracts the sealing pressure, is produced by the pressure of the pumped liquid.

SUMMARY OF THE PRESENT INVENTION

The present invention is intended to eliminate these disadvantages and is characterized essentially in that the coupling unit of the fixed outlet pipe has a seating or the like and the outlet connection has a preferably tapered aperture fitting thereto, or vice versa, in such a way that the said connection, after the pump unit has been essentially lowered, can be brought up against the coupling unit, or vice versa, into sealing engagement with the seating, essentially in the axial direction of the coupling unit or in a direction which forms a given limited angle with the axis of the coupling unit.

According to a suitable embodiment of the invention the tapered aperture of the pump connection has a bulge-shaped edge with preferentially semicircular or semielliptical wall section, while the seating of the coupling unit is preferentially essentially conical, or vice versa.

According to a further development of the invention a support for the pump unit in its lowered position is arranged at or close to the coupling unit, in addition to which, in the extension of the coupling unit, there is arranged at least one — possibly laterally displaced — stop with an inclined plane facing the coupling unit, the point of contact between the pump unit and the inclined plane of the stop being arranged to lie below an imaginary line of operation for the force of reaction generated at the pump connection and coupling unit by the pump pressure for the given area.

According to a suitable embodiment the pump unit bears against the inclined plane via at least one pin, stud, roller or the like. This pin, stud, roller or the like may be arranged so as, on raising and lowering of the pump unit, to engage with the guiding device for guiding of the pump unit to and from the connection.

Further advantages are gained through a special embodiment of the invention, in which coupling unit, support, stop and inclined plane are combined in one unit, which, for example, can be placed on the bottom of a basin, cesspool or the like.

One embodiment of the invention will now be described with reference to the attached drawing, in which

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the invention in schematic form, viewed from the side and partially in cross-section, the pump unit being shown with continuous lines in raised position and with broken lines in lowered position. The output device is tapered and the coupling unit conical.

FIG. 2 shows a partial cross-sectional side view of a modification of the present invention.

DESCRIPITION OF THE PREFERRED EMBODIMENT

The pump unit is in the conventional manner immersibly made up of a liquidtight-enclosed motor and a pump, preferentially a centrifugal pump. Laterally there projects from the pump housing a stub 3 with a connecting edge 8 which, viewed in cross-section, is semicircular. Pump and motor are coaxially arranged and, on the upper side of the motor on the common central axis 1, there is a suspension device in the form of an eyelet 2. The eyelet 2 need not lie on the central

axis 1 even if the subsequent description assumes this position. The point of gravity of the pump housing here lies, inter alia because of the connecting stub 3 projecting laterally from the pump housing, at the side of the central axis 1, to the left of it in the figure, so that the point of gravity Tp of the entire pump unit will lie outside this axis 1. Consequently, during suspension of the pump unit, i.e., when its point of gravity Tp is below the suspension eyelet 2, the central axis 1 will run slightly obliquely downwards. Owing to the eccentric position of the point of gravity Tp the pump unit, and thus also the connection 4 of the pump housing, hangs slightly obliquely, as shown by continuous lines in the figure. Should the point of gravity Tp coincide with the central axis 1 of the pump unit, the suspension device can be placed, for example, further to the right, in the figure so that, when suspended, the pump unit hangs slightly obliquely, with the side facing the coupling unit 5 slightly lower.

The pump unit is intended to be coupled to the coupling unit 5, to the flange 6 of which the outlet pipe is intended to be connected. The coupling unit 5 has an essentially conical bearing and sealing surface 7, which fits the corresponding essentially spherical bearing and sealing surface 8 of the connection 4 of the pump housing. These bearing and sealing surfaces 7, 8 are thus so designed that the pump housing can be rotated around the midpoint of the sphere without the sealing effect being thereby reduced. The connection 4 of the pump housing thus becomes self-centring in the coupling unit 5.

When the pump unit, slightly obliquely suspended in the eyelet 2, is lowered, being guided in the known manner with some clearance on one or more essentially vertical U-shaped guide-rails 10, the unit will finally assume a position with the connection 4 of the pump housing roughly opposite the coupling unit 5. A support 9 prevents the connection 4 of the pump housing from being lowered past the coupling unit 5 and furthermore,according to the invention, has the following function.

At the moment when, on lowering of the pump unit on the first occasion, the connection 4 of the pump housing comes into contact with the support 9, the pump unit still hangs obliquely. The lower part of the connection 4 of the pump housing is then at a slightly greater distance from the coupling unit 5 than its upper part. On being further lowered the pump unit, at the connection 4 of the pump housing, will be carried by the support 9, whereas it is not supported at the opposite side of the pump housing, i.e., on its right side in the drawing, as a result of which the pump unit is rotated in the figure clockwise around a horizontal axis and the bearing and sealing surface 8 of the pump housing thus approaches the bearing and sealing surface 7 of the coupling unit 5. At the end of the downward movement a pin, stud, roller 11 or the like comes up against a stop 12 connected to the coupling unit 5 through a base plate 15. This takes place on an inclined plane 13 of the stop 12 facing the coupling unit 5. The point of contact 14 between the stud or the like 11 and the inclined plane 13 here lies the distance *a* below the now preferentially horizontal midplane of the pump housing and connecting stub 3, and therefore below the force of reaction R resulting from the pump pressure, whereby, through the resulting wedge effect, the bearing and sealing surfaces 7 and 8 are pressed together. The placing of the point of contact 13 according to the invention, viewed in the direction of the force of reaction, below the point of engagement of the force of reaction, has the following advantageous effect.

When the pump is working — especially at a large head, i.e., pump pressure, and area of engagement — there is generated through the forces of reaction owing to the said pump pressure and area a large resulting force R in the midplane, directed to the right in the figure. As the line of operation of this force R is at a distance *a* from the point of contact 14, a clockwise torque is obtained in the figure, which presses the stud 11 further downward towards the inclined plane 13, with consequent intensification of the force which presses together the bearing and sealing surfaces 7, 8.

The greater the force R, the greater accordingly is the intensification of the compressing force.

By making the inclination of the plane 13 steeper, a further increase of the force pressing together the bearing and sealing surfaces 7, 8 can be attained. The downward directed suction aperture also contributes to an increase of the sealing force during operation of the pump.

The stop 12 with the inclined plane 13, the support 9 and the coupling unit 5 with coupling flange 6 are, in the embodiment described, connected together by means of a base plate 15, which can suitably be placed on the bottom of a basin, cesspool or the like, and from which the guides 10 may also proceed.

By using two studs 11 or the like, a three-point mounting is obtained, as a result of which the pump unit stands very rigid and nevertheless can be easily raised without manual release of any engaging device.

In pump units of this kind the invention thus provides an arrangement which is self-centering and self-coupling, and which permits movement of the sealing devices into engagement position even if the pump connection and the coupling of the outlet pipe are not fully coaxial. It also provides an increasing sealing pressure with rising pump pressure and is usable even for very large and heavy pump units.

Although the invention has been described with reference to one of its embodiments, it can be arbitrarily modified within the scope of the subsequent claims.

What I claim is:

1. In combination with a pump device of the type that is submergible for connection with a submerged delivery pipe, wherein the pump device includes a liquid-tight enclosed motor and a centrifugal pump having an outlet connection and guiding means permitting the lowering of the pump device to the delivery pipe, the improvements which comprise:

a. self centering spherical seating surfaces on the submerged delivery pipe and on the pump outlet connection thereby permitting a limited misalignment along the axial direction of the outlet connection while maintaining a sealing relationship,

b. a base member for supporting the delivery pipe, and

c. a supporting member extending relatively parallel and outward from the sealing surface of the delivery pipe and below the delivery pipe, the pump outlet connection having a protruding sup-

port portion adjacent its sealing surface for engagement with the support member of the delivery pipe.

2. The combination of claim 1, wherein the sealing surface of the delivery pipe is conical.

3. The combination of claim 1 wherein the sealing surface of the pump outlet connection is conical.

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