(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 July 2013 (18.07.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/105996 A1

(51) International Patent Classification:
F01C 19/12 (2006.01) *F04C 2/14* (2006.01)
F01C 21/10 (2006.01) *F01C 19/00* (2006.01)
F04C 15/00 (2006.01)

(21) International Application Number:
PCT/US2012/025394

(22) International Filing Date:
16 February 2012 (16.02.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/443,826 17 February 2011 (17.02.2011) US

(71) Applicant *(for all designated States except US)*: **STANDEX INTERNATIONAL CORPORATION** [US/US]; 11 Keewaydin Drive, Suite 300, Salem, NH 03079 (US).

(72) Inventors: **KIMBERLIN, Robert, R.**; 3911 Rowland Rd, Murfreesboro, TN 37128 (US). **JIANG, Jie**; 4435 Soper Ave., Nashville, TN 37204 (US).

(74) Agent: **ORR, Wade, R.**; P.O. Box 1871, Knoxville, TN 37901 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

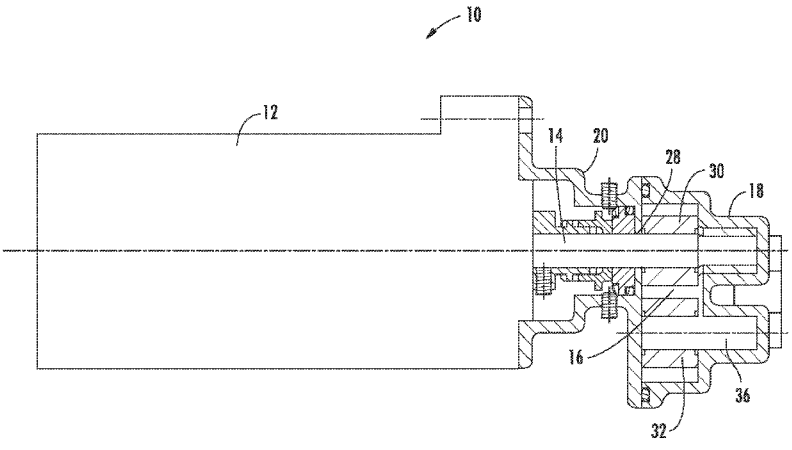
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: FLUID PUMP MECHANICAL SEAL



(57) Abstract: A fluid pump having a pump motor, pump housing, and pump seal enclosure. The pump housing includes an internal pumping chamber, a suction orifice in flow communication with the pumping chamber, a discharge orifice in flow communication with the pumping chamber, and a drive shaft opening. The pump seal enclosure is disposed between the pump motor and the pump housing. A pump drive shaft is rotatably driven by the pump motor and extends through the pump seal enclosure and the drive shaft-ing opening into the pumping chamber. A drive shaft seal assembly is disposed within the pump seal enclosure. The drive shaft seal assembly includes a spring seat fastened to the drive shaft, the spring seat being disposed coaxially with the drive shaft and adjacent the pump motor and further having a first alignment mechanism, a rotary ring disposed coaxially with the drive shaft and having a second alignment mechanism for engaging the first alignment mechanism of the spring seat, a stationary ring disposed coaxially with the drive shaft and fastened to the pump seal enclosure adjacent the drive shaft opening, and a compressible spring disposed coaxi-ally with the drive shaft between the spring seat and the rotary ring, wherein the spring biases the rotary ring against the stationary ring.

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FLUID PUMP MECHANICAL SEAL

FIELD

[0001] This disclosure relates to the field of fluid pumps. More particularly, this disclosure relates to an improved drive shaft mechanical seal for pumps such as gear pumps.

BACKGROUND

[0002] A variety of fluid displacement pumps are known and are well suited to a variety of pumping applications. In particular, gear pumps are known to be used in fluid applications requiring precise metering or dosing capabilities because the volume and flow rate of the liquid supplied by the gear pump is based upon the rate of rotation of the gears. Typical gear pumps include a pump housing and a pair of intermeshing gears disposed within an internal pumping chamber within the housing. Input and output ports are located on opposing sides of the pump housing. During operation, a drive gear is driven by a drive shaft which in turn rotates an idler gear. The fluid being pumped is primarily carried from the input port through the internal pumping chamber and the spaces disposed between adjacent idler teeth to the output port.

[0003] It is known to prevent leakage of the liquids being pumped in the pumping chamber using a mechanical seal attached to the drive shaft adjacent the pump housing. However, prior art pumps have had problems keeping the pumped fluids out of the seal enclosure of the mechanical seal as the natural inclination of the fluid is to go from the high pressure area of the internal pumping chamber to the low pressure area of the seal enclosure. Especially in sanitary applications, such as pumping liquids for use in carbonated water systems and espresso and cappuccino machines, this is highly undesirable. Similar sanitation concerns may apply to pumps intended for medical applications as well. What is needed is a mechanical seal that prevents pumped fluids from entering the pump seal enclosure during normal operation of the pump.

SUMMARY OF THE INVENTION

[0004] According to certain embodiments, the present disclosure provides a fluid pump having a pump motor, a pump housing, and a pump seal enclosure. The pump housing includes an internal pumping chamber, a suction orifice in flow communication with the pumping chamber, a discharge orifice in flow communication with the pumping chamber, and a drive shaft opening. The pump seal enclosure is disposed between the pump motor and the pump housing. A pump drive shaft is rotatably driven by the pump motor and extends through the pump seal enclosure and the drive shafting opening into the pumping chamber. A drive shaft seal assembly is disposed within the pump seal enclosure. The drive shaft seal assembly includes a spring seat fastened to the drive shaft, the spring seat being disposed coaxially with the drive shaft and adjacent the pump motor and further having a first alignment mechanism, a rotary ring disposed coaxially with the drive shaft and having a second alignment mechanism for engaging the first alignment mechanism of the spring seat, a stationary ring disposed coaxially with the drive shaft and fastened to the pump seal enclosure adjacent the drive shaft opening, and a compressible spring disposed coaxially with the drive shaft between the spring seat and the rotary ring, wherein the spring biases the rotary ring against the stationary ring.

[0005] In certain embodiments, the spring seat is fastened to the drive shaft by at least one set screw. A washer may be disposed coaxially with the drive shaft and adjacent the stationary ring, and the washer and stationary ring are non-rotatably fastened to the pump seal enclosure by at least one set screw. An O-ring may also be disposed between the stationary ring and the pump housing.

[0006] In certain embodiments, the draft seal assembly causes substantially no pumped fluids to enter the pump seal enclosure during normal operation of the pump. Also, substantially no pumped fluids contact the spring seat, the compressible spring, or the rotary ring during normal operation of the pump.

[0007] In some embodiments, the stationary ring comprises one of a ceramic material and a silicon carbide material and the rotary ring comprises a graphite material. The first

alignment mechanism of the spring seat includes may includes at least one alignment rib and the second alignment mechanism of the rotary ring includes at least one slot for receiving and engaging the at least one alignment rib.

[0008] According to another embodiment of the disclosure, a fluid gear pump is disclosed having a pump motor, a pump housing, and a pump seal enclosure. The pump housing includes an internal pumping chamber, a suction orifice in flow communication with the pumping chamber, a discharge orifice in flow communication with the pumping chamber, and a drive shaft opening. The pump seal enclosure is disposed between the pump motor and the pump housing. A pump drive shaft is rotatably driven by the pump motor and extends through the pump seal enclosure and the drive shafting opening into the pumping chamber. A drive gear, having a plurality of drive gear teeth, is disposed within the pumping chamber and is rotatably driven by the drive shaft. An idler gear, having a plurality of idler gear teeth intermeshed with the drive gear teeth, is disposed within the pumping chamber and attached to an idler shaft disposed within the pumping chamber. A drive shaft seal assembly is disposed within the pump seal enclosure. The drive shaft seal assembly includes a spring seat fastened to the drive shaft, the spring seat being disposed coaxially with the drive shaft and adjacent the pump motor and further having a first alignment mechanism, a rotary ring disposed coaxially with the drive shaft and having a second alignment mechanism for engaging the first alignment mechanism of the spring seat, a stationary ring disposed coaxially with the drive shaft and fastened to the pump seal enclosure adjacent the drive shaft opening, and a compressible spring disposed coaxially with the drive shaft between the spring seat and the rotary ring, wherein the spring biases the rotary ring against the stationary ring.

[0009] In certain embodiments, the spring seat is fastened to the drive shaft by at least one set screw. A washer is disposed coaxially with the drive shaft and adjacent the stationary ring, and the washer and stationary ring are non-rotably fastened to the pump seal enclosure by at least one set screw. An O-ring is disposed between the stationary ring and the pump housing.

[0010] In certain embodiments according to the present disclosure, substantially no pumped fluids enter the pump seal enclosure during normal operation of the pump. Also, substantially no pumped fluids contact the spring seat, the compressible spring, or the rotary ring during normal operation of the pump.

[0011] According to some embodiments of the disclosure, the stationary ring comprises one of a ceramic material and a silicon carbide material and the rotary ring comprises a graphite material.

[0012] In some embodiments the first alignment mechanism of the spring seat includes at least one alignment rib and the second alignment mechanism of the rotary ring includes at least one slot for receiving and engaging the at least one alignment rib.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Further advantages of the invention are apparent by reference to the detailed description when considered in conjunction with the figures, which are not to scale so as to more clearly show the details, wherein like reference numbers indicate like elements throughout the several views, and wherein:

[0014] FIG. 1 is a cross-sectional side view of a fluid gear pump according to one embodiment of the present disclosure;

[0015] FIG. 2 is a cross-sectional front view of a fluid gear pump according to one embodiment of the present disclosure illustrating the internal pumping chamber;

[0016] FIG. 3 is a cross-sectional view side view of a pump housing and pump seal enclosure according to one embodiment of the present disclosure; and

[0017] FIG. 4 is an exploded view of a drive shaft seal assembly according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0018] According to one embodiment of the present disclosure, a fluid pump 10 is provided. The fluid pump 10 according to the present disclosure is suitable for pumping a wide variety of liquids. The fluid pump 10 is particularly suited for pumping liquids for use in beverages, such as for pumping liquids in carbonated water systems, for espresso and cappuccino machines, and for beer cooling systems.

[0019] As may be seen in FIG. 1, the fluid pump 10 includes a motor 12. The pump motor 12 is preferably an electric motor; however, the pump motor 12 may alternatively be powered by other means such as by internal combustion. A pump drive shaft 14 is attached to the pump motor 12 and driven thereby. The pump drive shaft 14 is preferably made from a metal such as steel.

[0020] The fluid pump 10 includes a pump assembly 16 having a pump housing 18 and a pump seal enclosure 20 disposed between the pump motor 12 and pump housing 18. The pump seal enclosure 20 is preferably readily removable from the pump housing 18 for pump disassembly and cleaning. The pump drive shaft 14 extends through the pump seal enclosure 20 into the pump housing 18 for driving the pump assembly 16. While it should be understood that the mechanical seal assembly of the present disclosure may be used in connection with numerous types of fluid displacement pump such as a gear pump, vane pump, centrifugal pumps, etc., the mechanical seal assembly of the present disclosure, as shown and described in the exemplary embodiments herein, is preferably used with a gear pump.

[0021] With further reference to FIGS. 1-2, the pump housing 18 is preferably oval shaped and includes an internal pumping chamber 22, a suction orifice 24 in flow communication with the pumping chamber 22, and a discharge orifice 26 in flow communication with the pumping chamber 22. The pump housing 18 further includes a drive shaft opening 28 through which the drive shaft 14 extends into the pump housing 18. A drive gear 30, having a plurality of drive gear teeth 31, is disposed within the pumping chamber 22 and is operable to be rotatably driven by the drive shaft 14. An

idler gear 32, having a plurality of idler gear teeth 33 operable to be intermeshed with the drive gear teeth 31 so that the idler gear 32 is rotatable when the drive gear 30 is driven by the drive shaft 14, is also disposed within the pumping chamber 22 and is attached to an idler shaft 36 disposed within the pumping chamber 22.

[0022] During operation of the gear pump, the drive shaft 14 rotates the drive gear 30 which in turn rotates the idler gear 32. As the drive gear teeth 31 come out of mesh with the idler gear teeth 33, the teeth 31 and 33 create expanding volume on the suction orifice 24. Liquid flows into the suction orifice 24 and is trapped by the gear teeth 31 and 33 as they rotate. Liquid then travels around the interior of the pumping chamber 22 until it is forced out through the discharge orifice 26 at a greater pressure than when the liquid flowed into the suction orifice 24. The suction orifice 24 and discharge orifice 26 are interchangeable depending on the direction of rotation of the drive gear 30 and idler gear 32.

[0023] The pump housing 18 is generally formed from a high strength material. In certain embodiments, the pump housing 18 is preferably formed of a metal such as brass or stainless steel; however, in other embodiments, the pump housing 18 is preferably made from a high strength plastic material. More preferably, the pump housing 18 is made from an injection molded plastic material. The plastic material may be reinforced with fibers such as glass fibers for added strength.

[0024] The pump seal enclosure 20 is generally formed from a high strength material. In certain embodiments, the pump seal enclosure 20 is preferably formed of stainless steel, carbon, or silicon carbide. However, these and other materials may be used and are often dependent on the particular fluids being pumped through the pump assembly 16.

[0025] In accordance with the present disclosure, the drive shaft opening 28 is sealed by a drive shaft seal assembly 34 disposed within the pump seal enclosure 20. Referring to FIGS. 3-4, the drive shaft seal assembly 34 includes a spring seat 36 disposed adjacent the pump motor 12, a stationary ring 50 disposed adjacent the pump housing 18, and a rotary ring 44 disposed between the spring seat 36 and the stationary ring 50. Each of the spring seat 36, rotary ring 44, and stationary ring 50 are disposed coaxially with the drive

shaft 14. The spring seat 36 is fastened to the drive shaft 14 adjacent the pump motor using at least one set screw 38, or other known attachment mechanisms. The spring seat 36 includes at least one first alignment mechanism 40 attached to the spring seat 36 for engaging a corresponding second alignment mechanism 46 attached to the rotary ring 44 for coupling the spring seat 36 with the rotary ring 44. In preferred embodiments, the first alignment mechanism 40 is an alignment rib disposed on an outer surface 42 of the spring seat 36 and the second alignment mechanism 46 is a slot disposed within an outer surface 48 of the rotary ring 44 for receiving the alignment rib 40 of the spring seat 36. The stationary ring 50 is attached to the pump seal enclosure 20 adjacent the drive shaft opening 28 using at least one set screw 52, or other known attachment mechanisms. A compressible spring 54 is also disposed coaxially with the drive shaft 14 between the spring seat 36 and the rotary ring 44 for biasing the rotary ring 44 against the stationary ring 50.

[0026] The drive shaft seal assembly 34 may include a washer 56 disposed between the stationary ring 50 and the rotary ring 44. Washer 56 is preferably also fixed to the pump seal enclosure using set screws 52. The drive shaft seal assembly 34 may also include an O-ring 58 disposed between the stationary ring 50 and the pump housing 18 for further sealing the drive shaft seal assembly 34 against the pump housing 18.

[0027] As the stationary ring 50 is attached to the pump seal enclosure 20, the stationary ring 50 is fixed and does not rotate in conjunction with the drive shaft 14 during operation of the pump 10. Accordingly, the stationary ring 50, and O-ring 58 if present, prevents pumped fluids from entering the pump seal enclosure 20 during normal operation of the pump 10. Thus, substantially no pumped fluids contact the spring seat 36, the compressible spring 54, or the rotary ring 44 during normal operation of the pump. This design results in a fluid pump operable to be used in sanitary applications because fewer parts of the pump are in contact with the fluid flow path, and the design reduces the amount of liquid waste when the pump is being flushed for cleaning.

[0028] While the stationary ring 50 is fixed to the pump seal enclosure 20 so that the stationary ring 50 does not rotate during operation of the pump 10, the spring seat 36 is

attached to and rotates with the drive shaft 14. Because the rotary ring 44 is coupled with the spring seat 36, the rotary ring 44 also rotates in conjunction with the spring seat 36 and drive shaft 14. Due to the friction caused by the rotary ring 44 being biased against the stationary ring 50, the stationary ring 50 is preferably composed of a ceramic material while the rotary ring 44 is composed of a graphite material.

[0029] The foregoing description of preferred embodiments for this invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments are chosen and described in an effort to provide the best illustrations of the principles of the invention and its practical application, and to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

CLAIMS

What is claimed is:

1. A fluid pump comprising:

a pump motor;

a pump housing having an internal pumping chamber, a suction orifice in flow communication with the pumping chamber, a discharge orifice in flow communication with the pumping chamber, and a drive shaft opening;

a pump seal enclosure disposed between the pump motor and the pump housing;

a pump drive shaft rotatably driven by the pump motor and extending through the pump seal enclosure and the drive shafting opening into the pumping chamber; and

a drive shaft seal assembly disposed within the pump seal enclosure, the drive shaft seal assembly including:

a spring seat fastened to the drive shaft, the spring seat being disposed coaxially with the drive shaft and adjacent the pump motor and further having a first alignment mechanism,

a rotary ring disposed coaxially with the drive shaft and having a second alignment mechanism for engaging the first alignment mechanism,

a stationary ring disposed coaxially with the drive shaft and fastened to the pump seal enclosure adjacent the drive shaft opening, and

a compressible spring disposed coaxially with the drive shaft between the spring seat and the rotary ring, wherein the spring biases the rotary ring against the stationary ring.

2. The fluid pump of claim 1, wherein the spring seat is fastened to the drive shaft by at least one set screw.

3. The fluid pump of claim 1, further comprising a washer disposed coaxially with the drive shaft and adjacent the stationary ring.

4. The fluid pump of claim 3, wherein the washer and stationary ring are non-rotatably fastened to the pump seal enclosure by at least one set screw.

5. The fluid pump of claim 1, further comprising an O-ring disposed between the stationary ring and the pump housing.

6. The fluid pump of claim 1, wherein substantially no pumped fluids enter the pump seal enclosure during normal operation of the pump.

7. The fluid pump of claim 1, wherein substantially no pumped fluids contact the spring seat, the compressible spring, or the rotary ring during normal operation of the pump.

8. The fluid pump of claim 1, wherein the stationary ring comprises a ceramic material.

9. The fluid pump of claim 1, wherein the rotary ring comprises a graphite material.

10. The fluid pump of claim 1, wherein the first alignment mechanism of the spring seat includes at least one alignment rib and the second alignment mechanism of the rotary ring includes at least one slot for receiving and engaging the at least one alignment rib.

11. A fluid gear pump comprising:

a pump motor;

a pump housing having an internal pumping chamber, a suction orifice in flow communication with the pumping chamber, a discharge orifice in flow communication with the pumping chamber, and a drive shaft opening;

a pump seal enclosure disposed between the pump motor and the pump housing;

a pump drive shaft rotatably driven by the pump motor and extending through the pump seal enclosure and the drive shafting opening into the pumping chamber;

a drive gear, having a plurality of drive gear teeth, disposed within the pumping chamber and rotatably driven by the drive shaft;

an idler gear, having a plurality of idler gear teeth intermeshed with the drive gear teeth, disposed within the pumping chamber and attached to an idler shaft disposed within the pumping chamber; and

a drive shaft seal assembly including:

a spring seat fastened to the drive shaft, the spring seat being disposed coaxially with the drive shaft and adjacent the pump motor and further having a first alignment mechanism,

a rotary ring disposed coaxially with the drive shaft and having a second alignment mechanism for engaging the first alignment mechanism of the spring seat,

a stationary ring disposed coaxially with the drive shaft and fastened to the pump seal enclosure adjacent the drive shaft opening; and

a compressible spring disposed coaxially with the drive shaft and between the spring seat and the rotary ring, wherein the spring biases the rotary ring against the stationary ring.

12. The fluid gear pump of claim 11, wherein the spring seat is fastened to the drive shaft by at least one set screw.

13. The fluid gear pump of claim 11, further comprising a washer disposed coaxially with the drive shaft and adjacent the stationary ring.

14. The fluid gear pump of claim 13, wherein the washer and stationary ring are non-rotably fastened to the pump seal enclosure by at least one set screw.

15. The fluid gear pump of claim 11, further comprising an O-ring disposed between the stationary ring and the pump housing.

16. The fluid gear pump of claim 11, wherein substantially no pumped fluids enter the pump seal enclosure during normal operation of the pump.

17. The fluid gear pump of claim 11, wherein substantially no pumped fluids contact the spring seat, the compressible spring, or the rotary ring during normal operation of the pump.

18. The fluid gear pump of claim 11, wherein the stationary ring comprises a ceramic material.

19. The fluid gear pump of claim 11, wherein the rotary ring comprises a graphite material.

20. The fluid gear pump of claim 11, wherein the first alignment mechanism of the spring seat includes at least one alignment rib and the second alignment mechanism of the rotary ring includes at least one slot for receiving and engaging the at least one alignment rib.

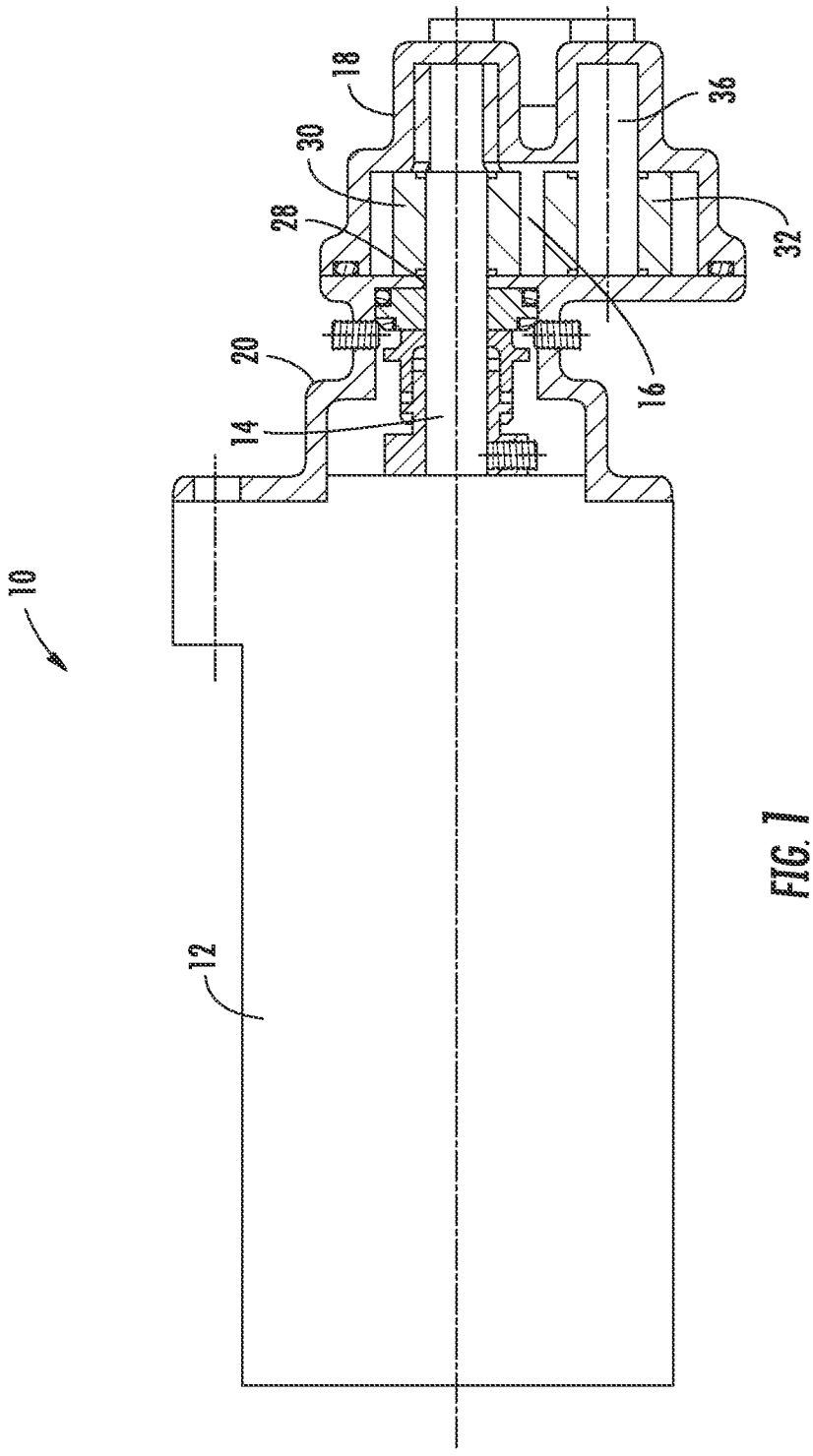

FIG. 1

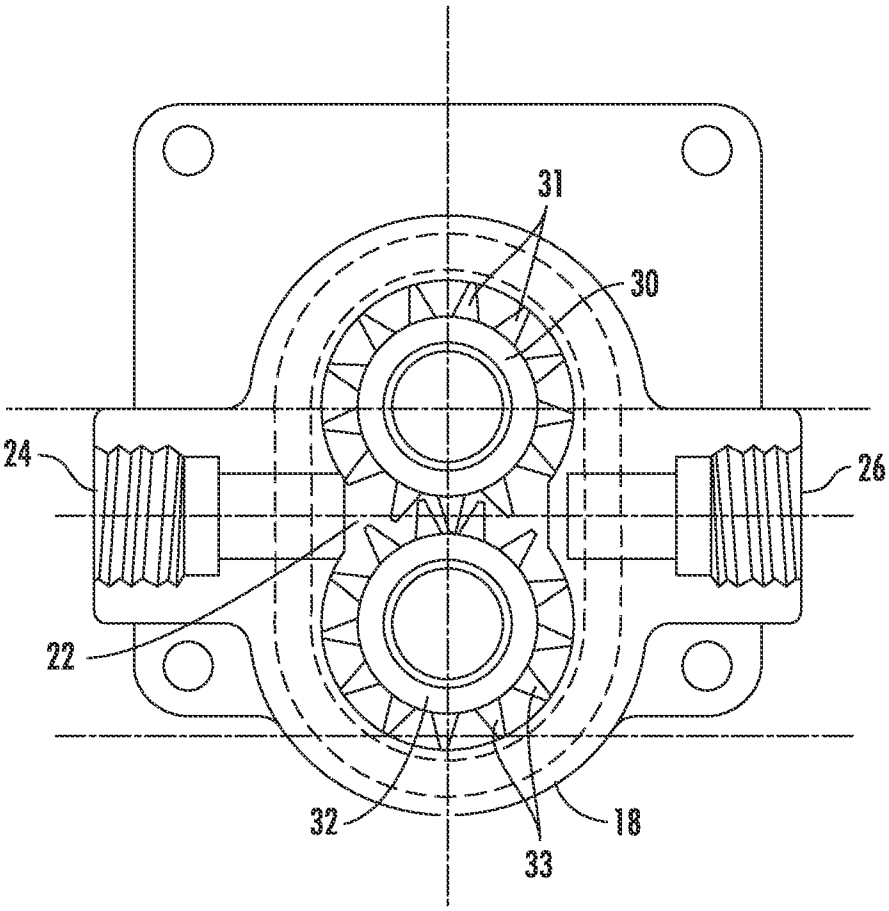

FIG. 2

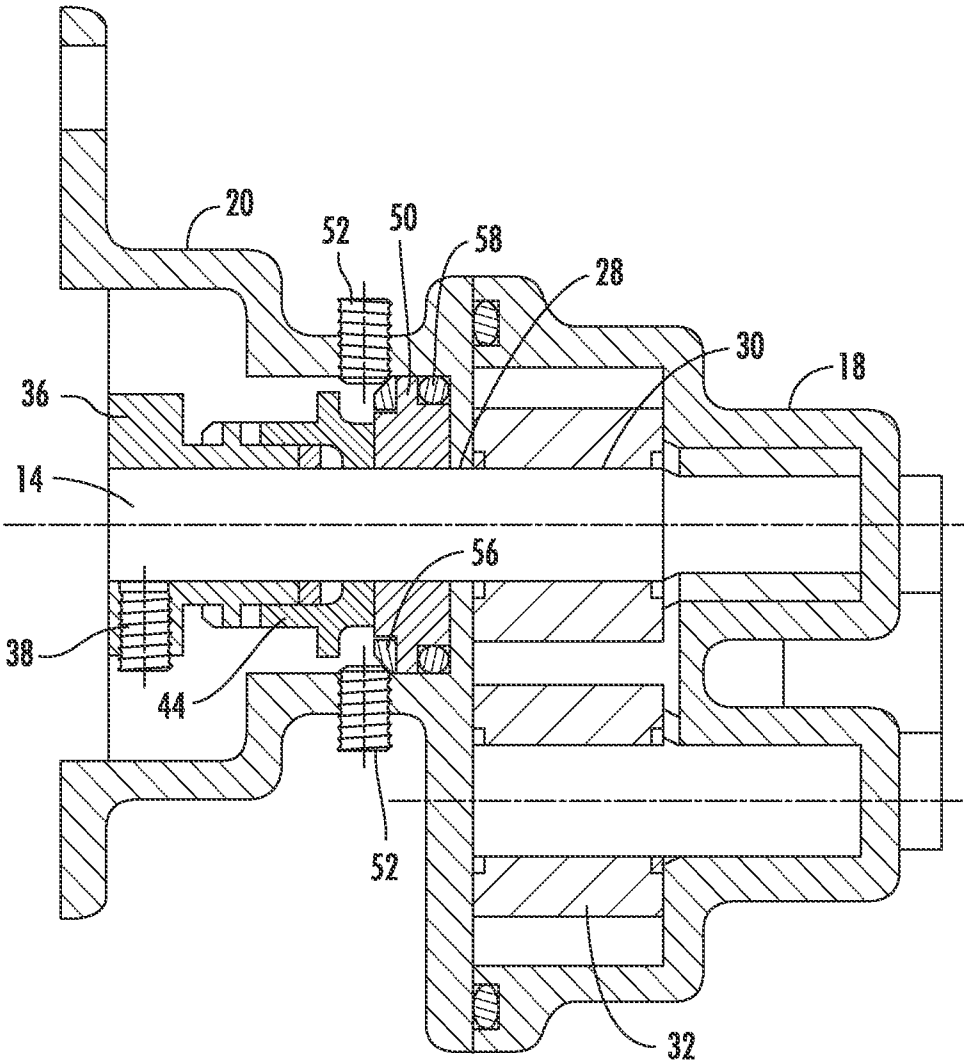

FIG. 3

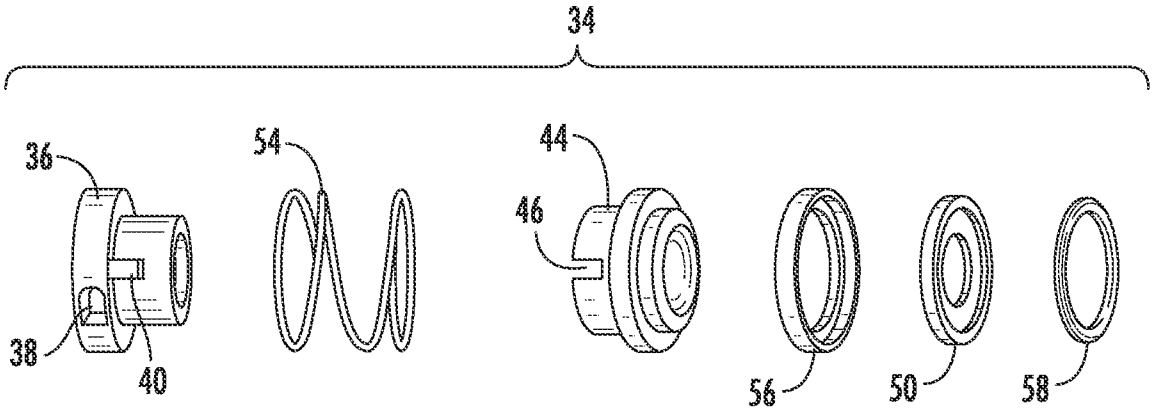

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/025394

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01C19/12 F01C21/10 F04C15/00 F04C2/14 F01C19/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 251 192 A (CLARK ALONZO R) 17 February 1981 (1981-02-17) the whole document	1-20
X	US 2006/061041 A1 (HUANG CHENG-SHIOU [TW]) 23 March 2006 (2006-03-23) the whole document	1-20
X	US 2 423 436 A (BLOM CARL J) 8 July 1947 (1947-07-08) the whole document	1-20
X	US 5 096 396 A (WELCH ELMER S [US]) 17 March 1992 (1992-03-17) figure 9 column 12, line 4 - line 42	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
20 June 2013	02/07/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sbresny, Heiko

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/025394

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4251192 A	17-02-1981	NONE	
US 2006061041 A1	23-03-2006	TW M262618 U	21-04-2005
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