Jan. 1, 1963 L. E. HENYON 3,071,079

SINGLE VANE PUMP

Filed Dec. 12, 1958

2 Sheets-Sheet 1

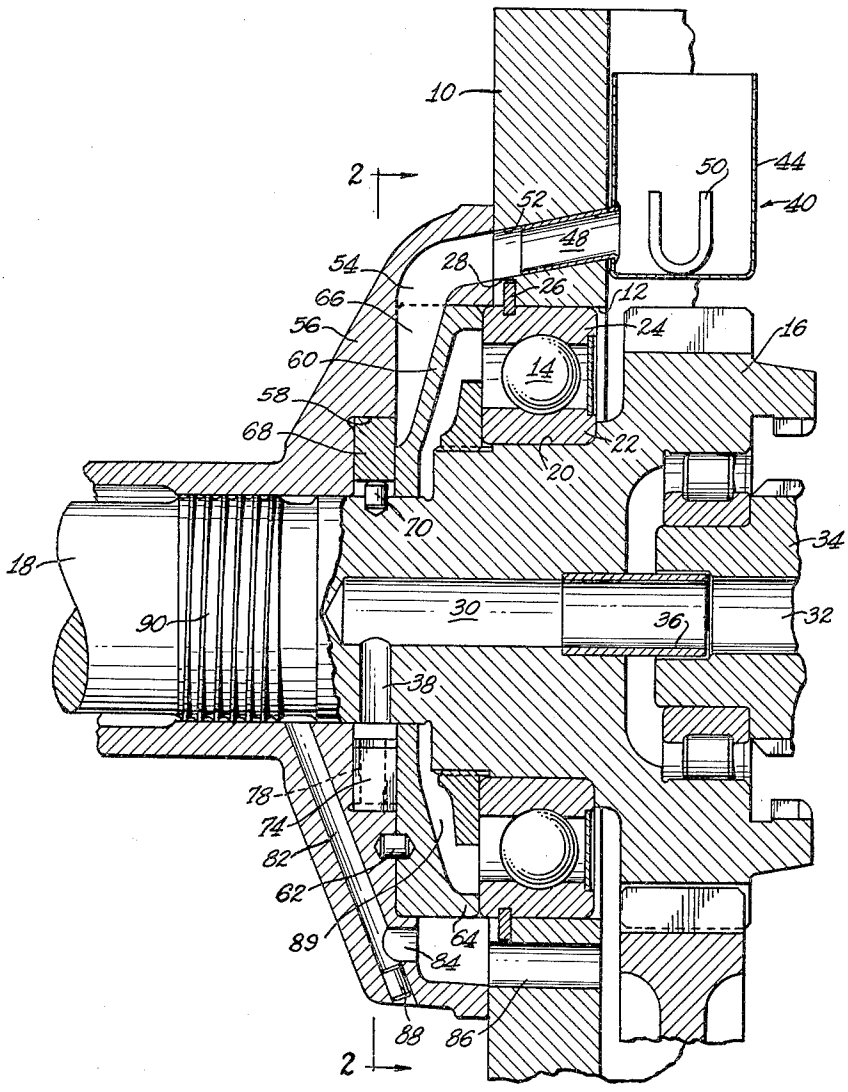

Fig. 1.

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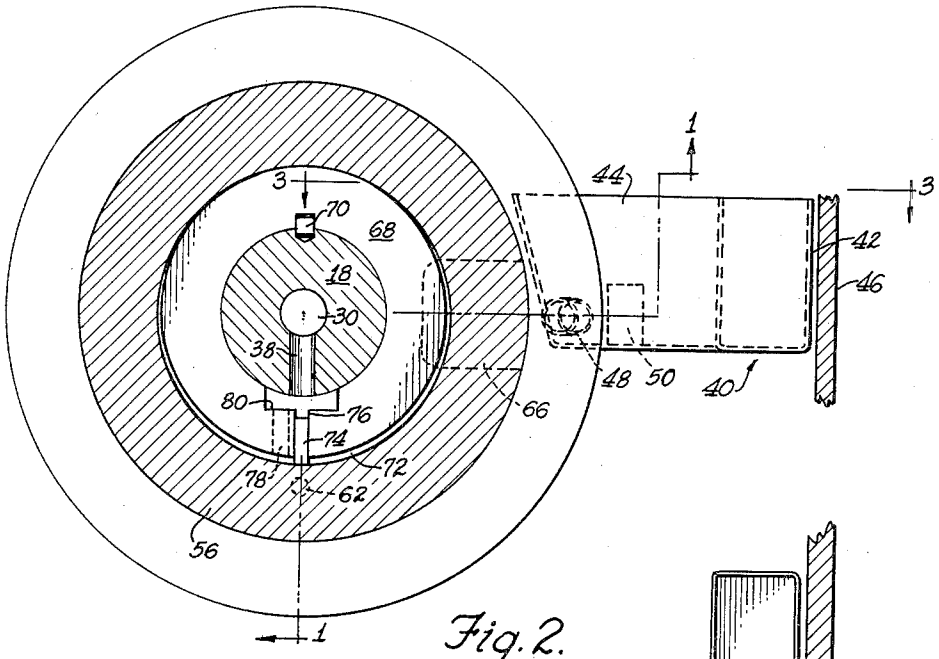

Fig. 2.

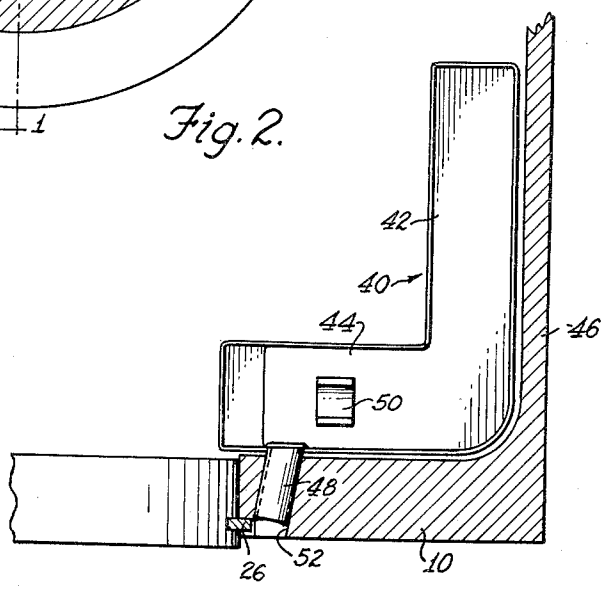

Fig. 3.

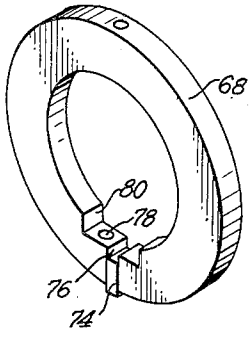

Fig. 4.

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SINGLE VANE PUMP

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4 Claims. (Cl. 103—136)

This invention relates to rotary fluid pumps, and more specifically, to vane type fluid pumps having a single vane.

The principal object of this invention is to provide an improved and simplified vane type fluid pump.

A more specific object of the invention is to provide a single vane pump having a minimum of readily manufactured and easily assembled parts which yet form an efficient and effective pump.

A further object is to provide a pump of very compact and short design.

In carrying out my invention in one form, I provide a shaft rotatably mounted in a housing having a pump chamber which is eccentric relative to the axis of the shaft. A split ring is mounted on the shaft, and a single vane operates reciprocally in the gap in the ring during rotation to provide pumping operation. Fluid is admitted to the crescent shaped chamber formed jointly by the housing and the ring, while the discharge from the pump is through the ring and thence axially through the drive shaft.

The present pump is especially valuable for use in lubricating the bearings and other parts of change speed transmissions for automotive vehicles, and the preferred form of the invention described and illustrated herein is specifically adapted for this purpose. However, it will be readily apparent to those skilled in the art that the invention is not limited to such use but may be used with equal facility in other applicaions.

For a clearer and more complete understanding of my invention, reference should be had to the accompanying drawing forming a part hereof in which:

FIGURE 1 is a fragmentary cross sectional view through the drive shaft end of a transmission mechanism showing the general arrangement and relationship of the improved pump of the present invention, the view being taken substantially along the broken line 1—1 of FIGURE 2;

FIGURE 2 is a cross sectional view through the pump substantially as seen along the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary sectional view taken substantially along the line 3—3 of FIGURE 2 and showing the general configuration of one type of fluid inlet arrangement suitable for use with the pump of the present invention; and

FIGURE 4 is a view in perspective of the simplified rotor and vane structure for the pump of the present invention.

Referring to the drawing, the end wall of a transmission mechanism is shown at 10, and is formed with a circular aperture 12 which is adapted to receive a suitable bearing as indicated at 14. The bearing 14 serves as a means of supporting the main drive pinion 16 of a transmission mechanism for rotation. The pinion 16 is formed upon an enlarged section of the main drive shaft 18 of the transmission mechanism. Adjacent the pinion 16, the drive shaft 18 is formed with a shoulder 20 upon which is mounted the inner race 22 of the bearing 14. The outer race 24 of this bearing is provided with an annular groove for the reception of a snap ring 26 which is in turn received in an annular groove 28 adjacent the aperture 12 in end wall 10, thus completing the bearing mounting for the pinion 16.

The drive shaft 18 has formed in the enlarged pinion portion thereof an axial oil duct 30 by means of which

lubricant is supplied to an oil duct 32 in a coaxial shaft 34. A nipple 36 is provided to communicate between the ducts 30 and 32 in order that the oil may be directed effectively therebetween, while the duct 30 receives oil from a transverse duct 38 in the shaft 18.

In order that an adequate supply of lubricant may be provided for the oiling system of the transmission, oil is collected, for example, by splashing into a trough or container 40 which is suitably secured to a wall of the transmission in any convenient manner. Referring to FIGURE 3, it may be seen that the trough 40 comprises a sheet metal structure which is substantially L-shaped in plan view having a pair of legs 42 and 44 which are adapted and arranged such that one leg 42 extends for a distance along one side wall 46 of the transmission, and the leg 44 extends transversely along the end wall 10 thereof. If desired the trough may be formed integrally with the transmission housing.

The trough 40 functions as a collector for oil which is splashed around in the transmission housing by the action of the gears therein. The oil circulating in the transmission usually contains a certain amount of solid particles such as grit, metal chips, and the like, and accordingly the trough 40 is provided with an outlet duct 48 which is at a level somewhat above the bottom surface of the duct. This allows for the separation by gravity of such particles from the oil. The trough 40 may also, if desired, be provided with a magnet such as indicated at 50 for collecting magnetizable particles contained by the circulating oil. The trough 40 is of sufficient capacity that the flow rate therethrough is relatively slow thereby providing ample time for the separation of the solid particles by gravity and for collection of magnetizable particles by the magnet 50.

The oil passing through the outlet duct 48 is directed through a suitable aperture 52 in the end wall 10 of the transmission and thence through a duct 54 formed in an annular bearing cap or cover 56. The cap 56 is suitably secured to the end wall 10 of the transmission and includes a pump chamber 58 therein. The housing 56 encloses a radially and axially extending annular member 60 which fits over the drive shaft 18 and is non-rotatably secured to the housing 56 by means of a suitable pin 62. At its periphery, the member 60 is provided with an axially extending flange 64 which serves as a retainer to restrict axial movement of the bearing 14. The member 60 is provided with a slot or duct 66 which communicates with the duct 54 in the housing 56 to direct the oil into the pump chamber 58.

Suitably enclosed within the pump chamber 58 is a discontinuous annular rotor member 68 which is keyed to the drive shaft 18 at 70 and thus is driven by the shaft. The pump chamber 58 is disposed eccentrically with respect to the shaft 18 and rotor 68 to provide a crescent shaped space 72. At the top (see FIGURE 2) rotor 68 and the cylindrical wall of chamber 58 are in sealing relation. A vane member 74 is slidably carried within the radial gap or slot 76 formed in the rotor 68. The vane 74 is adapted and arrnaged so as to sweep the interior cylindrical surface of the pump chamber 58.

As viewed in FIGURE 2, the direction of rotation, when the device is in operation, is clockwise and, in order that the oil from the pump chamber 58 may be supplied under pressure to the duct 38, a discharge duct 78 is provided in the rotor 68 which is parallel with the radial slot 76, and communicates between the pump chamber 58 and the duct 38 by means of a transverse internal groove 80 formed in the rotor 68.

In operation, as the rotor 68 moves in a clockwise direction, fluid is drawn through the inlet duct 66 into the crescent shaped space 72 of the pump chamber 58.

During such rotation, the vane 74 is effective to discharge fluid from the pump chamber 58 through the duct 78, groove 80 and duct 38 into the axial ducts 30 and 32 for lubricating the desired portions of the transmission.

The sliding vane 74 is of such size and weight as to be held in its radially outward position in contact with the inner wall of the pump chamber 58 under the influence of centrifugal force, under normal operating conditions, to thereby seal the respective suction and pressure portions of the crescent shaped space 72 from one another. Under certain operating conditions, such as abnormally low speeds of rotation, the centrifugal force acting on the vane 74 may not be sufficient to effectively seal in the manner above mentioned. Such problem has been solved in previous pumps of a similar character by providing springs to urge the vane or vanes outwardly into cotnact with the wall of the pump chamber. It will be noted that the radial slot 76 and the transverse slot 80 formed in the rotor 68 are in communication with one another. By virtue of such intercommunication, the radially inner end of the vane member 74 is subjected to the pressure of the fluid being pumped through the ducts 78 and 38 and is thereby urged radially outward by such pressure. The result is, therefore, that the vane 74 is urged outwardly into sealing contact with the wall of the pump chamber 58 in part by centrifugal force and in part by the pressure of the fluid being pumped.

In order that the pressure within the pump chamber 58 may be maintained effectively and efficiently, the planar end faces of the rotor 68 are formed so as to have a close running fit with the cooperating planar surfaces of the cap 56 and the annular member 60. If oil should leak out of the pump chamber 58 and axially along the shaft 18 to the left (in FIGURE 1) it will drain back into the casing of the transmission through a radially extending duct 82 formed in the cap 56 and thence into an axially extending duct 84 formed therein. The front wall 10 of the transmission casing is provided with a passageway 86 communicating with the lower portion of the cap 56 to drain any oil passing through the ducts 82 and 84 into the transmission casing. To facilitate manufacture, the ducts 82 and 84 are separately drilled, and the radially outermost portion of the duct 82 is sealed by a suitable closure plug 88. Any oil which leaks from chamber 58 along the shaft 18 toward the right enters a passageway 89 from which it passes through bearing 14 back into the transmission housing. The above described structure is effective to provide a sufficiently leakproof arrangement to obviate the necessity for costly and troublesome oil seals on the shaft 18 at opposite sides of the rotor 68 as has usually been the practice in the past in connection with pumps of the type herein described.

In order to further assure the maintenance of an effective and oil-tight pump mechanism and to assure drainage of any leakage fluid through the duct 82, the shaft 18 is provided with a spiral groove 90 of conventional type which is effective upon rotation of the shaft to assure the drainage of such fluid into the duct 82 and thence into the transmission casing.

By virtue of the above described structure and operation the novel pump of the present invention satisfactorily provides an arrangement which meets the objects set out at the beginning of this description.

Summarizing, the pump structure of the present invention provides a simple and compact design which eliminates the end for expensive and troublesome sealing elements. The pump of the present invention requires very little space in the transmission and is readily manufactured and assembled. The novel arrangement of the single sliding vane together with the cooperative relationship of the ducts whereby the vane is biased outwardly in part by centrifugal force and in part by the pressure of the fluid being pumped thereby provides a simple and reliable structure having fewer and less costly parts than heretofore required in pumps of such type; yet the structure is rugged and reliable in operation to accomplish the stated function thereof.

While the present invention has been described by way of reference to one specific illustrative embodiment thereof as shown in the accompanying drawing, it is not intended that the invention be limited to such specific embodiment, nor otherwise than by the terms of the appended claims.

I claim:

1. A rotary pump comprising a first housing member having a first shaft opening therethrough and a recessed portion surrounding the said shaft opening having a cylindrical surface and a planar end surface, a second housing member having a second shaft opening therethrough and a planar surface thereon, the said second housing member being adapted to abut the said first housing member and provide a circular chamber formed by the cylindrical surface and planar end surface of the said first housing member and the planar surface of the said second housing member, the said chamber being eccentric to the said shaft openings, a rotatable shaft extending through the said shaft openings in sealing relation therewith, the said shaft having a key recess therein intermediate the said housing planar surfaces, a rotor comprising a discontinuous annular ring having a single gap therein and secured to the said shaft by means of a longitudinally extending key slot in the inner surface of the said ring and a key located in the said key recess in the said shaft, the said rotor being arranged for rotation within the said chamber upon rotation of the said shaft with the rotor in sealing relation with the said cylindrical surface at one location and forming with the said housing members a crescent-shaped pumping chamber, a vane member reciprocably mounted between the ends of the said discontinuous ring rotor for rotation therewith in sealing relation with the said cylindrical surface, the end surfaces of the said rotor and the ends of the said vane member being in sealing relation with the said planar surfaces of the said two housing members, a liquid inlet passageway through the said second housing member communicating with the said crescent-shaped chamber, an opening through the said ring closely adjacent the said gap therein and arranged to be ahead of the said gap during rotation of the shaft and ring, the said opening providing for discharge of liquid under pressure from the said crescent-shaped chamber radially inward through the said ring, means providing communication between the inner end of said opening and the inner end of the said gap in the said ring whereby the radially inner end of the said vane member located in the said gap is subjected to the pressure of the liquid being pumped, the outer end of the said vane being held in sealing communication with the said cylindrical surface jointly by such liquid pressure and by centrifugal force on the vane resulting from rotation, and outlet means for liquid including a radially disposed passage in the said shaft communicating with the said opening through the said ring and an axially extending passage in the said shaft communicating with the said radially extending passage.

2. For use with a mechanism having an end wall, a drive shaft extending through the end wall and an antifriction bearing rotatably journaling the shaft in the end wall, a liquid pump comprising a bearing cap secured to the end wall, said bearing cap having an opening through which the shaft extends and a circular recess opening toward the bearing, a bearing retainer member disposed between said bearing cap and the bearing and having an opening through which the shaft extends, said circular recess and bearing retainer member forming a cylindrical pump chamber, said bearing cap and said bearing retainer member together forming a liquid inlet passage means communicating with said pump chamber, an annular rotor disposed in said pump chamber and secured to the shaft for rotation therewith, said cylindrical pump chamber being disposed eccentrically relative to the axis

of rotation of said rotor so that said rotor contacts the wall of said pump chamber at one place to provide a substantially crescent shaped chamber therewith, a single radially extending gap in said rotor, a single pump vane reciprocally positioned within said gap and adapted to reciprocate therein when said rotor is rotated, said recess and said bearing retainer member having surfaces providing a close running fit with the end faces of said rotor and with said pump vane, and liquid outlet passage means including passage means in the shaft and said rotor, said liquid outlet passage means communicating with said gap so that the radially inner end of said pump vane is subjected to the pressure of the liquid being pumped thereby to bias vane member radially outwardly.

3. A rotary pump comprising a first housing member having a first shaft opening therethrough and a recessed portion surrounding the said shaft opening having a cylindrical surface and a planar end surface, a second housing member having a second shaft opening therethrough and a planar surface thereon, the said second housing member cooperating with the said first housing member to provide a circular pump chamber formed by the said cylindrical surface and planar end surface of the said first housing member and the said planar end surface of the said second housing member, a rotatable shaft extending through the said shaft openings in sealing relation therewith, a rotor comprising an annular ring having a single radially extending slot therein and secured to said shaft for rotation therewith, the said rotor being arranged for rotation within said chamber upon rotation of said shaft, said chamber and said shaft being disposed eccentrically relative to each other so that the rotor is in sealing relation with said cylindrical surface at one location and forms with said housing members a crescent-shaped pumping chamber, a vane member reciprocally positioned between the sides of said slot for rotation with said rotor in sealing relation with said cylindrical surface, the end surfaces of said rotor and the ends of said vane member being in sealing relation with said planar surfaces, fluid inlet means communicating with said crescent-shaped chamber, an opening through said ring adjacent said vane

member, said opening providing for discharge of fluid under pressure from said crescent-shaped chamber inwardly through said ring, means providing communication between the inner end of said opening and the inner end of said slot so that the radially inner end of said vane member located in said slot is subjected to the pressure of the fluid being pumped, the outer end of said vane member being held in sealing communication with the said cylindrical surface jointly by said fluid pressure and by centrifugal force on said vane member resulting from rotation, and fluid outlet means located in said shaft and communicating with said opening.

4. A rotary pump as set forth in claim 3 wherein said fluid inlet means comprises a passage formed by the cooperation of said housing members.

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