

[54] **PUMP ROTOR ADJUSTMENT MECHANISM**

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[58] Field of Search **418/30, 39, 107**

[56]

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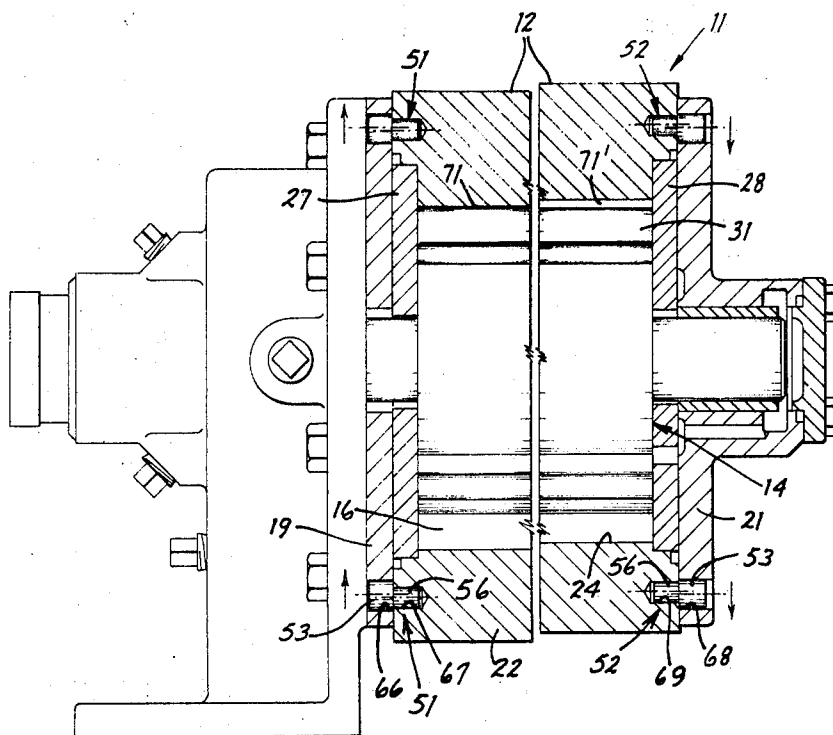
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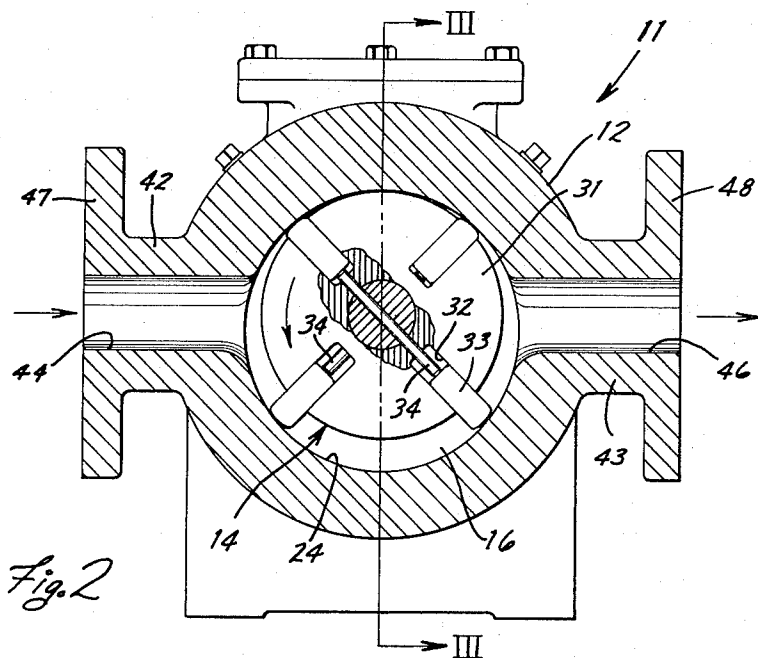
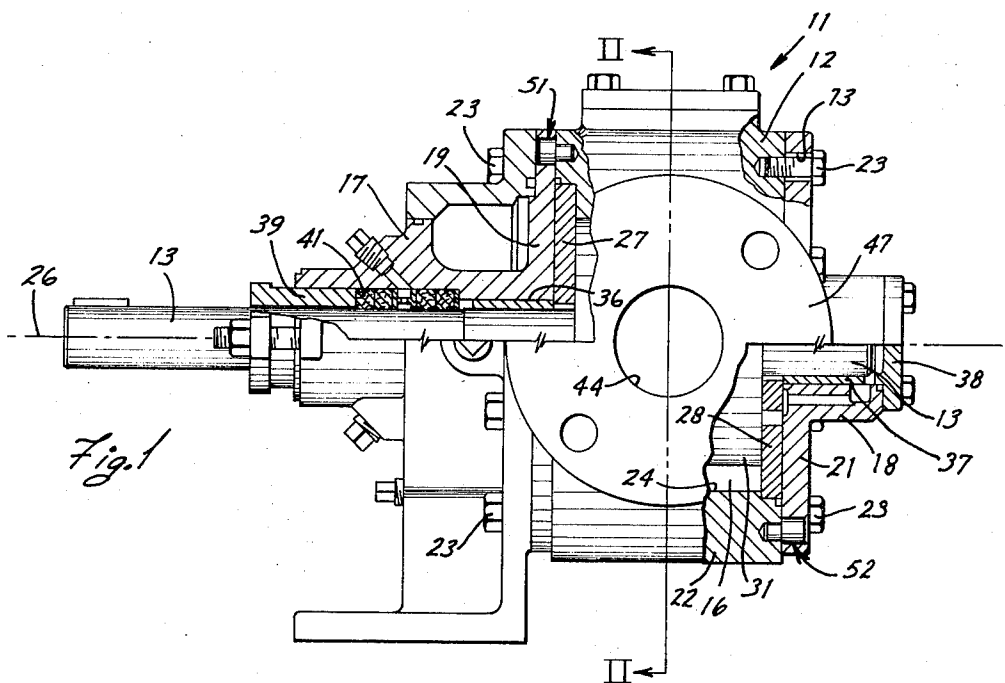
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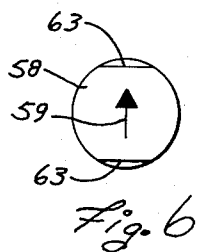
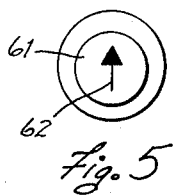
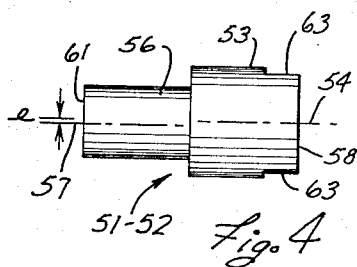
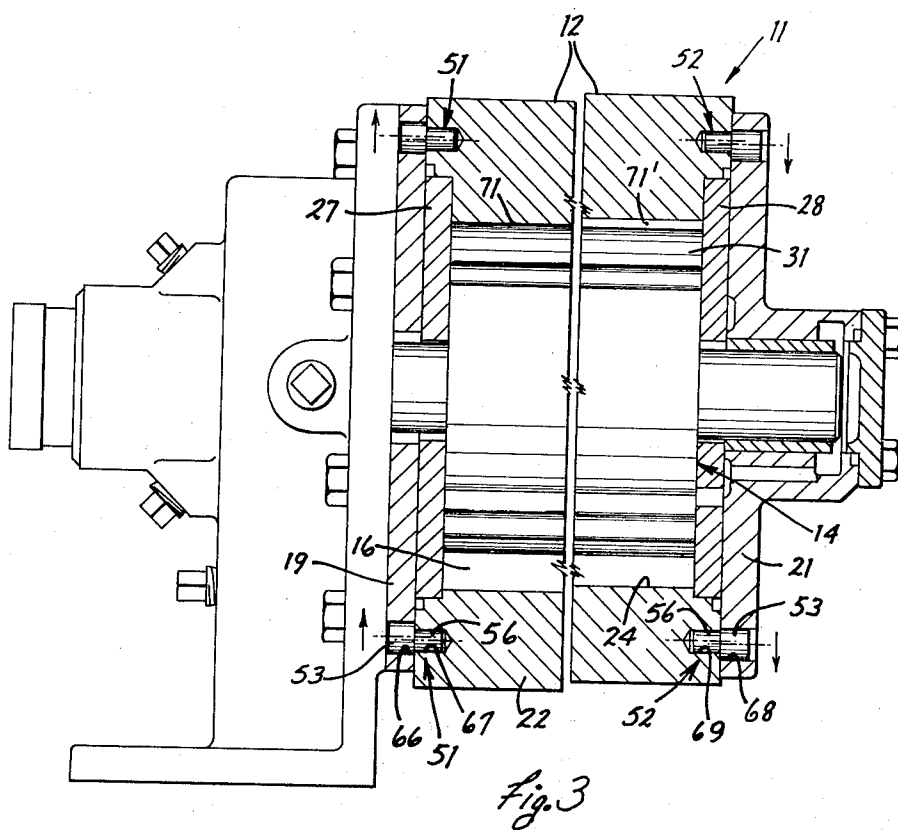
ABSTRACT

A rotary pump having a housing defining therein a pump chamber and a rotor disposed within said pump chamber for pumping fluid between inlet and outlet ports. The rotor includes slidable vanes which slidably engage an internal guide surface formed on a ringlike cylinder. The ringlike cylinder is fixedly connected to a pair of head members which define opposite ends of the pump chamber and rotatably support the rotor shaft. A plurality of eccentric pins are fixedly connected between each head member and the adjacent axial end of the cylinder for permitting the cylinder, when the pump is being assembled, to be selectively positioned in one of at least two predetermined positions relative to the head members to permit the minimum clearance between the rotor and the inner guide surface to be selected in accordance with the type of fluid to be pumped.

2 Claims, 6 Drawing Figures







PUMP ROTOR ADJUSTMENT MECHANISM

FIELD OF THE INVENTION

This invention relates to a rotary pump and, in particular, to an improved rotary pump having eccentric means coacting between the cylinders and the pump head members, which eccentric means can be selectively positioned during assembly of the pump to permit a preselection of the minimum rotor clearance.

BACKGROUND OF THE INVENTION

Rotary pumps are extensively utilized for pumping both low viscosity and high viscosity fluids. While rotary pumps are satisfactory for pumping these different types of fluids, nevertheless successful utilization of rotary pumps requires that the minimum rotor clearance be varied in accordance with the viscosity of the fluid being pumped. For example, the minimum clearance between the rotor and the surrounding guide surface as formed on the liner or cylinder must be substantially greater when pumping a highly viscous fluid than when pumping a fluid of low viscosity.

To permit rotary pumps to be readily adapted to the different types of fluids, it has been conventional to utilize two different types of rotary pumps. The first type of rotary pump in common usage provides a fixed rotor clearance, whereupon after assembly of the pump the rotor clearance cannot be varied. Pumps of this type are highly desirable since the structure and mechanical complexity are maintained at a minimum, so that the pumps thus have a minimum size and weight, and can be manufactured and assembled relatively economically and efficiently. However, the known rotary pumps having a fixed rotor clearance are not readily adaptable for use with different types of fluids due to the variation required in the rotor clearance in order to permit use with fluids of different viscosity.

To overcome the problems caused by the use of different fluids in a fixed clearance pump, it is a conventional manufacturing practice to provide a common housing structure for the pump, with the common housing being usable with a plurality of rotors having different diameters. The rotor diameter is then selected in accordance with the type of fluid to be pumped, whereby the rotor clearance is thus determined during assembly of the pump solely by selecting a rotor of the desired diameter. While this manufacturing technique is satisfactory, nevertheless it increases the overall cost of the pump since the manufacturer has to manufacture and stock several different rotor diameters. This necessarily increases the manufacturing cost and also increases the amount of inventory which the manufacturer must maintain in his plant. This also makes replacement of the rotor a more difficult task since the user of the pump must be sure to replace the old rotor with a new rotor of the proper diameter. Also, after the pump has been assembled, the rotor is totally enclosed within the pump housing and thus it is difficult to determine whether the pump parts are properly aligned.

Another technique which has been widely used to permit rotary pumps to be usable with fluids having widely different viscosities involves the use of rotary pumps having adjustment structures associated therewith for varying either the position, of the rotor or the position of the surrounding casing. These adjustable pumps have employed numerous techniques for per-

forming this adjustment. For example, various pumps of this type have utilized rotatable eccentric cams coacting with slots formed in the casing for permitting the position of the casing to be varied relative to the rotor. These adjustment operations can often be carried out at any time after the pump has been assembled so as to provide the desired rotor clearance. Other adjustable pumps of this type have utilized a casing constructed of a plurality of pivotally connected links which are deformed by suitable adjustment structure into the desired configuration. However, these adjustable pumps are not as desirable as fixed-clearance pumps since they are structurally and mechanically complex, and result in the pump being bulky and heavy. Also, the structural and mechanical complexity of these adjustable pumps makes them extremely costly to manufacture and assemble, and more difficult to repair and maintain. The adjustment structure also substantially complicates the sealing of the pump. Accordingly, pumps of this type have found wide usage only in those situations where fluids of widely varying viscosities are being pumped through the same pump during various operational periods thereof so that the pump must be capable of adjustment without being disassembled. However, in situations where the pump is used for substantially continuous operation with fluids of similar viscosity, a fixed-clearance pump is more economical and desirable.

Accordingly, it is an object of the present invention to provide an improved rotary pump which overcomes the above-mentioned disadvantages. Particularly, it is an object of the present invention to provide:

1. An improved rotary pump of the fixed-clearance type which can be selectively assembled to provide at least two different rotor clearances in order to permit same to have a clearance selected in accordance with the type of fluid which is to be pumped therethrough.

2. A pump, as aforesaid, which includes the same identical structure irrespective of which rotor clearance is provided therein.

3. A pump, as aforesaid, which utilizes the same rotor and surrounding cylinder irrespective of the rotor clearance selected.

4. A pump, as aforesaid, which includes eccentric connecting structure coacting between the cylinder and the housing head members for permitting the cylinder to be stationarily mounted in at least two different positions relative to the rotor whereby the rotor clearance can be a selected one of two predetermined magnitudes merely by varying the position of the eccentric connecting structure during assembly of the pump.

5. A pump, as aforesaid, which includes eccentric pins coacting between stationary housing parts and the cylinder, which pins can be selectively connected between the cylinder and the stationary housing parts in two different angular orientations to vary the cylinder position relative to the rotor.

6. A pump, as aforesaid, wherein the eccentric pins, after being positioned in a selective orientation to provide either a small or a large rotor clearance, are snugly fitted within openings in the cylinder and the stationary housing parts to provide a fixed clearance.

7. A pump, as aforesaid, which permits the tolerances of the pump components to be more closely maintained, which permits more economical manufacturing

of the components, and which simplifies and facilitates the assembly and alignment of the pump.

Other objects and purposes of the present invention will be apparent to persons acquainted with devices of this type upon reading the following specification and inspecting the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partially in section, illustrating a rotary pump according to the present invention.

FIG. 2 is a sectional, elevational view taken substantially along the line II—II in FIG. 1.

FIG. 3 is an enlarged, fragmentary, sectional view taken substantially along the line III—III of FIG. 2, and illustrating therein the two positions of the cylinder relative to the rotor.

FIG. 4 is a side view of the eccentric connecting pin constructed according to the present invention.

FIG. 5 is an end view of the eccentric pin as taken from the left side of FIG. 4.

FIG. 6 is an end view of the eccentric pin as taken from the right side of FIG. 4.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. For example, the words "upwardly," "downwardly," "leftwardly" and "rightwardly" will refer to directions in the drawings to which reference is made. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the pump and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

SUMMARY OF THE INVENTION

In general, the objects and purposes of the present invention are met by providing a rotary pump having housing means defining a pumping chamber and, by way of example, a vaned rotor positioned within the chamber. The housing means includes a ringlike cylinder having an inner annular guide surface disposed in surrounding relationship to the rotor, which guide surface is eccentrically positioned relative to the rotational axis of the rotor. The cylinder is fixedly connected between a pair of stationary head members which are disposed on opposite sides of the pumping chamber, which head members rotatably support the rotor shaft. The cylinder is fixedly connected to each head member by a plurality of screws and eccentric pins. During assembly of the pump, the pins can be oriented in at least two different positions relative to the head members for enabling the cylinder to be positioned between the head members in a selected one of two different predetermined positions. The position of the cylinder as determined by the eccentric pins determines the magnitude of the minimum clearance between the rotor and the inner guide surface, whereby the minimum rotor clearance can thus be selected from two different magnitudes depending upon the preselection of the position of the eccentric pins relative to the head members upon assembly of the pump. The eccentric pins each include a pair of axially spaced, cylindrical portions which are eccentrically positioned relative to one another. The axially spaced cylindrical portions of each eccentric pin are adapted to be snugly fitted, as by being press-fitted, within cylindrical recesses formed

in the cylinder and the head members, respectively. When the eccentric pins are installed in the position providing for a small minimum rotor clearance, then the pump is usable with nonviscous or low viscosity fluids, whereas when the eccentric pins are installed to provide a larger minimum rotor clearance, then the pump is usable with high viscosity fluids or where the shear properties of the fluids become significant. The pins are preferably provided with visible indicia thereon to readily indicate the selected rotor clearance.

DETAILED DESCRIPTION

FIGS. 1-3 illustrate a rotary pump 11 having a housing 12 which supports a rotatable shaft 13. A pump rotor 14 is nonrotatably secured to the shaft 13 and is positioned within a pump chamber 16 formed within the housing 12.

The pump housing 12 includes a pair of opposing head members 17 and 18 which have integral head plates 19 and 21, respectively, disposed in spaced but opposed relationship to one another. A ringlike casing or cylinder 22 is positioned between the head plates 19 and 21 and is fixedly connected thereto, as by a plurality of screws 23. The cylinder 22 has an inner annular guide surface 24 which is disposed in eccentric relationship relative to the rotational axis 26 of the shaft 13. The configuration of the inner guide surface 24 may either be circular or non-circular depending upon the type of pumping profile desired, and the exact configuration of the surface 24 does not constitute an essential portion of the present invention.

The cylinder 22 also has a pair of annular wear plates 27 and 28 mounted thereon adjacent the opposite axial ends thereof. The wear plates 27 and 28 are disposed directly adjacent the head plates 19 and 21, respectively, and define the opposite ends or boundaries of the pumping chamber 16. The wear plates 27 and 28 are positioned to slidably but sealingly bear substantially against the opposite axial ends of the pumping rotor 14 in a conventional manner.

Considering now the pumping rotor 14, same includes a substantially cylindrical member 31 nonrotatably secured to the shaft 13 and positioned within the pumping chamber 16. The member 31 has the opposite axial ends thereof positioned closely adjacent and in substantial rotatable sliding engagement with the wear plates 27 and 28. Cylindrical member 31 has a plurality of angularly spaced, radially extending slots 32 formed therein. A vane 33 is slidably supported within each slot 32 and is resiliently urged outwardly of the member 31 by means, such as the push rods 34, whereupon the tip or outer end of each vane is disposed in slidable engagement with the inner guide surface 24.

The drive shaft 13 for the rotor 14 is rotatably supported on a pair of spaced bearings 36 and 37 which are mounted on the head members 17 and 18, respectively. The outer end of the head member 18 is also sealingly closed by means of an end cap 38. The other end of the drive shaft 13 extends outwardly beyond the head member 17 and is adapted to be connected to a suitable power source, such as a motor. The shaft 13 is sealed relative to the head member 17 by conventional means such as the packing gland 39 and conventional seal rings 41.

Fluid is supplied to the pumping chamber 16 through inlet and outlet conduits 42 and 43, respectively, which

conduits in the illustrated embodiment are fixedly connected to the opposite sides of the cylinder 22. The conduits 42 and 43, respectively, include therein inlet and outlet flow openings 44 and 46. Suitable mounting flanges 47 and 48 may be provided on the free ends of the conduits 42 and 43, respectively, for permitting same to be suitably connected to associated pipes or conduits (not shown).

The structure of the rotary pump 11, as described above, is substantially conventional and thus further description thereof is not believed necessary. Further, it will be apparent to persons acquainted with pumps of this type that numerous variations can be made in same without departing from the essence of the present invention. For example, while the attached drawings illustrate the guide surface 24 as being formed directly on the interior of the cylinder 22, it will be appreciated that in many situations rotary pumps utilize a separate annular lining which is constructed of a specific material or configuration in order to provide a desired flow pattern or wear characteristic, which separate lining is then pressed or fixedly fitted within the casing or cylinder. Such a modification could also be incorporated into the rotary pump of the present invention. Further, the location of the inlet and outlet passages and their relationship to the housing and the rotor can likewise be varied while still resulting in an operable pump structure.

Considering now the rotary pump 11 incorporating therein the present invention, same includes suitable positioning means coacting between the head members 17 and 18 and the intermediate cylinder 22 for permitting the cylinder 22 to be disposed in at least two alternate positions relative to the rotor 14 when the pump is being assembled. In this manner, the pump can be assembled to have a minimum clearance between the rotor and the cylinder for use with less viscous fluids, or alternately the cylinder can be assembled to provide for increased clearance between the cylinder and the rotor to permit utilization of same with highly viscous fluids. However, after the pump is assembled, then the cylinder is maintained stationary relative to the housing so that the clearance between the rotor and the cylinder is thus maintained at a fixed value.

The positioning means of the present invention specifically includes a plurality of eccentric pin means 51 and 52 coacting between the head plates 19 and 21, respectively, and the cylinder 22 for positioning the cylinder 22 relative to the rotor. In the disclosed embodiment, cylinder 22 is connected to head plate 19 by a pair of eccentric pin means 51 which are disposed on diametrically opposite sides of the cylinder 22, and is connected to the head plate 21 by a pair of eccentric pin means 52 which are also disposed on opposite diametrical sides of the cylinder 22. However, the number of angularly spaced eccentric pin means 51 and 52 can be selectively varied if desired.

The eccentric pin means 51 and 52 are identical and, as illustrated in FIGS. 4-6, each includes a large diameter cylindrical portion 53 having a central axis 54 and fixedly connected to a small diameter cylindrical portion 56 having a central axis 57. The central axes 54 and 57 are parallel with one another but are laterally offset by a predetermined distance e as illustrated in FIG. 4, which distance e may vary between 0.001 and 0.060 of an inch for the type of pump illustrated herein. However, this range might be extended materially

where a modified pump is involved. The offset or eccentricity e of the small cylindrical portion 56 relative to the large cylindrical portion 53 is utilized according to the present invention to permit the initial position of the cylinder 22 to be varied relative to the head plates 19 and 21.

The large cylindrical portion 53 is preferably provided with an arrow 59 imprinted on the axial end face 58 thereof, and the small cylindrical portion 56 is similarly provided with an arrow 62 imprinted on the axial end face 61 thereof. The arrows 59 and 62 are parallel and point in the same direction, and are similarly parallel to a plane containing therein the axes 54 and 57. The arrows 59 and 62 thus point in a direction which represents the maximum distance e between the axes 54 and 57. The large cylindrical portion 53 may also be provided with a pair of opposed flats 63 for example, to permit same to be engaged and rotated by a suitable tool.

The large diameter portion 53 of each pin means 51 is snugly received within a cylindrical bore or recess 66 formed in the head plate 19, and the small diameter portion 56 is similarly snugly received within a cylindrical bore 67 formed in the adjacent axial end of the cylinder 22. The eccentric pin means 52 is similarly mounted in that the large diameter portion 53 is snugly received within a cylindrical recess 68 formed in the head plate 21, and the small diameter portion 56 is snugly received within a cylindrical recess 69 formed in the adjacent axial end of the cylinder 22. The relative positions of the large and small ends of the pins may be reversed, if desired. The recesses 67 and 69, as formed on the opposite axial ends of the cylinder 22, are substantially axially aligned with one another in the preferred embodiment.

The eccentric pins 51 and 52, when assembled within the rotary pump 11 such that the arrows point upwardly, result in the cylinder 22 being positioned in its lowermost position relative to the axis 26 of the shaft 13, whereby the minimum clearance between the rotor 14 and the surrounding guide surface 24 is of a first predetermined magnitude, which minimum clearance is designated 71 of the left side of FIG. 3. On the other hand, when the eccentric pin means 51 and 52 are assembled within the rotary pump with their arrows pointing downwardly (as illustrated on the right side of FIG. 3), then the cylinder 22 is disposed in its uppermost position relative to the axis 26 of the shaft 13, so that the minimum clearance between the rotor 14 and the guide surface 24 is a second predetermined value, which minimum clearance is designated 71' in FIG. 3. The minimum clearance 71' is greater than the minimum clearance 71. Thus, by selectively assembling the cylinder relative to the head plates through use of eccentric pins 51 and 52 which are alternately positionable in two positions which are angularly displaced from one another by an angle of 180°, the cylinder 22 can be disposed relative to the rotor 14 to thus provide for a minimum rotor clearance having two different predetermined values.

Further, bolt holes 73 as formed in the head plates 19 and 21 are slightly larger than the diameter of the screws 23 to permit the cylinder 22 to be selectively disposed in either of the above-mentioned positions when the pump is assembled.

ASSEMBLY AND OPERATION

The operation of the rotary pump 11 constructed according to the present invention is conventional, and thus a detailed description thereof is not believed necessary. However, inasmuch as rotary pumps of this type are often utilized with fluids having a wide range of viscosity, the pump 11 of the present invention incorporates therein the eccentric pin means 51 and 52 which permit the pump to be most efficiently utilized with either a low viscosity or a high viscosity fluid.

If the pump 11 is to be utilized with a low viscosity fluid, then the pump is assembled with the eccentric pin 51 and 52 disposed so that the arrows 59 and 62 point upwardly. This thus results in the cylinder 22 being disposed in its uppermost position relative to the axis 26 of the shaft 13, thereby resulting in the rotor clearance 71 having its smallest possible magnitude. This assembly of the pump is illustrated in the left side of FIG. 3. Since the minimum clearance 71 is at its smallest value, this thus results in the pump 11 being most efficiently utilized for pumping low viscosity fluids.

On the other hand, if the pump is to be utilized for pumping highly viscous fluids, then the eccentric pins 51 and 52 are initially rotated during assembly of the pump so that the arrows 59 and 62 point downwardly. This results in the cylinder 22 being disposed in its uppermost position so that the rotor clearance 71' is of a larger predetermined magnitude, substantially as illustrated on the right side of FIG. 3. Since the minimum rotor clearance 71' is larger than the rotor clearance 71, the pump is thus most efficiently utilized for highly viscous fluids, such as syrups and the like.

After the pump has been assembled, the arrows 59 formed on the eccentric pin means 52 are readily visible since the cylindrical bores 68 extend through the head plate 21. Accordingly, a person can readily visually determine from the vertical direction of the arrows whether the pump is assembled for use with low viscosity or high viscosity fluids. Even though the large diameter portions of the eccentric pins may be totally disposed within the recesses formed in the head plates, they may be externally accessible. Accordingly, if the pins are rotatable, they can be rotated through an angle of 180° after the pump has been assembled, provided that the screws fastening the head plates to the cylinder are first loosened.

The pump of the present invention thus incorporates therein the structural and mechanical simplicity of a fixed clearance pump, while at the same time it permits the fixed minimum clearance to be initially selected between two different magnitudes in an easy and simple manner in order to permit the same basic pump structure to be utilized with fluids having substantially different viscosities. In this manner, the manufacturer no longer has to utilize or stock two different rotor sizes to permit the same pump housing to be used for both viscous and nonviscous fluids. Rather, the manufacturer can now utilize the same pump housing and the same rotor for either viscous or nonviscous fluids, with the only modification being in the orientation of the eccentric pin means 51 and 52 during assembly of the pump in accordance with the type of fluid with which the pump is to be utilized.

Utilization of the eccentric pin means 51 and 52, and the manner in which they coat with the cylinder 22 and the head plates 19 and 21, also results in other sig-

nificant manufacturing advantages which permit the overall pump structure to be manufactured more economically and efficiently while still resulting in a pump having closer tolerances. For example, one axial end of the cylinder 22 is initially bored so as to have the pair of recesses 67 or 69 formed therein. Thereafter, all turning and drilling operations which have to be performed on the cylinder 22 can then be keyed to these two holes. Because of this design feature and procedure, tolerances of the cylinder can be held much closer than was previously possible. These same holes can then be utilized to permit precise location of the coacting openings and recesses which are to be formed in the head plates, whereby the overall assembly can thus be machined economically and with extremely close tolerances, thereby providing for extremely accurate clearances between the rotor and its surrounding guide surface. This thus results in more accurate clearances between the rotor and the guide surface and also minimizes the alignment problems associated with the assembly of the pump.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a rotary pump of the fixed-clearance type, including housing means having a pair of spaced head plates and a ringlike cylinder disposed between and fixedly connected to said head plates, said cylinder having an inner annular guide surface, said cylinder and said head plates defining a pumping chamber therebetween, a rotatable pumping rotor disposed within said chamber and mounted for rotation about an axis which is fixed relative to said head plates, said rotor having a plurality of vanes thereon disposed for slidable engagement with an inner annular guide surface formed on said cylinder, and means defining inlet and outlet openings communicating with said pumping chamber, the improvement comprising:

- connecting means coacting between said cylinder and said head plates for permitting said cylinder to be positioned in a selected one of two predetermined positions relative to said head plates only during assembly of said pump housing means, the preselection of one of said two positions during assembly of the pump housing enabling the pump to be provided with a preselected one of two different minimum clearances between the rotor and the surrounding cylinder;

- said connecting means comprising eccentric pin means coacting between each of said head plates and said cylinder for fixedly connecting and positioning said cylinder relative to said head plates in a selected one of said two predetermined positions, said eccentric pin means including at least two eccentric pin members fixedly connected between each said head plate and an adjacent axial end of said cylinder;

- each said eccentric pin member including first and second cylindrical portions axially spaced but fixedly connected together, said first and second cylindrical portions respectively having first and

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second longitudinally extending axes which are substantially parallel but laterally spaced from one another by a predetermined distance;
at least one axial end face of said eccentric pin members being provided with indicia means thereon for indicating the orientation of said eccentric pin members relative to the longitudinally extending axis thereof, said indicia means permitting selective orientation of said pin members relative to said cylinder during assembly of said pump so as to permit said cylinder to be fixed relative to said head plates in a selected one of said two predetermined positions to permit preselection of the minimum clearance between the cylinder and the pump rotor;
each said head plate having at least two cylindrical recesses formed therein for snugly receiving therein one of the cylindrical portions of said ec-

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centric pin members, and each axial end of said cylinder also having at least two cylindrical recesses formed therein for snugly receiving therein the other cylindrical portions of said eccentric pin members, the cylindrical portions of the eccentric pin members being press-fitted into their respective cylindrical recesses as formed in said head plates and said cylinder for fixedly and rigidly connecting together said head plates, said cylinder and said eccentric pins, thereby providing said assembled pump with a non-adjustable fixed minimum clearance.

2. A pump according to claim 1, wherein the first and second axes of said eccentric pin member are laterally spaced from one another by a distance in the range between 0.001 and 0.060 of an inch.

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