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[Continued on next page]

(54) Title: THRUST WASHER INCLUDING WET FRICTION MATERIAL WITH RESIN COATED SURFACE

(57) Abstract: A thrust washer is provided. The thrust washer includes a wet friction material and a phenolic resin layer coating an outer surface of the wet friction material. A torque converter comprising the thrust washer is also provided. A method of forming a thrust washer is further provided. The method includes providing a layer of phenolic resin on an outer surface of a wet friction material.

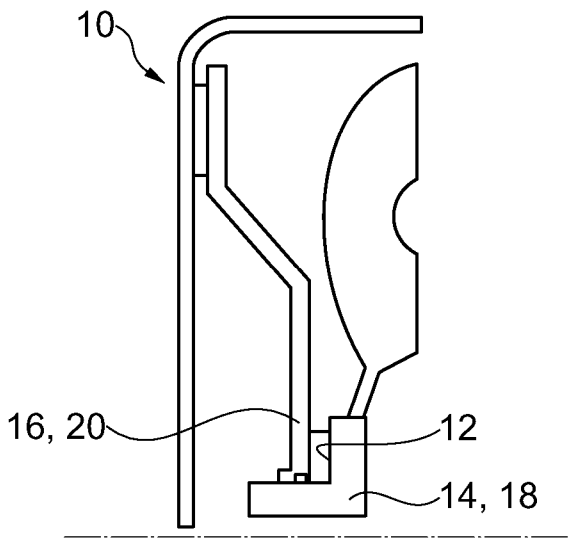


Fig. 1

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THRUST WASHER INCLUDING WET FRICTION MATERIAL WITH RESIN COATED SURFACE

[0001] This claims the benefit to U.S. Provisional Patent Application No. 61/815,923, filed on April 25, 2013, which is hereby incorporated by reference herein.

[0002] The present disclosure relates to thrust washers for use in a torque converter.

BACKGROUND

[0003] U.S. Patent No. 5,188,867 discloses a thermoplastic film coating including an acrylic copolymer made from 30 to 60% finely divided wax, 5 to 25% finely divided inorganic solid and 0 to 1% talc or Syloid.

[0004] U.S. Patent No. 8,281,912 discloses that thrust washers for torque converters are usually plastic or metal.

SUMMARY OF THE INVENTION

[0005] A thrust washer is provided. The thrust washer includes a wet friction material and a phenolic resin layer coating an outer surface of the wet friction material.

[0006] Embodiments of the thrust washer may also include one or more of the following advantageous features:

[0007] The phenolic resin layer may be a laminated sheet of phenolic resin. The wet friction material may include surface pores and the phenolic resin may fill the surface pores. The phenolic resin may include grooves formed in an outer surface thereof. The thrust washer may further include a metal layer, the wet friction material being attached to the metal layer. The phenolic resin may include a first phenolic resin layer on a first outer surface of the wet friction material and a second phenolic resin layer on a second outer surface of the wet friction material. The wet friction material may include a first wet friction material layer on a first outer surface of the metal layer and a second wet friction material layer on a second outer surface of the metal layer. The first wet friction material layer may include the first outer surface of the wet friction material and the

second wet friction material layer may include the second outer surface of the wet friction material.

[0008] A torque converter is also provided that includes the thrust washer.

[0009] A method of forming a thrust washer is also provided. The method includes providing a layer of phenolic resin on an outer surface of a wet friction material.

[0010] Embodiments of the method may also include one or more of the following advantageous features:

[0011] The layer of phenolic resin layer provided on the outer surface of the wet friction material may be a laminated sheet of phenolic resin. The method may further include providing a layer of non-stick material on top of the phenolic resin layer. The providing the layer of phenolic resin on the outer surface of the wet friction material may include curing the phenolic resin layer onto the wet friction material after the layer of non-stick material is provided on top of the phenolic resin. The curing may include pressing the phenolic resin layer onto the wet friction material with a hot press. The pressing may include pressing a hot press plate against the non-stick material to cure the phenolic resin onto the wet friction material. The providing the layer of phenolic resin on the outer surface of the wet friction material may include coating two opposing outer surfaces of the wet friction material with phenolic resin layers to form a first phenolic resin layer and a second phenolic resin layer. The method may further include providing a first layer of non-stick material on an outer surface of the first phenolic resin layer and a second layer of non-stick material on an outer surface of the second phenolic resin layer. The providing the layer of phenolic resin on the outer surface of the wet friction material may include curing the phenolic resin onto the wet friction material after the first and second layers of non-stick material are provided on the outer surfaces of the first and second phenolic resin layers on top of the phenolic resin by pressing a first hot press section against the first layer of non-stick material to cure the first phenolic resin layer onto the wet friction material and pressing a second hot press section against the second layer of non-stick material to cure the second phenolic resin layer onto the wet friction material.

The wet friction material may include a first layer of wet friction material and a second layer of wet friction material. The method may further include providing a metal layer between the first and second layers of wet friction material. The method may further include providing the wet friction material on a metal layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention is described below by reference to the following drawings, in which:

[0013] Fig. 1 shows a torque converter according to an embodiment of the present invention;

[0014] Fig. 2 shows a thrust washer in accordance with an embodiment of the present invention;

[0015] Fig. 3a schematically shows a method for forming the thrust washer shown in Fig. 2 in accordance with an embodiment of the present invention; and

[0016] Fig. 3b schematically shows a method for forming a thrust washer in accordance with an alternative embodiment of the present invention.

DETAILED DESCRIPTION

[0017] Fig. 1 shows a portion of a torque converter 10 according to an embodiment of the present invention. Torque converter 10 includes a thrust washer 12 positioned axially between a first rotating component 14 and a second rotating component 16, at least one of which subjects the other component 14, 16 to a thrust. In this embodiment, component 14 is a turbine hub 18 and component 16 is a piston 20. In other embodiments, thrust washer 12 may be positioned between different rotating components of a torque converter. Fluid within torque converter 10 flows along outer surfaces 32 of thrust washer 12 to help prevent wear between components 14, 16.

[0018] Fig. 2 shows thrust washer 12 in accordance with an embodiment of the present invention. Thrust washer 12 is ring shaped and includes a wet friction material layer 22 sandwiched between two phenolic resin layers 24. Phenolic resin layers 24 may be for

example Resin Arofene 295-E-50 or MACtac IF-4023A. Wet friction material layer 22 is a porous material including surface pores 26 on opposing outer surfaces 28 thereof before phenolic resin layers 24 are applied to outer surfaces 28. Phenolic resin layers 24 are formed on wet friction material layer 22 such that surface pores 26 are filled by the phenolic resin and outer surfaces 32 of thrust washer 12 have a low coefficient of friction, which provides for smooth interactions between outer surfaces 32 and components 14, 16. Wet friction material layer 22 may be formed of any known wet friction material, for example a fiber matrix impregnated with resin. A plurality of grooves 30 may be formed in the outer surfaces 32, at outer surfaces 34 of phenolic resin layers 24, to provide passages for fluid to flow along outer surfaces 32.

[0019] Fig. 3a schematically shows a method for forming thrust washer 12 in accordance with an embodiment of the present invention. Wet friction material layer 22 is coated with phenolic resin layers 24 on opposite sides thereof. In one preferred embodiment, phenolic resin layers 24 are formed as laminated sheets. Phenolic resin layers 24 are appropriately positioned on outer surfaces 36 of wet friction material layer 22 and layers 22, 24 are placed between two press sections of a hot press 42, which is this embodiment are a lower press plate 38 and an upper press plate 40. A first non-stick layer 44 is provided between the lower phenolic resin layer 24 and lower press plate 38 a second non-stick layer 46 is provided between the upper phenolic resin layer 24 and upper press plate 40 to prevent phenolic resin layers 24 from sticking to press plates 38, 40. Non-stick layers 44, 46 may be formed of for example waxed paper or TEFLON. Press plates 38, 40 are heated to between 350°F and 420°F and a downward force may be applied to upper press plate 40 to heat and cure phenolic resin layers 24, causing phenolic resin layers 24 to plug surface pores 26 of wet friction material 22.

[0020] Fig. 3b schematically shows a method for forming a thrust washer 12a in accordance with an alternative embodiment of the present invention. In this embodiment, thrust washer 12a is formed in the same manner as thrust washer 12, but with wet friction material 22 being split into a first wet friction material layer 22a and a second wet friction material layer 22b that are separated by a metal layer 48. Layers 22a, 22b may be attached to metal layer 48 by adhesive or another connection. As with the embodiment in

Fig. 3a, non-stick layers 44, 46 are provided between resin layers 24 and respective press plate 38, 40, which are used to heat and cure phenolic resin layers 24, causing phenolic resin layers 24 to plug surface pores 26 of wet friction material 22.

[0021] In the preceding specification, the invention has been described with reference to specific exemplary embodiments and examples thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of invention as set forth in the claims that follow. The specification and drawings are accordingly to be regarded in an illustrative manner rather than a restrictive sense.

WHAT IS CLAIMED IS:

1. A thrust washer comprising:
a wet friction material; and
a phenolic resin layer coating an outer surface of the wet friction material.

2. The thrust washer as recited in claim 1 wherein the phenolic resin layer is a laminated sheet of phenolic resin.

3. The thrust washer as recited in claim 1 wherein the wet friction material includes surface pores, the phenolic resin filling the surface pores.

4. The thrust washer as recited in claim 1 wherein the phenolic resin includes grooves formed in an outer surface thereof.

5. The thrust washer as recited in claim 1 further comprising a metal layer, the wet friction material being attached to the metal layer.

6. The thrust washer as recited in claim 1 wherein the phenolic resin includes a first phenolic resin layer on a first outer surface of the wet friction material and a second phenolic resin layer on a second outer surface of the wet friction material.

7. The thrust washer as recited in claim 6 further comprising a metal layer, the wet friction material including a first wet friction material layer on a first outer surface of the metal layer and a second wet friction material layer on a second outer surface of the metal layer, the first wet friction material layer including the first outer surface of the wet friction material, the second wet friction material layer including the second outer surface of the wet friction material.

8. A torque converter comprising the thrust washer recited in claim 1.

9. The torque converter as recited in claim 8 further comprising a first component and a second component, at least one of the first component and the second component subjecting the other of the first and second component to a thrust, the thrust washer being positioned between the first and second components to absorb the thrust.

10. A method of forming a thrust washer comprising:

providing a layer of phenolic resin on an outer surface of a wet friction material.

11. The method as recited in claim 10 wherein the phenolic resin layer is a laminated sheet of phenolic resin.

12. The method as recited in claim 10 further comprising providing a layer of non-stick material on top of the phenolic resin layer.

13. The method as recited in claim 12 wherein the providing the layer of phenolic resin on the outer surface of the wet friction material includes curing the phenolic resin layer onto the wet friction material after the layer of non-stick material is provided on top of the phenolic resin.

14. The method as recited in claim 13 wherein the curing includes pressing the phenolic resin layer onto the wet friction material with a hot press.

15. The method as recited in claim 14 wherein the pressing includes pressing a hot press plate against the non-stick material to cure the phenolic resin onto the wet friction material.

16. The method as recited in claim 10 wherein the providing the layer of phenolic resin on the outer surface of the wet friction material includes coating two opposing outer surfaces of the wet friction material with phenolic resin layers to form a first phenolic resin layer and a second phenolic resin layer.

17. The method as recited in claim 16 further comprising providing a first layer of non-stick material on an outer surface of the first phenolic resin layer and a second layer of non-stick material on an outer surface of the second phenolic resin layer.

18. The method as recited in claim 17 wherein the coating includes curing the phenolic resin onto the wet friction material after the first and second layers of non-stick material are provided on the outer surfaces of the first and second phenolic resin layers on top of the phenolic resin by pressing a first hot press section against the first layer of non-stick material to cure the first phenolic resin layer onto the wet friction material and pressing a second hot press section against the second layer of non-stick material to cure the second phenolic resin layer onto the wet friction material.

19. The method as recited in claim 16 wherein the wet friction material includes a first layer of wet friction material and a second layer of wet friction material, the method further comprising providing a metal layer between the first and second layers of wet friction material.

20. The method as recited in claim 11 further comprising providing the wet friction material on a metal layer.

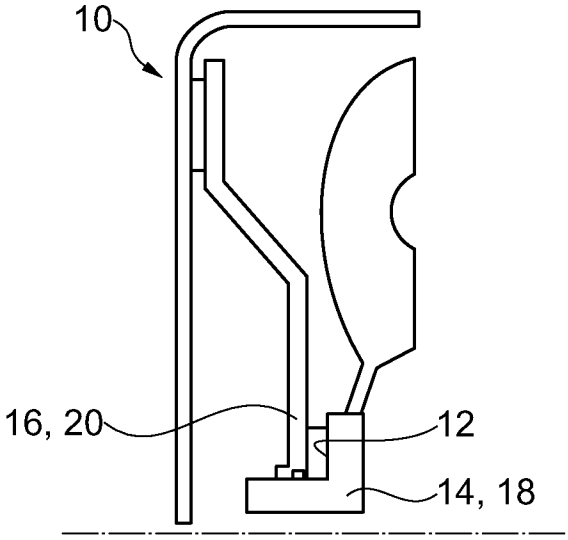


Fig. 1

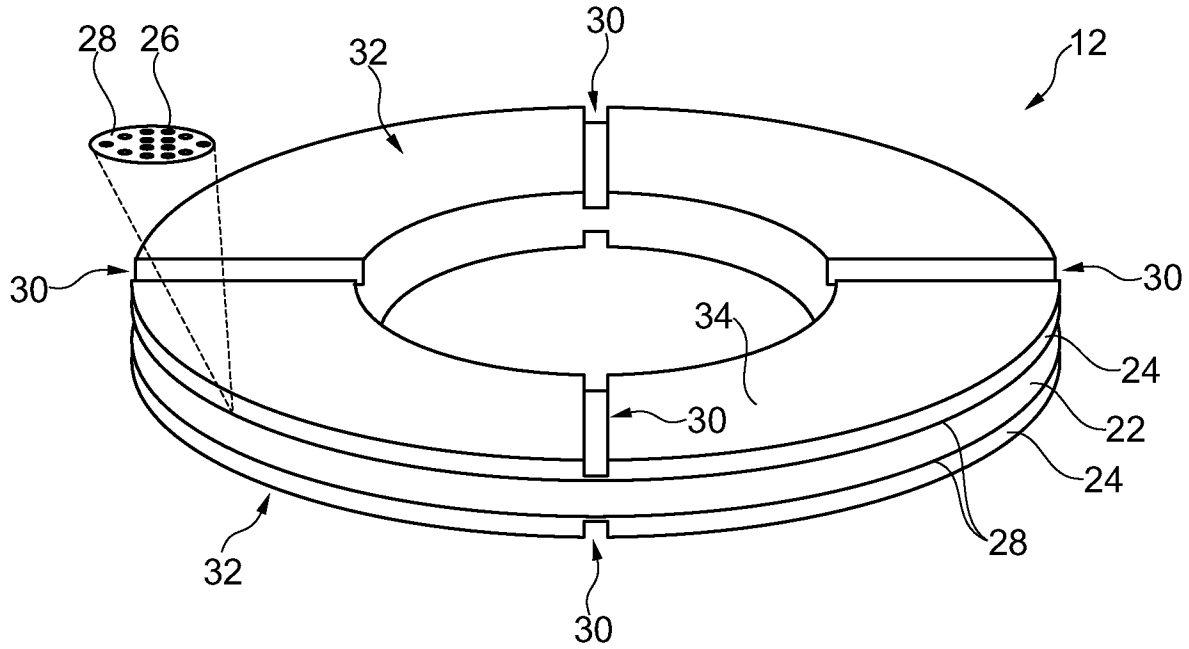


Fig. 2

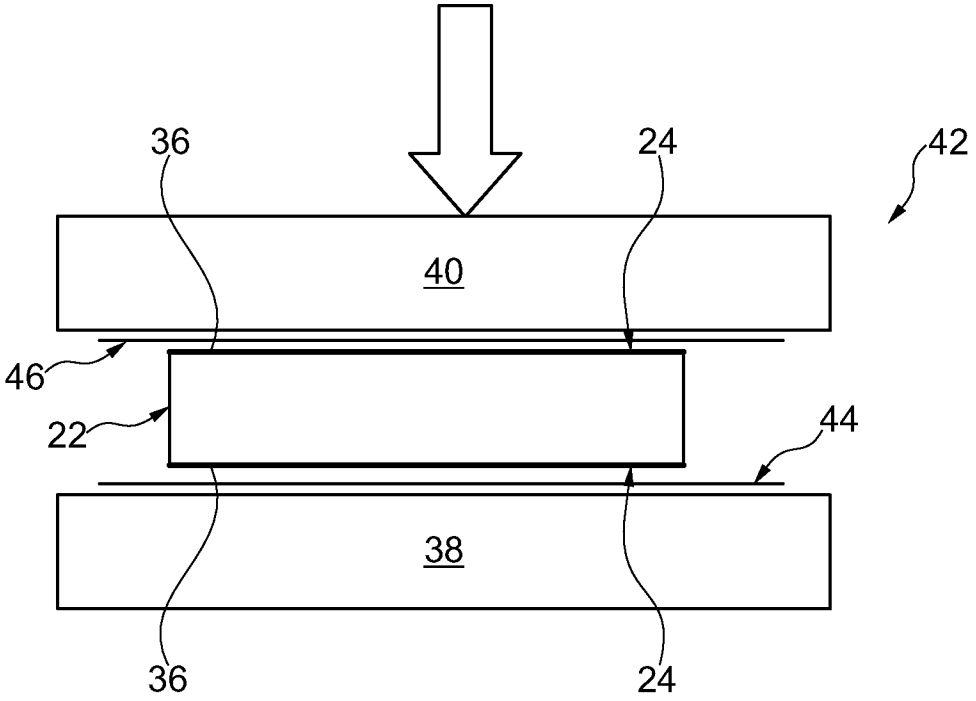


Fig. 3a

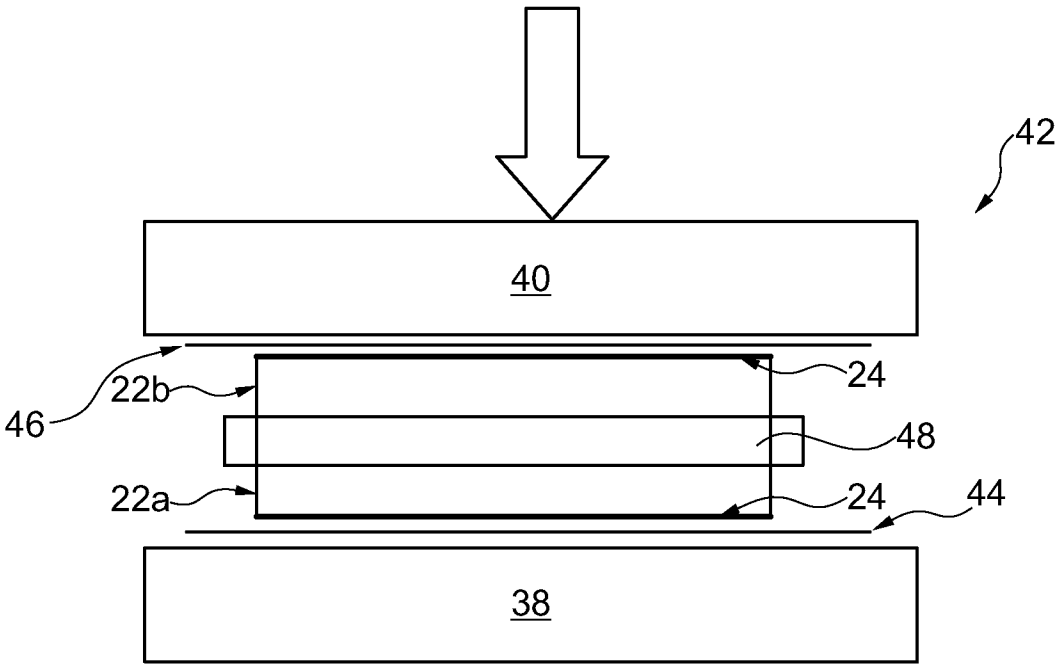


Fig. 3b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/035064

A. CLASSIFICATION OF SUBJECT MATTER

F16B 43/00(2006.01)i, F16C 33/10(2006.01)i, F16C 33/20(2006.01)i, B32B 27/00(2006.01)i, F16H 41/24(2006.01)i, F16H 41/30(2006.01)i

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)
F16B 43/00; B29D 31/00; B29C 43/20; C08J 5/14; F16C 17/04; B32B 18/00; C09K 3/14; B32B 5/16; B32B 5/02; F16C 32/06; F16D 13/60; F16C 33/10; F16C 33/20; B32B 27/00; F16H 41/24; F16H 41/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: thrust washer, torque converter, wet friction, and phenolic resin

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 07-020681 B2 (SHIN KOBE ELECTRIC MACHINERY CO., LTD.) 08 March 1995 See column 4, lines 1-19, claim 1 and figures 1a-1b.	1-4,6,8-18
A		5,7,19-20
Y	JP 63-022888 A (SHOWA DENKO K.K.) 30 January 1988 See claims 1-2 and page 2, upper left column.	1-4,6,8-18
Y	US 8281912 B2 (JAMESON, JONATHAN) 09 October 2012 See column 1, lines 21-56 and figures 1A-1C.	4,8-9
Y	US 2005-0025951 A1 (GRUBER et al.) 03 February 2005 See paragraph [0045] and figure 4.	12-15,17-18
A	US 2013-0037373 A1 (DONG et al.) 14 February 2013 See paragraphs [0012]-[0013] and figures 1-3.	1-20

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

☒ See patent family 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 application or patent 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)
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"P" document published prior to the international filing date but later than the priority date claimed
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"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	Date of mailing of the international search report
25 August 2014 (25.08.2014)	**26 August 2014 (26.08.2014)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/035064

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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