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Amended claims in accordance with Rule 137(2) EPC.

(54) **Pump arrangement, in particular water hydraulic pump arrangement for a reverse osmosis installation**

(57) A pump arrangement (1), in particular a water hydraulic pump arrangement for a reverse osmosis installation, is provided comprising a driving motor (2) having an axis (3) of rotation, and pump means (4) releasable coupled to said motor (2).

Such a pump arrangement should allow for a simple inspection of said pump means (4).

To this end said pump means (4) are supported in guide means (9) having guide surface (10) extending parallel to said axis (3) of rotation.

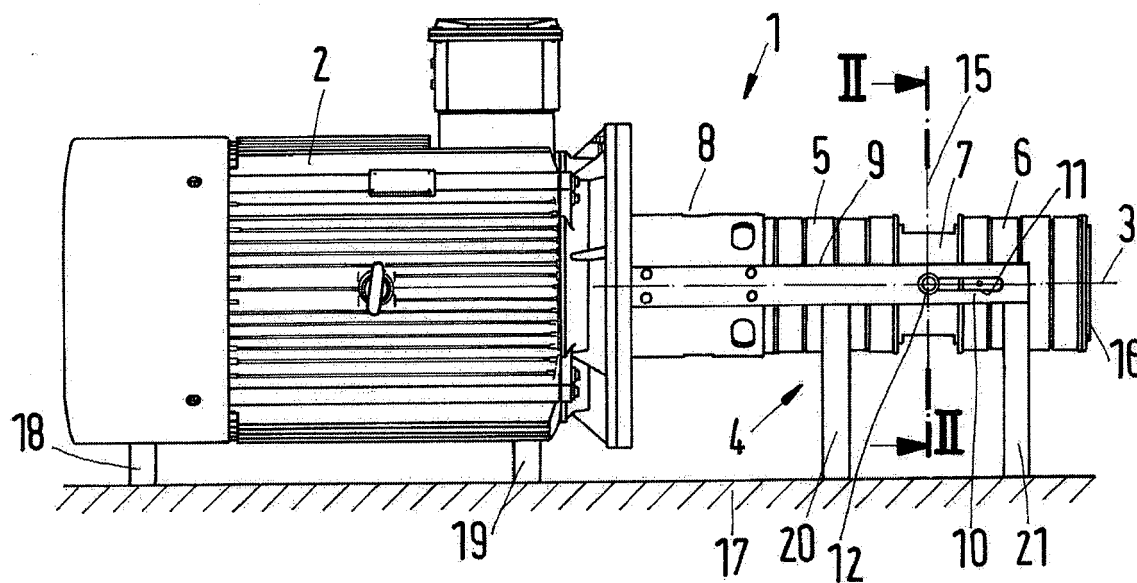


Fig.1

Description

[0001] The present invention relates to a pump arrangement comprising a driving motor having an axis of rotation, and pump means releasably coupled to said motor.

[0002] The pump arrangement according to the present invention is in particular a water hydraulic pump arrangement which is used to pressurize water to be supplied to a reverse osmosis unit in order, for example, to gain drinking water from salt water. Drinking water is usually needed with a large volume. Therefore, the pump means have a considerable size and as a consequence a considerable weight. The weight of the pump means according to the present invention can have a mass of approximately 200 kg or more. For proper operation the pump means have to be inspected from time to time. To this end an operator needs access to some parts of the pump means requiring in some cases the separation of the pump means from the driving motor. The considerable weight of the pump means makes such an inspection difficult.

[0003] The object underlying the invention is to allow for a simple inspection of said pump means.

[0004] This object is solved with a pump arrangement described at the outset in that said pump means are supported on guide means having a guide surface extending parallel to said axis of rotation.

[0005] Such a pump arrangement allows to separate the pump means from the driving motor and to move it away from the driving motor without the need of any lifting device. Since the guide surface extends parallel to the axis of rotation of the driving motor which is in many cases arranged in a horizontal plane, the movement of the pump means away from the motor or back to the motor after inspection can be performed with low forces. It is only necessary to overcome the friction between the pump means and the guiding surface on which the pump means are supported.

[0006] Preferably said pump means and said motor are connected by means of a plug-in coupling having a first member connected to one of said motor and said pump means, said first member being inserted into a second member connected to the other one of said motor and said pump means over an insertion length, said guide surface having a length in a direction parallel to said axis corresponding at least to said insertion length. The pump means can be moved with respect to the driving motor on the guide surface to an extent which is sufficient to release the connection between motor and pump means in the coupling means. The first member can be completely drawn out of the second member so that the sight of pump means facing the motor is freely accessible.

[0007] Preferably said guide means is in form of at least one guide rail extending parallel to said axis of rotation. This guide rail can, for example, be fixed to a housing of the driving motor. The guide rail has a sufficient strength to support the pump means.

[0008] Preferably said guide rail has a C-shaped cross section. The C-shaped cross section gives a high degree of stability without increasing the weight of the guide rail dramatically.

5 [0009] Preferably said guide surface is formed in a slot of said guide rail. The slot or elongated hole in the guide rail does not only support the pump means in the direction of gravity. It is also a protection that the pump mean is not lifted off too far the guide surface.

10 [0010] Preferably said guide means comprise at least two guide rails located on opposite sides of said pump means. The pump means are guided laterally. Therefore, even the underside of the pump means is accessible for inspection. The guide rail can be dimensioned small enough so that they do not cover more than necessary of the sides of the pump means.

15 [0011] Preferably said pump means comprise two protrusions extending radially outwardly with respect to said axis of rotation, said protrusions bearing on said guide surface. The protrusion can form a kind of a hinge so that the pump means can be pivoted about the protrusions.

20 [0012] Preferably said pump means have a center of mass and said protrusions extend in a plane in which said center of mass is located. This has the advantage that the pump means can easily be rotated about an axis formed by said protrusion. Such a pivoting or rotation simplifies access to most parts of the pump means.

25 [0013] Preferably said protrusions comprise rotatable surfaces. They can be in form of rollers or in the form of rotating sleeves. Such rotatable surfaces are used to have a low friction between pump means and guide surface during movement.

30 [0014] In a preferred embodiment said motor is mounted on a basis and said guide means are supported on said basis by means of a support structure. In a reverse osmosis system the water hydraulic pump-motor-arrangement is usually supported on the floor. When the guide means are supported on the floor as well, it can have a considerable length. Consequently the pump means can be moved away from the motor without increasing a tilting torque on the driving motor. Therefore, the bearings supporting the motor on the basis can be kept small.

35 [0015] In a preferred embodiment said pump means comprise two pump units arranged on a common shaft. This is a simple possibility to increase the displacement of the pump and the pump capacity. Only one motor is used for two pump units. Since the doubling of the pump unit increases the weight of the pump means correspondingly, the doubling of the pump normally would cause difficulties during inspection and repair since a correspondingly larger mass has to be moved. However, using the guide means this problem is no longer present.

40 [0016] Preferably said pump units are in form of axial piston pumps. An axial piston pump comprises a cylinder drum rotating about the axis of rotation and several pistons in cylinders in this cylinder drum moving parallel to said axis of rotation.

[0017] Preferably said axial piston pumps are connected to a common port housing. Therefore, only one common port housing is needed for the two pump units. The pistons of the two axial piston pumps can be arranged so that the piston of one axial piston moves simultaneously with a piston of the other axial piston pump, however in opposite direction. This keeps the resulting forces and pressures on the common port housing small.

[0018] Preferably each pump comprises a releasable cover on a side opposite said port housing. In an axial piston pump it is mostly sufficient for inspection purposes to release and remove the cover on the side opposite the port housing. In this case it is possible to have a look to the pistons and to the swash plate and the slide shoes of the axial piston pumps. When these parts are in order, there is a high probability that the other parts of the axial piston pumps are in order as well. Since the pump means can be moved away from the driving motor the releasable covers on both sides of the pump means are accessible.

[0019] Preferred embodiments of the invention will now be described in more detail with reference to the drawing, wherein:

Fig. 1 is a schematic side view of a pump arrangement,

Fig. 2 is a cross sectional view II-II of Fig. 1,

Fig. 3 is a detail III of Fig. 2,

Fig. 4 is a perspective view of the pump arrangement,

Fig. 5 is a second embodiment in a view according to Fig. 3, and

Fig. 6 is a third embodiment in a view according to Fig. 3.

[0020] A pump arrangement 1 comprises a driving motor 2, in particular an electric driving motor, having an axis 3 of rotation.

[0021] Pump means 4 are releasably coupled to the driving motor 2. The pump means 4 comprise a first pump unit 5 and a second pump unit 6 which are connected with each other by means of a common port housing 7. The two pump units 5, 6 are each in form of an axial piston pump. Both pump units 5, 6 are driven by the common driving motor 2.

[0022] The pump means 4 and the driving motor 2 are coupled with each other by means of a releasably coupling, in particular a plug-in coupling. Such a plug-in coupling has a first coupling member connected to the driving motor 2 and a second coupling member connected to the pump means 4. The second coupling member can be inserted into the first coupling member. The insertion depth or insertion length must be sufficiently dimensioned so that the driving motor can transmit the necessary torque to the pump means 4.

[0023] The coupling means is surrounded by a sleeve 8 which could also be named "bellhousing". The sleeve 8 forms a protection and makes the coupling means invisible. The sleeve 8 comprises openings or holes through which the coupling means are accessible so that it is possible to manipulate the coupling means in order to separate the pump means 4 and the driving motor 2.

[0024] Guide means 9 are connected to the driving motor 2, for example, via the sleeve 8. The connection between the guide means 9 and the driving motor 2 is rather stiff so that the guide means 9 are able to support a considerable way of, for example, more than 100 Kg.

[0025] The guide means 9 comprise a guide surface 10 extending parallel to the axis 3 of the driving motor 2 as well. The axis 3 of the driving motor 2 is arranged perpendicular to the direction of gravity. Consequently, the guide surface 10 is arranged parallel to the direction of gravity as well.

[0026] The guide surface 10 is formed as lower limitation of a slot 11 or elongated hole. The slot 11 has a length in a direction parallel to the axis 3 of rotation corresponding at least to the above mentioned insertion length or insertion depth. The guide surface 10 can have a length of, for example, 10 to 20 cm.

[0027] As can be seen in Fig. 4, guide means 9 are arranged on both sides of the pump means 4, so that the pump means 4 can be supported on opposite side in a plane perpendicular to the direction of gravity.

[0028] The pump means 4 are provided with protrusions in form of bolts 12. These bolts 12 are screwed into the port housing 7. Each bolt 12 is provided with a sleeve 13 rotatable on said bolt 12 which penetrates the slot 11 and has a washer 14 on the outside of the guide means 9. The sleeve 13 rests on the guide surface 10.

[0029] The bolts 12 are located in a vertical plane 15, i. e. a plane oriented in direction of gravity. In this plane 15 the center of mass of the pump mean 4 is located.

[0030] Each pump unit 5, 6 is provided with an end cover 16 (shown only for pump unit 6). This end cover 16 must be released and removed to enable an operator to perform an inspection of inner parts of the pump unit 5, 6.

[0031] Removal of the end cover 16 is no problem for the second pump unit 6 being remote from the driving motor 2. However, the respective end cover of the first pump unit 5 is not accessible since it is located on the side facing the driving motor 2 and access is not possible because of the sleeve 8.

[0032] To overcome this problem, the pump means 4 can be released from the driving motor 2.

[0033] After releasing the pump means 4 from the driving motor 2 the pump means 4 can be shifted parallel to the axis 3 of rotation. During such movement the sleeve 13 surrounding the bolt 12 acts as a roller with which the pump means 4 can roll on the guide surface 10. The guide surface 10 is long enough to move the second member of the plug-in coupling out of the first coupling member so that a connection between the driving motor

2 and the pump means 4 is completely released and the pump means 4 come free from the driving motor 2. Furthermore, the guide surface 10 is long enough to move the pump means 4 completely out of the sleeve 8.

[0034] When the pump means 4 have been moved away from the driving motor 2 far enough, the pump means 4 can be pivoted around the bolts 12 without any difficulty. This pivoting does not require large forces or a larger torque since the bolts 12 are arranged at the center of mass of the pump means 4. Under ideal condition the pump means 4 would rest in any angular position of pivoting. Even if the conditions are not ideal, an operator does not have to apply big forces to pivot the pump means 4.

[0035] After pivoting the pump means 4 around the axis of the bolts 12, the end cover of the first pump unit 5 is freely accessible and can be removed to inspect interior parts of the first pump unit 5.

[0036] As a rule, when the pistons of the pump units 5, 6 are in order and do not show any indication of damage or larger wear, it can be expected that the other parts of the pump units 5, 6 are in order as well. Therefore, for a regular inspection it is sufficient to be able to remove the end covers 16.

[0037] Since the pump means 4 comprises two pump units 5, 6, it has a considerable weight. The weight of the pump means 4 can be in the magnitude of almost 200 kg. The guide means 9 supporting the pump means 4 after releasing it from the driving motor 2 is a good help for handling the pump means 4.

[0038] This has the additional advantage that the sleeve 8 between the pump means 4 and the driving motor 2 is no longer required to have a sufficient strength to bear the weight of the pump means 4. The greatest part of the weight is taken over by the guide means 9. Therefore, the sleeve 8 can be weaker dimensioned. Presently, such sleeves 8 are made of steel. Using the guide means 9 they can be, for example, of aluminum.

[0039] The driving motor 2 is placed on a base 17, for example a floor of a building or a floor of an installation area. To this end the driving motor 2 is provided with two bearings 18, 19.

[0040] The guide means 9 can be provided with a supporting structure 20, 21 as well. This supporting structure 20, 21 can comprise to posts, as shown. These posts can have, as shown, an equal distance to the bolts 12, when the pump means 4 are connected to the driving motor 2. In this way, the complete weight of the pump means 4 is supported by the support structure 20, 21 during operation. Only during inspection a small torque is applied to the driving motor 2. When the supporting structure 20, 21 is used, the sleeve 8 can be made of a weaker material, for example aluminum or the like. When the supporting structure 20, 21 is used it is no longer necessary that the sleeve 8 is able to bear the full weight of the pump means 4.

[0041] As can be seen in Fig. 3, the guide means 9 are in form of a rail having a C-shaped cross section. This

gives a rather high stability for the guide means 9.

[0042] Fig. 5 shows a slightly modified embodiment of the guide means 9. The guide means 9 is in form of a I-profile or Double-T-profile. Such a guide means 9 has a sufficient stability as well.

[0043] Fig. 6 shows a third embodiment of the guide means 9 having a I-profile or a Double-T-profile as well. The bolts 12 are supported on the guide surface 10 by means of roller bearings 16 which decreases the friction during the movement of the pump means 4 the way from or towards to the driving motor 2.

Claims

1. Pump arrangement (1), in particular water hydraulic pump arrangement for a reverse osmosis installation, comprising a driving motor (2) having an axis (3) of rotation, and pump means (4) releasably coupled to said motor (2), **characterized in that** said pump means (4) are supported on guide means (9) having a guide surface (10) extending parallel to said axis (3) of rotation.
2. Pump arrangement according to claim 1, **characterized in that** said pump means (4) and said motor (2) are connected by means of a plug-in coupling having a first member connected to one of said motor and said pump means, said first member being inserted into a second member connected to the other one of said motor (2), and said pump means (4) over an insertion length, said guide surface (10) having a length in a direction parallel to said axis (3) corresponding at least to said insertion length.
3. Pump arrangement according to claim 1 or 2, **characterized in that** said guide means (9) is in form of at least one guide rail extending parallel to said axis of rotation.
4. Pump arrangement according to claim 3, **characterized in that** said guide rail has a C-shaped cross section.
5. Pump arrangement according to claim 3 or 4, **characterized in that** said guide surface (10) is formed in a slot (11) of said guide rail.
6. Pump arrangement according to any of claims 3 to 5, **characterized in that** said guide means (9) comprise at least two guide rails located on opposite sides of said pump means.
7. Pump arrangement according to claim 6, **characterized in that** said pump means (4) comprise two protrusions (12) extending radially outwardly with respect to said axis (3) of rotation, said protrusions (12) bearing on said guide surface (10).

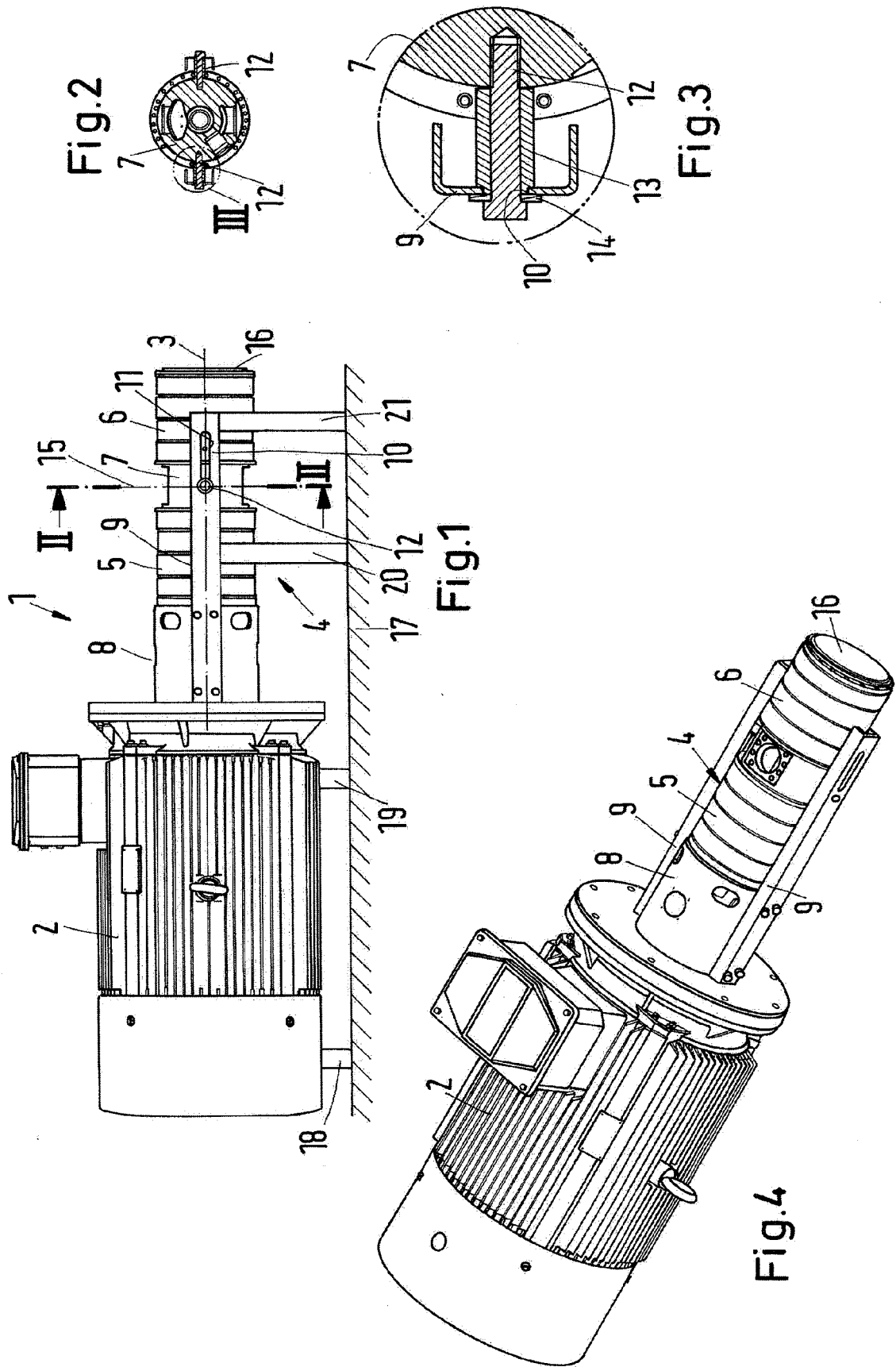
8. Pump arrangement according to claim 7, **characterized in that** said pump means (4) have a center of mass and said protrusions (12) extend in a plane (15) in which said center of mass is located.
9. Pump arrangement according to claim 7 or 8, **characterized in that** said protrusions (12) comprise rotatable surfaces.
10. Pump arrangement according to any of claims 1 to 9, **characterized in that** said motor (2) are mounted on a basis (17) and said guide means (9) is supported on said basis (17) by means of a support structure (20, 21).
11. Pump arrangement according to any of claims 1 to 10, **characterized in that** said pump means (4) comprise two pump units (5, 6) arranged on a common shaft.
12. Pump arrangement according to claim 11, **characterized in that** said pump units (5, 6) are in form of axial piston pumps.
13. Pump arrangement according to claim 12, **characterized in that** said axial piston pumps (5, 6) are connected to a common port housing (7).
14. Pump arrangement according to claim 13, **characterized in that** each pump unit (5, 6) comprises a releasable cover (16) on a side opposite said port housing (7).

Amended claims in accordance with Rule 137(2) EPC.

1. Pump arrangement (1), in particular water hydraulic pump arrangement for a reverse osmosis installation, comprising a driving motor (2) having an axis (3) of rotation, and pump means (4) releasably coupled to said motor (2), wherein said pump means (4) are supported on guide means (9) having a guide surface (10) extending parallel to said axis (3) of rotation, wherein said guide means (9) is in form of at least two guide rail extending parallel to said axis of rotation and being located on opposite sides of said pump means **characterized in that** said pump means (4) comprise two protrusions (12) extending radially outwardly with respect to said axis (3) of rotation, said protrusions (12) bearing on said guide surface (10), wherein said pump means (4) have a center of mass and said protrusions (12) extend in a plane (15) in which said center of mass is located and form a kind of a hinge.
2. Pump arrangement according to claim 1, **characterized in that** said pump means (4) and said motor (2)

are connected by means of a plug-in coupling having a first member connected to one of said motor and said pump means, said first member being inserted into a second member connected to the other one of said motor (2), and said pump means (4) over an insertion length, said guide surface (10) having a length in a direction parallel to said axis (3) corresponding at least to said insertion length.

3. Pump arrangement according to claim 1 or 2, **characterized in that** said guide rail has a C-shaped cross section.
4. Pump arrangement according to any of claims 1 to 3, **characterized in that** said guide surface (10) is formed in a slot (11) of said guide rail.
5. Pump arrangement according to any of claims 1 to 4, **characterized in that** said protrusions (12) comprise rotatable surfaces.
6. Pump arrangement according to any of claims 1 to 5, **characterized in that** said motor (2) are mounted on a basis (17) and said guide means (9) is supported on said basis (17) by means of a support structure (20, 21).
7. Pump arrangement according to any of claims 1 to 6, **characterized in that** said pump means (4) comprise two pump units (5, 6) arranged on a common shaft.
8. Pump arrangement according to claim 7, **characterized in that** said pump units (5, 6) are in form of axial piston pumps.
9. Pump arrangement according to claim 8, **characterized in that** said axial piston pumps (5, 6) are connected to a common port housing (7).
10. Pump arrangement according to claim 9, **characterized in that** each pump unit (5, 6) comprises a releasable cover (16) on a side opposite said port housing (7).



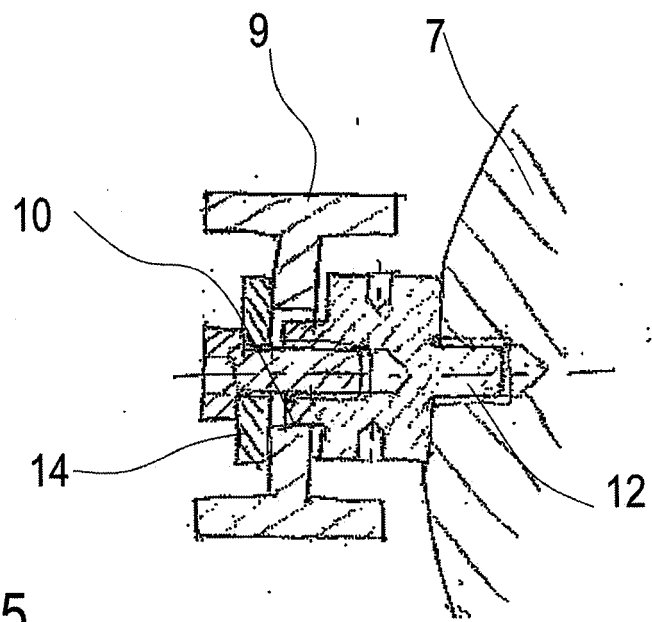


Fig. 5

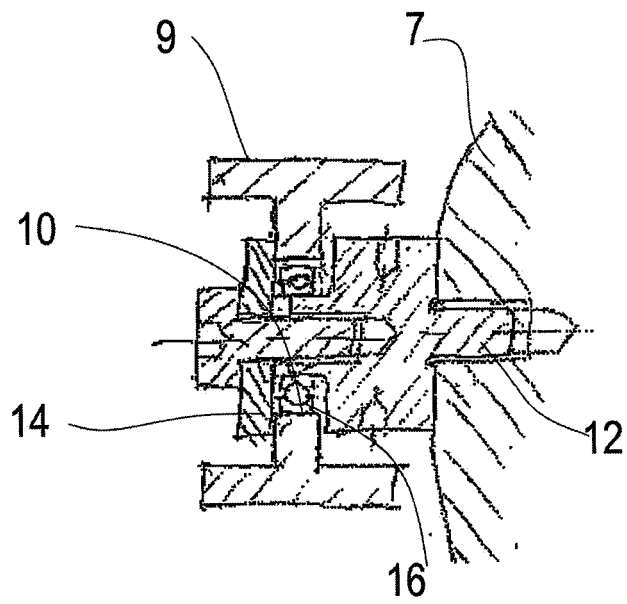


Fig. 6



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**ANNEX TO THE EUROPEAN SEARCH REPORT
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