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(54) Vane pump.

(57) A vane pump for working at relatively low rotary speed (even < 70 rpm), which pump comprises a pump housing 3 (with inlet 5 and outlet 7 ports), a rotatable seated pump wheel 15 fitted in said housing with its axis 51 of rotation eccentrically placed in relation to the interior of the pump housing, said pump wheel being fitted with two vanes 37 seated such as to be radially slidable in relation to the pump wheel and being movable between two extreme positions dependent on the shape and internal siting within the pump housing of parts 57 intended for guiding radially facing edges 45 of the vanes, wherein each vane stretches diametrically through the pump wheel and is substantially at right angles to the other vane, the parts guiding the vane edges are shaped to define circular arc-sections of travel for the vane edges centred in the rotation axis of the wheel in at least one section between the inlet port and the outlet port, said section covering an angle of at least 90° as viewed parallel to the rotation axis.

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Vane Pump

The present invention relates to a vane pump for working with relatively low rotary speed, which pump consists of a pump housing (with an inlet port and an outlet port), where in said pump housing is fitted a rotatable seated pump wheel with its rotation axis placed eccentric in relation to the interior of the pump housing. The pump wheel is equipped with two radially slidable vanes, which vanes may be movable in relation to the pump wheel between two extreme positions dependent on the shape and siting internally in the pump housing of the parts designed to support the edges of the vanes. By low rotary speed is meant that the pump wheel during normal operation makes less than 100 revolutions per minute.

This type of pump is disclosed in DK patent publication no. 139.880 and is designed for the transport of whole fish in water. The known pump is thus designed to transport solid parts suspended in liquid in a gentle manner. The known pump has a large capacity in relation til its external measurements. It is, however, not particularly robust as a movable valve flap which lies up against the pump wheel, thus forming packing between the casing and the wheel, has a tendency to jam due to impurities in the liquid. In the part of the pump chamber where the pressure is created and during the passage of which the load on the vanes is greatest, the vanes slide in relation to the pump wheel. This causes extensive wear on the vanes and hereby considerable maintenance.

The aim of this present invention is to produce a rotating positive-displacement type pump of the above-mentioned kind, which compared to the known pumps has a more robust and maintenance-free construction for pumping tasks demanding large torque, and especially for pumping sluggish or highly viscous mediums or pumping at high pumping pressures.

Aaccording to the present invention this is achieved with a pump of the type described in the introduction to claim 1, but being distinctive in that the vanes each stretch diametrically through the pump wheel and are essentially at right-angles to one another, that the parts guiding the vane edges are shaped as to define circular arc-sections of travel for the vane edges with centre in the rotation axis of the wheel in at least one section between the inlet port and the outlet port, the section covering an angle of at least 90° as seen parallel to the rotation axis.

The vanes reach out to the pump housing sides on each side of the wheel and are guided by parts, i.e. surfaces or rails, which stretch round the wheel. The actual pump pressure can thereby be built up in this section and as the surfaces in this section are concentric with the wheel's rotation axis, the vanes will not move in relation to the wheel during passage through these sections. In this way, one entirely avoids the wear caused by movement between wheel and vane in precisely this area, where the load exercised on the pump medium by the vanes, and, therefore, also by the wheel on the vanes, is greatest. Thus highly viscous mediums can be pumped and the possibility of high pump pressure is treated at the same time as the gentle treatment of the pump medium in such a slowly rotating positive-displacement pump with great internal volume is retained.

Typical areas of use for the pump according to this invention are pump mediums such as slaughter-house waste, which up to now has been transported in open screw pumps with the subsequent nuisance of unpleasant smells, and floculated waste water which requires careful treatment so as not to break up the floculated lumps of solid material in the water, and for which piston pumps have been used up to now.

Exceptionally simple embodiments of this invention, which are therefore advantageous from a manufacturing point of view are shown in claims 2 and 3.

In order to avoid replacing whole vanes when the edges of these are worn, the vane edges can, as dealt with in claim 4, consist of detachable fixed pieces.

As dealt with in claim 5, the removable vane edges can be made shock-absorbent by means of a shock-absorbing liner, the purpose being to counteract hard particles in the pumping medium. Also, the liner can thus act as a compression spring so the vane edges are always held pressed against the bars or surfaces along which the vane edges slide.

When the pump according to this invention is needed for pumping mediums with low viscosity it can be made as dealt with in claim 6, where the circular arc-shaped section and, at least the adjoining and toward the rotation axis extended surfaces inside the pump housing, are mainly coated with a relatively flexible material, for example plastic or rubber material. Thus an adequate water tightness is achieved in the area of the pump where the pump pressure is created, so that for example water can be pumped with a pump outlet pressure of up to 250 metres of water column.

When pumping medias containing solids, for example, slaughter house waste, which contains larger pieces of bone, it is an advantage to equip the pump with a cutting device as dealt with in

claim 7, where, as seen in the direction of rotation of the pump wheel, by or immediately after the inlet port and essentially parallel to the wheels rotation axis, there is a kind of knife which can be passed by the vanes with little or no clearance. This sharp edge has a length at least equal to the broadest part of the inlet port. Thus a passing vane and the sharp edge can cut over any solids which would otherwise block the pump.

Embodiments for the invention will hereafter be described in more detail with reference to the drawings, of which:

Fig. 1 shows a vertical section through a pump according to this invention,

Fig 2 shows a section on the line II-II on fig. 1,

Fig. 3 shows a pump vane seen at right angles to the plane of extension of the vane,

Fig. 4 shows the vane according to fig. 3 seen from the right and,

Fig 5 shows an enlarged section of one of the vane's radially facing edges.

A preferred embodiment of the pump according to this invention has a mounting flange or foot 1, whereon a cast pump housing 3 is fixed. The pump housing 3 has a rectangularly shaped, radially directed inlet 5, a tangential directed outlet 7 and an internal form like a cylinder. On each side of the pump housing 3 covers 9 are mounted by screws, on which covers 9 bearing housings 11 are eccentrically mounted, the housings 11 being closed with end covers 13 and 14.

The pump has a pump wheel 15 which in this embodiment consists of two end pieces 17 and 19 and a middle piece 21. As shown on fig. 1 this middle piece 21 is divided into four quarter parts. All three pieces 17, 19, 21 are made of a solid material and are mutually connected with screws, the fitting screw holes 23 being shown on fig. 1. The end pieces 17 and 19 are made in one piece with an axle journal 25 and a drive axle 27, respectively, both of which rest in bearings 29 in the bearing housings 11. A hole in the cover 14 allows passage of the drive axle 27 which is driven by a not shown hydraulic motor.

In the bearing housings 11, packings 31 are fitted to prevent the pump medium leaving the pump housing 3, and packings 33 and 35 are fitted to protect the bearings 29.

In the middle piece 21 and the two end pieces 17 and 19 two identical vanes 37 are seated, the shape of the vanes being shown on figs. 3 - 5.

Each vane 37 is thus cut oute of a solid sheet in a U-shape with a cut-out 41 which stretches from the one side edge 43 of the vane to a depth a little over half the width of the vane. The radially facing edges 45 of the vanes are fitted with detachable pieces 47 fixed with counter-sunk screws 48 to the web of the vane 37. Between pieces 47 and the web of the vane 37 there is a flexible liner 49, which for example may be of solid rubber and shaped as shown on fig. 5.

Replaceable wear irons 39 control the vanes in the wheel 15, the rotation axis 51 of which is in a first plane of symmetry 53 to the pump housing's interior and at a distance from a second plane of symmetry 55. In the pump housing's interior, the vane's 37 position in relation to the wheel 15 is controlled by rails 57, the surfaces of which have three different radiuses of curvature. The smallest radius is determined by the radiuses of end pieces 17 and 19, as these lie close up against bars 57 in area 59. The remaining radiuses and sitings of the rail surfaces in areas 61 and 63 are determined by area 59, as the height and rotation axis siting of the vanes determines these. Thus in area 63, a semi-cylindrical curve is formed, with its centre in rotation axis 51 and in area 61 the curve is fixed as a transition between areas 59 and 61.

In order to be able to build up adequate pump pressure in a pump medium as water and with slow rotational speed, there must be some kind of packing between the housing 3 on the one hand and the vanes 37 and rotor 15 on the other hand in the area between inlet 5 and outlet 7. Therefore between rails 57 semi-cylindrical packing elements 65 have been provided in areas 59 and 63. The packing elements 65 consist of neoprene rubber or polyethylene fixed in seatings built up of welded steel pieces 67. Furthermore, the internal sides 69 of the covers are covered with flat packings 68 of the same type of packing material as elements 65 for packing the vane's axially directed edges, at least in an area equal to the circular section limited by the circular arc-sections defined by the surfaces of elements 65.

In addition there is a deflector 66 at the transition between outlet 7 and surface 59, this deflector 66 keeps impurities from wedging themselves between the rotor 15 and the surface 59 and supports packing 65, all at the same time.

In area 63, elements 65 stretch over a circular arc a little larger than 90°, at the same time the middle section 21 of the rotor, which has a little larger diameter than the end pieces 17 and 19, always lies up against the corresponding element 65 in area 59. In this embodiment of the pump with packings 65 the pump can pump water with greater difference pressure over the pump, even at rotary speeds less than 70 rpm. The low rotary speed of the pump and resulting gentle treatment of the pump medium particularly prove their worth when one wants to transport floculated waste water without spoiling the floculated lumps of solid material in the water.

In an alternative embodiment of the pump according to this invention designed for pumping slaughter-house waste or other mediums containing solid parts, the pump may as shown by the stippled line on fig. 1 be equipped with a knife 71 which stretches across inlet 5. The knife 71 is provided with an edge 73 of hardened steel; this edge is placed between bars 57 close to the track created by vane edges 45 during the movement of the wheel 15. If, for example, a piece of rib gets stuck between vane edge 45 and the knife edge 73 this will simply be cut over. In this type of embodiment when pumping highly viscous liquids containing hard objects, packings 65 and 68 can be dispensed with, as a gap of a few hundredths of a millimeter between surfaces 59, 63, 69 and vane edges 45 is adequate to maintain the pump outlet pressure.

The robust and simple construction obtained with the pump according to this invention is also useful in other areas, for example, for transporting highly viscous liquids and liquids which are difficult to handle. The pump construction can thus withstand heating, a property which can be utilized when pumping raw oil in refineries.

Claims

1. Vane pump for working with a relatively low rotary speed comprising a pump housing provided with an inlet port and an outlet port, where in said pump housing is fitted a rotatable pump wheel with its rotation axis eccentrically placed in relation to the inner contour of the pump housing, the pump wheel being fitted with two vanes seated radially slidable in relation to the pump wheel, the vanes being movable between two extreme positions dependent on the shape and siting internally in the pump housing of parts intended for guiding radially facing edges of the vanes, **characterized** in that the vanes each stretch diametrically through the pump wheel and are essentially at right-angles to one another, that the parts guiding the vane edges are shaped as to define circular arc-sections of travel for the vane edges with centre in the rotation axis of the wheel in at least one section between the inlet port and the outlet port, the section covering an angle of at least 90° as seen parallel to the rotation axis.

2. Vane pump according to claim 1, **characterized** in that the body of the pump wheel has cylindrical shape and that there is two circular arc-sections shaped as cylindrical surfaces whereof the smallest cylindrical surface has the same or almost the same radius as the pump wheel's cylindrically shaped outer surface.

3. Vane pump according to claim 1 or 2, **characterized** in that each vane essentially consists of a web of flat sheet material, the web being essentially shaped as a U when seen at right-angles to the the plane of extension of the vane.

4. Vane pump according to claims 2 - 3, **characterized** in that each radially facing edge of the vane consists of one or more removable fixed pieces.

5. Vane pump according to claim 4, **characterized** in that between the removable fixed pieces and the web of the vanes there is a shock-absorbing liner of a relatively flexible material.

6. Vane pump according to claim 1 - 5 , **characterized** in that the circular arc-shaped section or sections and at least the adjoining surfaces extending herefrom in direction of the rotation axis inside the pump housing, are mainly covered with a layer of relatively flexible material.

7. Vane pump according to claim 1 - 5, **characterized** in that, as seen in the direction of vane movement during operation, by or immediately after the inlet port and essentially parallel with the wheel's rotation axis, there is provided a sharp edge or knife which may be swept by the vane edges with little or no clearance, the knife having a length at least equal to the greatest width of the inlet port.

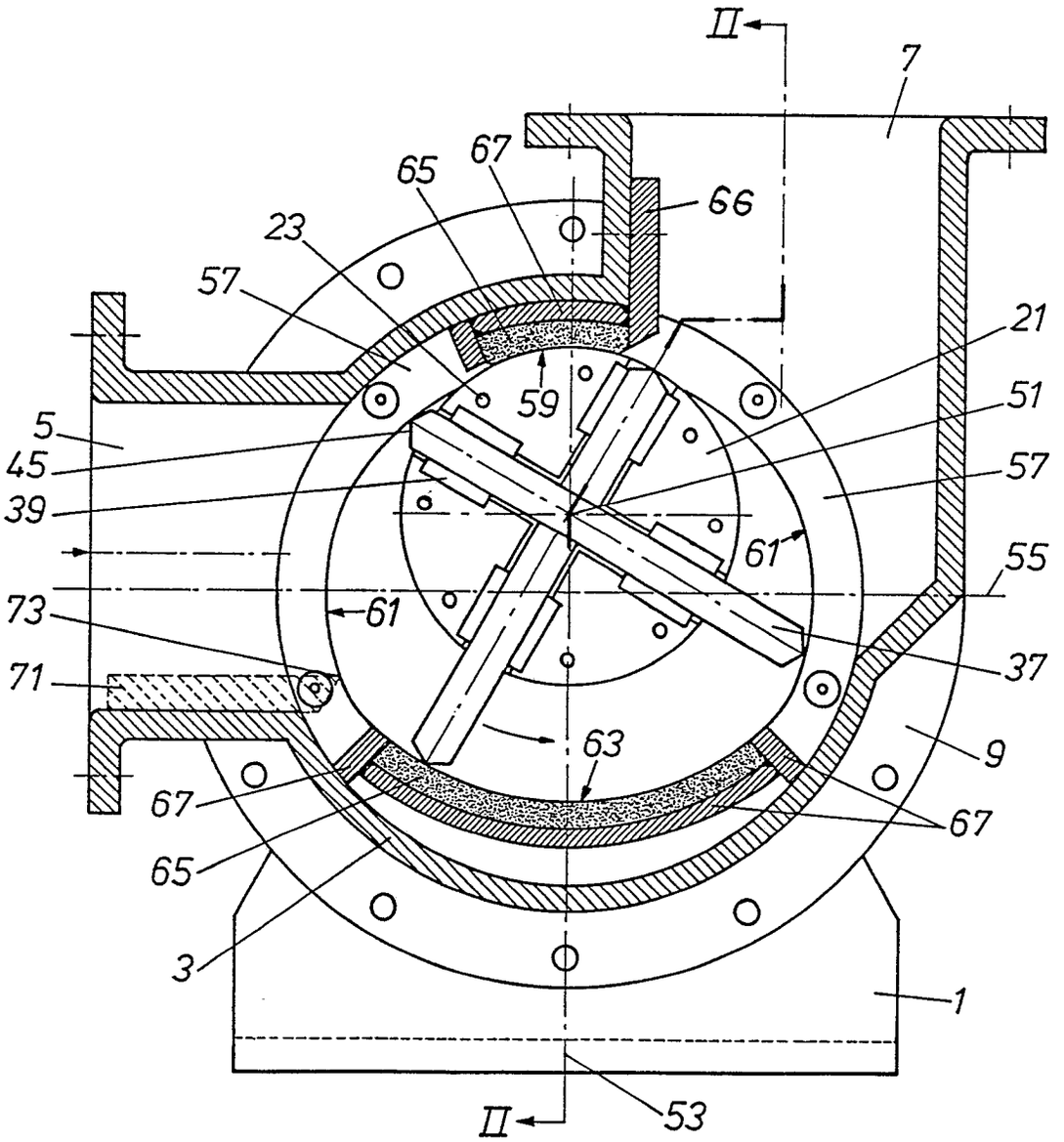
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Fig. 1

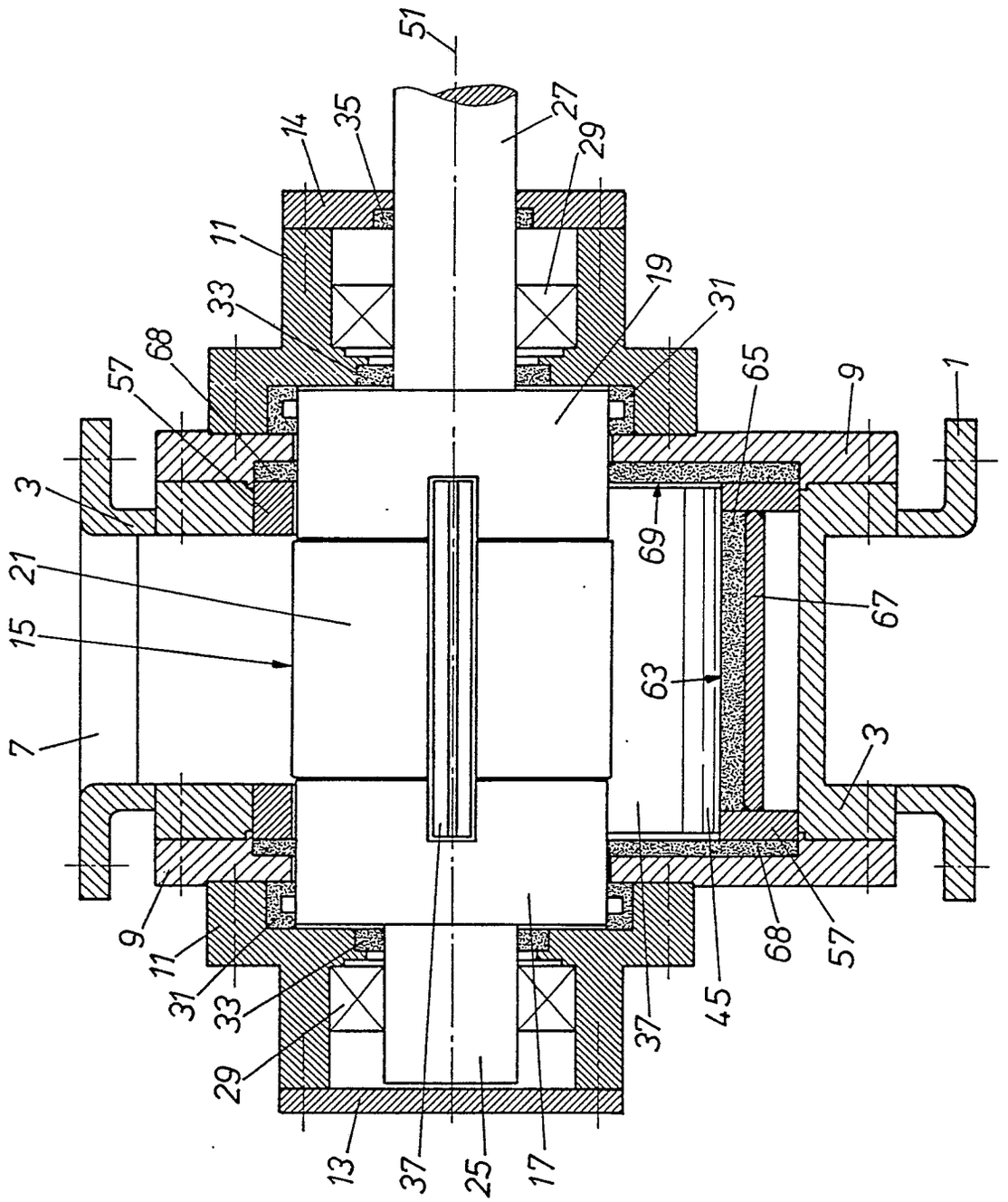
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Fig. 2

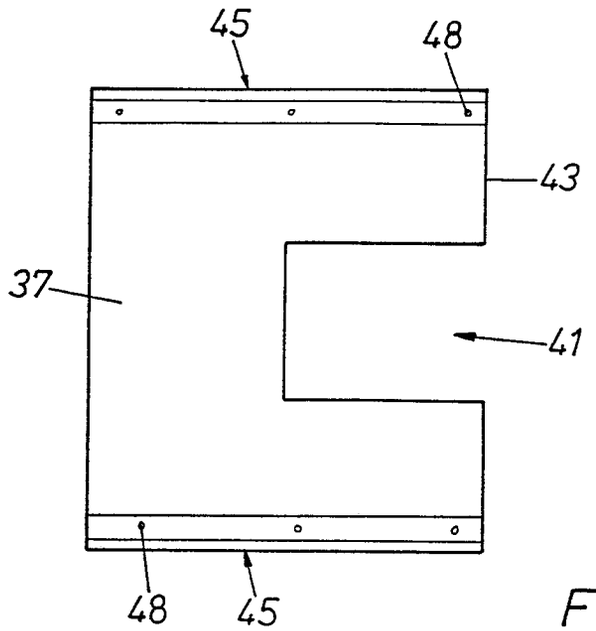

Fig. 3

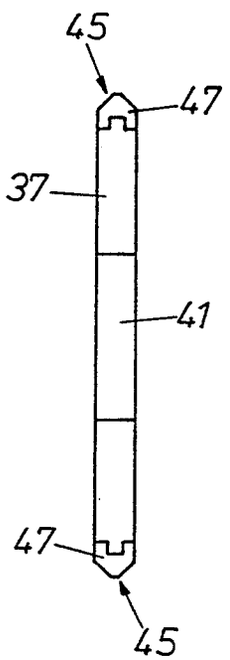

Fig. 4

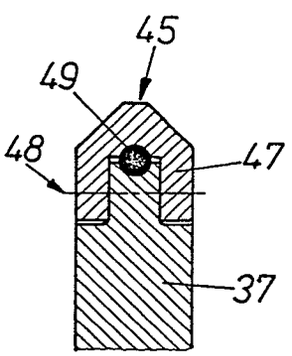

Fig. 5