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DESCRIPTION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application No. 60/592,988 filed July 30, 2004, and entitled "Gear Pump".

FIELD OF THE INVENTION

[0002] The present invention pertains to a gear pump.

BACKGROUND OF THE INVENTION

[0003] Positive displacement gear pumps can be used for low rate metering pump applications. Depending on the substances to be conveyed, chemical resistance may be a required characteristic of the materials of construction for the pump. In order to handle corrosive materials, the pumps are typically constructed from corrosion resistant materials such as 316 stainless steel. There is a need for a non-metallic pump that is easier and less expensive to manufacture and that is chemically resistant.

[0004] US 2004/0105768 describes a magnetically coupled positive displacement pump with a metallic containment can having high and low pressure port passageways through a flange of the pump which can provide communication between the interior of the can and the pumping cavity of the pump to remove heat generated by eddy currents in the can. Either or both of the port passageways can be provided with a removable or otherwise adjustable orifice which allows easy modification of cooling fluid rate for improved heat removal to more closely meet the needs of a given application.

SUMMARY OF THE INVENTION

[0005] The present invention is set out in the appended claims. Described herein is a non-metallic pump with a central housing having a suction side, a discharge side, a top flange and a bottom flange. A drive gear assembly is disposed in the central housing. The drive gear assembly comprises a drive shaft having a plurality of first gear flights extending therefrom. An idler gear assembly is disposed in the central housing in operative relation to the drive gear assembly. The idler gear assembly comprises an idler shaft having a plurality of second gear flights. A first bearing has a pair of openings defined therein. The openings are capable of receiving the drive shaft and idler shaft. A second bearing has a pair of openings defined therein. The openings are capable of receiving the drive shaft and the idler shaft. A gear insert is disposed between the first and second bearings and is sized to fit over the plurality of first and second gear flights. The gear insert has an inner wall disposed in spaced apart relation to the gear flights. A cover is attached to the top flange of the central housing and encloses the drive and idler gear assemblies. An adapter spool has a central opening for receiving a containment can. The adapter spool has a top flange and a bottom flange. The top flange is capable of mating with the bottom flange of the central housing. A drive magnet assembly is disposed in the adaptor spool. A driven magnet assembly is disposed in the containment can in operative relation to the drive magnet assembly. An electric motor is coupled to the drive magnet assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention is illustrated in the drawings in which like reference characters designate the same or similar parts throughout the figures of which:

Fig. 1 is a perspective view of a gear pump of the present invention;

Fig. 2 is a cross-sectional view taken along lines 2-2 of Fig. 1;

Fig. 3 is an exploded view of the gear pump assembly of the present invention;

Fig. 4 is a side elevational view of the universal flange of the present invention;

Fig. 5 is a schematic view of the pump chamber of the present invention showing the gear teeth and fluid grooves on the face of the bearing;

Fig. 6 is a side elevational view of one of the bearings of the present invention;

Fig. 7 is a cross-sectional view taken along lines 7-7 of Fig. 6;

Fig. 8 is a perspective view of the drive shaft; and,

Fig. 9 is a partial enlarged view taken from Fig. 2.

DETAILED DESCRIPTION

[0007] - Referring to FIG. 1, a gear pump assembly 10 includes an adaptor spool 93 mounted to an electric motor 16. An inlet port 19 and an outlet port 22 include universal flanges 25, 28 with alignment features as described in greater detail herein. The assembly 10 is also provided with a front cover 31 that provides access to the internal parts. Most maintenance and service tasks can be performed by opening the front cover 31 without the need for breaking any of the pipe connections. The gear pump assembly 10 is constructed of non-metallic parts as described in greater detail below.

[0008] The adaptor spool 93 has a motor adaptor plate 34 with multiple patterns for use with NEMA or IEC type motor enclosures. The center housing 43 can be rotated in forty-five degree increments to provide a vertical orientation for the input and output ports 19 and 22. The base plate 40 has multiple slotted patterns 41 that match standard motor mounting patterns for retrofitting the assembly 10 to match the footprint of existing installed pumps.

[0009] Turning to Figs. 2 and 3, the front cover 31 is bolted to the center housing 43 and is sealed with a first O-ring 46. For ease of installation, the center housing 43 is provided with nut retaining plates 47 that automatically hold the nuts in place to provide for installation of the mounting bolts with a single socket or wrench. The center housing 43 and the cover 31 form a pump chamber that contains the drive gear assembly 49 and the idler gear assembly 52. The gear assemblies 49, 52 may be constructed of Ethylene/Tetrafluoroethylene ("ETFE") copolymer which is an injection molded fluoropolymer having chemical resistance properties suitable for a wide variety of applications. Alternate non-metallic materials are also suitable as will be evident to those of ordinary skill in the art. The gear assemblies 49, 52 have gear teeth 50, 51 that are integrally molded on their respective shafts 61, 64. Shafts 61, 64 are manufactured from non-metallic and preferably ceramic materials.

[0010] A pair of bearings 55, 58 support the drive shaft 61 and the idler shaft 64. The bearings 55, 58 are disposed on opposite sides of the gears 49, 52 and can be mounted facing in either direction. The bearings 55, 58 include wear plates with fluid grooves on the surfaces facing the gear teeth 50, 51 as will be described in further detail herein.

[0011] A gear insert or liner 67 is disposed around the teeth 50, 51 of the respective gear assemblies 49, 52. The liner 67 is a precision manufactured part having an inner wall 68 that is disposed in spaced apart relation to the teeth on the gear assemblies 49, 52. The gap between the end of the teeth of the gear assemblies 49, 52 and the inner wall 68 is maintained to a tight tolerance in order to provide optimal performance of the pump assembly 10. The liner 67 provides for control of tolerances and easy replacement. The pump assembly 10 can be maintained and restored to its original performance by replacing the liner 67. The replaceable liner 67 also prevents the gear teeth from damaging the inner wall 71 of the center housing 43 when the bearings are worn out.

[0012] A second O-ring 73 is disposed inside the front cover 31 and acts as a spring and takes up any variation in tolerance resulting from variations in the length of the housing 43, cover 31, bearings 55, 58 or the liner 67. The O-ring 73 also compensates for thermal expansion of the parts. By taking up the tolerance, the O-ring 73 reduces the cost of manufacturing the housing 43, cover 31, bearings 55, 58 and the liner 67. Under low pressure, the O-ring 73 exerts a force against the outer bearing causing it to press against the liner. Under high pressure, the hydraulic fluid forces the bearings against the liner. An opening 66 is used in the idler shaft 64 to balance this hydraulic force equally from side to side. Other manufacturer's assemblies typically require highly toleranced metal parts to achieve tolerance control or use narrow temperature operating ranges. The present invention allows for use of non-precision non-metallic parts over a wide temperature range.

[0013] The shaft 61 of the drive gear 49 engages with a driven magnet assembly 83. The shaft 61 may be constructed from a ceramic material having chemical resistance suitable for a wide variety of applications. The shaft 61 has a spline system 85

comprising a plurality of splines 86 machined thereon such that the driven magnet assembly 83 can float on the splines 86 without any axial load being transmitted to the shaft 61. The spline system 85 eliminates the need for keys and retaining rings for connecting the shaft to the driven magnet. The spline system 85 also spreads out the load from the driven magnet assembly 83. The driven magnet assembly 83 is disposed inside a containment can 90 located in an adaptor spool 93. The containment can 90 is sealed against the center housing by a third O-ring 96. A drive magnet assembly 100 is disposed outside of the containment can 90 and is driven by the electric motor 16 (Fig. 1) as will be evident to those of ordinary skill in the art. The drive magnet assembly 100 is coupled to the motor 16 by an interchangeable motor hub adaptor 103.

[0014] The gear pump assembly 10 may be provided with flush and drain ports 110 and 113, respectively.

[0015] In Fig. 4, universal connection flange 25 is provided to allow the pump to mate to ANSI (American National Standards Institute) and two different DIN (Deutsches Institut für Normung E.V.) size flanges. This is achieved by incorporating three different patterns for bolt holes 197. To properly align the holes 197 on the universal flange 25 concentrically, a visual indicator is necessary. The visual indicator is provided by utilizing the outside diameter 200 of the raised face sealing surface 203 for one size and a stepped outside diameter with two different diameters 206, 209 for the other two sizes. The raised face sealing surface insert 203 is Polytetrafluoroethylene (Teflon) in the embodiment described, but can be any compliant material. The insert 203 is replaceable in case of damage so the main housing is not sacrificed. The insert 203 can also be reversed to present a fresh side for sealing.

[0016] Turning to Figs. 5-7, the pump uses a lubrication system where there are an odd number of teeth 50, 51 on the gear assemblies 49 and 52 which alternately cover - and uncover fluid circulation grooves 300, 301, 342, and 304 to recirculate fluid from the discharge side 303 of the pump to the intake 306 of the pump. At the bottom of Fig. 5, the groove 300 on the left hand side of the figure is uncovered providing an open flow path. The groove 304 on the top right hand side of the figure is also open. When the teeth rotate, the grooves 300, 301, 302, and 304 alternate between the open and closed position as described below.

[0017] As best shown in Figs. 6 and 7, the fluid grooves 300 and 302 start on the face of the bearing 55 and follow a spiral pathway 306, 308 (grooves 301 and 304 have identical spiral pathways that are not shown due to the direction of the orientation of the cross-section) to the opposite side of the bearing where the pathway 306 ends on the same side of the bearing. Accordingly, each bearing 55 has a fluid groove that begins at the front and a fluid groove that begins at the rear. Because the orientation of the teeth alternately exposes the grooves 300, 301, 302, 304 to the pumped fluid stream, there is never a time when two grooves are exposed on the same gear. Due to the meshing of the gear pair, as one groove is exposed on the discharge side of a gear, an alternate groove is exposed on the suction side of the second gear. As shown in Fig. 6, the fluid pathway indicated by arrows 307 is as follows: fluid enters the uncovered groove 304 on the discharge side and goes through the spiral pathway to the bottom of the bearing where it then crosses over to the other side. The fluid enters the spiral pathway 306 leading to the uncovered groove 300 on the face at the suction side. Because of the arrangement of the teeth on the gears, the pathway alternates from pathway 307 to a second pathway indicated by arrows 310 in Fig. 6.

[0018] Turning to Fig. 8, drive shaft 61 with teeth 50 is shown in greater detail. The spline system 85 on drive shaft 61 is manufactured such that the ends of the splines 86 form a smooth transition with the body of the shaft 61. A first feathered section 350 provides a transition from the body of the shaft 61 to the spline 86. At a position located distal to the first feathered section 350, a second feathered section 353 is provided. The smooth transition between the spline system 85 and the shaft 61 eliminates any sharp transitions that could create stress points on the shaft 61.

[0019] In Fig. 9, the locating feature of the containment can 90 is shown in greater detail. The containment can 90 fits into a recessed portion 400 in the adapter spool 93 such that the containment can 90 is disposed above the top of the adapter spool. The top of the containment can 90 mates with a recessed portion 403 in the center housing 43. Accordingly, the parts locate themselves during assembly such that once the containment can 90 is seated properly, the center housing 43 slides into the correct position and there is a positive indication of proper alignment due to the engagement with the top of the containment can 90.

[0020] While the invention has been described in connection with certain embodiments, it is not intended to limit the scope of the invention to the particular forms set forth, but it is intended to cover such alternatives, modifications, and equivalents falling within the scope of the appended claims.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US59298804P [0001]
- US20040105768A [0004]

Patentkrav**1. Tandhjulpumpe omfattende:**

et centralt hus (43) med en sugeside (306), en udledningsside (303), en første flange (25) og en anden flange (28);

5 en drivtandhjulsenhed (49), der er anbragt i det centrale hus (43), hvor drivhjulsenheden omfatter en drivaksel (61) med en flerhed af første tandhjulsbaner, der strækker sig derfra;

en mellemtandhjulsenhed (52), der er anbragt i det centrale hus (43) i funktionsforhold med drivtandhjulsenheden (49), hvor mellemtandhjulsenheden (52) omfatter en mellemaksel (64) med en flerhed af anden tandhjulsbaner;

10 et første leje (55) med indvendige vægge, der definerer et par åbninger, hvor åbningerne kan modtage drivakslen (61) og mellemakslen (64);

et andet leje (58) med indvendige vægge, der definerer et par åbninger, hvor åbningerne kan modtage drivakslen (61) og mellemakslen (64);

15 en tandhjulsindsats (67), der er anbragt mellem det første og andet leje (55 og 58) og er dimensioneret til at passe over flerheden af første og anden tandhjulsbaner, hvor tandhjulsindsatsen har en indvendig væg, der er anbragt i et afstandsforhold til tandhjulsbanerne;

20 en afdækning (31), der er fastgjort til den første flange af det centrale hus og omslutter driv- og mellemtandhjulsenhederne;

en adapterspole (93) med en central åbning til modtagelse af en opbevaringsdåse, hvor adapterspolen har en første flange og en anden flange, hvor den første flange kan passe sammen med den anden flange af det centrale hus;

25 en drivmagnetenhed (100), der er anbragt i adapterspolen;

en drevet magnetenhed (83), der er anbragt i opbevaringsdåsen i funktionsforhold med drivmagnetenheden;

en elektrisk motor (16), der er koblet til drivmagnetenheden;

og kendetegnet ved, at

30 hver åbning i det første leje (55) har et første fluidcirkulationsindløb på en udledningsside og har et andet fluidcirkulationsindløb på en sugeside, hvor det første fluidcirkulationsindløb fører hen til en fluidcirkulationsrille (300,302), der er defineret i de indvendige vægge af det første leje (55) og strækker sig fra en forside af det første leje til en bagside af det første leje,

35 hvor bagsiden er modsat forsiden;

- 5 hvor hver åbning i det andet leje (58) har et første fluidcirkulationsindløb på en udledningsside og har et andet fluidcirkulationsindløb på en sugeside, hvor det første fluidcirkulationsindløb fører hen til en fluidcirkulationsrille (300,302), der er defineret i de indvendige vægge af det andet leje (58) og strækker sig fra en forside af det andet leje til en bagside af det andet leje, hvor bagsiden er modsat forsiden;
- 10 hvor de første og anden tandhjulsbaner er anbragt således at, når det første indløb er utildækket på en sugeside af drivtandhjulet, er det andet indløb dækket på en udledningsside af drivtandhjulet.
- 15 **2.** Tandhjulspumpe ifølge krav 1, hvor det første og andet indløb er ca. 180 grader fra hinanden.
- 3.** Tandhjulspumpe ifølge krav 1 eller 2, hvor drivakslen (61) og mellemakslen (64) har et ulige antal baner.
- 4.** Tandhjulspumpe ifølge krav 1, 2 eller 3, hvor drivakslen (61) endvidere omfatter en flerhed af noter udformet deri.
- 20 **5.** Tandhjulspumpe ifølge et af de foregående krav, hvor drivakslen (61) er keramisk.
- 6.** Tandhjulspumpe ifølge et af de foregående krav, endvidere omfattende: en O-ring, der er anbragt mellem det andet leje (58) og afdækningen (31).
- 25 **7.** Tandhjulspumpe ifølge et af de foregående krav, endvidere omfattende: universelle flanger på suge- og udledningssiden.
- 8.** Tandhjulspumpe ifølge et af de foregående krav, hvor opbevaringsdåsen passer ind i en forsænket del i adapterspolen, således at en ende af opbevaringsdåsen strækker sig ud over en ende af adapterspolen.
- 30 **9.** Tandhjulspumpe ifølge krav 8, hvor det centrale hus (43) har en forsænket del, der modtager enden af opbevaringsdåsen.
- 35

10. Tandhjulspumpe ifølge krav 1, hvor de første og anden tandhjulsbaner er anbragt således at, når det første indløb er utildækket på en sugeside af drivtandhjulet (49), er det første indløb dækket på sugesiden af mellemtandhjulet (52).

DRAWINGS















