May 21, 1957 W. R. EAMES, JR 2,792,788

ROTOR PUMP

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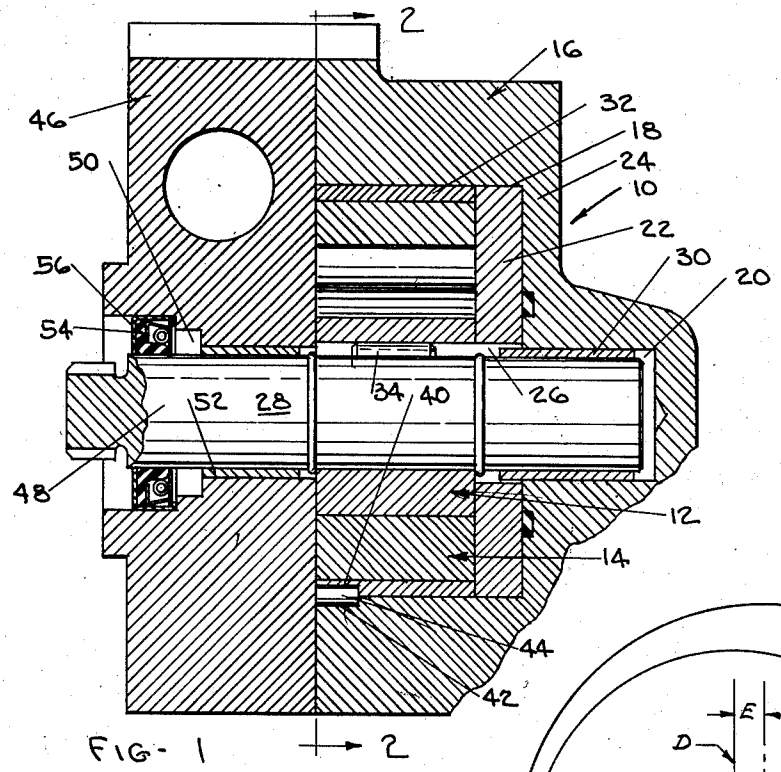


FIG. 1

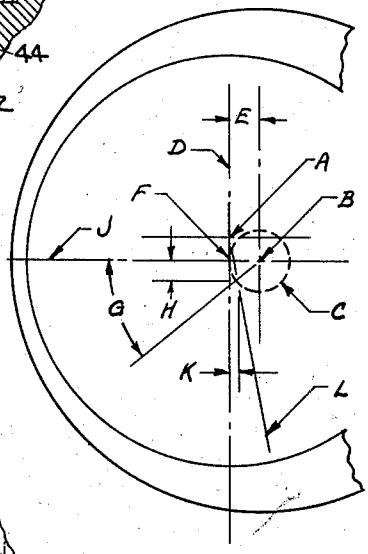


FIG. 6

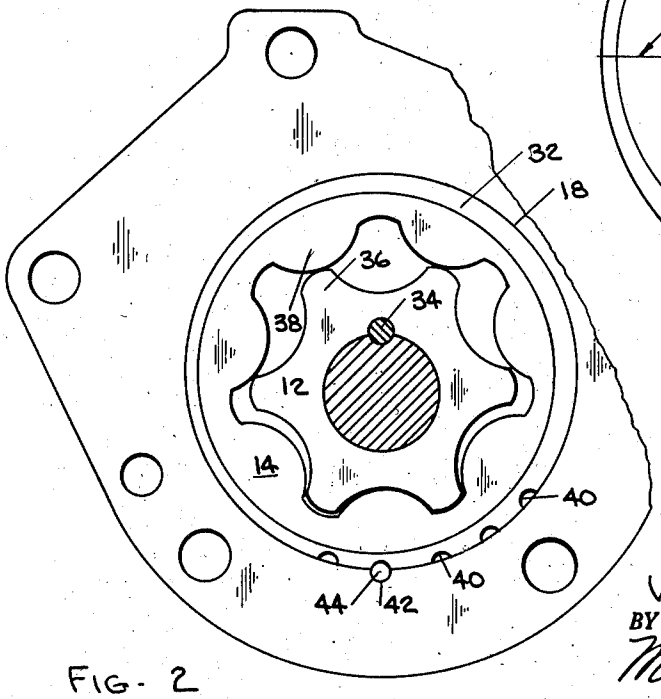


FIG. 2

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ROTOR PUMP

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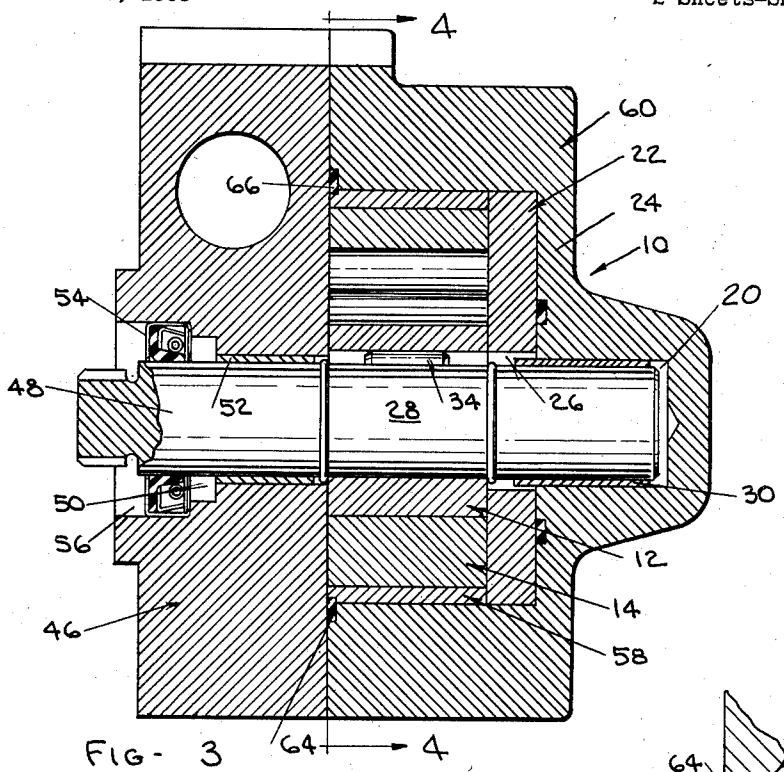


FIG- 3

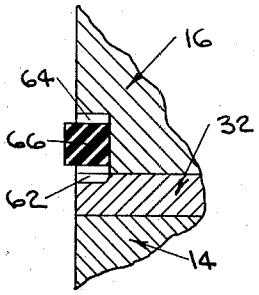


FIG-5

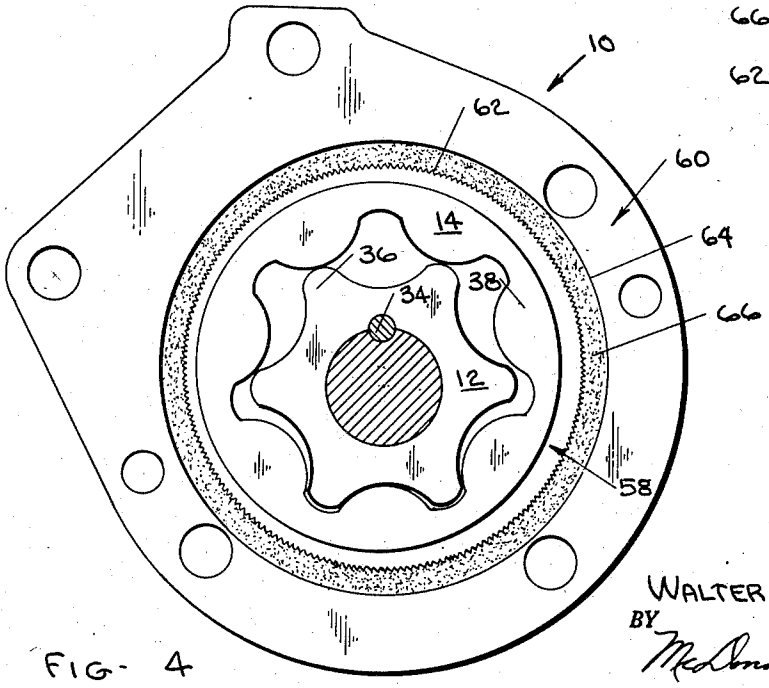


FIG- 4

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ROTOR PUMP

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6 Claims. (Cl. 103—126)

This invention relates to pumps and more particularly to means for adjusting the rotor eccentricity of rotary pumps of the type having cooperating external and internal rotors.

It has been the general requirement in the manufacture of rotary pumps, of the type having cooperating external and internal rotors and wherein teeth or lobes on the respective rotors mesh with one another and the axis of rotation of the rotors are offset to one another, to maintain a high degree of accuracy between the mating teeth of the rotors both as to tooth form and eccentric relation of the rotors to one another to provide a rotary pump of high efficiency.

Broadly the invention comprehends the provision of a rotary pump of the aforesaid type wherein through the use of an eccentric bushing, moveable to any of various positions in the pocket of the pump, a desired eccentric relation can be attained between the internal and external rotors of the pump thus simplifying the manufacture thereof.

Among the principal objects of the invention is the provision of a rotary pump of the type including eccentrically rotatable and cooperable internal and external rotors, that:

a. Includes means for easily attaining a proper desired eccentricity between the rotors;

b. Eliminates the necessity of maintaining close manufacturing tolerances for establishing proper rotor eccentricity;

c. Utilizes an eccentric bushing for establishing desired rotor eccentricity;

d. Includes an eccentric bushing supportable in and adjustably rotatably movable in the pocket of the pump for accurately establishing the proper desired eccentricity between a set of meshing rotors and means for securing the bushing fast to the pump housing onse a proper eccentric relation between the rotors is established; and,

e. Includes an eccentric bushing for established desired rotor eccentricity which can be adjustably secured to the housing at a multiple of circumferentially spaced points on the housing or in infinite rotatable relation thereto.

Other objects and advantages of the invention will appear from the following description taken in connection with the drawings forming a part of the specification; and in which:

Fig. 1 is a cross-sectional view of a rotary pump of the internal-external rotor cooperating type embodying the invention;

Fig. 2 is a view taken substantially along lines **2—2** of Fig. 1;

Fig. 3 is a cross-sectional view of a modified form of rotary pump from that shown by Fig. 1;

Fig. 4 is a view taken substantially along lines **4—4** of Fig. 3;

Fig. 5 is a partly fragmentary view of the body of the pump of Figs. 3 and 4 prior to the assembly of the end plate of the pump thereon, and

Fig. 6 is a diagrammatic illustration of the manner of adjustment to be provided by the eccentric bushing incorporated in the pump of Figs. 1 through 5.

This invention is predicated upon the provision of a rotary pump including eccentrically rotatable and cooperable internal and external rotors having adjustable means in the form of an eccentric bushing for simplifying the establishment of proper eccentricity between the rotors of said pump.

The eccentric bushing is so formed as to be receivable in supported relation in the pocket of the pump whereby it can be rotated relative to the pump housing to a desired position in the assembly of the rotors centrally of the bushing to establish a proper eccentricity of the rotors relative to one another. Once the proper eccentricity is established the eccentric bushing is fixedly secured to the housing so that an assured adjusted eccentricity of the rotors can thereafter be maintained. The bushing can be fixedly secured to the housing through the provision of an axial groove on the outer periphery of the groove adapted to mate with any one of several circumferentially spaced axial grooves on the inner peripheral wall of the housing adjacent the pump pocket and wherein a pin is inserted in mating holes of the bushing and housing to so inhibit the bushing from movement away from its adjusted position. As another means of securing the bushing in adjusted position in the pump pocket a rubber or the like gasket can be deformed to engage axial serrations formed on the outer periphery of the bushing and thus hold the bushing by frictional locking engagement of the gasket on the housing.

In establishing proper rotor eccentricity it is necessary to shift the eccentric bushing in the pocket of the pump housing with the rotors arranged centrally therein until an acceptable nose clearance of the rotor teeth is attained, thereby minimizing the leakage path at this point. With the rotors so adjusted the bushing is then fixedly secured to the pump housing. In this manner it is possible to maintain a large nose clearance in the production of rotors thereby simplifying the manufacturing problems normally involved to obtain proper rotor eccentricity.

Referring to the drawings for more specific details of the invention **10** represents generally a rotary pump of the type including internal and external cooperative rotors **12** and **14** respectively.

Pump **10** in addition to rotors **12** and **14** includes a pump housing **16** having a circular walled pump pocket **18** therein and a bore **20** eccentric to the pocket **18**.

An end plate **22** is fitted in the pump pocket **18** adjacent closed end **24** of the housing **16** having a circular opening **26** therethrough through which a driving or input shaft **28** for the pump projects for journalled relation in a sleeve bearing or bushing **30** fitted in bore **20**.

An eccentric bushing **32**, that is, a bushing where the internal and external peripheries thereof are eccentric to one another, is fitted in the pump pocket **18** of housing **16** in which it is adapted to be adjustably secured.

Internal and external rotors **12** and **14** respectively are centrally arranged in bushing **32** with the outer periphery of the external rotor journalled for rotation on the inner peripheral surface of bushing **32** and with the internal rotor splined by a cylindrical pin **34** to the shaft **28** for rotation therewith.

The internal rotor **12** is shown as having six teeth **36** whereas the external rotor **14** has seven teeth **38** such that, upon driving rotation of the internal rotor, pumping chambers are formed between the rotors through the cooperative meshing engagement of the teeth of the rotors, said pumping chambers extending between intake and discharge ports for the pump, not shown, adapted to have fluid flow communication with the pumping chambers.

As a simple means of establishing a proper nose clearance between the teeth of the rotors with the rotors arranged in the pump pocket centrally of the bushings 32, the bushing 32 is rotated relative to the housing to a position wherein a proper adjusted eccentricity is attained between the axes of rotation of the internal and external rotors. It is to be noted that whereas the axis of rotation of internal rotor is established in the manufacture of the pump with the shaft journalled for rotation in the housing, a rotation of bushing 32 accounts for a graduated shifting of the axis of rotation of the external rotor, by reason of the external rotors in journalled relation in bushing 32, relative to the axis of the internal rotor 12. As such the proper adjustment of nose clearance between the crests of the teeth of the rotors is obtained so that the leakage path therebetween is held to a minimum.

A plurality of axially extended circumferentially spaced semi-cylindrical cross-sectional shaped slots 40 are provided in the outer peripheral surface of bushing 32, any one of which is adapted to mate with an axially extended semi-cylindrical cross-sectional shaped slot 42 on the inner peripheral wall of housing 16 adjacent pump pocket 18. With the bushing arranged in adjusted position relative to the housing for a proper eccentricity of the rotors a cylindrical pin 44 is inserted in the mating slots 40 and 42 of the respective bushing 32 and housing 16 serving to lock the bushing 32 in the housing.

The bushing 32, and internal and external rotors 12 and 14 are made of equal axial length such that one axial extremity of each bears against end plate 22, fitted in the pump pocket 18, and with the other axial extremities bearing against an end cover plate 46 for the pump secured to the pump housing oppositely disposed from end 24 of the pump housing.

An end 48 of shaft 28 which is adapted to be coupled to means for driving the pump extends through a bore 50, of the end cover plate 46, which is coaxial with bore 20 in the housing. A sleeve bearing or bushing 52, fitted in end cover plate 46 serves to support a portion of end 48 of shaft 28 for rotation therein.

An annular seal 54 mounted in a counterbore 56 of the end cover plate 46 has rotative sealing engagement upon end 48 of shaft 28 operative to seal the pump along shaft 28 thereof.

End cover plate 46 is adapted to have therein appropriate intake and discharge ports for the pump, not shown.

The pump structure of Figs. 3 through 5 differs from that of Figs. 1 and 2 solely with regard to the means for fixedly securing an eccentric bushing 58, corresponding to bushing 32 of the structure of Figs. 1 and 2, in a pump housing 60. Instead of the mating slots 40 and 42 of the respective bushing and housing 32 and 16 and the pin 44 for securing said bushing and housing 32 and 16 together, the outer periphery of bushing 58 is axially serrated 62 whereas a recess or shallow counterbore 64 is provided on the inner periphery wall of the housing adjacent the end thereof oppositely disposed from the integrally closed end thereof. A rubber or the like resilient gasket 66 is adapted to be deformed between the recess 64 and serrations 62 serving to secure the bushing 58 and housing 60 together for an adjusted position of the bushing 58 in housing 60. Fig. 5 discloses the disposition of the gasket 66 prior to its deformation to the shape shown by Fig. 3 wherein the end cover plate of the pump serves to impinge an axial load thereon effective to squash the gasket 66 and move it radially in recess 64 and into serrations 62. As such the gasket is securely frictionally held between housing 60 and the end cover plate for the pump with portions thereof gripping the bushing 58 through engagement with the serrations 60 thereof.

In adjusting the bushings 32 or 58 in their respective housings it is desirable that a nose clearance at the crests

of the teeth of the rotors be established of an amount not to exceed .002 inch.

The bushings 32 and 58 can be rotated effectively in their respective housing to produce a desired nose clearance without materially altering the position of the rotors in relation to the intake and discharge ports of the pump.

Fig. 6 diagrammatically illustrates the effect of adjustable movement of the eccentric bushing for adjusting the nose clearance in the rotors. The illustration exaggerates an actual adjustment and is disclosed as such merely for clarity of explanation. Point A represents the center or axis of rotation of an input shaft upon which the male or internal rotor is secured for rotation therewith. Point B is the center of the outside diameter of the eccentric bushing and represents the center about which the center of the outer or female rotor rotates. Circle C about center B represents the line upon which the center or axis of rotation of the outer rotor lies through the rotative or arcuate movement of the bushing in the adjustment of nose clearance between the rotors. Line D represents a desirable line upon which the centers of both rotors should preferably lie if extreme accuracy is obtained in the manufacture of the rotors providing an ultimate desired nose clearance therebetween. E represents the distance that the center of the outside diameter of the eccentric bushing is eccentric to the line of centers D. When the bushing is rotated about its own center B, it causes the center F of the outer rotor to move in a circle of radius. If we rotate the bushing through an angle G we will cause the center F of the outer rotor to move to a new position. This position is H distance below horizontal center line J and a distance K to the left of vertical center line D.

The displacement J, along the vertical line D, is desirable in that it decreases nose clearance between the inner and outer rotors providing for an efficient operation of pumps so adjusted. The movement K is undesirable, in that it changes the line of centers of the rotors. This change in the line of centers of the rotors, as represented by line L for an adjustment of the eccentric bushing to decrease nose clearance between inner and outer rotors, causes the pumping action of the rotors to be displaced with respect to the inlet and discharge ports and can cause a noise condition to result. By properly determining the eccentricity of the eccentric bushing, as represented by dimension E, such that in the operating or adjustable range of the eccentric bushing the dimension K is held to a minimum while obtaining a movement of dimension J sufficient to provide for desired nose clearance between the rotors, no condition of noise will result.

While this invention has been described in connection with certain specific embodiments, the principle involved is susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention, therefore, is limited only as indicated by the scope of the appended claims.

What I claim is:

1. In a rotary pump, in combination, a housing, a cylindrical wall internally thereof, a cylindrical external surfaced sleeve supported internally of the housing with its external surface in bearing engagement with the cylindrical wall of the housing, said sleeve being adjustably rotatable in the housing and having a cylindrical internal surface, the axis of which is eccentric to the axis of the external surface of the sleeve by a predetermined amount, means for locking the sleeve in adjusted position in the housing, a power input shaft supported for rotation in the housing with its axis substantially parallel but eccentric to the axis of the internal and external surfaces of the sleeve, and pumping means in the housing comprising inner and outer eccentrically rotatable rotors having interengaging teeth forming pumping chambers therebetween with the inner rotor secured for rotation with the shaft and with the outer rotor having an external perinheral sur-

face supported in bearing engagement on the internal surface of the sleeve, said sleeve effective upon adjustment thereof to vary the eccentric relation between the rotors and thus adjust nose clearance between the teeth of the rotors.

2. A rotary pump according to claim 1 wherein the means for locking the sleeve in adjusted position in the housing includes serrations on at least a portion of the external surface of the sleeve and resilient means pressed into engagement with the housing and serrations on the sleeve.

3. A rotary pump according to claim 1 wherein the means for locking the sleeve in adjusted position in the housing includes a plurality of circumferentially spaced axially extended slots in a peripheral surface of the engageable surfaces of the housing and sleeve and at least one axially extended slot in the other peripheral surface of the engageable surfaces of the housing and sleeve, and pin means receivable in a slot of each of the engageable surfaces to secure the sleeve and housing together.

4. A rotary pump according to claim 2 wherein the serrations extend circumferentially around the external surface of the sleeve, and wherein the resilient means is an annular member.

5. A rotary pump according to claim 3 wherein the plurality of circumferentially spaced slots are arranged on the external surface of the sleeve and the one slot is arranged on the wall of the housing adapted to be aligned with any one of the slots on the sleeve with the pin means received therein extending radially between the sleeve and housing.

6. A rotary pump according to claim 4 wherein the housing is formed of a cup-shaped main body and end plate with the cylindrical wall of the housing located in the main body, said main body having an annular recess adjacent the open end of the body with the recess adjacent the serrations on the sleeve, said annular resilient member being arranged in the recess and having a normal axial length greater than the axial depth of the recess and said end plate of the housing distorting the annular member into frictional engagement on the housing and engagement in the serrations on the sleeve.

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