

The invention relates to a two cylinder viscous liquid pump according to the precharacterising part of claim 1.

In such a viscous liquid pump the switching member executes a to and fro movement in time with the pump lifts, at the end points of which the respective priming delivery cylinder is connected to a preliminary container and the forcing delivery cylinder is connected to a feed pipe. During the movement of the switching member, the cutting ring breaks up solid bodies in the viscous liquid which cannot avoid the ring. So far as it thereby avoids itself, that is made possible by the guide on the switching member, which also allows the adjustment of the cutting ring on wear of the sealing surfaces. The cutting ring outwardly cuts off the stream of viscous liquid and preferably seals metallically on a spectacle-shaped plate, in which apertures are formed for the delivery cylinder. This operating method requires strong forces, which push the cutting ring forwards in its guide in the direction of the cylinder apertures and press on the spectacle-shaped plate.

The invention stems from a known two cylinder viscous liquid pump (EP-A1-57288 or DE-OS 3103321). In this the function-dependent slot in the guide is sealed between the cutting ring and the switching member (Fig. 8 loc. cit.). This slot opens out into a radial slot between the face of the switching member and the cutting ring. The hydrostatic pressure there prevailing presses

the cutting ring onto the spectacle-shaped plate. Furthermore in operation there is a slot between the cutting ring and the spectacle-shaped plate in which the hydrostatic pressure from the metallic seal of the cutting ring is outwardly removed. The pressure thereby effective in the slot produces a separating force by loading of the sealing surfaces. On satisfactory operation of such a seal this separating force is balanced between the conveying phases such that, the free faces of the cutting ring connected with the pressure of the delivery medium are loaded by the delivery pressure. In the delivery phases of the switching member, in which the hydrostatic pressure temporarily collapses, the cutting ring is pressed by the mechanical potential of the annular spring onto the spectacle-shaped plate, so that the cutting ring also abuts sealingly to the spectacle-shaped plate in these movement phases.

For this purpose the seat for the rubber-elastic annular spring is made from the radial surfaces on the back of the cutting ring and on the outside of the switching member as well as from an axial surface running over the length of the annular spring on the switching member itself and from short and parallel opposed surfaces which are formed at the cutting ring and at the switching member. The annular spring is therefore prevented from breaking out of its seat on maximum compression by the cutting ring inserting into the guide. Between the seat surfaces an expanded axial annular spring surface remains,

which is free.

Under certain operating conditions and with unfavourable compositions of the viscous liquid, such as is the case, i.a., with concrete, higher wear and switching difficulties are noticed in the operation of such two cylinder viscous liquid pumps. They are a result of a partial or total blockage of the slot entrance between the cutting ring and the spectacle-shaped plate by deposited grains of the viscous liquid, which obviously work firstly in a similar way to a blocked filter and accordingly remove the hydrostatic pressure in front of the sealing surface. This results in a releasing of the cutting ring from the separating forces on the spectacle-shaped plate and in such a way that the cutting ring is pressed, by the effect of the delivery pressure on its free rearward face, with great excess force onto the spectacle-shaped plate. This higher contact pressure leads to a quick wearing of the overburdened sealing surfaces and to the braking, i.e. to switching difficulties, of the switching member in the delivery phases.

A limitation of the wear is already achieved by the embodiment of Fig. 4 of the above mentioned published specification. In this embodiment the inside surface of the annular spring is accessible from the inside of the switching member and is loaded with the hydrostatic pressure of the delivery medium. Nevertheless in this embodiment the access slot from the inside chamber

of the switching member to the annular spring is selected to be very large, so that this can be drawn into the delivery medium in the suction operation of the viscous liquid pump and is lost there. If this slot is made narrower then a blockage due to small stones in the concrete being supplied can very quickly occur. In this way, however, the pressure load of the annular spring would be lifted and as a result of the pressure in the slot between cutting ring and spectacle-shaped plate it would lead to the lifting of the cutting ring from the spectacle-shaped plate.

It is nevertheless known (DE-OS 26 14 895), to inwardly install the sealing ring serving for the sealing of the function-dependent slot in the guide of the cutting ring and to load it with the pressure of the viscous liquid. The sealing ring is thereby, however, not restrained sufficiently. It can therefore only pretension the cutting ring between the delivery phases on the spectacle-shaped plate by means of its radial potential. This potential is too small to seal the switching member. Besides which viscous liquid pumps must work not only in the forcing mode but also in suction mode. On suction mode the inwardly arranged sealing ring of the viscous liquid is easily lifted from its seat and is lost in the delivery medium.

The invention has the object of limiting the contact pressure of the cutting ring in all operational phases to the necessary minimum for raising the functional

safety in two cylinder viscous liquid pumps of the known type.

This object is solved by the invention with the characteristics of Claim 1. Useful embodiments of the invention are the subject of the sub-claims.

According to the invention the entire contact pressure of the cutting ring against the spectacle-shaped plate by the annular spring is transferred via its radial seating surfaces on the cutting ring to the cutting ring. This is a question as much of the mechanical elastic potential of the annular spring as of the tension transferred to the annular spring from the delivery pressure operating in the cylinder slot between the guide connection of the switching member and annular spring, which for its part transfers to the cutting ring. For this reason the annular slot (acc. DE-OS 31 03 321) falls between the face of the switching member and the rearward face of the cutting ring, and according to the invention there remains only one slot between the face of the switching member and spectacle-shaped plate as access for the supply medium for the slot between the cutting ring and spectacle-shaped plate and also for the cylinder slot between the switching member and annular spring.

A solid body seal, in case it forms at the entrance of this slot, thereby at the same time interrupts either wholly or partly the access of the delivery medium to the sealing slot and also to the slot between switching member and annular spring

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That has as a result a simultaneous immediate dependence as much on the hydrostatic pressure between the sealing surfaces of the cutting ring and the spectacle-shaped plate as on the hydrostatic pressure on the radial seating surfaces of the annular spring from the actual delivery forces. This leads in practice to the balancing out of both above mentioned hydrostatic pressures, dependent on the delivery pressure, on each operating condition, independent of how high the actual delivery pressure is and whether the hydrostatic pressures between the sealing surfaces or at the radial seating surfaces of the annular spring, through the effect of the solid body seal, are wholly or partly lifted.

The cutting ring is pressed in each operating phase essentially only by the mechanical expansion force of the annular spring against the spectacle-shaped plate.

When the access slot is not blocked by a solid body seal, the delivery medium pressure in the sealing slot between cutting ring and spectacle-shaped plate, as well as in the annular slot between the switching member and annular spring, comes into full effect. The effect of the delivery pressure on the annular spring is such that its radial extension is prevented by a surrounding frame and is converted to an axial extension, so that a force or pressure component arises in the axial direction on the cutting ring against the spectacle-shaped plate on axial supporting of the annular spring against the switching member. The annular spring at the same time outwardly

seals the inside space.

Due to its condition, separated from the stream of delivery medium by the cylinder connection of the switching member and loaded simply by the hydrostatic pressure of the delivery medium, there is no further current-dependent wear at the annular spring and also no current-dependent eroding of the seal.

The invention has the advantage that even with unfavourable properties in the viscous liquid, as are particularly encountered with concrete, which under certain conditions particularly often forms the described slot blockages or seals, an untimely destruction of the mutually sealing surfaces and building components is prevented. Furthermore the invention affords an equal train of movement of the switching member, because it removes the contact forces necessary for the seal to about the mechanical potential of the annular spring.

A short projection of the cutting ring over the cylinder-side face of the switching member and a correspondingly extended guide surface is also achieved, wherein the tilt resistance of the cutting ring on the switching member is achieved or improved.

In a preferred embodiment of the invention the frame of the annular spring is accommodated in the rubber-elastic material itself. This can have the form of a reinforcing spiral or a number of single rings arranged behind each other and can consist of gauze or gauze fibres, but also of wires.

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With the characteristics of Claim 3 both radial slots between the annular spring and their radial seating surfaces are prevented from being loaded at the same time with the hydrostatic pressure on too low a potential of the annular spring, wherein the forces raise the potential of the annular spring. The hydrostatic pressure in this embodiment of the invention operates more exclusively radially on the annular spring and is converted into axial forces which press together the sealing surfaces at the cutting ring.

Further embodiments of the invention are served by a frame of the annular spring which is arranged outside the rubber-elastic material.

Further embodiments of the invention are given in the following description on the basis of the figures in the drawings. These show:

Fig. 1 schematically and in longitudinal section, a first embodiment of the invention in an operating phase of a two cylinder viscous liquid pump,

Fig. 2 a further operating phase in a representation corresponding to Fig. 1,

Fig. 3 a third operating phase in a representation corresponding to Figures 1 and 2,

Fig. 4 the cross-section of an annular spring, which is used in the embodiments of Figures 1 to 3,

Fig. 5 a modified embodiment of the invention in a representation corresponding to Figures 1 to 3,

Fig. 6 a contrarily modified embodiment in a



representation corresponding to Figure 5, and

Fig. 7 a further modified embodiment of the invention in a representation corresponding to Figures 5 and 6.

The objects shown in the figures are in each case in cross-section and in Figures 1 to 3 and 5 to 7 are only reproduced in half-section.

A two cylinder viscous liquid pump has a cylinder head 1, which is connected to a spectacle-shaped plate 2 and sealed at 3. In front of the spectacle-shaped plate 2 a switching member 5 moves with a front part 6 which is replaceable for reasons of wear. On a front outside cylinder surface 7 of the switching member 5 a cutting ring 13 is guided with a cylindrical inside surface 8. Its front face 10 lies on an opposite surface 11 of the spectacle-shaped plate 2. Its back face 12 forms a radial seating surface for an annular spring 14 of rubber-elastic material. This has a rectangular cross-section, whose longer sides form the axial dimensions of inside and outside annular surfaces 15, 16, whilst the annular faces 17, 18 of the annular spring 14 is supported on the radial seating surface 12 of the cutting ring 13 or on a radial seating surface 19 of a flange 20 of the switching member 5, whereby the flange 20 projects outwardly over the axial guide surface 7 of the switching member.

On construction of the annular spring 14 this is put under axial potential. Fig. 1 shows the annular



spring forces at 21, whereby the respective resultants are shown at 22 and 23. As a result the cutting ring 13 is pressed by the force 22 in the direction of the spectacle-shaped plate 2 for the production of the sealing pressure on the sealing surfaces 10, 11. Contrary to the representation of Fig. 1 an intermediate position of the switching member 5 is assumed, in which the pressure of the viscous liquid in the inside 25 of the switching member and in the inside space 26 of the cylinder head 1 is broken down. The necessary contact pressure on the sealing surfaces 10, 11 is therefore correspondingly low and can be maintained by the force 22.

In the representation of Fig. 2 on the other hand it is assumed that in the inside spaces 25, 26 the pressure of the viscous liquid on the operating pressure of the continuous conveyor pipeline (not shown) has risen. That is the case in the final positions of the switching member if one of the delivery cylinders is connected with the switching member 5 and the conveyor pipeline.

Between the guide surfaces 7, 8 on the switching member 5 and the cutting ring 13 a function-dependent clearance 28a is present, which on one hand is open at the seat of the annular spring 14 and on the other reaches to the front face 27 of the front part 6. This clearance which can also be enlarged over its function-dependent size and can be formed as a slot, thereby forms a connection for the hydrostatic pressure in the inside spaces 25, 26 between a radial slot 38 and an annular slot

28b under the annular spring 14, so that the hydrostatic pressure forming there corresponds to the pressure in the spaces 25 and 26.

The annular spring is reinforced with a steel wire 29. This is shaped as a spiral or annularly in the axial direction and developed in an annular plane. It does however form several layers, of which a few are shown at 30 to 32, which run from the outside to the inside. The steel wire reinforcement forms an annular ring frame, which encircles the rubber-elastic material of the annular spring and thereby a considerable resistance opposes the radial extension of the annular spring, so that the annular spring preferably extends in the axial direction. As a result of the rubber-elastic property of the annular spring material, the annular spring 14 seals on the radial seating surfaces 17, 18 and builds the hydrostatic pressure which prevails in the slot 28b somewhat corresponding to the train of forces shown at 34 and 35. The hydrostatic forces with their resultants 36, 37 press the cutting ring 13 onto the spectacle-shaped plate 2 and add themselves to the forces 22, 23 of the mechanical annular spring potential.

On the other hand the hydrostatic pressure, which exists in the radial slot 38 between the front 27 of the switching member 5 and the face of the spectacle-shaped plate 2, reduces on the sealing surfaces 10,11 of the cutting ring 13 and the spectacle-shaped plate 2 from the inside to the outside according to the train of forces

shown at 39, whose resultant is shown at 40. As can be originated from approximately equal forces 35, 39, in practice the cutting ring in this operating phase of the two cylinder viscous liquid pump is pressed with an excess force onto the spectacle-shaped plate, which corresponds to the mechanical annular spring potential force 22. The cutting ring 13 is thereby reliably sealed.

In the representation of Fig. 3 emanating from a blockage of the radial slot 38 by an accumulation of fine grains at the entrance of the slot 38 and in its surroundings, which has cemented together in increasing amount, so that the hydraulic pressure in the slot 38 behind the fine grain accumulation is practically removed. As a result of the open annular slot between the guide surfaces 7, 8 the pressure in the annular slot 26 under the annular spring 14 is also removed. Therefore the annular spring 14 is pressed onto the cutting ring 13 solely by the by force 22, which corresponds to the annular spring potential 21. Since on the other hand the hydrostatic forces to be removed by the sealed surfaces 10, 11 of the cutting ring 13, corresponding to the pressure loss in the annular slot 38 have also fallen away, there is also no separating force, so that the cutting ring is only pressed by the resultants 22 onto the spectacle-shaped plate 2.

In order to achieve the seal of the annular spring 14 for the avoidance of the pressure drop shown at 34 and 35, this is, according to the representation of

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Fig. 4 which reproduces the annular spring 14 in extended position, provided at its inside limiting edges of its radial surfaces 18, 17 with respective axial outwardly projecting sealing lips 42, 43, which form a unity with the annular seal 14.

According to the embodiment of Fig. 5 the annular seal 14 has respectively a vulcanised steel ring 44, 45 on its radial surfaces and in the region of the inside limiting edges. Each steel ring 44, 45 seals on an O-ring 46, 47, which lies in a respective annular groove 48, 49; the annular grooves are turned in the radial seating surfaces 12, 19 of the cutting ring 13 or the switching member 5.

In the embodiments of Figs. 6 and 7 which reproduce other annular spring frames with regard to the sealing function of the annular spring, the forces shown in Figs. 1 to 3 are not shown. According to the representation of Fig. 6, however, the central diameter 50 of the guide of the cutting ring 13 with the surfaces 7, 8 on the switching member 5 is reproduced. This central diameter is smaller than the working diameter 51 of the metallic seal of the cutting ring 13 on the spectacle-shaped plate 2 (resultant 40 in Fig. 2).

These diameter relationships are valid for all embodiments of the invention. Furthermore, in the embodiment of Fig. 6 the annular spring 14 is not reinforced. For this reason the annular flange 20 of the switching member 5 has an axial extension which forms a

casing 52, which surrounds the cutting ring 13 with its front part 53, without guiding it. The guide also take over the seat 7, 8. By means of this frame 52 there is a closed inside space 54 for the annular spring 14, which can only withdraw, on increase in pressure in the annular space 28b, in the direction of the cutting ring 13 and therefore pretensions this on the spectacle-shaped plate 2.

Fig. 7 differs from this by means of a frame, in which the casing 52 no longer forms a unity with the annular flange 20 corresponding to the representation of Fig. 6, but represents a contrary movable part which is supported by a flange 54 on the face 55 of the flange 20. In this casing 52 the annular spring 14 is inserted. The casing 52 surrounding the cutting ring 13 with its front part 53, forms for its part an annular spring frame, which only permits the withdrawal of the rubber-elastic material of the annular spring 14 in the axial direction 13, so that on the rise in pressure in the annular space 28, the cutting ring 13 is again pressed by the hydrostatic force onto the spectacle-shaped plate 2.



Patent Claims

1. A two cylinder viscous liquid pump, preferably a concrete pump, whose switching member has a guide for the centering of a sealing cutting ring on the cylinder-side and a seat for a pretensioned rubber-elastic annular spring, characterised in that the annular spring (14) is loaded by the pressure of the viscous fluid through the annular slot (28a) open up to the annular spring seat between the cutting ring (13) and the switching member (5) and has a reinforcement or frame (29, 52) which surrounds the annular spring (14) between the radial seating surfaces (19, 12), and that the guide surface (8) of the inside of the cutting ring (13) is cylindrical and extends up to the sealing surface (10) of the cutting ring.

2. A two cylinder viscous liquid pump according to Claim 1, characterised in that the reinforcing wire (29) is shaped as a spiral or annularly in the longitudinal direction of the annular spring (14) and is accommodated in several consecutive layers (30 to 32) from outside to inside in the rubber-elastic material of the annular spring (14).

3. A two cylinder viscous liquid pump according to either of claims 1 or 2, characterised in that the inside edges of the radial annular spring surfaces (17, 18) are provided with axial outwardly pointing sealing lips (42, 43), which form a unity with the annular spring (14).

4. A two cylinder viscous liquid pump according



to any of claims 1 to 3, characterised in that the frame of the annular spring (14) consists of a casing (52) which stems from the radial seating surface (19) of the annular spring (14) to a flange (20) and surrounds the cutting ring (13) with its front part (53).

5. A two cylinder viscous liquid pump according to Claim 4, characterised in that the casing (52) forms a unity with an annular flange (20) of the switching member (5) on which the radial seating surface (19) is constructed.

6. A two cylinder viscous liquid pump according to Claim 4, characterised in that the casing (52) is supported on a radial annular surface (55) of the switching member flange (20) and the rubber-elastic annular spring (14) is inserted in the casing.

7. A two cylinder viscous liquid pump according to any of claims 1 to 3, characterised in that a number of single rings serve for the reinforcing of the annular spring (14), which are embedded in the rubber-elastic material.