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Rosenthal

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[54] **APPARATUS FOR LUBRICATING AREAS ON ROTATING PARTS**

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[51] **Int. Cl.**.....**F16n 13/16**

[58] **Field of Search** 184/6.28, 31; 417/398, 470

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[57] **ABSTRACT**

The specification discloses a device for lubricating areas of rotating parts in which a pump structure is carried by the rotating part. A stationary part surrounds the rotating part and forms a lubricating chamber connected to the pump. An actuating ring carried by the stationary part is operable for actuating the piston means of the pump structure. Conduit means lead from the pump structure to the area to be lubricated.

8 Claims, 4 Drawing Figures

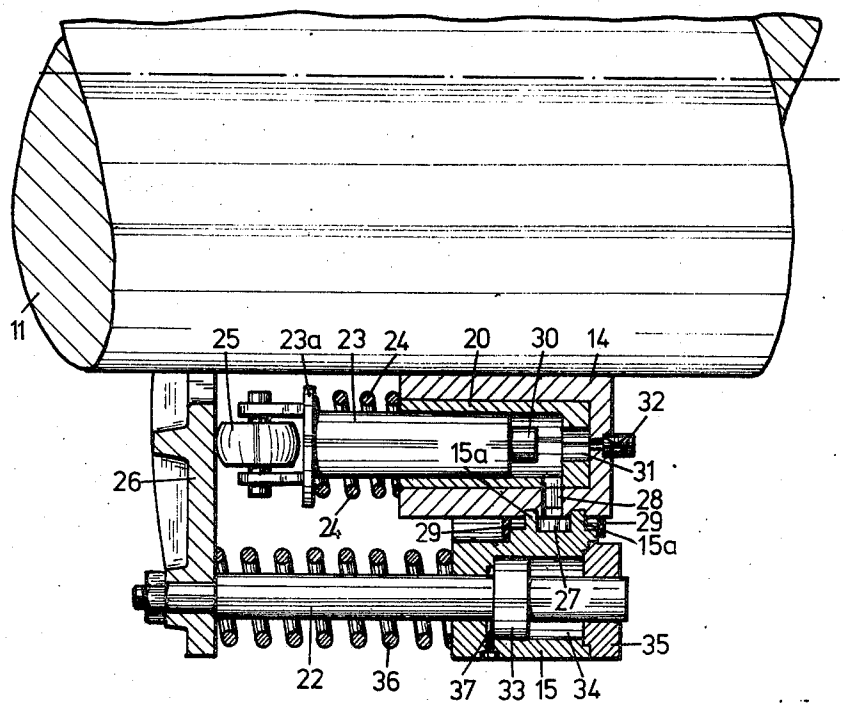

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Fig.1

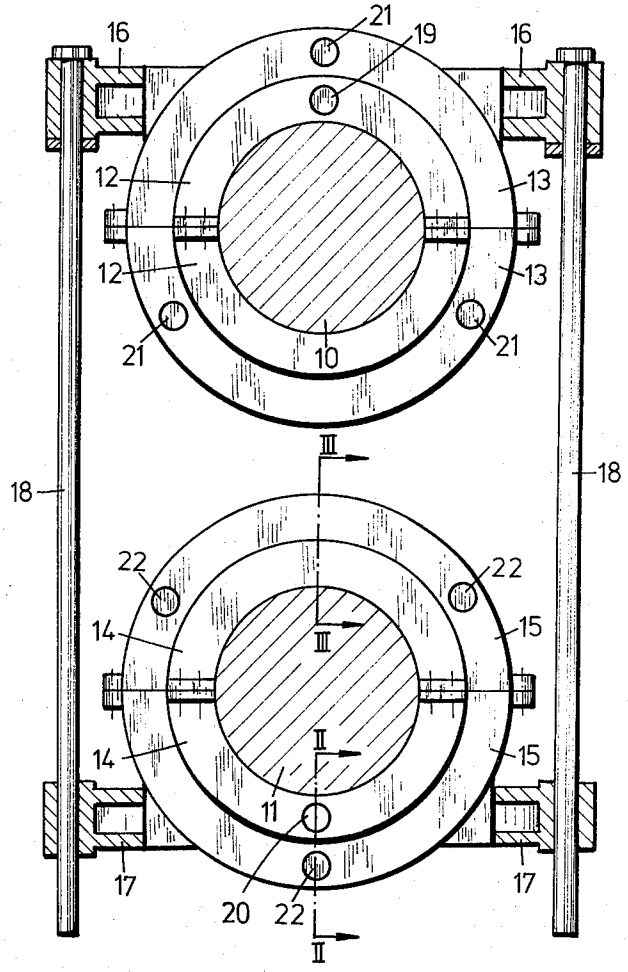

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Fig.2

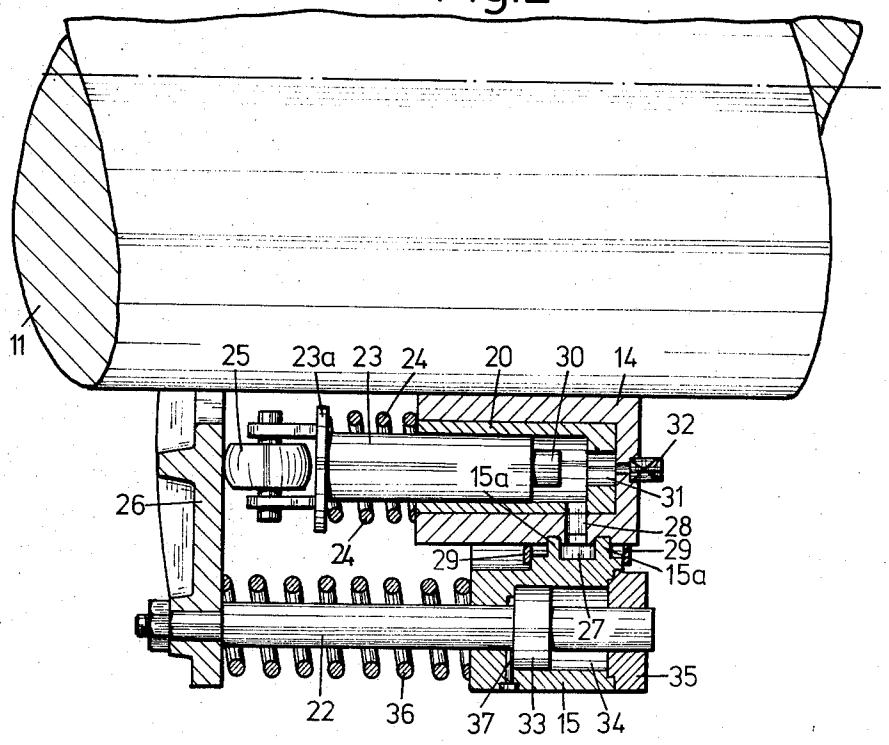

Fig.3

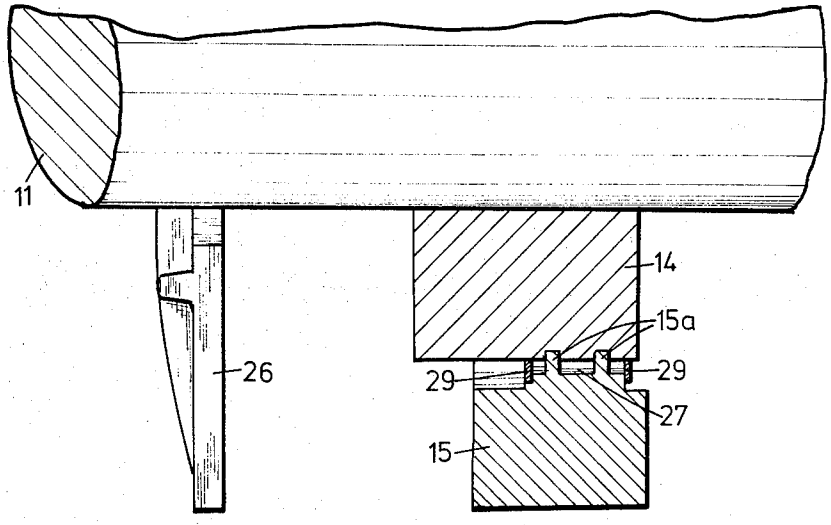

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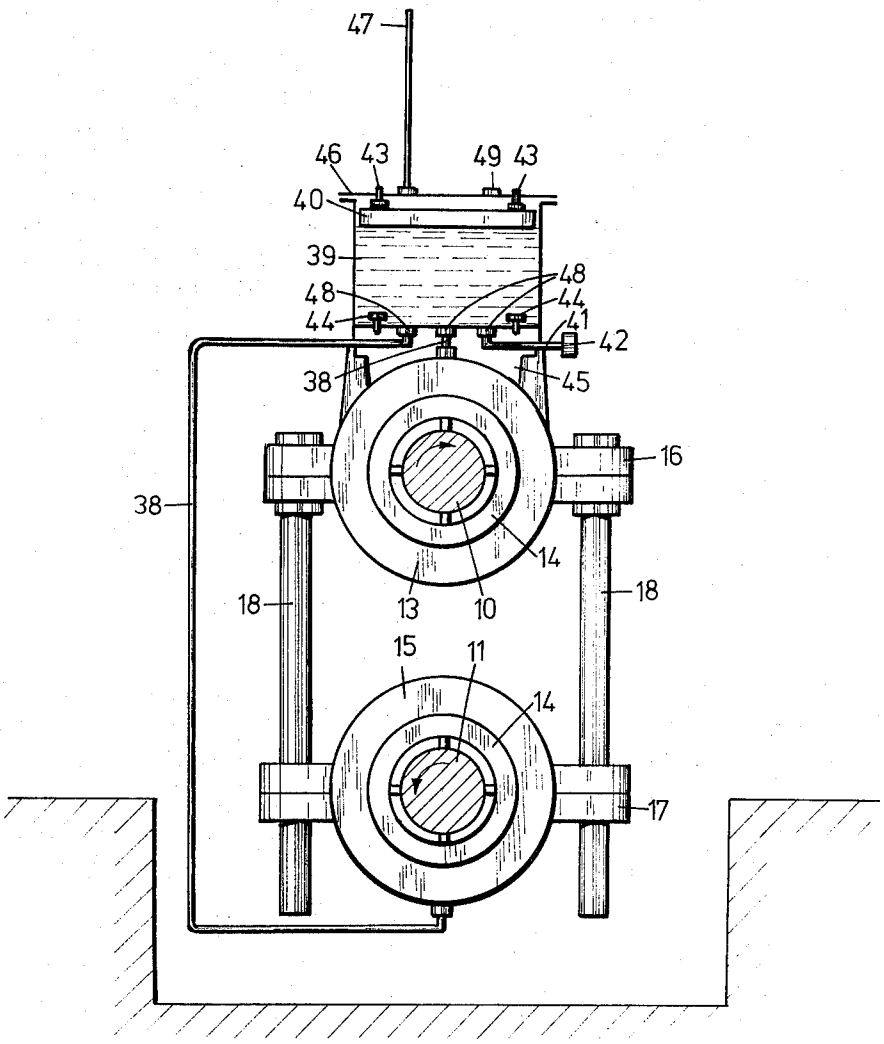
Fig.4



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APPARATUS FOR LUBRICATING AREAS ON ROTATING PARTS

The present invention relates to an apparatus for lubricating area on rotating parts such as shafts, which areas are fed with lubricant through lubricant conveying conduits by a pump from an annular chamber surrounding the rotating element. More specifically, the present invention relates to an apparatus of the above mentioned type in which the annular chamber is formed by an inner ring firmly connected to the rotating part and by a stationary outer ring which is slidingly sealing with regard to said inner ring, said annular chamber communicating with a lubricant storage container from which the lubricant is adapted through the stationary outer ring to be fed to said annular chamber.

Various devices have become known which serve for lubricating areas on rotating elements such as shafts and the like. According to one of these heretofore known devices a pump is inserted into the center of a shaft. This pump is fed from a storage container likewise arranged in said shaft. The essential drawbacks of this known device are seen in the fact that the shaft must have a relatively large diameter in order to permit installation of the pump in said storage container. In view of such large diameter, however, the shaft is easily unbalanced. Moreover, the cost of construction for such heretofore known device is rather high, while the said known device has the further drawback that the charging of the storage container is possible only when the rotating part is at a standstill.

For the above reasons it has been suggested according to another embodiment of a heretofore known device of the type involved to provide the lubricating device on the outer circumference of the shaft or of a corresponding spindle. This device has an inner ring connected to a shaft or a spindle, which inner ring together with an outer ring slideably and sealably mounted, forms an annular chamber in which in addition to the lubricant there is provided a gear ring which is connected to the inner ring and rotates together therewith. On the inner side of the stationary outer ring there is arranged a freely rotatable gear which meshes with said gear ring and presses the lubricant through passages at the bottom of the tooth spaces and in the inner ring to the individual tap areas for the areas to be lubricated. Gear and gear ring together form a kind of gear pump.

With this heretofore known device, the pressure and the quantity of the lubricant fed to an area to be lubricated are dependent on the speed of rotation of the shaft or spindle and on the number of the gears meshing with the gear ring as well as on the distance between the pitch circles of the teeth of the gear ring and of the gear. To vary the quantity of the delivered lubricant by a control mechanism is not possible. While with increasing speed also the lubricant consumption increases, above all the possibility is lacking to adapt the delivery and the conveying pressure to the viscosity of the respective employed lubricant which is dependent not only on the quality of the lubricant itself but also on the temperature of operation. In this connection, it is also disadvantageous that the delivery pressure occurs only during the very short time period during which a tooth of the gear meshes with a tooth space provided with a delivery bore. Therefore, it is hardly possible to assure a uniform supply of lubricant to each area to be lubricated. inner ring

Also, oil pressure generators have become known which are designed in the manner of an axial piston pump, by means of which oil under pressure is pumped as driving medium for a hydraulic motor.

It is an object of the present invention to provide a device for lubricating areas on rotating parts such as shafts or spindles, in which the delivery of equal quantities of lubricant with each lubricating operation will be assured while the frequency and the duration of the individual lubricating step and the respective furnished quantity of lubricant will be variable independently of the speed of the shaft or spindle and other structural features.

These and other objects and advantages of the invention will appear more clearly from the following specification, in connection with the accompanying drawings, in which:

FIG. 1 illustrates two roller spindles arranged one above the other and provided with devices according to the invention.

FIG. 2 is a section taken along the line II—II of FIG. 1.

FIG. 3 shows a section along the line III—III of the device according to FIG. 1.

FIG. 4 illustrates the device according to Fig. 1 with a storage container for supplying the annular chambers of the device with a lubricant.

The present invention is based on a device for lubricating areas on rotating parts, which areas through lubricant conveying conduits are fed by a pump from an annular chamber surrounding the rotating part, said annular chamber being formed by an inner ring firmly connected to the rotating part and by a stationary outer ring which is sealingly slideable relative to said outer ring. The said annular chamber communicates with a lubricant storage container from which the lubricant may be conveyed through the stationary outer ring into said annular chamber. The invention is characterized primarily in that the pumping device comprises at least one piston pump arranged in a manner known per se in axial direction, while the cylinder of said piston pump is arranged within the inner ring, and while the piston cooperates with a non-rotatably mounted actuating ring that is adjustable in axial direction.

The device according to the invention has the advantage that the quantity of the lubricant delivered with each pump stroke may be adjusted by a simple change in the spacing between actuating ring and inner ring by a simple variation in the distance between the actuating ring and the inner ring. Inasmuch as the actuating ring according to a further development of the invention is connected to the outer ring by guiding bolts extending in axial direction, said guiding bolts respectively comprise a working piston guided by a fluid pressure controlled cylinder piston system, it will be possible in addition to changing the quantity of the lubricant fed during a stroke, also to change the frequency of the pump strokes and the duration of the individual lubricating operations independently of the speed and other structural features.

In order to assure that the actuating ring following each pump stroke returns to its starting position, compression springs are arranged on the guiding bolts and expediently rest on the outer ring. Also between the piston and the cylinder there is provided a pressure spring so as to make sure that the piston pump will, fol-

lowing each pump stroke, again return to its starting position.

Referring now to the drawings in detail, it will be seen that two devices according to the invention are respectively arranged on spindles **10** and **11** which rotate in directions counter to each other. One of said spindles has an inner ring **12** and an outer ring **13** whereas the other one of said spindles has an inner ring **14** and an outer ring **15**. The two outer rings **13, 15** respectively have supporting arms **16, 17**. Connected to the supporting arm **16** is a guiding bar **18** which is slidably journaled on the supporting arm **17**. A change in the spacing between the outer rings **13, 15** is also possible while the guiding bars **18** prevent a rotation of the outer rings **13, 15** with regard to each other.

According to the showing of Fig. **1**, each inner ring **12, 14** is provided with one cylinder **19, 20** only. However, the number of the cylinders may be selected at will in conformity with the respective requirements. Outer rings **13, 15** are respectively supported by groups of three guiding bolts **21, 22**. Of course any other number of guiding bolts may be selected.

The construction of the device according to the invention appears to be best in Figs. **2** and **3**. In the cylinder **20** which has been inserted into the inner ring **14** there is slidably arranged a piston **23** which has an abutment **23*a*** against which rests a compression spring **24** which is arranged on the piston **23**. The other end of the compression spring **24** rests upon the marginal area of the cylinder **20** and on the inner ring **14** respectively. The compression spring **24** has the tendency to hold the piston **23** always in its rest position in which it will be pulled out as far as possible from the cylinder **20**. The free end of piston **23** carries a roller **25** which, due to the effect created by the compression spring **24**, continuously engages an actuating ring **26**. The ordinary position of the actuating ring **26** as shown in the drawings thus also determines the rest position of the piston **23**.

Between inner ring **14** and outer ring **15** there is provided an annular chamber **27** which through an inlet opening **28** communicates with the inner chamber of cylinder **20**. The outer ring **15** has its inner side provided with two radial extensions **15*a*** for engaging corresponding recesses on the outer side of the inner ring **14**, thereby forming a labyrinth sealing. In addition, at both sides of the extensions **15a** there are provided sealing discs **29**. The piston **23** has its working surface provided with a cylindrical extension **30** which latter during a working stroke enters the conveying chamber **31** and presses the lubricant in said conveying chamber **31** through a check valve **32** into a non-illustrated lubricant conveying conduit leading to an area to be lubricated.

The guiding bolts **22** which carry the actuating ring **26** have a working piston **33** that is displaceable in a working cylinder **34** formed in the outer ring **15** and illustrated in the drawings as occupying its rest position. The working cylinder **34** is closed by a cover **35** in which the end of the guiding bolt **22** is guided.

A compression spring **36** is arranged between the actuating ring **26** and the outer ring **15** while being mounted on the guiding bolt **22**. This compression spring **36** brings about that the actuating ring **26** is continuously pressed away from the outer ring **15**, and the working piston **33** occupies its rest position shown in the drawings. When the working piston **33** is subjected to pressure through an inlet opening **37**, the guiding bolt **22** is tightened toward the outer ring **15**.

As pressure medium for actuating the working pistons **33**, compression air is particularly suitable. If all three working pistons **33** are uniformly acted upon by fluid, it may be done by a corresponding control of the compressed air supply in a simple manner, on guiding bolts **22** which are simultaneously tightened. The device itself will then operate as follows: In view of the uniform tightening of the guiding bolts **22**, the actuating ring **26** is displaced in axial direction so that it approaches the inner ring **14** and thereby remains parallel thereto. In this way, all pistons **23** are uniformly pushed into cylinder **20** while the inner ring **14** rotates and the rollers **25** roll along the actuating ring **26**. The lubricant contained in the conveyor chamber **31** is, in these circumstances, pressed into the individual lubricating conduits. The lubrication proper is effected as long as the working piston **33** is subjected to air and pressure. During the end phase of the lubricating operation, the air pressure prevailing on the working piston **33** is turned off so that the compression spring can become effective and the actuating ring **26** is pressed into its rest position. Thus, also the force of the compression spring can become effective and can press the piston **23** out of the cylinder **20**. In view of the blocking of the check valve **32** during a suction stroke of piston **23**, new lubricant is withdrawn from annular chamber **27** through the inlet opening **28**. This filling operation is aided by the pressure of the lubricant prevailing in the annular chamber **27**. The device is then ready for carrying out the next lubricating operation, which may be effected as soon as the inlet opening **37** conveys compressed air to the working pistons **33**.

The inlet openings leading into the annular chamber **27** are not shown in FIGS. **1** and **2**. These inlet openings are, however, provided in the outer ring **15** as shown in FIG. **4**, and to each device there is leading a distributing conduit **38** which leads into the annular chamber **27** of the respective device. The supply conduits **38** are connected to one storage container **39** which is filled with a lubricant. A pressure plate **40** sealingly engages the inner wall of the storage container **39** and by means of its own weight presses upon the lubricant in the storage container **39**. The weight of the pressure plate **40** is so great that the pressure exerted upon the lubricant will suffice to overcome the resistance in the supply lines **38** up to the annular chambers **27**. In addition to the supply lines **38**, a feeding line **41** with a connecting member **42** is connected to the storage container **39** at the bottom thereof. To the connecting member **42** there may be connected a lubricant conveying conduit through which the storage container **39** may be filled when the lubricant contained in said storage container has been used or nearly used.

For purposes of ascertaining the maximum admissible upper filling level, there is provided a feeler member **43**, whereas the maximum permissible lower filling level at which a post filling of the storage container **39** is necessary is ascertained by a feeler **44** adapted to emit optical and acoustic signals.

The storage container **39** by means of a framework placed upon the upper one of the two devices **47** is

passed through a cover **46** of the storage container **39** by means of which air under pressure can additionally be conveyed to the pressure plate **40** when the when the pressure exerted through the pressure plate **40** upon the lubricant should not be sufficient.

The connections of the supply lines **38** and the feeding line **41** at the bottom of the storage container **39** are adapted to be blocked by a valve **48**. A safety valve **49** serves as protection against undue pressure in the storage container **39**.

In view of the weight of the pressure plate **40**, a pressure can be maintained in the storage container **39** and in the supply lines **38** which pressure is of the magnitude of that pressure that is necessary for overcoming the resistance in the conduits. This pressure value varies in conformity with the viscosity of the lubricant and also in conformity with the outer temperature. For purpose of equaling this varying pressure supply, the air pressure conveyed through the compressed line **37** may be employed. A compressor for generating this air pressure may likewise be mounted on the framework **45**.

It is, of course, to be understood that the present invention is by no means limited to the specific showing in the drawings, but also comprises any modifications within the scope of the appended claims.

What is claimed is:

1. In a device for lubricating an area on a rotating element, such as a shaft: a first ring fixed to the said element to rotate therewith, a second nonrotatable ring mounted on said first ring and forming a sealed chamber therewith, lubricant supply means connected to said chamber, cylinder means in said first ring parallel to the axis of rotation of said element and communicating with said chamber, lubricant supply conduit means leading from said cylinder means to said area, piston means also parallel to the axis of rotation of said element and reciprocably mounted in said cylinder means, an axially movable nonrotatable ring carried by and operatively connected to said second ring and engaging the said piston means at the axial end thereof opposite said cylinder means, and means for adjusting said actuating ring in the axial direction of said piston means.

2. A device according to claim **1** in which said actuating ring is coaxial with said first ring and is parallel thereto.

3. A device according to claim **1** which includes axial rods connected to said actuating ring and extending toward said second ring, axial cylinders in said second ring and pistons on said rods reciprocable in said cylinders, and means for supplying fluid under pressure to at least one end of said cylinders for moving said actuating ring in the axial direction.

4. A device according to claim **3** which includes a spring on each rod acting on said actuating ring for urging the actuating ring in the axial direction opposite to the direction in which it is moved by the said pistons.

5. A device according to claim **1** which includes spring means acting on said piston means and urging the piston means axially toward said actuating ring.

6. A device according to claim **1** which includes check valve means controlling the flow into said chamber and one of said cylinder means.

7. A device according to claim **1** in which said lubricant supply conduit means are connected to said cylinder means at one end thereof, and said piston means when moved toward said one end of said cylinder means entrap fluid therein and force the fluid into said lubricant supply conduit means.

8. A device according to claim **1** in which said second ring surrounds said first ring on the radially outer side thereof and is sealed thereto at axially spaced annular regions, the space between said annular regions comprising said chamber.

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