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(54) Title: A PROTECTOR FOR A MARINE VESSEL

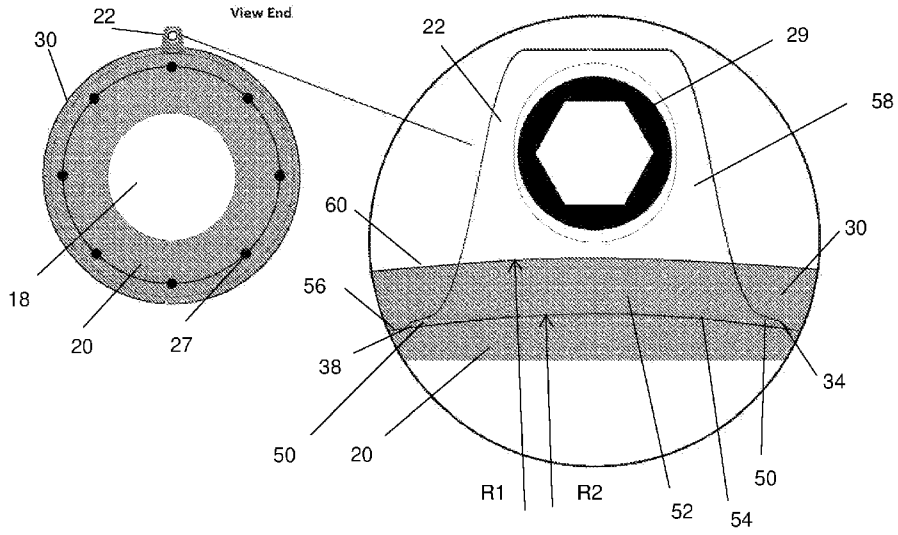

Fig. 3B

(57) Abstract: A protector for a marine vessel comprises a spool 20 through which a propeller shaft (18) passes and a cutter (22) fixed relative to the propeller shaft. The spool is positioned between a propeller and a seal (16) of a propeller shaft bearing and/or the propeller shaft bearing. The spool is arranged to rotate with the propeller shaft. There is at least one step (21) in a circumference of the spool that increases a first radius R1 of the spool closer to the propeller shaft bearing relative to a second radius R2 of the spool. The cutter has a respective cutting edge (34) positioned adjacent the step and at a distance from an axis of rotation of the propeller shaft that is between the first radius and the second radius.

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[Continued on next page]

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A Protector for a Marine Vessel

Field of the Invention

[001] The present invention relates to protection from material, such as rope, fishing line or net. In particular, the protection includes protection from material entering a seal of a propeller shaft bearing of a marine vessel or from material entering the bearing.

Background

[002] Marine vessels often inadvertently run through rope or fishing line/net which gets wound on to the propeller of the marine vessel. Further this material also can wind onto the propeller shaft. Friction and compression can cause this material to be forced, melted or extruded first into the seal of a bearing carrying the propeller shaft and even into the bearing itself. A damaged seal can cause lubricating oil to leak into the ocean. A bearing blocked with debris can cause increased wear due to the bearing overheating or seizure of the bearing.

[003] The cost and time required to replace a seal and/or a worn or seized bearing on larger marine vessels can be significant.

[004] Some known devices seek to cut by severing or scissor action. However, when the material is not wound at the location of the cutter it can bypass the cutter and still enter the bearing.

[005] AU 2001277421 uses a spool and cutter to pare away material wound around the spool. The cutter sits close to the spool but in larger vessels wobble in the propeller shaft, and thus the spool, could permit material to pass under the cutter and move towards the shaft and seal (if fitted), and eventually into the bearing. US 8062083 is an example of a “scissor type” cutter formed of a rotating blade 14 and a stationary blade 21. There is a groove 18 in a hub 12 connected to the rotating blade that accommodates the stationary blade. The side of the groove (adjacent thrust washer 18a) increases the radius of the hub closer to the propeller 2 than to the stern tube 4. It is highly undesirable for material to accumulate on the hub of scissor type cutters, as it does on the spool of AU 2001277421, because of the potential for failure if material could interpose between the blades and not be cut by the scissor like action. Thus, the hub in US 8062083 does not operate like the spool in AU 2001277421. Further, if material

were to enter the groove, it may cause failure as there is no manner of coping with this described in US 8062083.

[006] The present invention may address or at least reduce one or more of the above mentioned problems, including the problem of material entering the seal and/or the bearing.

Summary of the Present Invention

[007] According to an aspect of the present invention there is provided a protector for a marine vessel comprising:
a spool through which a propeller shaft passes, wherein the spool is positioned between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein the spool is arranged to rotate with the propeller shaft;
at least one step in a circumference of the spool that increases a first radius of the spool closer to the propeller shaft bearing relative to a second radius of the spool;
a cutter fixed relative to the propeller shaft and having a respective cutting edge positioned adjacent the step and at a distance from an axis of rotation of the propeller shaft that is between the first radius and the second radius.

[008] In an embodiment, the step is part of a groove in the circumference of the spool.

[009] In an embodiment, the cutting edge is in the groove.

[0010] In an embodiment, there are a plurality of steps in the spool, each having a respective cutting edge of the cutter adjacent thereto.

[0011] In an embodiment, there are a plurality of grooves in the spool, each having a respective cutting edge of the cutter therein.

[0012] In an embodiment, the respective cutting edge is arranged to remove accumulated material from the step and preferably to remove material from the groove.

[0013] In an embodiment, the respective cutting edge is directed to cut material in the groove and which is moving with, or rotating in the same direction as, rotation of the spool.

[0014] In an embodiment, the respective cutting edge is directed to act as, or like, a plough or scoop to remove material from the groove.

[0015] In an embodiment, there is a plurality of cutters positioned circumferentially around the spool, each with a respective cutting edge positioned adjacent to a respective step in the spool.

[0016] In an embodiment, there is a plurality of cutters positioned circumferentially around the spool, each with a respective cutting edge positioned in the or each respective groove.

[0017] In an embodiment, a length of the or each cutting edge is oriented to be substantially parallel with the axis of rotation of the propeller shaft.

[0018] In an embodiment, a dimension of the cutting edge that is substantially parallel with the axis of rotation of the propeller shaft is substantially the same as a width of the respective groove.

[0019] In an embodiment, the cutting edge is provided on a blade that is triangular in cross-section.

[0020] In an embodiment, the or each cutting edge contacts or is close to contacting a bottom of the respective groove, such that there is negligible, or a relatively small, clearance between the bottom of the respective groove and the respective cutting edge.

[0021] In an embodiment, the cutter is disposed radially of the circumference of the spool and the or each cutting edge is disposed on a blade portion which extends from a cutter body radially inwardly towards the spool and into step or groove.

[0022] In an embodiment, the spool is comprised of a material relatively softer than the cutting edge. Typically, the spool is of a plastics material and the cutting edge is of a hard metal.

[0023] Also according to another aspect of the invention there is a method of protecting a marine vessel comprising:
positioning a spool through which a propeller shaft passes between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing;

providing a step in a circumference of the spool which increases the radius of the spool closer to the propeller shaft bearing;
fixing a cutter relative to the propeller shaft bearing, wherein the cutter has a cutting edge;
positioning the cutting edge within the step and adjacent to a radially extending portion of the step;
rotating the spool with the propeller shaft so that the spool moves relative to the cutting edge and the cutting edge is able to contact material in the step.

[0024] Also according to an aspect of the present invention there is provided a protector for a marine vessel comprising:
a spool through which a propeller shaft passes, wherein the spool is positioned between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein the spool is arranged to rotate with the propeller shaft;
at least one groove in a circumference of the spool;
a cutter fixed relative to the propeller shaft and having a respective cutting edge positioned in the groove.

[0025] Also according to another aspect of the invention there is a method of protecting a marine vessel comprising:
positioning a spool through which a propeller shaft passes between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing;
providing a groove in a circumference of the spool;
fixing a cutter relative to the propeller shaft bearing, wherein the cutter has a cutting edge;
positioning the cutting edge in the groove;
rotating the spool with the propeller shaft so that the spool moves relative to the cutting edge and the cutting edge is able to contact material in the groove.

[0026] Also according to an aspect of the present invention there is provided a protector for a marine vessel comprising:
a body connected to a propeller shaft or a propeller and positioned between the propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein material can be wound onto the body as it rotates with the propeller shaft;
wherein the body comprises a collection region for collecting the material and which provides a barrier of increased diameter for discouraging the material from moving towards the propeller shaft bearing;
a clearing device for ablating collected material from the collection region.

[0027] In an embodiment, the collection region is also defined by a decrease in diameter. In an embodiment, a gap formed between the decrease in diameter and the increase in diameter forms a groove in the body.

[0028] Also according to an aspect of the present invention there is provided a method of protecting a marine vessel comprising:
positioned a body between a propeller and a seal of a propeller shaft bearing and/or a propeller shaft bearing, and connected the body to the propeller shaft or the propeller so that it rotates with the propeller shaft;
winding material onto the body as it rotates;
providing a barrier of increased diameter which discourages the material wound onto the body from moving towards the propeller shaft bearing, the barrier defining a collection region of the body;
collecting the material at the collection region;
removing collected material from the collection region.

Summary of Drawings

[0029] In order to provide a better understanding of the present invention, a preferred embodiment will now be described in detail, by way of example only, with reference to the accompanying drawings:

[0030] Figure 1A is a plan view of a protector according to an embodiment of the present invention;

[0031] Figure 1B is an enlargement of a portion of Figure 1A;

[0032] Figure 2A is a side elevational cross-sectional view of the protector of Figure 1A according to an embodiment of the present invention;

[0033] Figure 2B is an enlargement of a portion of Figure 2A;

[0034] Figure 3A is an end cross-sectional view of the protector of Figure 1A according to an embodiment of the present invention;

[0035] Figure 3B is an enlargement of a portion of Figure 3A; and

[0036] Figure 4 is an end cross-sectional view of an alternative protector according to an embodiment of the present invention.

Detailed Description of Embodiment of the Invention

[0037] Referring to the Figures there is a protector 10 comprising a spool 20 and a cutter 22. The spool 20 is generally annulus shaped with a hole extending axially therethrough. The spool 20 is mounted to a propeller 12 by bolts 27 (or in an alternative is mounted to the propeller shaft 18) with the propeller shaft 18 extending through the hole through the spool 20. The cutter 22 is mounted to a bearing carrier 14 by bolts 26.

[0038] The propeller 12 is mounted to a propeller shaft 18 in the normal manner. The propeller shaft 18 is rotatably mounted to a bearing 17 which is protected by a seal 16. The seal 16 may be recessed in a cut-out of the spool 20 or the spool 20 may sit on the seal 16. The bearing 17 is mounted to a marine vessel by the bearing carrier 14 in the normal manner.

[0039] The spool 20 is positioned between the boss of propeller 12 and the bearing 17. The spool 20, being fixed to the propeller 12, will rotate with the propeller shaft 18.

[0040] The spool 20 has at least one step 21 in a circumferential surface of the spool 20 that increases a first radius R1 (see Figure 3B) of circumference 60 of the spool 20 closer to the bearing 17 relative to a second radius R2 (see Figure 3B) of circumference 56 of the spool 20 (which is closer to the propeller 12). In this embodiment the step 21 forms a wall of a groove 30 in the spool 20. In this embodiment the groove 30 is formed by a gap between a down step 23 and the up step 21. In this embodiment there are two grooves 30, 32. There may be only one groove, or there may be many grooves.

[0041] The cutter 22 is fixed to a mount 24 by a bolt 29. The mount 24 is fixed relative to the bearing carrier 14 by one or more screws 26. The cutter 22 has a respective cutting edge 34 (or 38 if the propeller is in rotating in the opposite direction) positioned adjacent the wall of the step 21 towards the bearing 17 (away from the propeller 12). The cutting edge 34 is at a distance from an axis of rotation of the propeller shaft 18 that is between the first radius R1 and the second radius R2.

[0042] The wall created by the up step 21 of the groove 30 provides a barrier which discourages material that enters the groove 30 from moving axially towards the bearing 17. In case material does get past the step 21, a second 32 or more grooves with cutting edges 36/40 can be provided.

[0043] When material enters the groove 30, the cutting edge 34 (or 36, 38, 40) is arranged to remove accumulated material from the groove 30 (or 32). The cutting edges 34, 36, (or 38, 40) are directed to cut material in the groove 30,32 which is moving with, or rotating in the same direction as, rotation of the spool 20. The respective cutting edges 34, 36, 38, 40 each act as, or like, a plough or scoop to remove material from the groove 30, 32. In an embodiment, a length of the or each cutting edge 34, 36, 38, 40 is oriented to be substantially parallel with the axis of rotation of the propeller shaft 18.

[0044] In an embodiment, a dimension of the cutting edge 34, 36, 38, 40 that is substantially parallel with the axis of rotation of the propeller shaft 18 is substantially the same as a width of the respective groove 30, 32. In an embodiment, the cutting edges 34, 36, 38, 40 are provided on a respective blade portion 50 that is triangular in cross-section (see Figures 1B and 2B). It is noted that other the blade portion 50 may be of other cross-sectional shapes, such as rectangular or trapezoidal. The or each blade portion 50 is generally be tapered to form the respective cutting edge 34, 36, 38, 40.

[0045] In an embodiment, the or each cutting edge 34, 36, 38, 40 contacts or is close to contacting a bottom 56 of the respective groove 30, 32, such that there is negligible, or a relatively small, clearance between the bottom 56 of the respective groove and the respective cutting edge 34, 36, 38, 40. This clearance may increase if there is wobble in the propeller shaft 18. However, the clearance is preferably significantly smaller than the change in radius provided by the step 21 so as to discourage material from getting past the step 21 and encourage the material to remain in the groove 30, 32 so that it can be cleared out by the cutting edges 34, 36, 38, 40.

[0046] As shown in Figure 3B, the cutter 22 is disposed radially of the outermost circumference 60 of the spool 20. Each cutting edge 34, 36, 38, 40 of the respective blade portions 50 is disposed on a respective projection 52 which extends from a body 58 of the cutter 22 radially inwardly towards the spool 20 and into the respective groove 30, 32.

[0047] The underside 54 of the projection 52 provides the clearance from it to the bottom 56 of the groove 30. The underside 54 is typically curved to substantially match the curvature of the bottom 56 of the groove 30.

[0048] In an embodiment, the cutter 22 may be provided with another cutting edge 70 which extends radially relative to the spool 20 to operate as the cutter described in AU 2001277421, the contents of which is incorporated herein by reference.

[0049] In an embodiment, there is a second cutter 22' positioned circumferentially around the spool 20, each with a respective cutting edge positioned in the or each respective groove 30, 32.

[0050] In an embodiment, the spool 20 is comprised of a material relatively softer than the cutting edge 34, 36, 38, 40. Typically the spool 20 is formed of a plastics material and the cutting edges 34, 36, 38, 40 is typically formed of a hardened metal.

[0051] In an alternative embodiment, the up step 21 may be provided without forming a wall of a groove.

[0052] The method of operation of the present invention will now be described.

[0053] The spool 20 is positioned on the propeller shaft 18 (or seal 16) so that it passes through a hole in the centre of the spool 20. It is fixed to the boss of the propeller 12 by bolts 27. It is located on the propeller shaft 18 between the propeller 12 and the propeller shaft bearing 17. The cutter mount 24 is fixed to the bearing carrier 14 by bolts 26 and the cutter 22 is fixed to the mount by bolt 29.

[0054] Projections 52 having the cutting edges 34, 36, 38 and 40 are inserted into the grooves 30, 32 in the spool 20.

[0055] In use, rotation of the spool 20 with the propeller shaft 18 causes any material (which may get past the cutting edge 70, if present) between the cutter body 58 and the spool 20 to run into the projection 52 and which are encouraged to move into the groove 30. The up step 21 of the wall of the groove 30 encourages material to remain in the groove 30. Rotation of the spool 20 will bring accumulating material in the groove 30 into contact with the cutting edge 34, 36, 38 or 40, which will cut/plough/scoop the material in an ablative manner.

[0056] In this specification the terms “comprising” or “comprises” are used inclusively and not exclusively or exhaustively.

[0057] Modifications and variations may be made to the present invention within the context of that described herein and shown in the drawings. Such modifications are intended to form part of the inventive concept described in this specification.

Claims

1. A protector for a marine vessel comprising:
a spool through which a propeller shaft passes, wherein the spool is positioned between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein the spool is arranged to rotate with the propeller shaft;
at least one step in a circumference of the spool that increases a first radius of the spool closer to the propeller shaft bearing relative to a second radius of the spool;
a cutter fixed relative to the propeller shaft and having a respective cutting edge positioned adjacent the step and at a distance from an axis of rotation of the propeller shaft that is between the first radius and the second radius.

2. A method of protecting a marine vessel comprising:
positioning a spool through which a propeller shaft passes between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing;
providing a step in a circumference of the spool which increases the radius of the spool closer to the propeller shaft bearing;
fixing a cutter relative to the propeller shaft bearing, wherein the cutter has a cutting edge;
positioning the cutting edge within the step and adjacent to a radially extending portion of the step;
rotating the spool with the propeller shaft so that the spool moves relative to the cutting edge and the cutting edge is able to contact material in the step.

3. A protector for a marine vessel comprising:
a spool through which a propeller shaft passes, wherein the spool is positioned between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein the spool is arranged to rotate with the propeller shaft;
at least one groove in a circumference of the spool;
a cutter fixed relative to the propeller shaft and having a respective cutting edge positioned in the groove.

4. A method of protecting a marine vessel comprising:
positioning a spool through which a propeller shaft passes between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing;
providing a groove in a circumference of the spool;
fixing a cutter relative to the propeller shaft bearing, wherein the cutter has a cutting edge;

positioning the cutting edge in the groove;
rotating the spool with the propeller shaft so that the spool moves relative to the cutting edge and the cutting edge is able to contact material in the groove.

5. A protector for a marine vessel comprising:
a body connected to a propeller shaft or a propeller and positioned between the propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, wherein material can be wound onto the body as it rotates with the propeller shaft;
wherein the body comprises a collection region for collecting the material and which provides a barrier of increased diameter for discouraging the material from moving towards the propeller shaft bearing;
a clearing device for ablating collected material from the collection region.

6. A method of protecting a marine vessel comprising:
positioned a body between a propeller and a seal of a propeller shaft bearing and/or the propeller shaft bearing, and connected the body to the propeller shaft or the propeller so that it rotates with the propeller shaft;
winding material onto the body as it rotates;
providing a barrier of increased diameter which discourages the material wound onto the body from moving towards the propeller shaft bearing, the barrier defining a collection region of the body;
collecting the material at the collection region;
removing collected material from the collection region.

7. A protector according to any one of claims 1, 3 or 5, wherein the step is part of a groove in the circumference of the spool.

8. A protector according to claim 1, wherein the cutting edge is in the groove.

9. A protector according to any one of claims 1, 3 or 5, wherein there are a plurality of steps in the spool, each having a respective cutting edge of the cutter adjacent thereto.

10. A protector according to any one of claims 1, 3 or 5, wherein there are a plurality of grooves in the spool, each having a respective cutting edge of the cutter therein.

11. A protector according to claim 10, wherein the respective cutting edge is arranged to remove accumulated material from the step and preferably to remove material from the groove.

12. A protector according to claim 10 or 11, wherein the respective cutting edge is directed to cut material in the groove and which is moving with, or rotating in the same direction as, rotation of the spool.

13. A protector according to claim 10 or 11 or 12, wherein the respective cutting edge is directed to act as, or like, a plough or scoop to remove material from the groove.

14. A protector according to any one of claims 1, 3 or 5, or 7 to 13 wherein there is a plurality of cutters positioned circumferentially around the spool, each with a respective cutting edge positioned adjacent to a respective step in the spool.

15. A protector according to any one of claims 1, 3 or 5, or 7 to 13 wherein, there is a plurality of cutters positioned circumferentially around the spool, each with a respective cutting edge positioned in the or each respective groove.

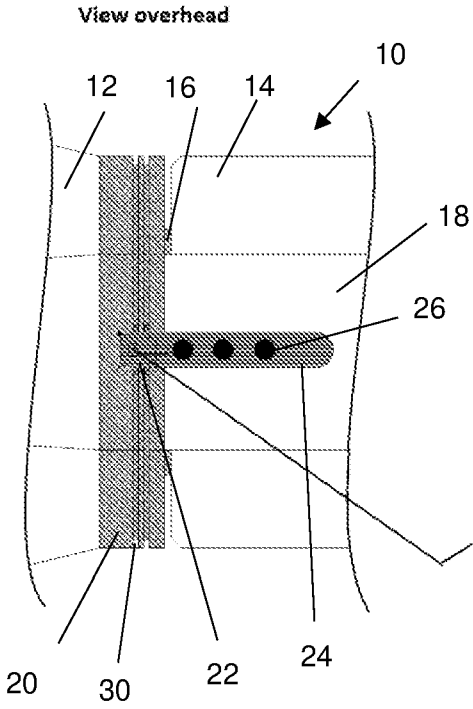
16. A protector according to any one of claims 1, 3 or 5, or 7 to 15 wherein a length of the or each cutting edge is oriented to be substantially parallel with the axis of rotation of the propeller shaft.

17. A protector according to any one of claims 1, 3 or 5, or 7 to 16 wherein a dimension of the cutting edge that is substantially parallel with the axis of rotation of the propeller shaft is substantially the same as a width of the respective groove.

18. A protector according to any one of claims 1, 3 or 5, or 7 to 17 wherein the cutting edge is provided on a blade that is triangular in cross-section.

19. A protector according to any one of claims 1, 3 or 5, or 7 to 18 wherein the or each cutting edge contacts or is close to contacting a bottom of the respective groove, such that there is negligible, or a relatively small, clearance between the bottom of the respective groove and the respective cutting edge.

20. A protector according to any one of claims 1, 3 or 5, or 7 to 19 wherein the cutter is disposed radially of the circumference of the spool and the or each cutting edge is disposed on a blade portion which extends from a cutter body radially inwardly towards the spool and into the step or groove.



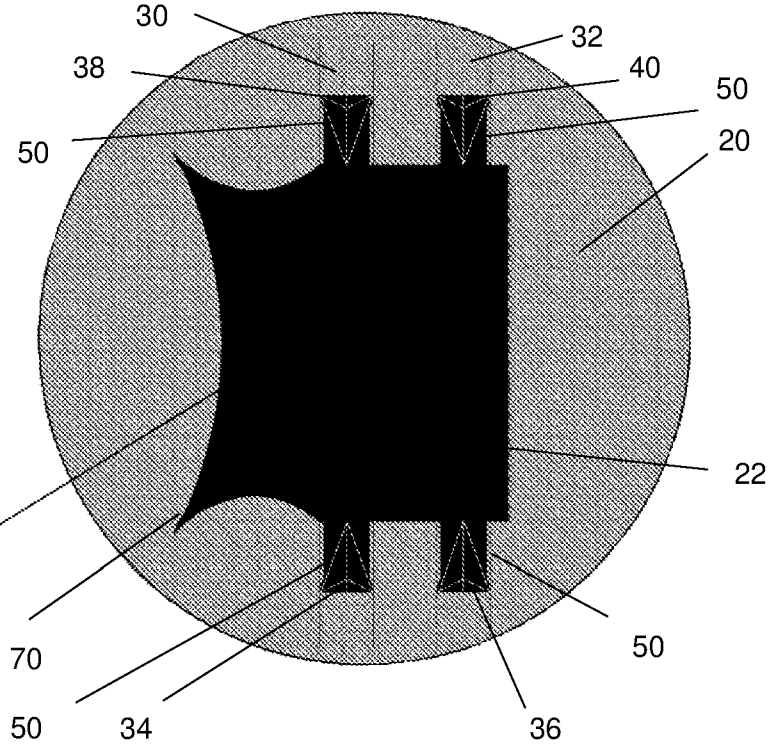
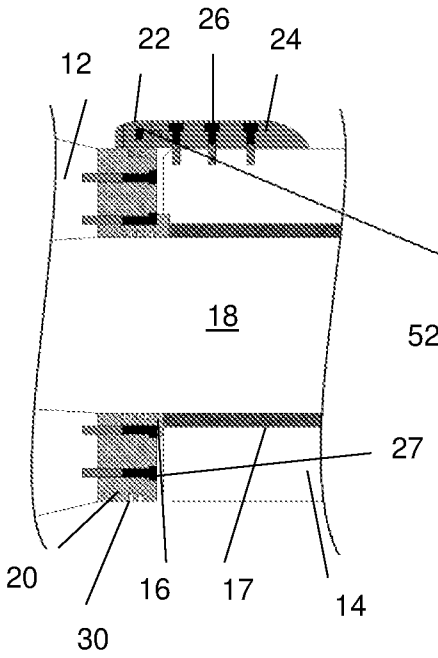


Fig. 1A

Fig. 1B



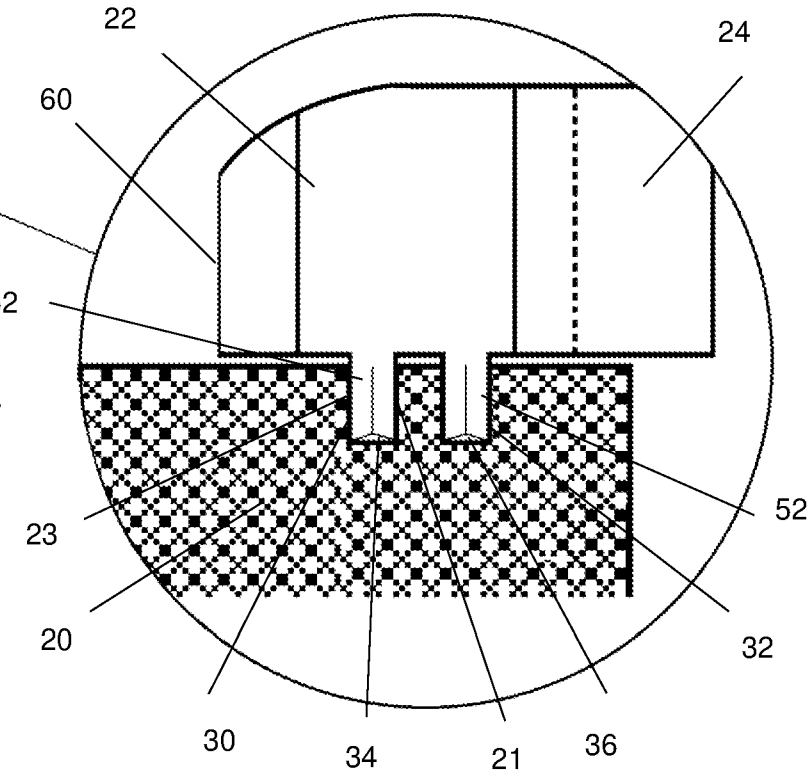


Fig. 2A

Fig. 2B

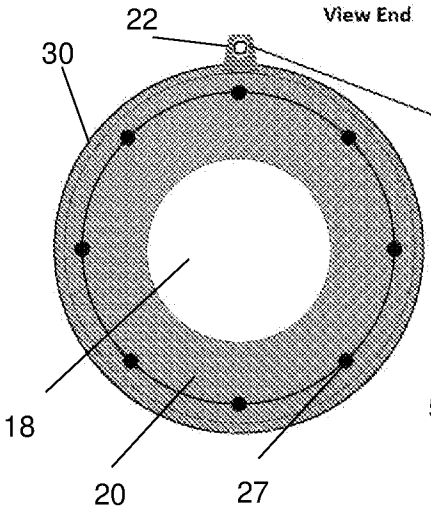


Fig. 3A

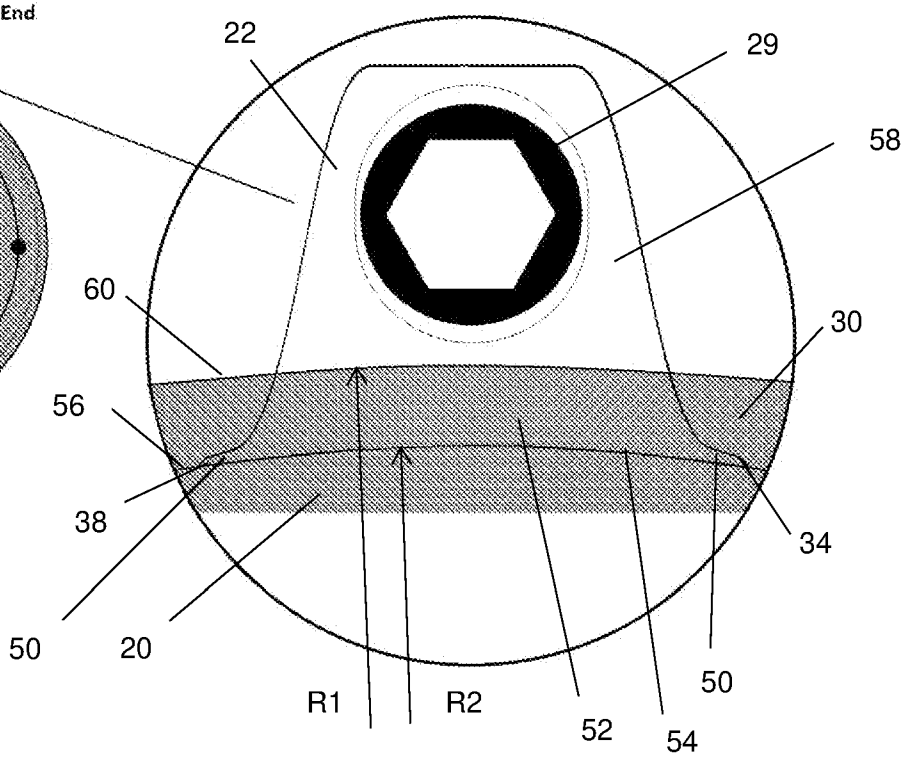


Fig. 3B

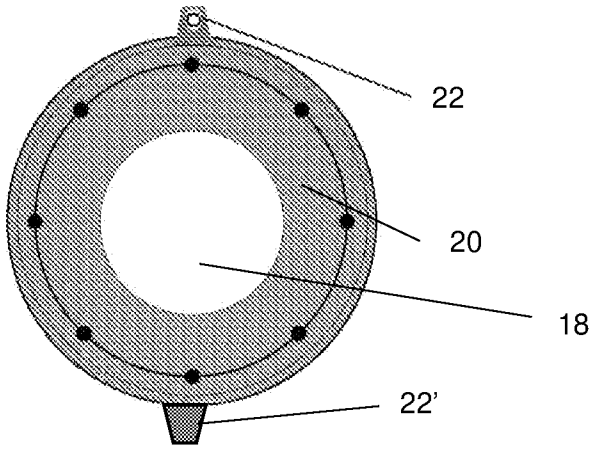


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2020/050003

A. CLASSIFICATION OF SUBJECT MATTER

B63H 5/16 (2006.01)

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)

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)

PATENW : IPC, CPC : B63H23/321, B63H23/32, B63H5/165, B63H5/16, B63H1/28 and keywords: groove, gap, channel, blade, cut, debris, spool, sleeve, rope, line and like terms. Google Search, Google Image Search, Google Patent Search with similar

IPC/CPC and keywords. Espacenet, Auspat, IP Australia internal databases: Applicant and Inventor name search: CAULFIELD

RICHARD as inventor and Environmental Separation Technologies Pty Ltd as applicant

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 March 2020	18 March 2020
Name and mailing address of the ISA/AU	**Authorised officer**
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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2020/050003**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4801244 A (STAHL) 31 January 1989 Abstract, Figures, Col.2, Lines 25-30	1-15, 18-19
Y	DE 10002865 A1 (MEINCKE, MANFRED) 26 July 2001 Abstract, Claim, Fig1-2	1-20
Y	US 7008277 B2 (CAULFIELD) 07 March 2006 Col.7, Lines 6- 28, Figures, Abstract	1-20
A	US 4450670 A (ROBINSON) 29 May 1984	
A	US 4722667 A (RIKHY et al.) 02 February 1988	

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2020/050003**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.