United States Patent [19]

Gardner

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[54] VISCOSITY PUMP

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[73] Assignee: **Waukesha Bearings Corporation**, Waukesha, Wis.

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[21] Appl. No.: **178,627**

[52] **U.S. Cl.** **415/90**

[51] **Int. Cl.** **F01d 1/36**

[58] **Field of Search** 415/90

[56] **References Cited**

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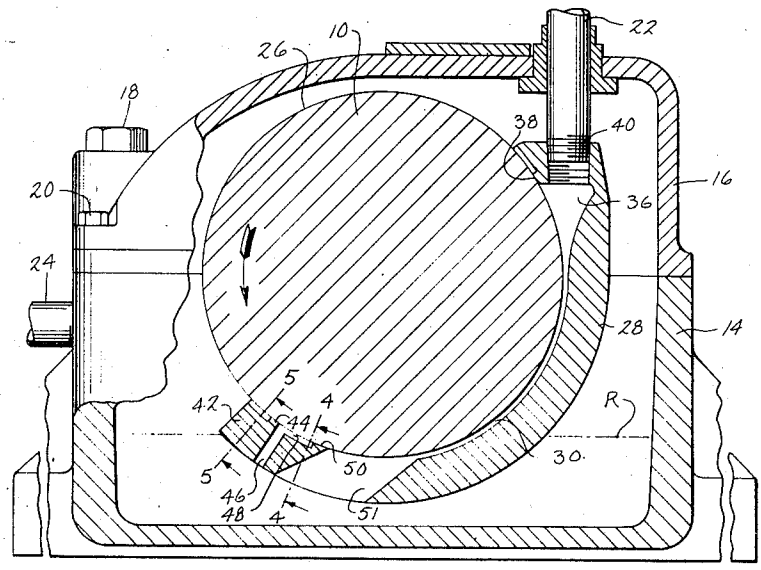
Primary Examiner—C. J. Husar

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[57] **ABSTRACT**

The inlet of a relatively large viscosity pump for high speed applications is sealed by a small viscosity pump which directs a stream of oil onto the rotor of the large viscosity pump to produce an air seal that increases the inlet suction of the large viscosity pump. The small viscosity pump includes (1) an air scraper in close proximity to the rotor of the large viscosity pump immediately before the rotor enters an oil chamber, and (2) a small oil conduit which extends adjacent the air scraper to the oil chamber of the large viscosity pump. The suction produced by the air scraper draws oil up through the small oil conduit and onto the periphery of the rotor to produce an air seal at the point where the rotor enters the inlet of the larger pump.

8 Claims, 5 Drawing Figures

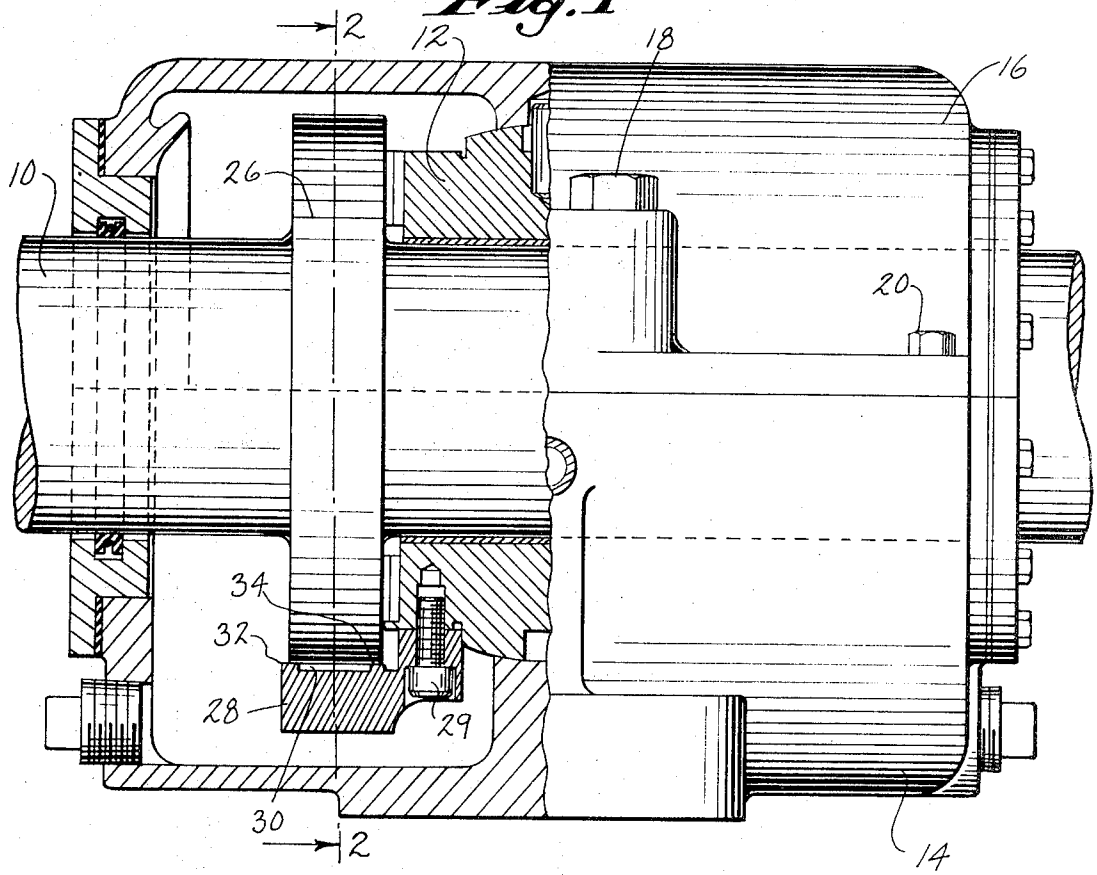


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SHEET 1 OF 2

Fig. 1



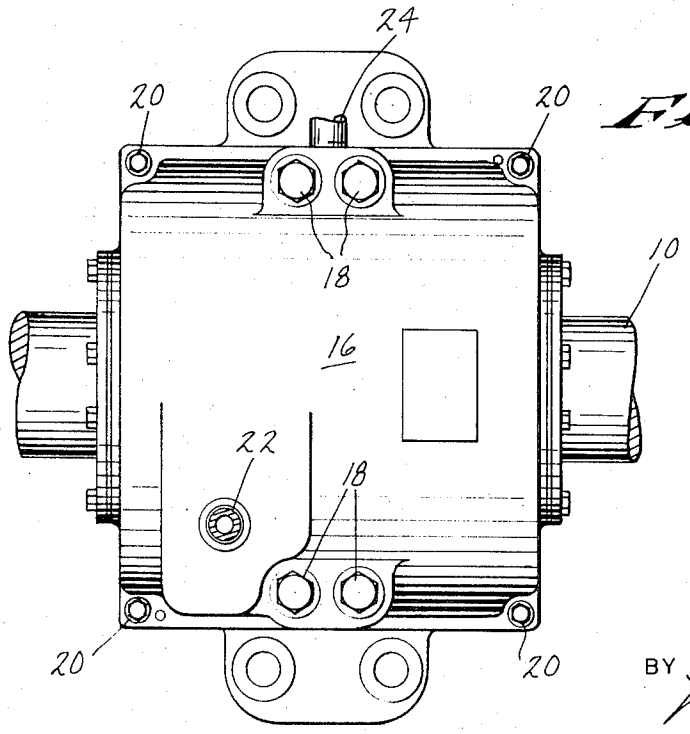


Fig. 3

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Fig. 2

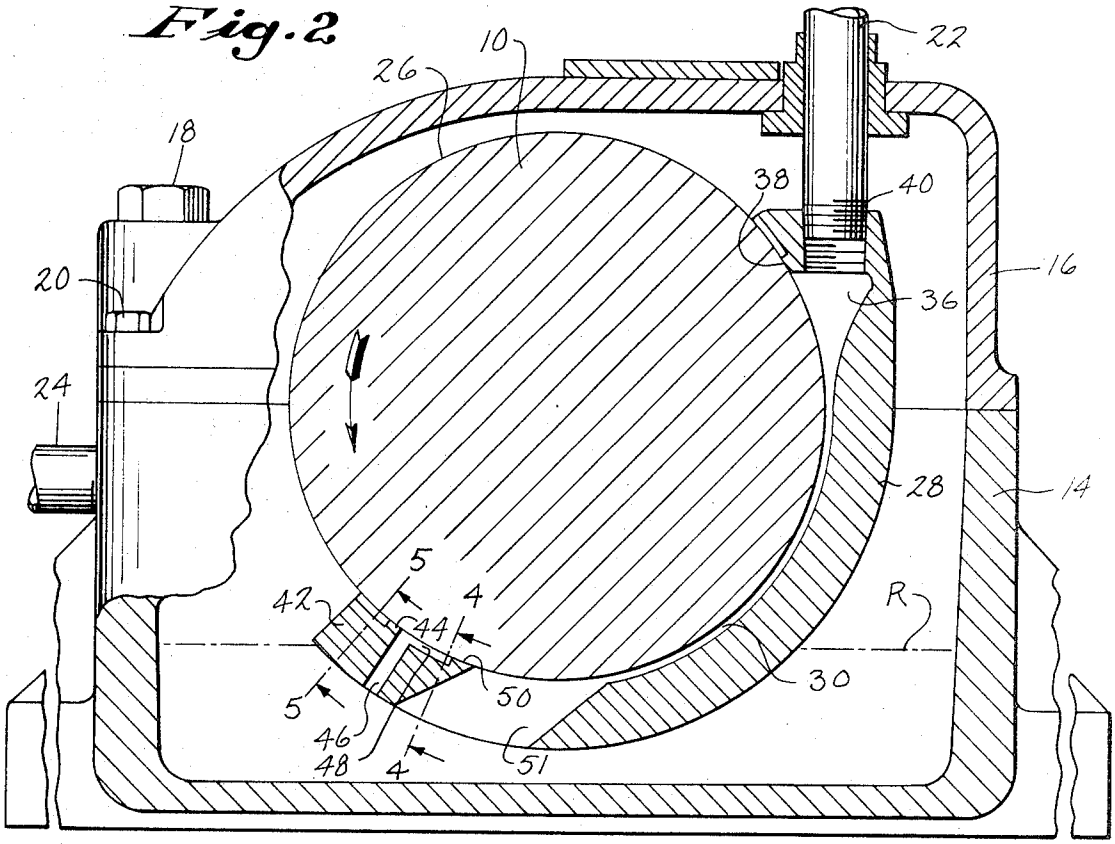


Fig. 4

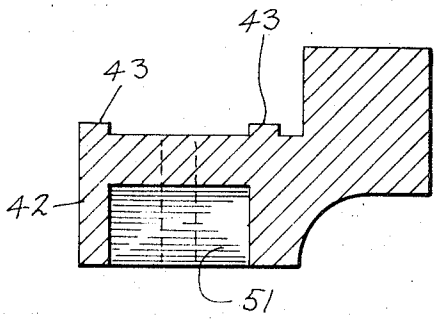
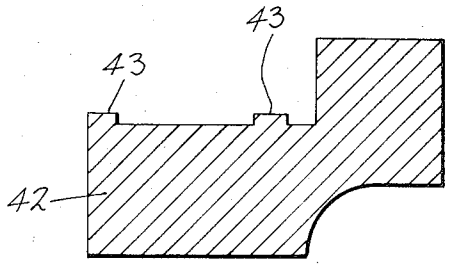


Fig. 5



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VISCOSITY PUMP

BACKGROUND OF THE INVENTION

This invention relates to viscosity pumps (also called viscous drag pumps) such as utilized in self-lubricating bearings or the like where the rotation of a shaft is utilized to pump a lubricant for a bearing attached to the same shaft. Typical prior art viscosity pumps are disclosed in U. S. Pat. No. 3,396,664, which was issued to R. J. Smith on Aug. 13, 1968, for a "Floating Ring Viscous Pump", and U. S. Pat. No. 3,324,970, which was issued to J. D. McHugh on June 13, 1967, for a "Self Contained Viscous Pump Lubrication System". As shown in the above-noted United States patents, the prior art pumps had a rotor which entered an oil reservoir, picked up oil by adhesion, and carried it into an oil channel formed by a small space between the rotor and a stator, with the oil channel being small enough in its radial dimension so that the oil would be dragged along the channel by the viscous drag of the rotor. At the end of the oil channel, the moving oil was directed to a pump chamber in the stator and from there to the bearing or other part that required forced lubrication. The oil would then make its way under the influence of gravity or by other means back to the oil reservoir to be picked up by the rotor and recirculated through the system again.

Although the above-noted prior art viscosity pumps have been successful in performing their intended functions, they had the disadvantage of requiring a full ring (360°) construction which complicates and limits their application. The full ring construction was necessary to provide an adequate seal for the inlet of the pump. With a half ring (180°) construction or less the installation and application of the pump to the shaft is greatly simplified but this requires an adequate seal at the inlet to prevent air from mixing with the oil at this point and reducing the flow rate of the pump.

Accordingly, the principal object of this invention is to provide an effective viscosity pump of less than 360° (full ring) construction to expand its range of application, particularly to higher speeds than heretofore possible with this type of pump.

A further object of the invention is to provide a viscosity pump which prevents air on the rotor from passing beyond a point where it will interfere with the suction effect in the main suction opening of the pump.

Another object of this invention is to provide a viscosity pump which has a higher inlet suction than heretofore known in the art for pumps of less than full ring construction.

An additional object of the invention is to provide a viscosity pump of less than full ring construction which is more reliable in operation than those heretofore known in the art.

SUMMARY OF THE INVENTION

In accordance with this invention, the flow rate of a viscosity pump operating at high speeds has been increased by first scraping air from the rotor and then causing the application of oil, preferably by means of a small viscosity pump, onto the rotor of the large viscosity pump immediately before the rotor enters the oil chamber of the pump. This produces an air seal at the point where the rotor enters the oil chamber.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a journal bearing assembly utilizing one illustrative viscosity pump of this invention;

FIG. 2 is a view principally in cross-section, taken on the plane 2—2 of FIG. 1;

FIG. 3 is a plan view of the journal bearing housing;

FIG. 4 is a fragmentary sectional view taken on the line 4—4 of FIG. 2; and

FIG. 5 is a fragmentary sectional view taken on the line 5—5 of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, a shaft **10** is journaled for rotation with a journal bearing **12** which is supported by a journal bearing housing comprising a lower half **14** and an upper half **16.** The upper half **16** and the lower half **14** of the housing are held together by four large machine screws **18** and four small machine screws **20.** The viscosity pump of this invention serves the function of pumping oil from an oil reservoir (R) in the bottom of the lower bearing housing **14** to an oil cooler, which is not shown in the drawings. The oil is pumped to the oil cooler through a conduit **22** and the cooled oil is returned from the oil cooler via a second conduit **24.** The cooled oil flows from the inlet conduit **24** into the journal bearing **12** and from there by the force of gravity it eventually returns to the oil reservoir in the bottom of the lower half **14** of the journal bearing housing. The viscosity pump of this invention comprises a rotor **26** which is coupled to the shaft **10** and rotates with the shaft, and a stator **28** which is positioned adjacent to the rotor and is secured to the bearing **12** by means of screws **29.** The stator **28** follows the curvature of rotor **26** and has a recessed central portion **30** which forms an oil channel in cooperation with the surface of rotor **26.** The lateral margins of the oil channel **30** are closed by lands **32** and **34** (FIG. 1) which are in close proximity to the surface of the rotor **26.**

Oil from an open oil reservoir (R) in the bottom half of the housing member **14** adheres to the rotor **26** and is carried by adhesion into the oil channel **30** formed between the rotor **26** and the stator **28.** The oil in oil channel **30** is carried by viscous drag due to the rotation of rotor **26** up to an enlarged pump chamber **36** into which the flow of oil is diverted by an oil scraper **38** at the upper end of the stator **28.** The oil in chamber **36** is under pressure due to the viscous drag force of rotor **26,** and the pressure forces the oil in chamber **36** out the flexible conduit **22** which is coupled to the chamber **26** at a threaded opening **40.**

The pumping capacity of the above-described viscosity pump is necessarily relatively limited by the small cross-sectional area of the pumping channel **30.** The pumping channel **30** has to be small enough to permit establishing pressure in chamber **36** sufficient to force the oil through the external cooler and/or filter and back to the bearing. If the channel depth is too large, excess recirculation within the channel will interfere with the pumping action. In accordance with this invention, however, it has been found that the flow rate can be increased without changing the size of the pumping channel **30** by sealing the inlet end of the pump so as to prevent the entry of air bubbles into the oil at the pump inlet. For this purpose an auxiliary stator portion **42** is mounted adjacent to the inlet end of the main vis-

cosity pump stator **28.** The auxiliary stator **42** has side land areas **43** as shown in FIGS. **4** and **5,** and land area **44** which acts as a scraper to remove air from the rotor **26** shortly before the rotor portion enters the oil reservoir in the bottom of the housing member **14.** Between the air scraper **44** and the main pump inlet is means for creating an oil seal on the rotor. In the preferred embodiment there is a small oil conduit **46** that extends radially completely through the stator portion **42** with the lower end of the conduit **46** being below the normal oil level in the oil reservoir. The combination of the air scraper **44** and the conduit **46** acts as an auxiliary viscosity pump with the air scraper **44** acting in conjunction with the rotor to create a suction which draws the oil up the conduit **46** and into a channel **48** which is formed in the stator portion **42.** The channel **48** has side lands **43** as shown in FIG. **4** and extends from the air scraper to a level which is below the normal oil level and is then terminated by a land or projection **50** which projects radially from the end of the auxiliary stator **42** into close proximity with the rotor **26,** any clearance between **50** and the rotor being sealed by oil from the channel **48.** The land **50** acts as an effective air seal (due to the presence of the oil) at the inlet end **51** of the main viscosity pump, thereby increasing the rate of flow of the main viscosity pump by increasing the suction at its input end.

With regard to the operation of the invention, it should be noted that the shaft in a conventional viscosity pump is rotating at a relatively high rate of speed so that when the rotor **26** of a viscosity pump enters the oil surface on the top of the oil reservoir it inevitably carries a certain amount of air along with it by viscous drag and creates air bubbles at the point where the rotor intersects the surface of the oil. In addition to these air bubbles there are other bubbles present on the surface of the oil reservoir due to oil turbulence at various points throughout the journal bearing housing. In accordance with this invention, however, such air bubbles are first removed by the air scrapper **44** before the rotor **26** reaches the oil level, and then an oil seal is created at a point where the rotor **26** intersects the oil surface. This is caused by the interaction of the air scraper **44,** oil scraper **50,** and oil conduit **46,** the latter drawing oil from below the surface and applying it as a film to the rotor **26** at the point where the rotor **26** intersects the oil level in the oil sump.

From the foregoing description it will be apparent that this invention provides a viscosity pump (particularly of less than 360° construction) having a higher flow rate than those heretofore known in the art. It will also be apparent that this invention provides a viscosity pump which is more reliable in operation due to the elimination of air bubbles at the inlet of the viscosity pump. And although this invention has been described in connection with one specific embodiment thereof, it should be understood that the invention is by no means limited to the disclosed embodiment, since many modifications are possible in the disclosed structure without altering its fundamental principles of operation. For example, other means than the small viscosity pump may be provided for applying oil to the rotor at **48** to create an oil seal in conjunction with the land **50.** In addition, although the small stator **42** for the viscosity pump has been disclosed as being of the same width and thickness as the large stator **28,** it will be apparent to those skilled in the art that the small stator could be varied in its dimensions if desired and also that the air scraper and oil scraper on the small stator could be varied in size without changing the operation of the device. These and many other modifications will be obvious to those skilled in the art and this invention includes all modifications falling within the scope of the following claims:

What I claim is:

1. In a viscosity pump having a housing, having a rotor journalled in said housing, having a stator in said housing constructed and positioned to provide a viscous fluid channel between the rotor and stator, said housing providing a reservoir for viscous fluid having a fluid level located so that a portion of the rotor is immersed in the fluid, and said stator having a pump inlet portion, the improvement comprising means creating an air seal adjacent a portion of the periphery of the rotor before said portion reaches the viscous fluid level in the reservoir, said air seal including means for applying viscous fluid from the reservoir to the periphery of the rotor for use in said air seal; there being means above the level of viscous fluid for scraping air from a peripheral portion of the rotor prior to said portion being immersed, and said means for creating an air seal being located between said air-scraping means and the pump inlet.

2. In a viscosity pump having a housing, having a rotor journalled in said housing, having a stator in said housing constructed and positioned to provide a viscous fluid channel between the rotor and stator, said housing providing a reservoir for viscous fluid having a fluid level located so that a portion of the rotor is immersed in the fluid, and said stator having a pump inlet portion, the improvement comprising an auxiliary stator close to a portion of the periphery of the rotor, part of said auxiliary stator being cooperable with a rotor portion before said portion reaches the viscous fluid level in the reservoir during rotation, said auxiliary stator having a face with a recess adjacent the periphery of the rotor, means for supplying viscous fluid from the reservoir to said recess to create an air seal, and means for removing air from a peripheral portion of the rotor before said portion passes the recess.

3. In a viscosity pump having a housing, having a rotor journalled in said housing, having a stator in said housing constructed and positioned to provide a viscous fluid channel between the rotor and stator, said housing providing a reservoir for viscous fluid having a fluid level located so that a portion of the rotor is immersed in the fluid, and said stator having a pump inlet portion, the improvement comprising means creating an air seal adjacent a portion of the periphery of the rotor before said portion reaches the viscous fluid level in the reservoir, said air seal including means for applying viscous fluid from the reservoir to the periphery of the rotor for use in said air seal, the means for applying viscous fluid to the periphery of the rotor for use in said air seal including an auxiliary viscous fluid pump.

4. A viscosity pump as claimed in claim **3** in which the auxiliary viscous fluid pump includes a viscous fluid channel, and in which there is a conduit leading from said reservoir to said fluid channel of the auxiliary pump.

5. In a viscosity pump having a housing, having a rotor journalled in said housing, having a stator in said housing constructed and positioned to provide a viscous fluid channel between the rotor and stator, said housing providing a reservoir for viscous fluid having a

fluid level located so that a portion of the rotor is immersed in the fluid, and said stator having a pump inlet portion, the improvement comprising means creating an air seal adjacent a portion of the periphery of the rotor before said portion reaches the viscous fluid level in the reservoir, said air seal including means for applying viscous fluid from the reservoir to the periphery of the rotor for use in said air seal, the air seal creating means including a fixed projection close to the periphery of the rotor with the space between the projection and rotor sealed by the viscous fluid from said viscous fluid applying means.

6. A viscosity pump as defined in claim **5** wherein said air scraping means and said air seal projection are formed on an auxiliary stator connected to said housing.

7. A viscosity pump as defined in claim **5** in which there is an auxiliary stator and in which there is means in said auxiliary stator for scraping air from a peripheral portion of the rotor prior to said portion being immersed, and in which the means for creating an air seal is located between said air-scraping means and the pump inlet, said viscous fluid channel of said auxiliary pump being in said auxiliary stator between said air-scraping means and said air seal creating means.

8. In a viscosity pump having a housing, having a rotor journalled in said housing, having a stator in said housing constructed and positioned to provide a viscous fluid channel between the rotor and stator, said housing providing a reservoir for viscous fluid having a fluid level located so that a portion of the rotor is immersed in the fluid, and said stator having a pump inlet portion, the improvement comprising means creating an air seal adjacent a portion of the periphery of the rotor before said portion reaches the viscous fluid level in the reservoir, said air seal including means for applying viscous fluid from the reservoir to the periphery of the rotor for use in said air seal, the viscous fluid channel between the rotor and stator being less than 360°, and the means for creating an air seal being located in advance of said viscous fluid channel.

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