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(54) Benævnelse: **PUMPEANORDNING MED VARMEVEKSLER TIL KØLING AF DREVET**

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Description

Prior art

The invention relates to a pump device according to the preamble of Patent Claim 1.

It has already been proposed to seal the motor compartment of pumps with sealing plates which, for a better cooling of the motor compartment, comprise cooling ducts for receiving a cooling fluid.

In addition, a pump device according to the preamble of Patent Claim 1 is already known from the publication DE 102 08 688 A1. The object of the invention consists in particular in providing a generic device with improved characteristics in terms of a heat exchange. According to the invention, the object is achieved through the features of Patent Claim 1, while advantageous configurations and further developments of the invention can be taken from the subclaims.

Advantages of the invention

The invention starts out from a pump device, in particular an immersible pump device, with at least one heat exchanger unit, which in at least one operating state is provided for a heat exchange between a cooling fluid and a liquid to be pumped, and comprises at least one cooling duct and at least one shaft receptacle having an axial direction, wherein a cross-section surface area of the cooling duct changes over at least a large portion of a course of the cooling duct by maximally 200%. In particular, the heat exchanger unit can comprise a multiplicity of cooling ducts. By way of this, a heat exchange can be improved. In particular, a homogeneous heat transfer from the cooling fluid to the liquid to be pumped can be achieved. Advantageously, an optimal cross-section surface area, which allows a high flow velocity of the cooling fluid and a high contact area for the heat transfer, can be at least substantially maintained over the large part of the course. Particularly advantageously, a simple manufacture of the heat exchanger unit can be achieved.

A "pump device" is to mean in particular at least one part, in particular a sub-assembly of a pump. In particular, the pump device can also comprise the entire pump. A "pump" in particular an immersible pump is to mean in particular a device which in at least one operating state provides a movement of a preferentially incompressible liquid to be pumped. Preferably, the pump device comprises a shell unit delimiting the pump towards the outside, a drive shaft operated by a motor unit of the pump device and/or a screw unit set into rotary motion by the drive shaft in at least one operating state, wherein the rotation of the screw unit provides the movement of the liquid to be pumped. Alternatively, the pump device can comprise a piston unit operated by a motor unit of the pump device, which, through a displacement process, sets the liquid to be pumped into motion. Advantageously, the motor unit is arranged within a motor compartment of the pump delimited towards the outside, in particular the motor unit can comprise an internal combustion engine. Particularly advantageously, the motor unit comprises an electric motor. The pump can be arranged in particular in at least one operating state outside and/or at least partly or completely within the liquid to be pumped.

A "heat exchanger unit" is to mean in particular a unit which is provided in order to absorb heat of at least one fluid and/or element and transfer the same in particular to at least one other fluid and/or element. In particular, the heat exchanger unit comprises at least one part region which forms at least one surface enlarging structure. Advantageously, the heat exchanger unit additionally comprises at least one plate-shaped element. A "plate-shaped element" is to mean in particular an element in which a smallest imagined cuboid, which the element only just accommodates, has a height which is maximally 50%, in particular maximally 20%, advantageously maximally 10% and preferentially maximally 5% of a length and width of the cuboid. Advantageously, the plate-shaped element contributes to a definition of the cooling duct. Particularly advantageously, the heat exchanger unit contributes to a delimitation of the motor compartment towards the outside. It would be conceivable that the heat exchanger unit is part of the shell unit. Preferably, the heat exchanger unit is arranged at an end of the motor compartment facing the screw unit. Particularly preferably, the heat exchanger unit forms in a mounted state, jointly with the shell unit, a sealing connection. It would be conceivable that the heat exchanger unit is pressed against and/or welded to the shell unit. Preferably, the heat exchanger unit is screwed to the shell unit. Preferentially, the heat exchanger unit comprises a material which is identical to a material of the shell unit. Because of this, a good sealing of the motor compartment in different temperatures can be ensured in particular. In particular, the heat exchanger unit can comprise at least one preferentially rubber-like sealing ring, which contributes to the sealing connection with the contact surface of the shell unit. Particularly preferably, the heat exchanger unit is formed as a baseplate of the motor compartment.

A "cooling fluid" is to mean in particular a liquid which is provided in order to absorb heat of at least one element and transfer the same in particular to at least one other element, for example the heat exchanger unit. Preferably, the cooling fluid has a high heat conductivity and/or heat capacity. Particularly preferably, the cooling fluid has a viscosity which allows the cooling fluid to be pumped. It is conceivable that the cooling fluid is identical to the pumped medium, but preferably the cooling fluid is distinct from the pumped fluid and especially provided for cooling the pump. Cooling fluids can comprise for example water and/or oils.

A "cooling duct" is to mean in particular a contiguous volume through which in at least one operating state cooling fluid flows. Advantageously, a contiguous recess, in particular a groove, of the heat exchanger unit contributes to a definition of the cooling duct. In particular, the recess defines a duct wall which delimits the cooling duct towards the heat exchanger unit. Preferentially, the duct wall has, over the large part of the course, a cross-section that is oval or round over a large part. An "oval or round cross-section over a large part" in this context is to mean in particular that at least 60%, advantageously at least 70%, preferably at least 80% and particularly preferably at least 90% of the cross-section of the duct wall can be covered by an oval or a circle without the oval or the circle cutting the duct wall. It would also be conceivable that the cooling duct is formed as a hollow space in the interior of the heat exchanger unit that is open towards the outside. In particular, the cooling duct comprises at least one inlet opening and at least one outlet opening, which preferentially define a flow direction of cooling fluid flowing through the cooling duct. Preferably, the inlet opening and the outlet opening are spaced apart from the shaft receptacle in a radially distinct manner. Particularly preferably, a radial distance of the inlet opening to the shaft receptacle is greater than a radial distance of the outlet opening to the shaft receptacle. Advantageously, the cooling fluid flows within a cooling circuit in which the cooling fluid flows from the shell unit into the inlet opening, through the cooling duct and from the outlet opening back into the shell unit. Preferably, the shell unit comprises cooling ducts, wherein a further outlet opening of at least one cooling duct of the shell unit is flow-connected with the inlet opening and a further inlet opening of at least one cooling duct of the shell unit, flow-connected with the outlet opening.

A "shaft receptacle" is to mean in particular a part region of the heat exchanger unit which surrounds an opening of the heat exchanger unit which the drive shaft of the heat exchanger unit can penetrate. Preferably, the shaft receptacle is at least substantially circular-disc-shaped. "At least substantially" in this context is to mean in particular taking into account popular manufacturing tolerances. Particularly preferably, the shaft receptacle when viewed perpendicularly to the axial direction is homogeneously spaced apart from an outer contour of the heat exchanger unit at least substantially. An "axial direction" of the shaft receptacle is to mean in particular a direction which is defined by the shaft receptacle and in which the drive shaft in a mounted state is oriented. Preferentially, the axial direction is the only possible direction in which the drive shaft in the mounted state can be oriented. Preferably, the axial direction is oriented perpendicularly to a main extension plane of the shaft receptacle. A "main extension plane" of an object is to mean in particular a plane which is parallel to a largest lateral surface of a smallest imagined cuboid which only just completely encloses the object, and in particular runs through the centre point of the cuboid. In particular, the drive shaft penetrates the shaft receptacle in the mounted state.

A "cross-section surface area" is to mean in particular the area of a cross-section of the cooling duct. A "cross-section" in this context is to mean in particular a surface which is situated completely within the cooling duct and is oriented perpendicularly to the duct wall of the cooling duct. Preferentially, the surface, when viewed perpendicularly to the extension direction of the surface, completely fills out an intermediate space defined by the duct wall.

A "large part of a course of the cooling duct" is to mean in particular at least 60%, advantageously at least 70%, preferably at least 80% and particularly preferably at least 90% of the course of the cooling duct. It would be conceivable that a large part of the course of the cooling duct comprises the entire cooling duct. Preferably, the large part of the course of the cooling duct is free of inlet openings and/or outlet openings of the cooling duct. A "course of the cooling duct" is to mean in particular a spatial extent of the cooling duct perpendicularly to the cross-section surface of the cooling duct.

"Provided" is to mean in particular specially designed and/or equipped. In particular, "provided" is to mean no mere suitability. In particular, a unit, which is provided for fulfilling a task, fulfils the said task to an extent satisfying an operator of a device to which the unit belongs. That an object is provided for a defined function is to mean in particular that the object fulfils or carries out a defined function in at least one application and/or operating state.

It would be conceivable that the cross-section surface area of the cooling duct alternately becomes smaller and larger over the large part of the course of the cooling duct. In order to improve a flow velocity of the cooling fluid within the cooling duct it is proposed, however, that the cross-section surface area of the cooling duct over the large part of the course maximally changes irreversibly. That the cross-section surface area changes "irreversibly" is to mean in particular that the cross-section surface area when viewed along the course of the cooling duct monotonically increases or monotonically decreases in one direction. Preferentially, the cross-section surface area when viewed from the inlet opening to the outlet opening of the cooling duct changes in a monotonically decreasing manner. Advantageously, a steady increase of the flow velocity of the cooling fluid while flowing through the cooling duct can be achieved. Particularly advantageously, a congestion of the cooling fluid through a sudden dropping of the flow velocity can be avoided.

Furthermore, it is proposed that the cross-section surface area of the cooling duct is constant over the large part of the course of the cooling duct at least substantially. Advantageously, the cooling duct, over the large part of the course of the cooling duct, has an at least substantially constant cross-section shape. A "cross-section shape" is to mean in particular an outer contour of the cross-section surface area. For example, the cross-section shape can correspond to a cut-off circle or a cut-off oval. Because of this, a heat transfer from the cooling fluid to the pumping liquid can in particular be even better homogenised. Advantageously, a manufacture of the heat exchanger unit can be further simplified.

According to the invention, the heat exchanger unit comprises a further cooling duct, wherein a circular-arc-wise distance extending concentrically to a centre point of the shaft receptacle from the cooling duct to the further cooling duct over the large part of the course of the cooling duct corresponds to at least 50%, in particular at least 100%, advantageously at least 150% and preferably at least 200% of a width of the cooling duct. A "circular-arc-wise distance extending concentrically to a point" in this context is to mean in particular a length of a section line which, when viewed along the axial direction and upon a section through the heat exchanger unit corresponds to the course of a circle about the point of the same, spaces apart both cooling ducts. A "width of the cooling duct" is to mean in particular a length of the section line which interconnects to points of the duct wall located opposite one another. By way of this, a heat transfer via the heat exchanger unit can be improved in particular. Advantageously it can be ensured that the heat exchanger unit can absorb and pass on an adequate heat quantity of the cooling fluid to the liquid to be pumped.

It would be conceivable that the circular-arc-wise distance corresponds over 400% of the width of the cooling duct. Preferentially, the heat exchanger unit comprises at least one further cooling duct, wherein a circular-arc-distance extending concentrically to a centre point of the shaft receptacle from the cooling duct to the further cooling duct corresponds, over the large part of the course of the cooling duct, to maximally 40%, in particular maximally 350%, advantageously maximally 300%, preferably maximally 250% and particularly preferably maximally 200% of the width of the cooling duct. By way of this, a heat emission of the cooling fluid can be improved in particular. Advantageously, an equilibrium of heat introducible by the cooling fluid and heat absorbable by the heat exchanger unit can be achieved.

In an alternative configuration, the cooling duct could be formed as an opened cooling duct, which is completely defined by a groove of the heat exchanger unit. In order to improve a contacting of the heat exchanger unit by the cooling fluid it is proposed that the heat exchanger unit comprises at least one sealing part and at least one cover element, which jointly define the cooling duct over the large part of the course. A "sealing part" is to mean in particular an element of the heat exchanger unit which delimits the motor compartment towards the outside. Preferentially, the sealing part comprises the shaft receptacle. Preferably, the sealing part comprises the recess. A "cover element" is to mean in particular a plate-shaped element of the heat exchanger unit, which jointly with the recess defines the cooling duct. In particular, the cover element in a mounted state lies on the recess. Preferentially, at least two part regions of the recess extend beyond the cover element and define the inlet opening and the outlet opening. For example, the cover element could be connected via a press fit and/or a welding process to the sealing part. Preferably, the cover element is screwed to the sealing part. Advantageously, a pressure in the cooling duct with which the cooling fluid is delivered, and accordingly the flow velocity of the cooling fluid in the cooling duct can be increased.

It would be conceivable that the cooling duct follows a linear course. Preferentially, the cooling duct is curved along the large part of the course. That the cooling duct is "curved" within a part region is to mean that the cooling duct within the part region is free of linear portions. In particular, the cooling duct within the entire part region comprises a consistent directional change. By way of this, in particular a contacting of the heat exchanger unit by the cooling fluid can be improved. Advantageously, a contact surface, at which the cooling fluid and the heat exchanger unit contact one another, can be increased independently of the cross-section surface area.

It would be possible that the cooling duct is alternately curved in different directions and comprises at least one point of reversal. In order to achieve a space-saving configuration of the heat exchanger unit it is proposed that the cooling duct is continuously curved along the large part of the course. That the cooling duct is "continuously" curved within a part region is to mean in particular that the cooling duct is free of points of reversal within the cooling duct. Preferably, a course direction of the cooling duct upon an imaginary movement along the large part of the course of the cooling duct is subjected to a steady rotation in one direction. A "course direction of the cooling duct" is to mean in particular a direction which runs perpendicularly to the cross-section surface of the cooling duct. Advantageously, an effective installation space utilisation of the cooling ducts and thus an increased contact area relative to the spatial extent of the heat exchanger unit can be achieved.

In addition to this it is proposed that the cooling duct comprises at least one end region, which when viewed along the axial direction has a tangential orientation, which at least substantially converges to a centre point of the shaft receptacle. An "end region" of the cooling duct is to mean in particular a part region which comprises maximally 10%, advantageously maximally 5% and preferably maximally 2% of a spatial extent of the cooling duct and along a course direction does not adjoin any further part regions of the cooling duct. "Tangential orientations" of a part region is to mean in particular two directions, which are anti-parallel to one another and parallel to a tangent, which lies against an outer contour of the part region. In particular, the end region adjoins the outlet opening of the cooling duct. Preferably, the cooling duct comprises at least one further end region which at least for a large part tangentially meets an imaginary circle, which only just encloses the cooling duct and the centre point of which is identical to the centre point of the shaft receptacle. That the end region "at least for a large part tangentially" meets the imaginary circle is to mean in particular that an orientation of the end region upon meeting the circle has a deviation of maximally 20°, advantageously maximally 15° and preferably maximally 10° from a tangent at a meeting point of the circle. Because of this, a flow velocity of the cooling fluid in the cooling duct can be increased in particular. Advantageously, reductions of the flow velocity through friction losses can be reduced.

In order to even further improve a contacting of the heat exchanger unit by the cooling fluid it is proposed that the cooling duct, when viewed along the axial direction, is situated within a circular sector of a circle, the centre point of which is identical to the centre point of the shaft receptacle, wherein the circular sector has a centre point angle of at least 20°, in particular 40%, advantageously at least 60% and preferably at least 80%. Because of this, a contacting of the heat exchanger unit by the cooling fluid can be improved even further, in particular. Advantageously, a contact area, at which the cooling fluid and the heat exchanger unit contact one another, can be increased even further independently of the cross-section surface area.

It would be conceivable that the cooling duct spirally winds around the shaft receptacle. In order to increase an efficiency of the heat transfer from the cooling fluid to the heat exchanger unit it is proposed that the heat exchanger unit comprises a multiplicity of cooling ducts, which jointly comprise an at least 10-fold, in particular at least 15-fold, advantageously at least 20-fold and preferably at least 25-fold rotation symmetry with respect to the axial direction. Advantageously, the cooling fluid, after the heat transfer to the heat exchanger unit, can be quickly conducted away from the heat exchanger unit.

Apart from this, it is proposed that the cooling ducts are arranged at least substantially in the form of a swirl impeller. Because of this, a heat transfer from the cooling fluid to the liquid to be pumped can be further improved in particular. Advantageously, a high contact area for the heat transfer, a high flow velocity of the cooling fluid, a high efficiency of the heat transfer and a high installation space efficiency of the cooling ducts can be achieved.

It would be conceivable that an additional motor unit pumps the cooling fluid through the cooling duct or the pump device comprises a cooling wheel, which is fastened to a half of the drive shaft facing away from the screw unit. Advantageously, the pump device comprises at least one rotatably mounted cooling wheel which is provided in order to transport the cooling fluid from an inlet opening of the cooling duct through the cooling duct to an outlet opening of the cooling duct. A "cooling wheel" is to mean in particular an element which is provided in order to rotate in the operating state and by means of the rotation, transport the cooling fluid. In particular, the cooling wheel transports the cooling fluid from a half of the drive shaft facing the screw unit to a half of the drive shaft facing away from the screw unit. Preferably, the cooling wheel is fastened to the drive shaft and rotates, in at least one operating state, jointly with the drive shaft. In particular, the cooling wheel is fastened to a half of the drive shaft facing the screw unit. Because of this, a flow behaviour of the cooling fluid can be improved in particular.

In order to increase an energy efficiency it is proposed that a curvature direction of the cooling duct is identical to a direction of rotation of the cooling wheel. That the curvature direction is "identical to the direction of rotation" is to mean in particular that upon an imaginary movement of the inlet opening to the outlet opening, the course direction of the cooling duct undergoes a rotation the direction of rotation of which is identical to the direction of rotation of the cooling wheel. Advantageously, a rotary impulse of the cooling fluid flowing through the cooling duct can be at least partly transferred to the cooling wheel.

Drawings

Further advantages are obtained from the following drawing description. In the drawings, an exemplary embodiment of the invention is shown. The drawings, the description and the claims contain numerous features in combination. The person skilled in the art will practically view the features also individually and combine them into practical further combinations. The scope of protection of the invention is determined by the claims.

There:

Fig. 1 shows a schematic representation of a pump with a pump device in a cross-section view,

Fig. 2 shows a schematic representation of a sealing part of the pump device in an oblique view,

Fig. 3 shows a schematic representation of the sealing part in a plan view,

Fig. 4 shows a schematic representation of a heat exchanger unit with the sealing part in the plan view, and

Fig. 5 shows a schematic representation of two cooling ducts of the heat exchanger unit in a sectional view.

Description of the exemplary embodiment

Figure 1 shows a pump 48 in a greatly simplified cross-section representation. The pump 48 comprises a motor unit 11. The motor unit 11 is formed as an electric motor. Alternatively, the motor unit 11 could be formed as an internal combustion engine. The pump 48 comprises a drive shaft 25. In an operating state, the motor unit 11 generates a rotation of a drive shaft 25. At one end, the drive shaft 25 is connected to a screw unit 15. The screw unit 15 is provided in order to set a liquid (not shown) to be pumped into motion. In the operating state, the screw unit 15 rotates jointly with the drive shaft 25. The pump 48 comprises a motor compartment 13. The motor unit 11 is completely arranged within the motor compartment 13. The pump 48 comprises a shell unit 17. The shell unit 17 is bell-shaped. The shell unit 17 delimits the motor compartment 13 partially towards the outside. The shell unit 17 comprises cooling ducts (not shown) for receiving a cooling fluid (not shown). The shell unit 17 consists of cast iron. Alternatively, the shell unit 17 could consist of stainless steel and/or ceramic. The pump 48 comprises a bearing cover 19. The bearing cover 19 forms a ceiling of the motor compartment 13 facing away from the screw unit 15. The bearing cover 19 consists of a material which is identical to the material of the shell unit 17.

The pump 48 comprises a pump device 10. The pump device 10 comprises a heat exchanger unit 12. In the operating state, the heat exchanger unit is provided for a heat exchange between the cooling fluid and the liquid to be pumped. The heat exchanger unit 12 comprises a sealing part 26 which is shown in more detail in the Figures 2 and 3. The sealing part 26 seals an opening of the shell unit 17 facing the screw unit 15. The sealing part 26 forms a bottom of the motor compartment 13 facing the screw unit 15. The sealing part 26 is formed shell-like. The sealing part 26 consists of a material which is identical to the material of the shell unit 17. The heat exchanger unit 12 comprises a cover element 28 which is shown in more detail in Figure 4. The cover element 28 is formed plate-like. The cover element 28 is formed circular-disc-like. The cover element 26 lies directly on the sealing part 26. The cover element 28 is screwed to the sealing part 26.

The heat exchanger unit 12 comprises 25 cooling ducts. The cooling ducts jointly comprise a 25-fold rotational symmetry with respect to the axial direction 18. The cooling ducts are designed in the form of a swirl wheel. The cooling ducts are formed identically to one another, which is why for the sake of clarity merely one cooling duct 14 and one further cooling duct 20 are given reference signs and are described in the following.

The sealing part 26 and the cover element 28 jointly define the cooling duct 14. The sealing part 26 comprises a recess which defines a duct wall 27 of the cooling duct 14. The duct wall 27 comprises, over the large part of the course, a cross-section that is oval for a large part. The cover element 28 lies on the recess and defines a duct sealing 29. A part region of the recess, which in an outer edge region extends beyond the cover element 28, defines an inlet opening 21 of the cooling duct 14. A part region of the recess, which extends in an inner edge region beyond the cover element 28, defines an outlet opening 23 of the cooling duct 14. The cooling fluid flows in a cooling circuit. The cooling fluid flows from the shell unit 17 into the inlet opening 21. The cooling fluid flows through the cooling duct 14 and through the outlet opening 23 back into the shell unit 17.

The heat exchanger unit 12 comprises a shaft receptacle 16. The shaft receptacle 16 is formed as a circular disc-shaped part region of the sealing part 26. The shaft receptacle 16 defines an inner edge of the heat exchanger unit 12. The shaft receptacle 16 has an axial direction 18. The drive shaft 25 is oriented along the axial direction 18. The drive shaft 25 penetrates the shaft receptacle 16.

A cross-section surface area of the cooling duct 14 changes over a large part of a course of the cooling duct 14 by approximately 20%. Alternatively, the cross-section surface area could also change by approximately 50% or approximately 100%. The cross-section surface area of the cooling duct 14 changes over the large part of the course of the cooling duct 14 irreversibly. The cross-section surface area of the cooling duct 14 radially decreases monotonically towards the shaft receptacle 16. Alternatively, the cross-section surface area of the cooling duct 14 could also be consistent over the large part of the course.

Fig. 5 shows the further cooling duct 20 in a sectional representation jointly with the cooling duct 14. The sectional representation corresponds to a circular section along the section line A, wherein the section surface was bent to a plane. The section line A corresponds to a circle the centre point of which is identical to a centre point 34 of the shaft receptacle 16. The further cooling duct 20 is arranged neighbouring the cooling duct 14. With respect to all further features, the further cooling duct 20 is identical to the cooling duct 14. A circular-arc-wise distance 24 extending concentrically to a centre point 34 of the shaft receptacle 16 from the cooling duct

14 to the further cooling duct 20 via the large part of the course of the cooling duct 14 corresponds to approximately 150% of a width 22 of the cooling duct 14. Alternatively, the circular-arc-wise distance 24 could also correspond to 50% or 400% of the width 22.

The cooling duct 14 is continuously curved along the large part of the course. Alternatively, the cooling duct 14 could run linearly in portions and/or have different curvature directions. The cooling duct 14 comprises an end region 30. The end region 30 adjoins the outlet opening 23 of the cooling duct 14. The end region 30, when viewed along the axial direction 18, has a tangential orientation 32. The tangential orientation 32 substantially runs towards a centre point 34 of the shaft receptacle 16. The cooling duct 14 comprises a further end region 31. The further end region 31 adjoins the inlet opening 21 of the cooling duct 14. The further end region 31, for a large part, tangentially meets a circle (not shown), the centre point of which is identical to the centre point 34 and which only just receives the cooling duct 14.

The cooling duct 14, when viewed along the axial direction 18, is situated within a circular sector 36 of the circle. The circular sector 36 comprises a centre point angle (not shown) of approximately 45°. Alternatively, the circular sector 36 could have a centre point angle of 90%.

The pump device 10 comprises a cooling wheel 38. The cooling wheel 38 is moveably mounted. The cooling wheel 38 is fastened to a half of the drive shaft 25 facing the screw unit 15. Alternatively, the pump device 10 could also comprise one or multiple cooling wheels, which could also be fastened to a half of the drive shaft 25 facing away from the screw unit 15. The cooling wheel 38 is provided in order to transport the cooling fluid from the inlet opening 21 of the cooling duct 14 through the cooling duct 14 to the outlet opening 23 of the cooling duct 14. A curvature direction 14 of the cooling duct 14 is identical to a direction of rotation 46 of the cooling wheel 38.

List of reference signs

10	Pump device
11	Motor unit
12	Heat exchanger unit
13	Motor compartment
14	Cooling duct
15	Screw unit
16	Shaft receptacle
17	Shell unit
18	Axial direction
19	Bearing cover
20	Cooling duct
21	Inlet opening
22	Width
23	Outlet opening
24	Circular-arc-wise distance
25	Drive shaft
26	Sealing part
27	Duct wall
28	Cover element
29	Duct sealing
30	End region
31	End region
32	Tangential orientation
34	Centre point
36	Circular sector
38	Cooling wheel
44	Curvature direction
46	Direction of rotation
48	Pump

Patentkrav

1. Pumpeanordning (10), især neddykkelig pumpeanordning, med i det mindste en varmevekslerenhed (12), som i i det mindste én driftstilstand er indrettet til en varmeudveksling mellem en kølefluid og en væske, der skal pumpes, og har i det mindste en kølekanal (14) og i det mindste en akseloptagelse (16) med en aksial retning (18), hvor et tværsnitsareal af kølekanalen (14) over i det mindste en størstedel af et forløb af kølekanalen (14) ændrer sig med højst 200 %, hvor varmevekslerenheden (12) har i det mindste én yderligere kølekanal (20), der er anbragt ved siden af kølekanalen (14), kendetegnet ved, at en cirkelbueafstand (24) fra kølekanalen (14) til den yderligere kølekanal (20), hvilken cirkelbueafstand forløber koncentrisk i forhold til et centrum (34) for akseloptagelsen (16), over størstedelen af kølekanalens (14) forløb svarer til i det mindste 50 % af en bredde (22) af kølekanalen (14).

2. Pumpeanordning (10) ifølge krav 1, kendetegnet ved, at kølekanalens (14) tværsnitsareal over størstedelen af kølekanalens (14) forløb højst ændrer sig irreversibelt, hvor tværsnitsarealet ved en betragtning langs kølekanalens (14) forløb ændrer sig monotont stigende eller monotont faldende i én retning.

3. Pumpeanordning (10) ifølge krav 1, kendetegnet ved, at kølekanalens (14) tværsnitsareal over størstedelen af kølekanalens (14) forløb er i det mindste i det væsentlige konstant.

4. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at varmevekslerenheden (12) har i det mindste én yderligere kølekanal (20), hvor en cirkelbueafstand (24) fra kølekanalen (14) til den yderligere kølekanal (20), hvilken cirkelbueafstand forløber koncentrisk i forhold til et centrum (34) for akseloptagelsen (16), over størstedelen af kølekanalens (14) forløb svarer til højst 400 % af kølekanalens (14) bredde (22).

5. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at varmevekslerenheden (12) har i det mindste en tætningsdel (26) og i det mindste et lågelement (28), hvilke i fællesskab definerer kølekanalen (14) over størstedelen af forløbet.

6. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at kølekanalen (14) er krum langs størstedelen af forløbet.

7. Pumpeanordning (10) ifølge krav 6, kendetegnet ved, at kølekanalen (14) er kontinuerligt krum langs størstedelen af forløbet.

8. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at kølekanalen (14) har i det mindste et endeområde (30), som ved en betragtning langs den aksiale retning (18) har en tangential orientering (32), som i det mindste i det væsentlige løber til et centrum (34) for akseloptagelsen (16).

9. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at kølekanalen (14) ved en betragtning langs den aksiale retning (18) ligger inden for en cirkelsektor (36) af en cirkel, hvis centrum er identisk med akseloptagelsens (16) centrum (34), hvor cirkelsektoren (36) har en centrumsvinkel på i det mindste 20°.

10. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved, at varmevekslerenheden (12) har et multiplum af kølekanaler (14, 20), som i fællesskab har en i det mindste 10-tallig drejesymmetri i forhold til den aksiale retning (18).

11. Pumpeanordning (10) ifølge krav 10, kendetegnet ved, at kølekanalerne (14, 20) er anbragt i det mindste i det væsentlige i form af et hvirvelhjul.

12. Pumpeanordning (10) ifølge et af de foregående krav, kendetegnet ved i det mindste et drejeligt lejret kølehjul (38), som er indrettet til at transportere kølefluiden fra en indgangsåbning (21) i kølekanalen (14) gennem kølekanalen (14) hen til en udgangsåbning (23) i kølekanalen (14).

13. Pumpeanordning (10) i det mindste ifølge kravene 6 og 12, kendetegnet ved, at en krumningsretning (44) for kølekanalen (14) er identisk med en drejeretning (46) for kølehjulet (38).

14. Pumpe (48), især neddykkelig pumpe, med en pumpeanordning (10) ifølge et af de foregående krav.

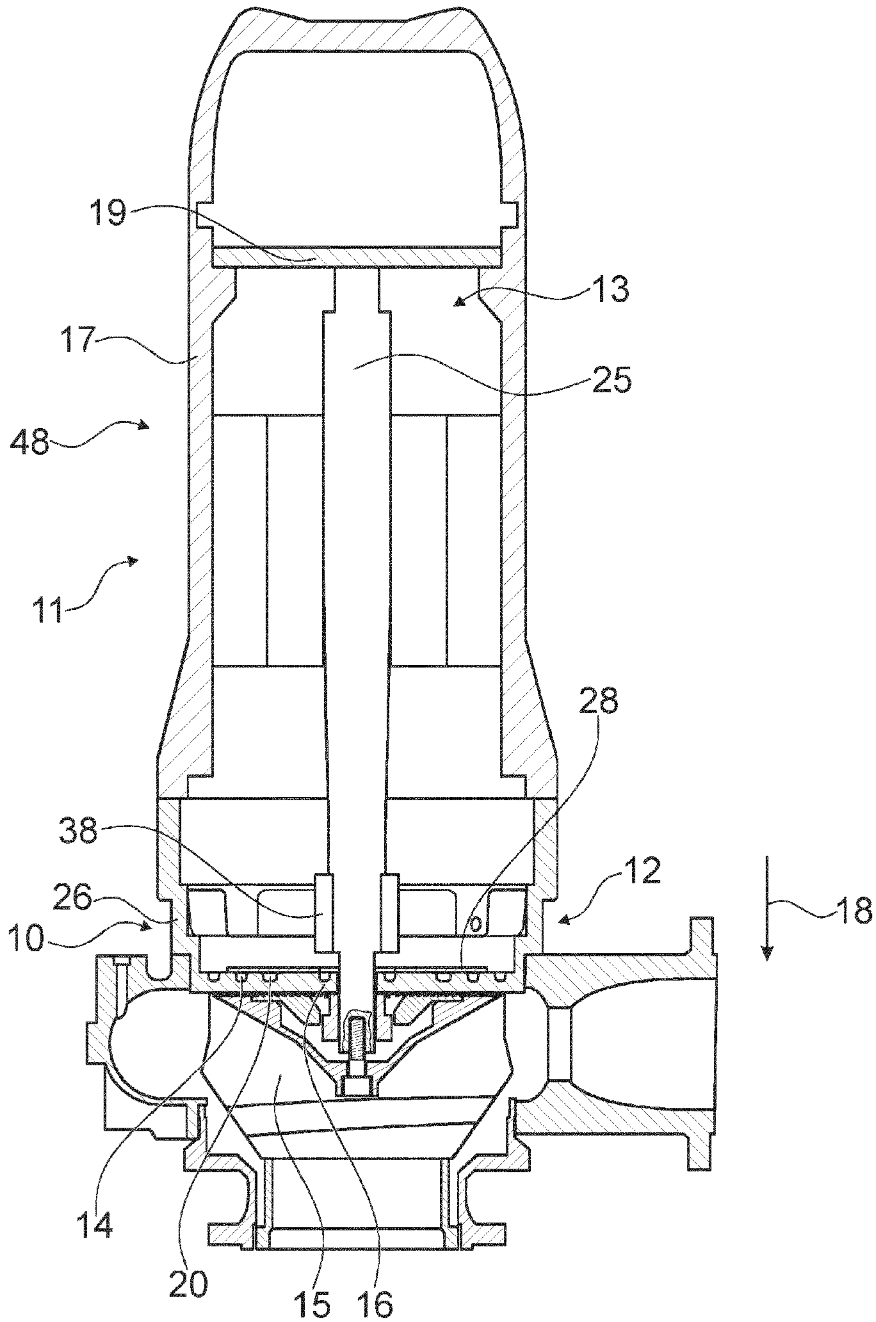

Fig. 1

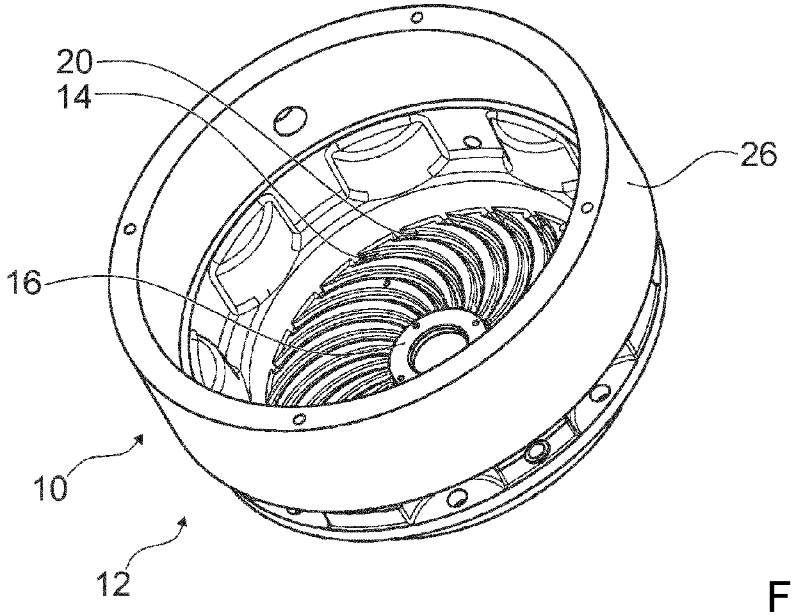

Fig. 2

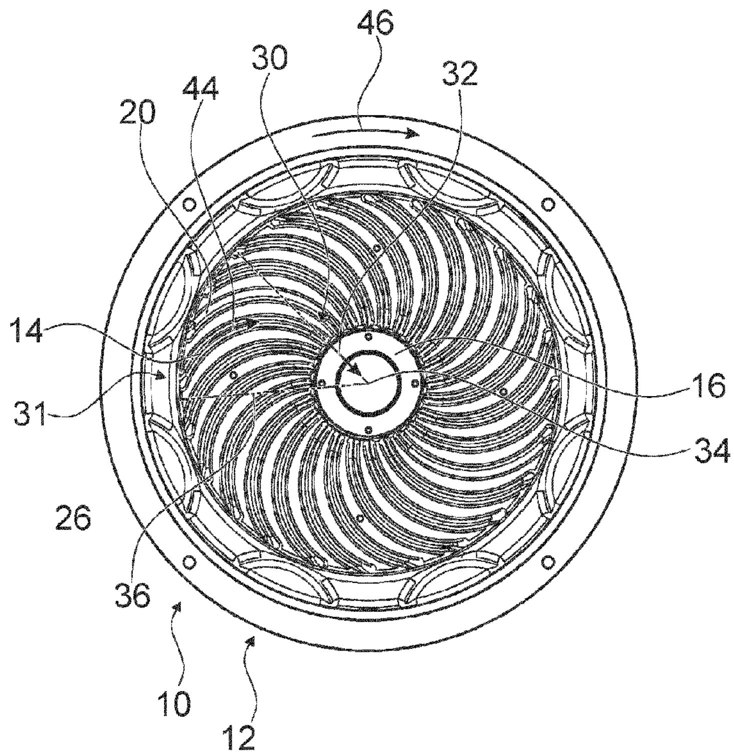

Fig. 3

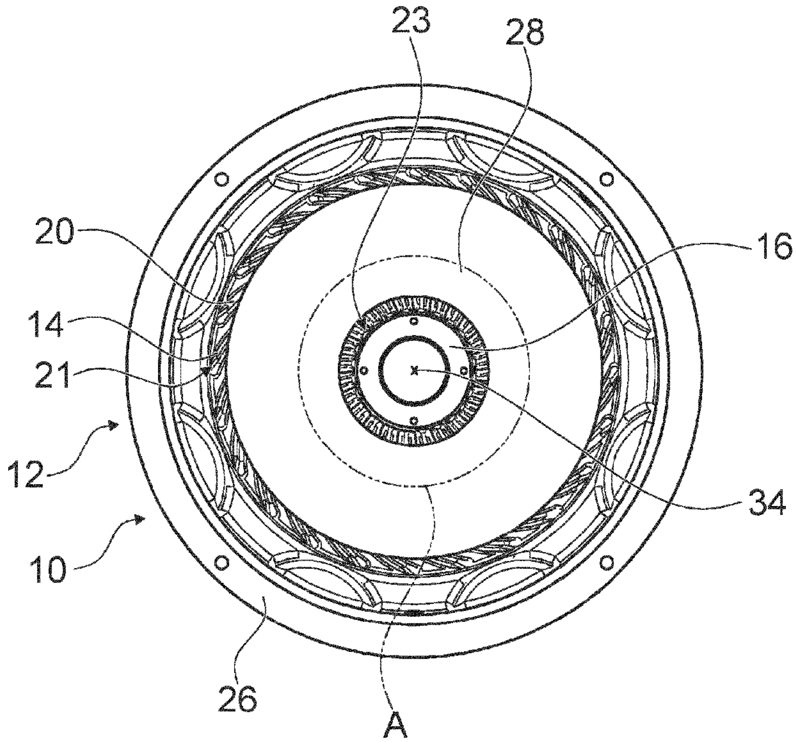

Fig. 4

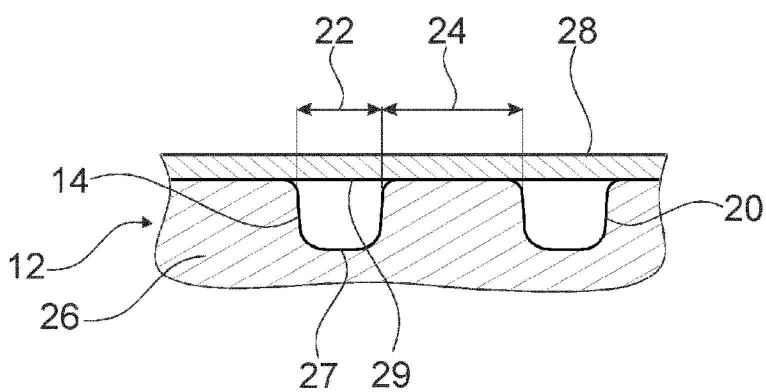

Fig. 5