

(19) World Intellectual Property Organization  
International Bureau



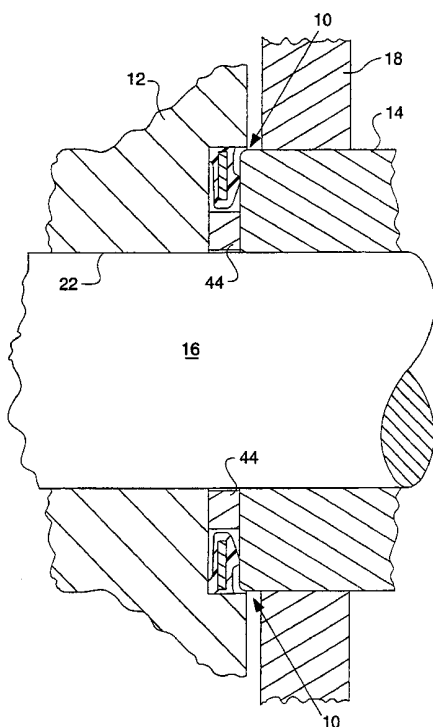
(43) International Publication Date  
22 February 2001 (22.02.2001)

PCT

(10) International Publication Number  
**WO 01/13016 A1**

- (51) International Patent Classification<sup>7</sup>: **F16J 15/34** (74) Agents: RYAN, Kathleen, M. et al.; 100 N.E. Adams Street, Peoria, IL 61629-6490 (US).
- (21) International Application Number: PCT/US00/20855 (81) Designated States (*national*): JP, KR.
- (22) International Filing Date: 31 July 2000 (31.07.2000) (84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
09/375,888 17 August 1999 (17.08.1999) US
- (71) Applicant: CATERPILLAR INC. [US/US]; 100 N.E. Adams Street, Peoria, IL 61629-6490 (US).
- (72) Inventors: METZ, Jerry, A.; 2361 N. Morton Avenue, Morton, IL 61550 (US). KUPPER, David, G.; 530 E. Lake Shore Drive, Edelstein, IL 61526 (US).
- Published:**  
— With international search report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: SEAL ASSEMBLY HAVING AN ENCAPSULATED CONE SPRING



(57) Abstract: A seal ring (10) having a frustoconical spring (40) completely encapsulated within an annular body (28) provides a bias force to an annular lip seal (38) of the annular body (28) to assure positive contact with an opposed face of an adjacently disposed member (12, 14) of a joint assembly. The seal ring (10) requires minimal counterbore depth in the member (12, 14) in which the seal ring (10) is mounted, and no modifications are required in the spring (40) or in the base (26) of the counterbore (22) to provide retention of the spring (40) in the joint.



WO 01/13016 A1

-1-

DESCRIPTIONSEAL ASSEMBLY HAVING AN ENCAPSULATED CONE SPRING5   Technical Field

        This invention relates generally to a seal ring, and more particularly to a seal ring having a cone spring encapsulated within the seal ring.

10   Background Art

        Various seals have been developed for use in sealing a variable space between two relatively rotatable members. A joint in which movement of this type occurs is that found in the track structure of a track-type vehicle such as a tractor or the like. For  
15   example, US Patent 4,392,657, issued 12 July 1983, to Robert D. Roley, titled *Belleville Spring Loaded Seal* and assigned to the assignee of the present invention, describes a seal structure having a Belleville spring  
20   which urges the sealing component of the structure having a Belleville spring which urges the sealing component of the structure into sealing engagement with an opposed face of the joint assembly. In the Roley seal structure, the Belleville spring is  
25   disposed within the actual sealing element of the assembly and is modified by a plurality of annularly arranged openings extending through the spring itself. The sealing element, containing the Belleville spring, is attached to one end of a support spring which has  
30   an opposite end pressed into an annular groove formed in the radial wall of a counterbore in which the seal assembly is positioned. The seal assembly described by Roley requires a relatively deep counterbore to support the sealing element, which uses a cantilevered  
35   spring to support the Belleville spring, in addition

-2-

to requiring a deep groove machined into the flat radial face of the counterbore to support the anchored end of the cantilevered spring.

The present invention is directed to  
5 overcoming the problems set forth above. It is desirable to have a seal ring in which a Belleville spring advantageously provides improved sealing performance as a result of a cone, or Belleville, spring encased in the seal ring. The cone spring  
10 applies a consistent load to a sealing element of the seal ring. It is also desirable to have a seal assembly which only requires a relatively shallow counterbore, thereby allowing more engagement area between the member in which the counterbore is formed  
15 and a pin pressed into the bore of the member. It is also desirable to have such a seal assembly that does not require mounting by an annular cantilevered spring that must be retained within an additionally formed groove in the base of the counterbore.

20 The present invention is directed to a seal assembly having a unitary structure.

#### Disclosure of the Invention

In accordance with one aspect of the present  
25 invention, an annular seal ring for sealing a joint between first and second members that are coaxially mounted on an elongated cylindrical member, are rotatably movable with respect to each other about a longitudinal axis of the elongated cylindrical member  
30 and have a variable space between axially opposed radial faces of the first and second members. A radial face of a preselected one of the first and second members has a counterbore defined by a cylindrical circumferential wall and a recessed radial  
35 wall extending radially inwardly from the cylindrical

-3-

circumferential wall. The annular seal ring embodying the present invention is positionable within the counterbore and includes an annular body having a radially outer cylindrical wall adapted to be  
5 received, and positioned in forced abutment with, the cylindrical circumferential wall of the counterbore. The annular body also has a radially inner cylindrical wall, axially spaced apart front and rear surfaces, and an annular lip projecting outwardly from the front  
10 surface of the annular body. The annular seal ring also includes an annular frustoconical spring that is axially aligned with the annular lip disposed on the front surface of the body, and is completely encapsulated within the annular body at a position  
15 between the annular lip and the rear surface of the body.

Another feature of the annular seal ring embodying the present invention includes the rear surface of the annular body having a seating surface  
20 extending outwardly from the rear surface at a position adjacent the radially outer cylindrical wall of the annular body for a distance sufficient to abut the recessed radial wall of the counterbore when the annular seal ring is assembled in the joint.

25 Yet another feature of the annular seal ring embodying the present invention includes the annular body having a thrust load-resisting surface extending axially outwardly from the rear surface of the annular body at a position adjacent the inner cylindrical wall  
30 of the annular body for a distance sufficient to abut the recessed radial wall of the counterbore when the annular seal ring is assembled in the joint.

Still other features of the annular seal ring embodying the present invention include the  
35 annular body being formed of a polymeric material, the

-4-

annular body being formed of a material having a Shore D hardness from about 45 to about 55, and the annular frustoconical ring being insert molded in the annular body.

5

#### Brief Description of the Drawings

A more complete understanding of the structure and operation of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings, wherein:

10

Fig. 1 is a fragmentary diametric section of a track pin joint having a seal ring embodying the present invention disposed therein;

15

Fig. 2 is a fragmentary enlarged section of a first embodiment of the seal ring embodying the present invention; and

Fig. 3 is a fragmentary enlarged section of a second embodiment of the seal ring embodying the present invention.

20

#### Best Mode for Carrying Out the Invention

An illustrated embodiment of a seal ring embodying the present invention is generally designated by the reference numeral 10 in the drawings. The seal assembly 10 is advantageously used to seal the variable space between a first joint member 12 and a second joint member 14, which have relative movement toward and from each other so as to have variable spacing therebetween during operation. In the illustrated embodiment, the first joint member 12 comprises a portion of a first track link, and the second joint member 14 comprises a bushing that is rotatably mounted on a track pin 16 and is received in a portion of a second track link 18. The track pin 16

25

30

35

-5-

is pressed into a bore 22 of the first track link 12, thereby prohibiting relative movement between the first track link 12 and the track pin 16. The first joint member 12 further has a counterbore defined by a cylindrical circumferential wall 24 and a recessed radial wall 26 extending radially inwardly from the cylindrical circumferential wall 24.

The seal ring 10 has an annular body 28 which has a radially outer circumferential wall 30 that is adapted to be received within the cylindrical circumferential wall 24 of the counterbore 22, in forced abutment with the cylindrical circumferential wall 24. The radially outer circumferential wall 30 of the annular body 28 has a diameter slightly greater than the diameter of the cylindrical circumferential wall 24 of the counterbore 22 so that the respective circumferential walls 24, 30 forcedly abut each other as a result of the interference fit between the respective walls. In an illustrative example of a typical suitable interference fit, the cylindrical circumferential wall 24 of the counterbore has a diameter of 59.4 mm and the outer circumferential wall 30 of the annular body 28 has a diameter of 60.9 mm, resulting in a radial interference of about 0.75 mm between the outer cylindrical wall 30 of the annular body 28 and the cylindrical circumferential wall 24 of the counterbore 22. This assures tight retention of the seal ring 10 within the counterbore 22 of the first joint member 12.

The annular body 28 of the annular seal ring 10 also has a radially inner cylindrical wall 32, a front surface 34, a rear surface 36 axially spaced from the front surface 34, and an annular lip seal 38 projecting outwardly from the front surface 34 of the annular body 28.

-6-

The annular body 28 is desirably formed of a polymeric material such as an injection-moldable polyurethane. Also, to provide a desirable combination of sealing elasticity and structural strength, the injection moldable material from which the annular body 28 is formed desirably has a Shore D hardness of from about 45 to about 55.

The annular seal ring 10 embodying the present invention also has an annular frustoconical spring 40 that is encapsulated, preferably by insert molding, within the annular body 28. The annular frustoconical spring 40 is axially aligned with the annular lip seal 38 at a position between the annular lip seal 38 and the rear surface 36 of the body 28. The frustoconical spring 40, also commonly referred to as a cone spring, cone washer, conical spring or Belleville spring, is insert molded within the annular body 28 in its free state, and is urged into a compressed state by assembly of the joint. Frustoconical springs occupy a very small axial space and are stressed, when compressed, in a manner such that they provide unusually high spring rates. The frustoconical spring 40 provides a bias force that is transmitted through the annular body 28 to the annular lip seal 38 to maintain the lip seal 38 in biased contact with the opposed face of the second joint member 14.

In a first embodiment of a seal assembly 10, the rear surface 36 of the annular body 28 has a seating surface 42 extending outwardly from the rear surface 36 at a position adjacent the radially outer cylindrical wall 30 of the annular body 28. The seating surface 42 is spaced from the rear surface 36 at a distance sufficient to abut the recessed radial wall 26 of the counterbore 22 when the annular seal

-7-

ring 10 is assembled in the joint. In this first embodiment, the joint preferably also includes a separate thrust ring 44 which is disposed between the first joint member 12 and the second joint member 14 to limit movement of the two members 12, 14 toward each other.

In a second embodiment of the present invention, the annular seal ring 10 has an integrally formed thrust load-resisting surface 46 that extends outwardly from the rear surface 36 of the annular body 28 at a position adjacent the inner cylindrical wall 32 of the body 28. The integrally formed thrust load-resisting surface 46 is spaced from the rear surface 36 at a distance sufficient to abut the recessed radial wall 26 of the counterbore 22 when the annular seal ring 10 is assembled in the joint. In this embodiment, the thrust load-resisting surface 46 serves as a thrust ring, thereby eliminating the need for a separate thrust ring in the joint assembly.

20

#### Industrial Applicability

The seal ring 10 embodying the present invention provides an improved seal for variably spaced joint members, such as found in track joints. The frustoconical spring 40 encapsulated within the annular body 28, provides a bias force that urges the annular lip seal 38 axially outwardly away from the counterbore of the first joint member 12 and into biased contact with the radial face of the second joint member 14, thereby assuring positive, continually biased, abutment of the resilient lip seal 38 with the opposed face of the second joint member 14 during movement of the joint.

The seal member 10 provides improved sealing performance due to the consistent load provided by the



-8-

frustoconical spring 40. Also, pin retention capability of the link assembly is improved due to the reduced requirement for a deep counterbore in the joint member that nonrotatably receives the common mounting pin. Thus, pin retention capability of the first joint member 12 is improved due to the requirement for reduced counterbore depth. Advantageously, the reduction in counterbore depth allows more pin engagement surface area with the link 12.

Although the present invention is described in terms of an illustrated exemplary embodiment, with specific illustrative constructions related to a track pin joint, those skilled in the art will recognize that application of the annular seal ring embodying the present invention in other joint arrangements and constructions may be made without departing from the spirit of the invention. Such changes are intended to fall within the scope of the following claims. Other aspects, features, and advantages of the present invention may be obtained from a study of this disclosure and the drawings, along with the appended claims.

-9-

Claims

1. An annular seal ring (10) for sealing a joint between first and second members (12,14) coaxially mounted on an elongated cylindrical member (16) having a longitudinal axis, said first and second members (12,14) being rotatably movable with respect to each other about said longitudinal axis and having a variable space between axially opposed radial faces of said first and said second members (12,14), a radial face of a preselected one of said first and second members (12,14) having a counterbore (22) defined therein by a cylindrical circumferential wall (24) and a recessed radial wall (26) extending radially inwardly from said cylindrical circumferential wall (24), said annular seal ring (10) being positionable within said counterbore (22) and comprising:

an annular body (28) having a radially outer cylindrical wall (30) adapted to be received within the cylindrical circumferential wall (24) of the counterbore (22) of said preselected radial face in forced abutment with the cylindrical circumferential wall (24), a radially inner cylindrical wall (32), axially spaced apart front and rear surfaces (34, 36), and an annular lip seal (38) projecting outwardly from said front surface (34); and

an annular frustoconical spring (40) axially aligned with the annular lip seal (38) and completely encapsulated within said annular body (28) at a position between said annular lip seal (38) and the rear surface (36) of the body (28).

-10-

2. The annular seal ring (10), as set forth in Claim 1, wherein said rear surface (36) of the annular body (28) includes a seating surface (42) spaced outwardly from said rear surface (36) at a position adjacent the radially outer cylindrical wall (30) of the annular body (28) for a distance sufficient to abut the recessed radial wall (26) of the counterbore (22) of the preselected one of the first and second members (12, 14) when said annular seal ring (10) is assembled in said joint.

3. The annular seal ring (10), as set forth in Claim 1, wherein said annular body (28) includes a thrust load-resisting surface (46) spaced axially outwardly from said rear surface (36) of the annular body (28) at a position adjacent the inner cylindrical wall (32) of the annular body (28) for a distance sufficient to abut the recessed radial wall (26) of the counterbore (22) of the preselected one of the first and second members (12, 14) when said annular seal ring (10) is assembled in said joint.

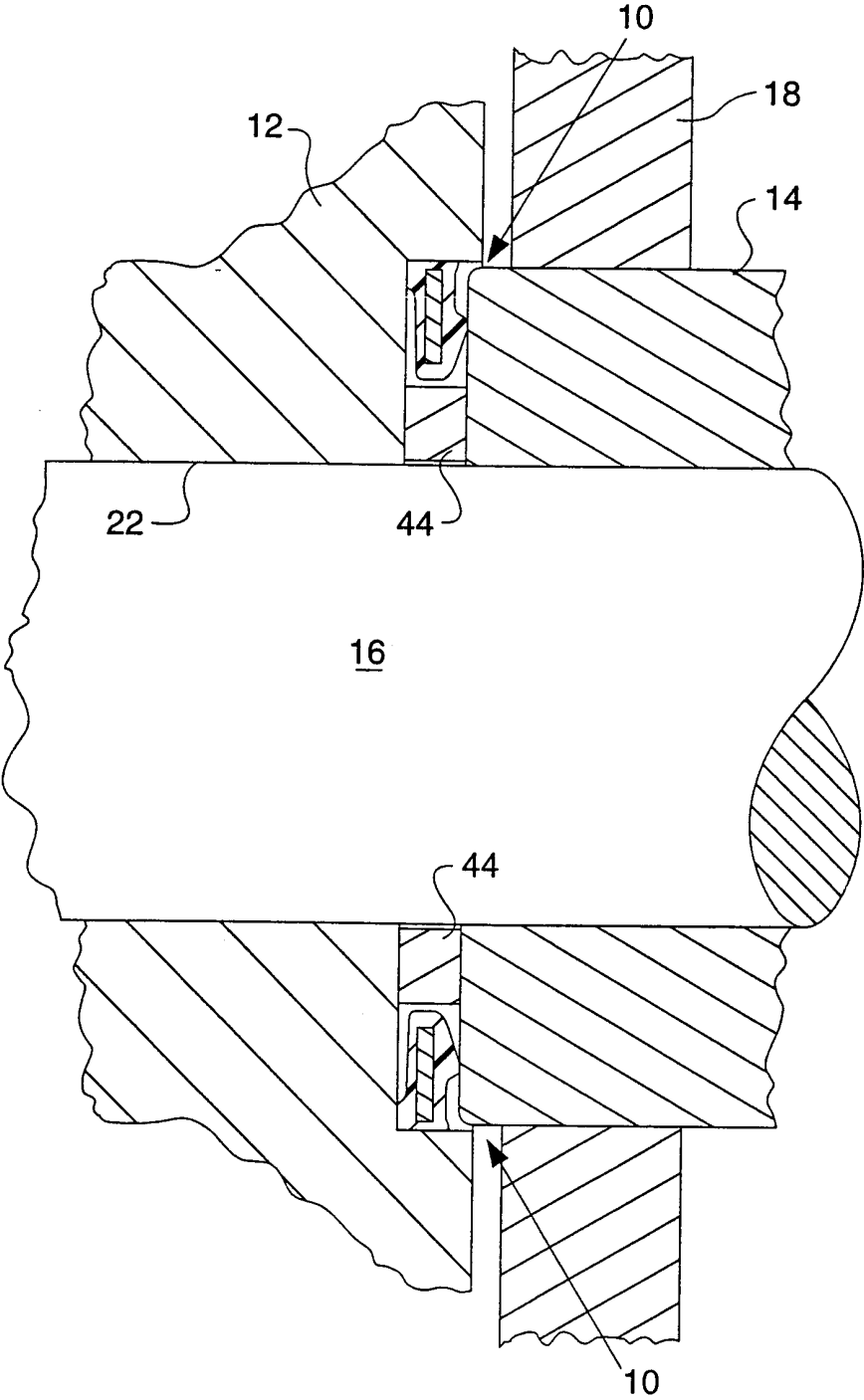
4. The annular seal ring (10), as set forth in Claim 1, wherein said annular body (28) of the annular seal ring (10) is formed of a polymeric material.

5. The annular seal ring (10), as set forth in Claim 1, wherein said annular body (28) of the annular seal ring (10) is formed of a material having a Shore D hardness of from about 45 to about 55.

-11-

6. The annular seal ring (10), as set  
forth in Claim 1, wherein said annular frustoconical  
spring (40) is insert molded in said annular body  
5 (28).

**FIG. 1**





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/20855

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16J15/34

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)

IPC 7 F16J

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 practical, 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 3 096 835 A (NEILSON) 9 July 1963 (1963-07-09) the whole document	1, 2, 4-6
A	US 4 275 890 A (REINSMA) 30 June 1981 (1981-06-30) column 3, line 60 -column 4, line 9; figures	1, 3, 5

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

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

10 November 2000

Date of mailing of the international search report

20/11/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Narminio, A

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/20855

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3096835 A	09-07-1963	NONE	
US 4275890 A	30-06-1981	WO 8100293 A	05-02-1981
		BR 7909018 A	05-05-1981
		CA 1133533 A	12-10-1982
		GB 2066389 A,B	08-07-1981
		IT 1174679 B	01-07-1987
		JP 56500861 T	25-06-1981