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Rotary Pump with Rotor Bearing Cap

Abstract

Lobe pumps have bearing discs or caps which can be located at least partially in at least one of cover plates and rotors, if not both to provide at least thrust bearings to space the rotors from the cover plates while facilitating the possibility of clean in place operations. Many embodiments have bearing discs on the rotors which do not restrict axial movement on the shaft, but prevent pumped material from contacting the shaft, and many embodiments have bearing discs friction fit in bearing cutouts and bores (through the rotor and/or cover plate) to facilitate removal when disassembled.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention relates to a rotary pump construction such as a positive displacement pump and more particularly to such pumps potentially having improved rotor constructions and/or improved clean-in-place features over prior art pumps.

BACKGROUND OF THE INVENTION

[0002] The applicant is the owner of at least U.S. Pat. Nos. 8,087,914, 9,017,052, and 9,377,021 for improved positive displacement pumps with rotors. These pumps lock the rotors to the shafts. These designs have been well received in the marketplace. U.S. Pat. No. 11,353,019 is a recent design of the applicant which works well, and is likely the closest prior art, but this design does not axially secure rotors to the shafts along the shaft axes.

[0003] While these designs have rotor pads on the faces that face the cover (and opposing side) in an effort to reduce wear on the rotors themselves, they do not specifically address sealing shafts from pumped material except, possibly, for the rotor bolts 44,46 shown in FIG. 1 of U.S. Pat. Nos. 8,087,914, 9,017,052 and 9,377,021.

[0004] These prior art rotor bolts extend into the shafts to prevent axial mount of the shafts (col 3, lines 37-45). Furthermore, the covers on these designs are typically secured with nuts such as nut 20 in U.S. Pat. No. 9,937,021 requiring a wrench for installation/removal. U.S. Pat. No. 11,353,019 shows embodiments often requiring screwdriver blade notches 170,172, etc. to remove bearing rings where the material being pumped may accumulate in addition to around the splines of the rotors in an undesirable manner which would require the pump to be disassembled to be cleaned thoroughly.

[0005] In the field of food service, many pumps are regularly disassembled and cleaned. In order to accomplish this, tools are often required. Even U.S. Pat. No. 11,353,019 requires removing the bearing rings for cleaning the pump.

[0006] An improved clean in place design pump is believed to be desirable for many customers.

SUMMARY OF THE INVENTION

[0007] It is an object of many embodiments of the present invention provide an improved rotary pump with improved sealing characteristics.

[0008] It is another object of many embodiments to provide an improved rotary pump which can have a rotor having a cap sealing the splines from contact with material pumped while possibly permitting axial movement mount of the rotors relative to the shafts for at least some embodiments.

[0009] It is another object of many embodiments of the present invention to have an improved positive rotary pump having improved clean in place capability.

[0010] It is another object of many embodiments of the present invention to locate bearing discs in cutouts in at least one of a cover and a rotor for use in at least one of providing a thrust bearing, providing a sealing surface and/or providing a radial bearing.

[0011] Accordingly, in accordance with a presently preferred embodiment of the present invention, a rotary pump is providing having a rotor housing defining a cavity intermediate side walls, an end wall and a cover plate. An inlet and outlet communicate with the cavity. Parallel first and second shafts extend into the cavity from the end wall which rotate first and second rotors to provide pumping action (to direct fluid/material from the inlet to out the outlet).

[0012] Bearing discs could be installed at least partially into the cover and/or on the rotors themselves such as in a bearing cutout extending into at least one of the covers and/or the rotors of the various embodiments, preferably without connecting directly to the shafts. Bearing discs may also extend at least partially outwardly from the bearing cutouts. Additionally, first bearing discs may be located at/in the cover while second bearing discs may be disposed at/in the rotors with the first and second bearing discs contacting one another in the cavity, when both are utilized.

[0013] In accordance with the presently preferred embodiment of the present invention, a positive displacement pump, also known as a rotor pump, having parallel shafts with rotors thereon receive

an input (at input) and then expel an output (an output) based on the rotation of the rotors has improvements over prior art constructions. Specifically, the rotors may have ears extending from a hub which is received on a shaft. For many embodiments, the hub or other structure often extends the full length of the rotors on the shaft. Each of the hubs preferably provide an internal a cutout having a shelf at an end of the rotor radially external to a bore diameter receiving the shaft therein whereby a bearing disc is received, and possibly sealed, at least partially into the cutout, preferably against the shelf thereby preventing pumped material from contacting the shafts internal to the rotors. The shafts are preferably spaced from and not directly secured to the bearing discs like rotor bolts of prior art designs.
[0014] When disassembling the pump, the rotors may be slid rearwardly off the shaft with the cover plate removed and a tool or other device may be pushed through the front of the rotors to push the bearing caps off of the rear of the rotors.
[0015] Some embodiments may have planar rear cover plates which may potentially receive bearing discs in disc cutouts in the rear cover plate, preferably in a friction fit construction (preferably no notches like 170 in U.S. Pat. No. 11,353,019 exist about the discs for many embodiments). These discs may be connected to the cover plate with bolts extending through the cover plate into the bearing discs or otherwise if not solely friction fit into the cutouts. When the bolts are removed (if present), bores remaining through the cover plate, if present, may have a tool directed therethrough to assist in removing the bearing discs from the rear cover plate.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0016] The accompanying drawings illustrate the preferred embodiments of the invention and, together with the description, serve to explain the invention. These drawings are offered by way of illustration and not by way of limitation:
[0017] FIG. **1** is a front perspective partially exploded view of the presently preferred embodiment of the present invention;
[0018] FIG. **2** is a front perspective partially exploded view of the present invention as shown in FIG. **1** with the bearing discs removed from the rotors;
[0019] FIG. **3** is a rear perspective partially exploded view of the present invention shown in FIGS. **1-2**;
[0020] FIG. **4** is a rear perspective partially exploded view of the present invention as shown in FIGS. **1-3** with the bearing discs removed from the rear cover;
[0021] FIG. **5** is a schematic cutaway view of an assembled pump of FIGS. **1-4**;
[0022] FIG. **6** is a schematic cutaway view showing Detail B in FIG. **5**;
[0023] FIG. **7** is a rear perspective view of a first alternatively preferred cover plate removed from the pump;
[0024] FIG. **8** is a rear perspective view of the cover plate of FIG. **7** with a key partially inserted therein;
[0025] FIG. **9** is a rear perspective view of the cover plate of FIG. **7** with a key fully inserted therein; and
[0026] FIG. **10** is a rear perspective view of the cover plate of FIG. **7** with a key fully inserted therein and twisted to assist in removing the bearing cap in the cover plate.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT
[0027] Example embodiments will now be described more fully with reference to the accompanying drawings.
[0028] Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as

examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

[0029] The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms “a,” “an,” and “the” may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms “comprises,” “comprising,” “including,” and “having,” are inclusive and therefore specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

[0030] When an element or layer is referred to as being “on,” “engaged to,” “connected to,” or “coupled to” another element or layer, it may be directly on, engaged, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, when an element is referred to as being “directly on,” “directly engaged to,” “directly connected to,” or “directly coupled to” another element or layer, there may be no intervening elements or layers present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., “between” versus “directly between,” “adjacent” versus “directly adjacent,” etc.). As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0031] Although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as “first,” “second,” and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments.

[0032] Spatially relative terms, such as “inner,” “outer,” “beneath,” “below,” “lower,” “above,” “upper,” and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. Spatially relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, the example term “below” can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0033] As used herein, the term module refers to a part of, or includes an Application Specific Integrated Circuit (ASIC); a discrete circuit; an integrated circuit; a combinational logic circuit; a field programmable gate array (FPGA); a processor (shared, dedicated, or group) that executes code; other suitable hardware components that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip. In the example of a processor executing code, the term module includes memory (shared, dedicated, or group) that stores code executed by the processor.

[0034] The term code, as used above, may include software, firmware, and/or microcode, and may refer to programs, routines, functions, classes, and/or objects. The term shared, as used above, means that some or all code from multiple modules may be executed using a single (shared) processor. In addition, some or all code from multiple modules may be stored by a single (shared) memory. The term group, as used above, means that some or all code from a single module may be executed using a group of processors. In addition, some or all code from a single module may be stored using a group of memories.

[0035] The apparatuses and methods described herein may be partially or fully implemented by one or more computer programs executed by one or more processors. The computer programs include processor-executable instructions that are stored on at least one non-transitory tangible computer readable medium. The computer programs may also include and/or rely on stored data. Non-limiting examples of the non-transitory tangible computer readable medium include nonvolatile memory, volatile memory, magnetic storage, and optical storage.

[0036] The figures show a rotary lobe pump **10** having a rotor housing **12** defining a cavity **14** shown on FIG. **2** intermediate side walls **16** and **18**, an end wall **20** and a cover plate **26**. Into the cavity **14** from the end wall preferably extends first and second shafts **22**, **24** which are parallel shafts. The cover plate **26** is preferably located opposite the end wall **20** and will be discussed below. The pump **10** further comprises an inlet **36** and an outlet **38** (or vice versa) which may extend through the side walls **16**, **18** and/or other portion of the pump housing **12**. Mounted on the first and second shafts **22**, **24** are preferably first and second rotors **36** and **38** provided as a pair of rotors **32**,**34**. Rotors **32** and **34** are shown as having splined hubs **40** as will be explained in further detail below which can cooperate with splined exterior surfaces of the first and second shafts **22**, **24** as would be understood by those of ordinarily skill in the art for at least some embodiments, but for all embodiments, it is envisioned that there is a hub cavity **52** internal to the rotors **36**,**38** as explained in further detail below. Other methods of connecting the rotors **32**,**34** to shafts **22**, **24** could be employed with still other embodiments.

[0037] The rotors **32**,**34** preferably have hubs **40** connected to ears **42**,**44**. The hubs **40** have a central bore **46**, which receives the appropriate shaft **22**, **24** therein. The shafts **22**,**24** extend from a front **48** toward a rear **50** of the pump housing **12** when installed. However, the shafts **22**,**24** do not extend completely to the rear **50** of the pump housing **12**, but instead leave a hub cavity **52** spacing an end **54** of the shaft **22**,**24** from the rear **50** of the pump housing **12**. A rotor bolt does not extend into the shafts **22**,**24** holding the rotors to the shafts **22**,**24**. The hub cavity **52** preferably has a shelf **56** located radially externally of the central bore **46** receiving the shaft **22**,**24**. The shafts **56** are which is spaced from rear **50** of the pump housing **12** providing a larger diameter than the central bore **46** at that portion than the central bore **46** receiving the shaft **22**,**24**.

[0038] A seal **58** may be received in the hub cavity **52** which may or may not assist in retaining a bearing disc **62** with the bearing disc **62** received in a bearing disc cutout **64** at least partially defined by the shelf **56**. Seal **58** does not secure to the shafts **22**,**24** and may be spaced apart therefrom as illustrated or otherwise.

[0039] Bearing disc **62** may have an o-ring **60** on a circumferential surface **66** against the bearing disc cutout **64**, possibly at least partially disposed in a groove **68** on the side surface **66** of the bearing disc **62**. With such a construction the hub cavity **52** is sealed so that material being pumped by the pump **10** cannot contact the splines or other portions of shaft **22** or **24** so that as it relates to internal portions of the rotors **32**,**34**, the pump **10** can be cleaned in place without disassembly for many pumped goods. For many embodiments, the rotors **32**,**34** are free to move axially relative to the shafts **22**,**24**.

[0040] The cover plate **26** may have bearing disc cutouts **70**,**72** which receive bearing discs **74**,**76**, often in a friction fit when installed. A shelf **84** may assist in defining the bearing disc cutouts **70**,**72** which may leave a cavity **82** possibly communicating with a bore **78** and **80** through which bolts **88** may extend through, possibly into bearing disc **74** or **76**. With the bolt **88** removed a tool may be directed through bore **80** (or **78**) when the cover plate **26** is removed from the pump **10** so as to push the bearing discs off of the cover plate **26** for replacement purposes. Bearing discs **74**,**76** preferably have side surfaces **90** which may have channels **92** receiving o-rings **94** to assist in sealing and/or the friction fit, or not. With the friction fit, no pumped material can lodge in the cover plate **26** as can occur in the notches 170, etc. of U.S. Pat. No. 11,353,019.

[0041] Opposing surfaces **96**,**98** of each of the bearing discs **62** and **76** and **63** and **74**, respectively may possibly contact one another, possibly while leaving gap **100** therebetween, or not, for various embodiments.

[0042] Bearing discs **62**,**63** are preferably completely spaced apart from the shafts and not directly secured thereto as a rotor bolt would be in the prior art.

[0043] An alternatively preferred embodiment is shown in FIGS. **7-10** for the bearing cap or bearing discs **74**,**76** located relative to a cover plate **120**. Disc cutouts **122**,**124** can receive the bearing discs **74**,**76** somewhat similarly as disc cutouts **70**,**72** of the previously discussed embodiment. These disc cutouts may accommodate lateral bores **126**,**128**, which may receive a key **130** or other tool, at least partially therein and therethrough as will be explained in further detail below.

[0044] Key **130** may have an operator **132** which may be inserted through the lateral bores, and preferably behind a rear surface **134** of the bearing discs. Operator **132** may be semi-circular for at least some embodiments, such as approximately half the diameter of the lateral bores **126**,**128** (or slightly less), so that when inserted, a top surface of the operator **132** does not contact the rear surface of the bearing discs **74**,**76**. Once fully inserted as shown in FIG. **9**, the key **130** may be twisted, such as along bore axis **150**, so that the operator contacts the rear surface **134** of the bearing disc **74**,**76** and outwardly directs the bearing disc **74**,**76** from the affected disc cutout **122**,**124** at least sufficiently so that the bearing disc **74**,**76** may be handled from sides **136** to continue the removal process, if necessary.

[0045] With this construction, the lateral bores **126**,**128** may not possibly permit fluid to pass completely through from front **138** to rear **140** of cover plate **120** like the other embodiment discussed above, such as if either of the bearing discs **74**,**76** were to fail. Lateral bores **126**,**128** communicate the disc cutouts **122**,**124** with side surfaces **142**,**144**, respectively of the cover plate **120**.

[0046] Lateral bores **126**,**128** communicate with slots **146**, **148** which are at the bottom of disc cutouts **122**,**124**. Slots preferably have a height of about the height of a radius of the bores **126**,**128** which is slightly greater than a height of the operator **132** of the key **130** when inserted into the slots **146**,**148**. Once the key **130** turns about axis **150** the operator elevates at least partially out of the slot **146**,**148** to at least partially dislodge the bearing disc(s) **74**,**76** from the affected disc cutout(s) **122**,**124**.

[0047] Numerous alterations to the structures herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present disclosure relates to the preferred embodiment of the invention for which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appending claims.

Claims

1. A rotary lobe pump comprising: a rotor housing assisting defining a pump cavity intermediate side walls, an end wall and a cover plate; parallel first and second shafts extend into the cavity from the end wall; an inlet port and an outlet port communicating with the cavity; first and second rotors connected to the first and second shafts, respectively; each of the first and second rotors having cars with faces directed toward the cover plate connected respectively to a central hubs with the hubs connected to the respective first and second shafts, and a hub cavities extending respectively from ends of the first and second shafts to ends of the hubs; and first bearing discs located at least partially in the hub cavities sealing off the hub cavities from the pump cavity from fluid communication while the first bearing discs do not restrict axial movement of the first and second rotors along axes of rotation of the first and second shafts.

2. The rotary lobe pump of claim 1 further comprising bearing disc cutouts extending into the ends of the hub, said bearing disc cutouts have a larger diameter than a bore through the hubs receiving the first and second shafts, respectively.

3. The rotary lobe pump of claim 2 further comprising a seal located in the hub cavity between the first bearing disc and the ends of the first and second shafts, respectively.

4. The rotary lobe pump of claim 3 further comprising second bearing discs located at least partially in the cover plate colinearly disposed relative to the axes of rotation of the first and second shafts.

5. The rotary lobe pump of claim 4 wherein the second bearing discs are at least partially located within bearing disc cutouts in the cover plate.

6. The rotary lobe pump of claim 5 wherein the second bearing discs are friction fit within bearing disc cutouts in the cover plate and further comprising bores extending through the cover plate internal to a perimeter of the second bearing discs whereby a key is directed through the bores to push the second bearing discs out of the bearing disc cutouts to overcome the friction fit when the cover plate is removed from the pump.

7. The rotary lobe pump of claim 2 wherein the bearing disc cutouts in the rotors are at least partially defined by a shelf and the first bearing discs contact the shelf when installed.

8. The rotary lobe pump of claim 7 wherein the first bearing discs friction fit within the bearing disc cutouts,

9. The rotary lobe pump of claim 8 wherein the first bearing discs have sidewalls with grooves and an o-ring circumnavigates the sidewalls within the grooves, respectively.

10. The rotary lobe pump of claim 1 further comprising second bearing discs located at least partially in the cover plate colinearly disposed relative to the axes of rotation of the first and second shafts.

11. The rotary lobe pump of claim 10 wherein the second bearing discs are at least partially located within bearing disc cutouts in the cover plate.

12. The rotary lobe pump of claim 11 wherein the second bearing discs are friction fit within bearing disc cutouts in the cover plate and further comprising bores extending through the cover plate internal to a perimeter of the second bearing discs whereby a key is directed through the bores to push the second bearing discs out of the bearing disc cutouts to overcome the friction fit when the cover plate is removed from the pump.

13. The rotary lobe pump of claim 12 wherein the second bearing discs have sidewalls with grooves and an o-ring circumnavigates the sidewalls within the grooves, respectively.

14. The rotary lobe pump of claim 10 further comprising a central cavity located at least partially between the first and second bearing discs.

15. A rotary lobe pump comprising: a rotor housing assisting defining a pump cavity intermediate side walls, an end wall and a cover plate; parallel first and second shafts extend into the pump cavity from the end wall; an inlet port and an outlet port communicating with the cavity; first and second rotors connected to the first and second shafts, respectively; each of the first and second rotors having ears with faces directed toward the cover plate connected to a central hub with; and second bearing discs are at least partially located within bearing disc cutouts in the cover plate, said second bearing discs friction fit within bearing disc cutouts in the cover plate and further comprising bores extending through the cover plate internal to a perimeter of the second bearing discs whereby a key is directed through the bores to push the second bearing discs out of the bearing disc cutouts to overcome the friction fit when the cover plate is removed from the pump.

16. The rotary lobe pump of claim 15 further comprising a hub cavities extending respectively from ends of the first and second shafts to ends of the hubs, and first bearing discs located at least partially in the hub cavities sealing off the hub cavities from the pump cavity from fluid communication while the first bearing discs do not restrict axial movement of the first and second rotors along axes of rotation of the first and second shafts.

17. The rotary lobe pump of claim 16 further comprising bearing disc cutouts extending into the ends of the hubs, said bearing disc cutouts have a larger diameter than a central bore through the hubs receiving the first and second shafts, respectively.

18. The rotary lobe pump of claim 17 further comprising a seal located in the hub cavity between the first bearing disc and the ends of the first and second shafts, respectively.

19. The rotary lobe pump of claim 18 wherein the first bearing discs friction fit within the bearing disc cutouts.

20. The rotary lobe pump of claim 19 wherein the first bearing discs have sidewalls with grooves and an o-ring circumnavigates the sidewalls within the grooves, respectively.
