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(54) Benævnelse: **Rotationsstempelpumpe**

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Rotary piston pump

The invention relates to a rotary piston pump for conveying a fluid medium containing solids, having two rotary pistons having inter-engaging rotary piston vanes and each having a rotary spindle and an outer periphery, wherein the rotary spindles of the two rotary pistons are arranged spaced apart from each other and in parallel with each other and the outer peripheries of the two rotary pistons partially overlap, and a housing having an inlet opening and an outlet opening and an inner wall and an outer wall, wherein the inner wall of the housing surrounds a section of the outer peripheries of the rotary pistons in each case, and wherein the rotary piston pump is formed to convey the medium in a conveying direction from the inlet opening to the outlet opening.

Rotary piston pumps fall into the category of displacement pumps and have two rotary pistons each with two or more rotary piston vanes. The rotary pistons are arranged in a housing, the inner wall of which faces the rotary pistons and the outer wall of which terminates the rotary piston pump on the outside. With its inner wall, the housing surrounds a section of the outer peripheries of the rotary pistons in each case. The section surrounded by the housing outer wall is also referred to as the enclosed angle. The tips of the rotary piston vanes may be provided with a coating, preferably a sealing surface made of rubber, in order to create a seal between the rotary piston vanes and the housing inner wall and between the inter-engaging rotary piston vanes. The rotary pistons are each driven rotatably about a rotary spindle in mutually opposite directions, wherein an outer periphery of each rotary piston is defined by the circular paths on which the tips of the rotary piston vanes rotate. In the region in which the rotary piston vanes engage with each other, the two outer peripheries of the rotary pistons overlap. Rotary piston pumps are generally symmetrical in design in order to allow the conveying direction to be reversed.

Rotary piston pumps of the design mentioned in the introduction are known, for example, from DE 297 23 984 U1, DE 34 27 282 A1, US 2,848,952, NL 101 62 83, US 3,126,834 and US 15,221. Rotary piston pumps of this kind are also used to convey media which contain solids. A fluid medium, generally a liquid, which may contain various kinds and amounts of solids, is fed through the inlet opening into the region where the rotary pistons overlap and is further displaced to the outlet opening by the rotary piston vanes. Media of different viscosities may be conveyed. Rotary piston pumps of the type mentioned in the introduction

have conveying rates ranging, for example, from approximately 3 to 1,000 cubic metres per hour, i.e., approximately 50 to 16,667 litres per minute, and pressures of up to approximately 16 bar.

Solids contained in the medium are swept with the medium into the cavities between the rotary piston vanes and are transported with the medium in the conveying direction of the rotary piston pump from the inlet opening to the outlet opening. Solids contained in the medium may be stones, metal parts or other foreign matter, for example.

Rotary piston pumps are frequently deployed in challenging environments. Typical fields of application for rotary piston pumps are, for example, sewage plants, dirty water and wastewater engineering, disposal and recycling engineering, the paper and cellulose industry, rail and port operations, the food industry or the construction industry. Rotary piston pump are used, *inter alia*, as sludge pumps, wastewater pumps, dirty water or service water pumps, thick matter pumps, animal feed pumps, mobile pumps, pumps for media contaminated with foreign matter, liquid manure pumps, faeces pumps or pumps for mash and pulp. These application conditions require rotary piston pumps to have a robust, reliable and tough design.

However, pump component damage, shut-downs and severe wear and tear are recurrent phenomena in existing rotary piston pumps, as solids are not always transported in their entirety into the cavities between the rotary piston vanes, where they are further displaced, but may come between the rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes. Solids may become stuck between rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes of the two rotary pistons, which may result in the pump shutting down, in damage or wear and tear on the housing and/or on the rotary pistons, in particular on the rotary piston vanes and in particular on any provided (sealing) coating on the tips of the rotary piston vanes. Shut-downs lead to unwanted operational disruptions and damage and wear and tear on the rotary pistons and/or the housing result in reduced efficiency of the pump due to reduced conveying pressure and in higher costs due to the need for repairs and for the replacement of wearing parts and replacement parts.

In order to eliminate these disadvantages, it is proposed in DE 20 2005 010 467 U1 and in DE 20 2006 020 113 U1 by the applicant for the housing to engage around the outer peripheries of the rotary pistons beyond a housing half angle alpha of 90° (Delta alpha) on the inlet side and on the outlet side, as shown in figure 1. Although the above disadvantages can be decreased as a result of this reduction in the cross-section of the inlet opening and outlet opening on the inner wall of the housing, there is still a need for further improvement of rotary piston pumps in order to further prevent the disadvantages mentioned above.

Rotary piston pumps are described in disclosures US 6,099,277, DE 102 39 558 A1, WO 2009/039881 and DE 25 43 593 and have an outlet opening which has a maximum ejection expansion on the inner wall of the housing which is larger than a maximum expansion of the inlet opening on the inner wall of the housing. However, the disclosures do not provide any indication of forming the inlet opening and outlet opening with respect to the disadvantages mentioned above, and only the latter two disclosures relate to pumps for conveying media similar to those mentioned herein.

The object of the present invention is therefore to provide a rotary piston pump for conveying a fluid medium containing solids which reduces or eliminates one or more of said disadvantages. Another object of the present invention is to provide a rotary piston pump for conveying a fluid medium containing solids, which reduces the number of shut-downs and the wear and tear on the rotary piston pump or the components thereof and/or which reduces any decrease in the efficiency or conveying pressure of the rotary piston pump even over a protracted period of operation and/or in challenging conditions of use.

The object is achieved in accordance with the invention by a rotary piston pump having an ejection expansion and an outlet opening as claimed in claim 1.

The outlet opening is an opening in the housing such that the outlet opening passes through the inner wall and also the outer wall of the housing. The ejection expansion is defined as the expansion of the outlet opening which occurs on the inner wall of the housing, namely in a direction which is perpendicular to the two rotary spindles and connects those rotary spindles.

Rotary piston pumps are often used in an operating position in which the rotary spindles of the rotary pistons are oriented horizontally and are arranged vertically one above the other. In

this case, the ejection expansion extends in the vertical direction, i.e., in parallel with the plane of the rotary spindles and perpendicular to the rotary spindles. However, other operating positions of rotary piston pumps are also possible, for example with rotary spindles which are oriented vertically and arranged horizontally next to each other. In this case, the ejection expansion would extend in the horizontal direction.

The invention is characterised in that the cross-section of the outlet opening tapers from the inner wall of the housing to the outer wall of the housing. The cross-section of the outlet opening is larger on the inner wall of the housing than the cross-section of the outlet opening on the outer wall of the housing.

When forming the outlet opening in the housing, lateral surfaces of the outlet opening, which can also be referred to as ejection ramps, are produced between the inner wall and outer wall of the housing along the periphery of the outlet opening. At least one of the ejection ramps is inclined such that the outlet opening tapers in the conveying direction of the rotary piston pump. Turbulence and the formation of eddies in the region of the outlet opening are reduced by virtue of the outlet opening being so tapered in the conveying direction. As a result, the solids are directed in movement paths which prevent or reduce – advantageously to a greater extent – the solids becoming jammed between the tips of rotary piston vanes and the housing or between two inter-engaging rotary piston vanes.

In one development, the ejection expansion is larger than the distance between the rotary spindles and therefore larger than in the solutions disclosed in the prior art. Thus, the section of the outer peripheries which is engaged by the inner wall of the housing is smaller in the region of the outlet opening than in the solutions disclosed in the prior art.

The invention is based on the knowledge that, on the outlet side of existing rotary piston pumps, there is an outlet flow or eddy formation in the medium, which frequently causes solids at the outlet opening to come between the tips of the rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes, and which may lead to damage, wear and tear and shut-downs. Due to the preferred formation of the ejection expansion, the solids are released from the rotary piston vanes earlier. This causes the tangential direction in which the solids are flushed out of the cavities between the rotary pistons to move away from the opposite rotary piston vanes. As a result, the movement paths of the solids

advantageously change, compared to existing solutions, in such a way that the solids are guided away from the rotary pistons, in particular from rotary piston vanes of the opposite rotary piston in each case. This change in the movement paths of the solids leads to a clear reduction in the amount of solids which, at the outlet opening, come between the tips of the rotary piston vanes and the housing inner wall or between two inter-engaging rotary piston vanes. These advantages are particularly clear in the case of solids which have a specific weight greater than that of the medium.

This reduction in the sensitivity of the rotary piston pump to foreign matter makes it possible, in particular, to reduce the number of shut-downs of the rotary piston pump and the amount of wear and tear on the rotary pistons, and to reduce a decrease in the conveying pressure of the rotary piston pump even when there is a high content of solids in the medium. The solution in accordance with the invention also allows the service life of the rotary piston pump to be extended and the costs for repair and maintenance of the rotary piston pump to be reduced.

The cross-section of the ejection expansion may be of any shape, for example circular or oval. It is preferred that the ejection expansion is larger along the entire width of the outlet opening than the distance between the rotary spindles, as the positive effect on the movement paths of the solids also declines when the ejection expansion is smaller in some sections than the distance between the rotary spindles. It is particularly preferred that the outlet opening has a rectangular or square cross-section, wherein the ejection expansion is substantially constant across the entire width of the outlet opening.

The invention is characterised in that the ejection expansion is greater than an expansion of the inlet opening on the inner wall of the housing in a direction extending in parallel with the plane of the rotary spindles and perpendicular to the rotary spindles. This development thus abandons the symmetrical design of the rotary piston pump with identically designed inlet and outlet openings, since the reduction of the enclosed angle in the region of the outlet opening and also a larger enclosed angle in the region of the inlet opening reduce clogging with solids between the tips of the rotary piston vanes and the housing inner wall or between two inter-engaging rotary piston vanes. Since the flow conditions, e.g. also in relation to eddy formation, on the inlet side of the rotary piston pump on which the medium is drawn in, are different from those on the outlet side of the rotary piston pump, on which the medium is

forced out under pressure, a different formation of the inlet opening and outlet opening, adapted to the flow and pressure conditions, is also advantageous for preventing or reducing clogging with solids, not only at the inlet opening, but also at the outlet opening.

One particularly preferred development is one in which the rotary spindles of the rotary pistons are oriented horizontally and arranged vertically one above the other when the rotary piston pump is in the operating position. In this case, the ejection expansion extends in the vertical direction. In such a development, it is also particularly preferred for the outlet opening to have a rectangular or square cross-section, in which the lower and the upper lateral surfaces or ejection ramps are inclined in the conveying direction towards the centre axis of the outlet opening. The width of the outlet opening may be exactly as large at the inner wall of the housing as at the outer wall of the housing, which means that the lateral surfaces are not inclined.

The invention is preferably developed by the outlet opening on the outer wall of the housing having an expansion which, in a direction extending in parallel with the plane of the rotary spindles and perpendicular to the rotary spindles, at most corresponds to the distance between the rotary spindles. It is particularly preferred for the outlet opening on the outer wall of the housing to have an expansion which is less than the distance between the rotary spindles in a direction extending in parallel with the plane of the rotary spindles and perpendicular to the rotary spindles. These designs for the ejection ramps are particularly advantageous with regard to influencing the movement paths of the solids, such that clogging with the solids between the tips of the rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes can be prevented even more reliably.

Another preferred development of the invention is characterised by a tube connection flange encompassing the outlet opening and having a centre axis which is arranged offset to a centre axis of the outlet opening on the outer wall of the housing. It is particularly preferred, in an operating position of the rotary piston pump, for the rotary spindles of the two rotary pistons to be oriented horizontally and arranged vertically one above the other and for the centre axis of the tube connection flange to be offset vertically downwards with respect to the centre axis of the outlet opening on the outer wall of the housing.

In order to connect the rotary piston pump into a pipeline system in which the medium to be pumped flows, the rotary piston pump preferably comprises a tube connection flange. The tube connection flange preferably comprises connection means to which it is possible to attach a pipeline, tube or the like to be connected. The tube connection flange preferably surrounds the outlet opening so that the entire cross-section of the outlet opening is in fluid communication with the interior of a pipe to be connected. However, in accordance with the invention the tube connection flange is preferably not disposed concentrically with the outlet opening on the outer wall of the housing, but rather offset therefrom. An offset is thus produced between the outlet opening and the pipeline to be connected to the tube connection flange. This offset can serve advantageously as a barrier for solids and can prevent these from being washed back into the outlet opening, or between the tips of the rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes, after leaving the outlet opening. In this way, the sensitivity of the rotary piston pump to foreign matter, and the costs for repair and maintenance of the rotary piston pump are further reduced, and the service life of the rotary piston pump is further increased.

In particular, it is advantageous when the lower ejection ramp of the outlet opening is inclined to a greater extent than the upper ejection ramp, when the rotary piston pump is in an operating position in which the rotary spindles of the two rotary pistons are oriented horizontally and arranged vertically one above the other, such that a vertical offset is produced in particular at the lower ejection ramp of the outlet opening in relation to a pipeline to be connected, i.e., that the lower ejection ramp of the outlet opening is disposed on the housing outer wall above a lower wall of a pipeline to be connected. In this way, the offset between the outlet opening and the pipeline to be connected forms an obstruction for solids which have left the outlet opening and which are located, due to force of gravity or due to currents or eddies in the medium, in the lower region of a pipeline to be connected, such that the solids cannot enter the outlet opening again, or can do so only with difficulty.

The invention is preferably developed by the housing comprising a main frame having two receptacles and two flanges which can be mounted in the receptacles so as to be able to be exchanged, wherein one of the two flanges is formed as the outlet flange comprising the outlet opening and the other of the two flanges is formed as the inlet flange comprising the inlet opening. The invention is preferably also developed by the two flanges and/or the two

receptacles being formed in such a way that each of the two flanges can be mounted in either one of the two receptacles.

Due to the different design of the inlet opening and the outlet opening, an optimal conveying direction of the rotary piston pump from the inlet opening to the outlet opening is defined. A reversed conveying direction is possible in this design of the inlet and outlet openings, but is disadvantageous because there is a higher risk of solids becoming jammed between the tips of the rotary piston vanes and the housing, or between two inter-engaging rotary piston vanes. However, in some applications it is advantageous and desirable to be able to switch the conveying direction of a rotary piston pump, for example when media must be conveyed in different directions or in order to clear blockages. In the development in accordance with the invention, it is therefore provided that the housing be modular in structure, comprising a main frame which has two recesses or receptacles, into each of which a flange can be inserted. One flange preferably comprises the inlet opening or the outlet opening and also, if necessary, the tube connection flange surrounding the outlet opening. In a particularly preferred manner, the two flanges and/or the two receptacles have a geometry which allows each of the two flanges to be mounted in either of the two receptacles. When both flanges are detachably mountable in the receptacles, the optimum conveying direction can also be reversed by swapping the two flanges. In order to ensure simple handling and thus fast and simple reversal of the conveying direction, it is particularly preferred for the flanges to be attached in the receptacles by means of quick-release fasteners.

In this way, the advantages of an asymmetric design of inlet and outlet openings can be combined with the advantages of a reversible conveying direction.

The invention is preferably developed by the two receptacles being formed in a mirror-symmetrical manner with respect to each other on a symmetry surface extending through the main frame. This development is particularly preferred because a mirrored design of the receptacles and preferably also a mirrored design of the external geometry of the flanges allows the flanges to be swapped in a particularly simple manner.

The invention is preferably developed by the outlet opening comprising at least one movable control element which can be displaced between a first and a second position such that the conveying direction when the control element is in the first position is opposite the conveying

direction when the control element is in the second position. The invention is also preferably developed by the inlet opening comprising at least one movable control element which can be displaced between a first and a second position such that the conveying direction when the control element is in the first position is opposite the conveying direction when the control element is in the second position.

It is thus preferred in these developments that the geometry of the outlet and/or inlet opening be variable in design, alternatively or in addition to a development with flanges which can be mounted so as to be able to be exchanged. It is particularly preferred for the outlet opening to be able to be changed by the at least one movable control element in such a way that it has the geometry of an inlet opening when the control element is in the second position. It is also preferred for the inlet opening to be able to be changed by the at least one movable control element in such a way that it has the geometry of an outlet opening when the control element is in the second position. In this way, the conveying direction of the rotary piston pump can be reversed by moving the control element(s) from a first position to the second position. This allows the conveying direction to be reversed in a particularly simple manner, as it is not necessary to exchange any components. At the same time, the advantages of an asymmetric design of the inlet opening and outlet opening can be combined with the advantages of a reversible conveying direction.

The invention is preferably developed by the control element of the outlet opening comprising a pressure-contact surface which is formed such that the control element is arranged in the first position when the medium at the outlet opening is at a first pressure and is arranged in the second position when the medium at the outlet opening is at a second pressure, wherein preferably the second pressure is a negative pressure. Another preferred development provides a pressure sensor which is configured to detect the pressure of the medium at the outlet opening and which is coupled to the control element of the outlet opening in such a way that the control element is arranged in the first position when the medium at the outlet opening is at a first pressure and is arranged in the second position when the medium at the outlet opening is at a second pressure. The invention is also preferably developed by the control element of the inlet opening comprising a pressure-contact surface which is formed such that the control element is arranged in the second position when the medium at the inlet opening is at a first pressure and is arranged in the first position when the medium at the inlet opening is at a second pressure, wherein preferably the second pressure is

a negative pressure. Another preferred development provides a pressure sensor which is configured to detect the pressure of the medium at the inlet opening and which is coupled to the control element of the inlet opening in such a way that the control element is arranged in the second position when the medium at the inlet opening is at a first pressure and is arranged in the first position when the medium at the inlet opening is at a second pressure. It is particularly preferred in this regard for the pressure sensor for detecting the pressure of the medium at the inlet opening to be identical to the pressure sensor for detecting the pressure of the medium at the outlet opening.

These developments in accordance with the invention advantageously utilise the different pressure ratios in the medium prevailing at a rotary piston pump on the inlet side and the outlet side. On the inlet side, there is a prevailing negative pressure or suction in the medium, referred to as the second pressure, whereas on the outlet side there is a prevailing positive pressure, referred to as the first pressure. When the conveying direction is reversed, these pressure ratios also change accordingly. By activating the control element(s) in dependence upon these pressure ratios, it is possible to ensure a geometry of the inlet opening and the outlet opening, adapted to the conveying direction, in a simple manner. The control element(s) can be coupled to the pressure of the medium mechanically or via one or more sensors.

The invention is preferably developed by at least one of the control elements being coupled to at least one of the rotary pistons such that the control element(s) is/are arranged in the first position when the rotary piston has a first direction of rotation and in the second position when the rotary piston has a second direction of rotation.

Another option for activating the control element(s) resides in the coupling, as provided in this development, with the direction of rotation of one or both rotary pistons. When the conveying direction is reversed, the direction of rotation of the rotary pistons also changes, thus allowing the geometry of the inlet and outlet opening to be changed in dependence upon the direction of rotation and thus upon the conveying direction when the control element(s) is/are coupled, preferably mechanically or via sensors, to the direction of rotation.

The invention is preferably developed by at least one of the control elements being coupled to a switching device for adjusting the conveying direction of the rotary piston pump such that

the control element(s) is/are arranged in the first position when the rotary piston pump has a first conveying direction and in the second position when the rotary piston pump has a second conveying direction.

Another option for activating the control element(s) resides in the coupling, as provided in this development, with the switching device of the rotary piston pump, by means of which the conveying direction can be switched. By coupling the control element(s) mechanically or via sensors to the switch position of the switching device, the geometry of the inlet and outlet opening can be rendered directly dependent on the conveying direction.

A preferred embodiment of the invention will be described by way of example with reference to the accompanying figures, in which:

Figure 1: shows a cross-section through a rotary piston pump in accordance with the prior art,

Figure 2: shows a cross-section through a first embodiment of a rotary piston pump in accordance with the invention, and

Figure 3: shows a cross-section through a second embodiment of a rotary piston pump in accordance with the invention.

Figure 1 shows the prior art, comprising a rotary piston pump 100 having two rotary pistons 110, 120 and a housing 130. The two rotary pistons 110, 120 each have a rotary spindle 111, 121 and four rotary piston vanes 112, 122. The housing 130 has an inner wall 131 surrounding sections of the outer peripheries of the rotary pistons 110, 120, and an outer wall 132 terminating the rotary piston pump on the outside, and feet 133, 134. The housing 130 comprises one inlet opening 150 and one outlet opening 140. The outlet opening 140 is surrounded by a tube connection flange 143 to which a pipeline 160 with an upper wall 161, a lower wall 162 and a centre axis 163 is connected. The centre axis 163 of the pipeline 160 corresponds to the centre axis of the tube connection flange 143. The inlet opening 150 is also surrounded by another tube connection flange 153, to which another pipeline 170 with an upper wall 171, a lower wall 172 and a centre axis 173 is connected.

In order to convey a medium in the direction from the inlet opening 150 to the outlet opening 140, the rotary pistons 110, 120 rotate in the directions of rotation 113, 123. The inlet

opening 150 and the outlet opening 140 each taper towards the inner wall 131 of the housing and are formed in a mirror-symmetrical manner in relation to the mirror surface SF. The inlet and outlet openings form lateral surfaces 141, 142, 151, 152 between the inner wall 131 and the outer wall 132.

The enclosed angle of the housing, in the region of the inlet opening and also in the region of the outlet opening, is alpha plus Delta alpha, i.e., the inner wall of the housing surrounds in each case a section of the outer periphery of a rotary piston of 2 x alpha plus 2 x Delta alpha. Such a mirror-symmetrical design for the inlet opening and the outlet opening is advantageous with regard to a possible switching of the conveying direction of the rotary piston pump. However, this solution in accordance with the prior art needs to be improved with regard to sensitivity to foreign matter, frequency of shut-downs, pressure loss, wear and tear, service life and costs of repair and maintenance.

Figures 2 and 3 show two embodiments of rotary piston pumps in accordance with the invention. Components with the same or similar functions are designated with the same reference signs plus 100 (figure 2) and plus 200 (figure 3) compared to figure 1. The differences between the rotary piston pumps in accordance with the invention, as shown in figures 2 and 3, and the rotary piston pump in the prior art, as shown in figure 1, and the differences between the two variants in accordance with the invention as shown in figures 2 and 3 will primarily be discussed hereinafter.

Figures 2 and 3 differ from the solution shown in the prior art in figure 1 by the design of the outlet opening 240, 340. In the two variants shown in figures 2 and 3, the outlet openings 240, 340 are formed in an identical manner. Figures 2 and 3 differ in that the inlet opening 250 in figure 2 corresponds to the inlet opening 150 in accordance with the prior art in figure 1, whereas figure 3 shows an inlet opening 350 which differs not only from the prior art in figure 1 but also from the variant in accordance with the invention as shown in figure 2.

The different design for the inlet openings 250, 350 in figures 2 and 3 becomes clear, in particular by the different inflow characteristics of the medium which are schematically represented by the arrows in the region of the inlet openings 250, 350. Owing to the taper of the inlet opening 250 in the direction of the inner wall 231 of the housing 230 in figure 2, the medium is guided centrally between the two rotary pistons 210, 220. In contrast, in the non-

tapering inlet opening 350 in figure 3, the medium flows across the entire cross-section of the inlet opening 350 towards a wider region of the two rotary pistons 310, 320.

In accordance with the invention, the outlet openings 240, 340 in figures 2 and 3 taper in the conveying direction, i.e. in the direction from the inner wall 231, 331 to the outer wall 232, 332 of housing 230, 330. The circular paths on which the tips of the rotary piston vanes 212, 222, 312, 322 rotate define the outer peripheries 214, 224, 314, 324 of the rotary pistons, which partially overlap. The enclosed angle of the inner wall 231, 331 of the housing is, in each case, beta minus Delta beta at the top and bottom on the outlet side of the rotary piston pump. The ejection expansion of the outlet opening 240, 340 is therefore larger than the distance between the rotary spindles 211, 221, 311, 321 in a direction extending in parallel with the plane of the rotary spindles 211, 221, 311, 321 and perpendicular to the rotary spindles 211, 221, 311, 321.

The lower lateral surface or ejection ramp 242, 342 is inclined to a greater extent than the upper lateral surface 241, 241. This is achieved in the embodiment variants shown in figures 2 and 3 by the upper ejection ramp 241, 341 of the outlet opening 240, 340 terminating at the outer wall 232, 332 of the housing 230, 330 at the height of the rotary spindle 211, 311 of the upper rotary piston 210, 310, and by the lower ejection ramp 242, 342 of the outlet opening 240, 340 terminating at the outer wall 232, 332 of the housing 230, 330 only at an angle of beta plus Delta rho. A vertical offset V is thus produced between the outlet opening 240, 340 and the lower wall 262, 362 of the connected pipeline 260, 360, said offset serving as a barrier for the solids a, b. The dot-dash arrows show the tangential direction in which the solids are flushed out of the cavities between the rotary piston vanes. These tangential directions point away from the rotary piston vanes of each opposite rotary piston. As can be seen from the dotted arrows, the movement paths of the solids a conveyed by the lower rotary piston 220, 320 extend in a curve from the outlet opening 240, 340 into the interior of the connected pipeline 260, 360. The movement paths of the solids b conveyed by the upper rotary piston 210, 310 likewise extend in a curve from the outlet opening 240, 340 into the interior of the connected pipeline 260, 360. These movement paths of the solids achieved by the outlet openings being designed in accordance with the invention substantially reduce clogging with solids in the rotary piston pump and thus lead to improvements with regard to sensitivity to foreign matter, frequency of shut-downs, pressure loss, wear and tear, service

life and costs of repair and maintenance of the rotary piston pump in accordance with the invention in comparison with the prior art.

P A T E N T K R A V

1. Rotationsstempelpumpe (200, 300) til transport af en fluidt medium indeholdende et faststof (a, b),

med to rotationsstempler (210, 220) med rotationsstempelvinger (222, 322), der griber ind i hinanden, og med henholdsvis en rotationsakse (221, 321) og en ydre periferi (224, 324), hvor rotationsakserne af de to rotationsstempler er anbragt i afstand fra hinanden og parallelt med hinanden, og hvor de ydre periferier af de to rotationsstempler delvist overlapper hinanden, og et hus (230, 330) med en indløbsåbning (250, 350) og en udløbsåbning (240, 340) såvel som en inder- (231, 331) og en ydervæg (232, 332), hvor indervæggen af huset omslutter et respektive afsnit af de ydre periferier af rotationsstemplerne, og hvor rotationsstempelpumpen er udformet til at transportere mediet i en transportretning fra indløbs- til udløbsåbningen,

k e n d e t e g n e t ved, at i en retning, som forløber parallelt med planet af rotationsakserne (221, 321) og vinkelret på rotationsakserne, omfatter udløbsåbningen ved indervæggen af huset en maksimal udkastningsudstrækning, som er større end en maksimal udstrækning af indløbsåbningen (250, 350) ved indervæggen (231, 331) af huset (230, 330), og at tværsnittet af udløbsåbningen (240, 340) tilspidser sig fra indervæggen (231, 331) af huset (230, 330) mod ydervæggen (232, 332) af huset (230, 330).

2. Rotationsstempelpumpe (200, 300) ifølge det foregående krav,

k e n d e t e g n e t ved, at udløbsåbningen ved indervæggen af huset omfatter en maksimal udkastningsudstrækning, som i en retning, der forløber parallelt med planet af rotationsakserne og vinkelret på rotationsakserne, er større end afstanden mellem rotationsakserne.

3. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav,

k e n d e t e g n e t ved, at udløbsåbningen (240, 340) ved ydervæggen (232, 332) af huset (230, 330) omfatter en udstrækning, som i en retning, der forløber parallelt med planet af rotationsakserne (221, 321) og vinkelret på rotationsakserne, maksimalt svarer til afstanden mellem rotationskaserne.

4. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav,

k e n d e t e g n e t ved en rørtilslutningsflange (243, 343), som omgiver udløbsåbningen (240, 340), med en midterakse (263, 363), der er anbragt forskudt i forhold til en midterakse af udløbsåbningen ved ydervæggen (232, 332) af huset (230, 330), hvor fortrinsvis i en driftsstilling af rotationsstempelpumpen er rotationsakserne (221, 321) af de to rotationsstempler udrettet horisontalt og anbragt vertikalt over hinanden, og midteraksen (263, 363) af rørtilslutningsflangen (243, 343) ved ydervæggen (232, 332) af huset (230, 330) er forskudt i vertikal retning nedadtil i forhold til midteraksen af udløbsåbningen (240, 340).

5. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav,

k e n d e t e g n e t ved, at huset omfatter en grundramme med to optag såvel som

flanger, der kan monteres udskifteligt i optagene, hvor én af de to flanger er udformet som udløbsflange omfattende udløbsåbningen (240, 340) og den anden af de to flanger som indløbsflange omfattende indløbsåbningen (250, 350), fortrinsvis hvor de to flanger og/eller de to optag er udformet således, at hver af de to flanger kan monteres i såvel det ene som også det andet optag.

6. Rotationsstempelpumpe (200, 300) ifølge det foregående krav,

k e n d e t e g n e t ved, at de to optag er udformet spejlvendt i forhold til hinanden om en gennem grundrammen forløbende symmetriflade.

7. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav,

k e n d e t e g n e t ved, at udløbsåbningen (240, 340) omfatter mindst ét bevægeligt indstillingselement, som kan omstilles mellem en første og en anden stilling på en sådan måde, at transportretningen ved anbringelse af indstillingselementet i den første stilling er modsat rettet transportretningen ved en anbringelse af indstillingselementet i den anden stilling.

8. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav,

k e n d e t e g n e t ved, at indløbsåbningen (250, 350) omfatter mindst ét bevægeligt indstillingselement, som kan omstilles mellem en første og en anden stilling på en sådan måde, at transportretningen ved anbringelse af indstillingselementet i den første stilling er modsat rettet transportretningen ved en anbringelse af indstillingselementet i den anden stilling.

9. Rotationsstempelpumpe (200, 300) ifølge ét af de to foregående krav,

k e n d e t e g n e t ved, at indstillingselementet af udløbsåbningen (240, 340) omfatter en trykangrebsflade, som er udformet på en sådan måde, at indstillingselementet ved et første tryk af mediet ved udløbsåbningen er anbragt i den første stilling, og ved et andet tryk af midlet ved udløbsåbningen i den anden stilling, fortrinsvis hvor det andet tryk er et undertryk.

10. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav 7 til 9,

k e n d e t e g n e t ved, at indstillingselementet af indløbsåbningen (250, 350) omfatter en trykangrebsflade, som er udformet på en sådan måde, at indstillingselementet ved et første tryk af mediet ved indløbsåbningen er anbragt i den anden stilling, og ved et andet tryk af midlet ved indløbsåbningen i den første stilling, fortrinsvis hvor det andet tryk er et undertryk.

11. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav 7 til 10,

k e n d e t e g n e t ved, at mindst ét af indstillingselementerne er koblet med mindst én af rotationsstemplerne på en sådan måde, at indstillingselementet eller indstillingselementerne ved en første rotationsretning (213, 313) af rotationsstemplet (210, 310) er anbragt i den første stilling, og ved en anden rotationsretning af rotationsstemplet i den anden stilling.

12. Rotationsstempelpumpe (200, 300) ifølge ét af de foregående krav 7 til 11,

k e n d e t e g n e t ved, at mindst ét af indstillingselementerne er koblet med en koblingsindretning til indstilling af transportretningen af rotationsstempelpumpen på en sådan måde, at indstillingselementet eller indstillingselementerne ved en første transportretning af rotationsstempelpumpen er abragt i den første stilling, og ved en anden transportretning af rotationsstempelpumpen er anbragt i den anden stilling.

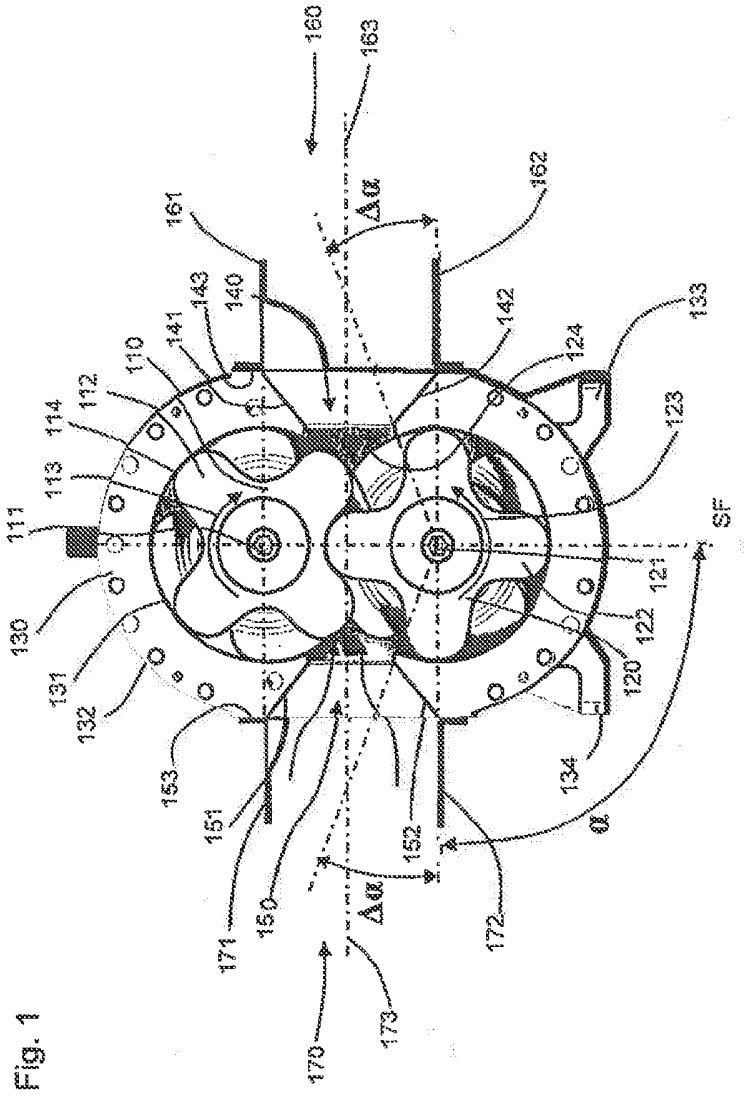
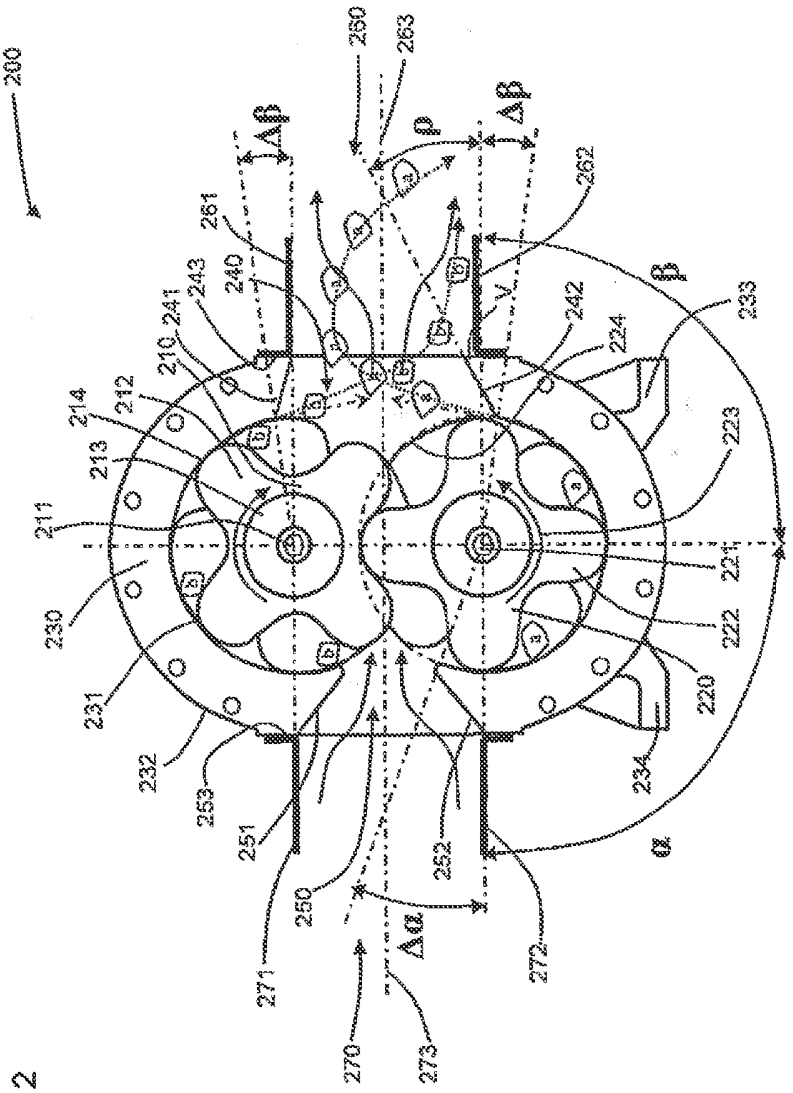


Fig. 1

Prior Art


200
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Δβ
262
261
240
243
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210
212
214
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273
252
272
α
β
242
224
233
223
221
222
220
234

Fig. 2

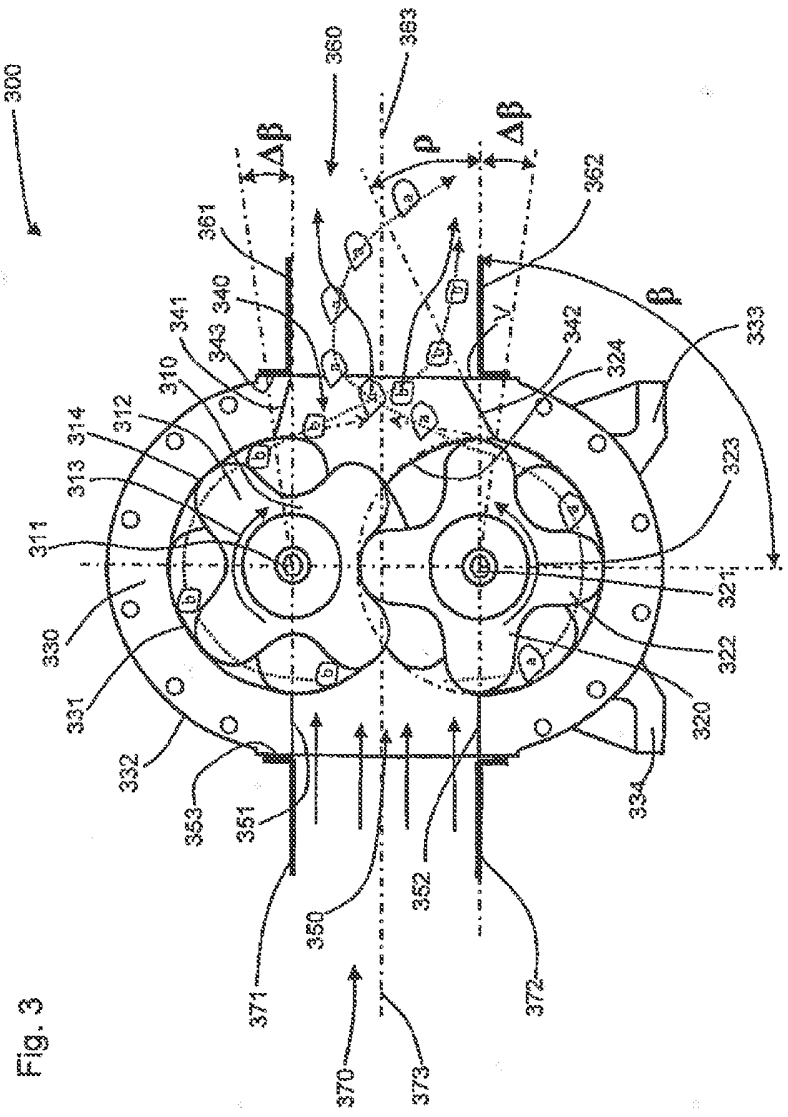
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Fig. 3