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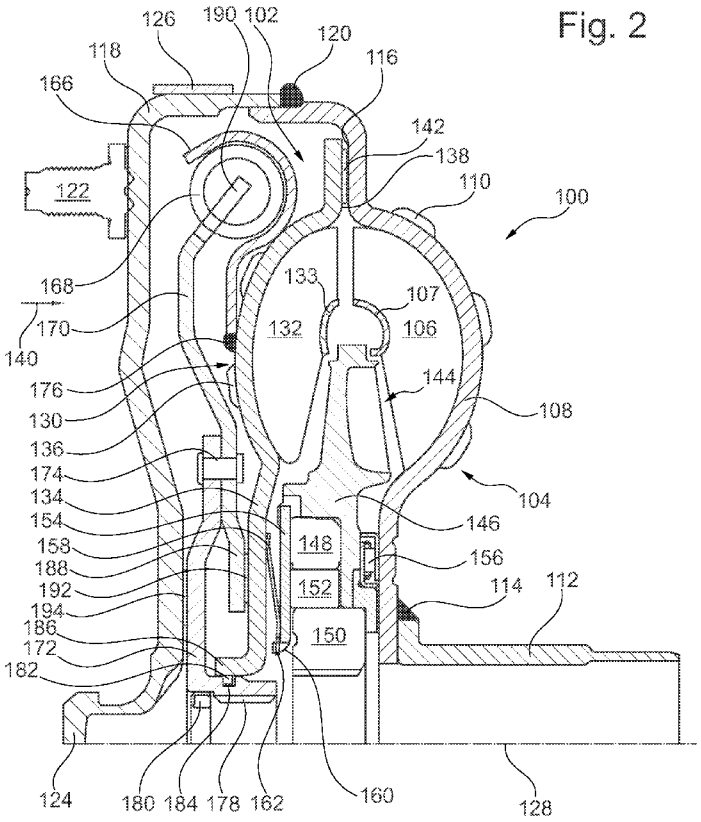
(54) Title: TURBINE PISTON

Fig. 2



(57) Abstract: A torque converter includes an impeller with a plurality of impeller blades and a shell with a radial wall disposed radially outside of the blades. The converter also includes a cover fixed to the impeller shell to form a housing, and a turbine. The turbine includes a plurality of turbine blades and a shell with a radial wall disposed radially outside of the turbine blades. The turbine radial wall is arranged to frictionally engage the impeller shell radial wall. In some example embodiments, the turbine shell includes indented slots and the turbine blades include tabs disposed in the slots. In an example embodiment, the turbine blades are fixed to the turbine shell by brazing.

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Published:

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TURBINE PISTON

FIELD

[0001] The invention relates generally to a torque converter, and more specifically to a torque converter with a turbine piston.

BACKGROUND

[0002] Torque converter turbines incorporating lockup clutches are known. One example is shown in commonly-assigned United States Patent No. 7,445,099.

BRIEF SUMMARY

[0003] Example aspects broadly comprise a torque converter including an impeller with a plurality of impeller blades and a shell with a radial wall disposed radially outside of the blades. The converter also includes a cover fixed to the impeller shell to form a housing, and a turbine. The turbine includes a plurality of turbine blades and a shell with a radial wall disposed radially outside of the turbine blades. The turbine radial wall is arranged to frictionally engage the impeller shell radial wall. In some example embodiments, the turbine shell includes indented slots and the turbine blades include tabs disposed in the slots. In an example embodiment, the turbine blades are fixed to the turbine shell by brazing.

[0004] In an example embodiment, the impeller shell radial wall or the turbine shell radial wall includes a friction material ring for frictional engagement with the other of the impeller shell radial wall or the turbine shell radial wall. In an example embodiment, the torque converter includes a stator assembly and a release spring disposed between the turbine shell and the stator assembly to urge the turbine away from the impeller.

[0005] In an example embodiment, the torque converter includes a damper spring retainer fixed to the turbine shell and a damper spring disposed in the spring retainer. In an example embodiment, the torque converter includes a damper flange arranged for driving and sealing engagement with a transmission input shaft. The turbine shell is sealed to the damper flange. In some example embodiments, the damper flange includes a thrust plate axially disposed between the flange and the turbine shell for transferring a thrust load from the turbine shell to the cover. In an example embodiment, the thrust plate or the turbine shell has a friction material ring and the flange or the cover comprises a friction material ring. In an example embodiment, the thrust plate includes a tab drivingly engaged with the damper spring.

[0006] In some example embodiments, the torque converter includes a damper spring retainer arranged for driving engagement with a transmission input shaft and a damper spring disposed in the spring retainer. The turbine shell includes an axial tab engaged with the damper spring. In an example embodiment, the axial tab is radially aligned with the turbine shell radial wall. In an example embodiment, the torque converter includes a damper hub fixed to the spring retainer by compressive engagement. In an example embodiment, the torque converter includes a turbine shell bushing arranged for sealing engagement with a transmission input shaft.

[0007] Other example aspects broadly comprise a torque converter assembly including a torus portion and a lockup clutch. The torus portion includes an impeller, a turbine, and a stator. The lockup clutch is for connecting the impeller and the turbine. The clutch is axially aligned with the stator. In some example embodiments, the lockup clutch is disposed radially outside of the torus portion. In an example embodiment, the lockup clutch comprises respective impeller and turbine radial walls. In an example embodiment, the torque converter includes a damper with a damper spring radially aligned and axially offset from the lockup clutch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The nature and mode of operation of the present invention will now be more fully described in the following detailed description taken with the accompanying drawing figures, in which:

Figure 1A is a perspective view of a cylindrical coordinate system demonstrating spatial terminology used in the present application;

Figure 1B is a perspective view of an object in the cylindrical coordinate system of Figure 1A demonstrating spatial terminology used in the present application;

Figure 2 is a top half cross section view of a first embodiment of a torque converter with a turbine piston according to an example aspect;

Figure 3 is a top half cross section view of a second embodiment of a torque converter with a turbine piston according to an example aspect;

Figure 4 is a top half cross section view of a third embodiment of a torque converter with a turbine piston according to an example aspect;

Figure 5 is a top half cross section view of a fourth embodiment of a torque converter with a turbine piston according to an example aspect.

DETAILED DESCRIPTION

[0009] At the outset, it should be appreciated that like drawing numbers appearing in different drawing views identify identical, or functionally similar, structural elements. Furthermore, it is understood that this invention is not limited only to the particular embodiments, methodology, materials and modifications described herein, and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present invention, which is limited only by the appended claims.

[0010] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this invention belongs. Although any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the following example methods, devices, and materials are now described.

[0011] Figure **1A** is a perspective view of cylindrical coordinate system **80** demonstrating spatial terminology used in the present application. The present invention is at least partially described within the context of a cylindrical coordinate system. System **80** has a longitudinal axis **81**, used as the reference for the directional and spatial terms that follow. The adjectives "axial," "radial," and "circumferential" are with respect to an orientation parallel to axis **81**, radius **82** (which is orthogonal to axis **81**), and circumference **83**, respectively. The adjectives "axial," "radial" and "circumferential" also are regarding orientation parallel to respective planes. To clarify the disposition of the various planes, objects **84**, **85**, and **86** are used. Surface **87** of object **84** forms an axial plane. That is, axis **81** forms a line along the surface. Surface **88** of object **85** forms a radial plane. That is, radius **82** forms a line along the surface. Surface **89** of object **86** forms a circumferential plane. That is, circumference **83** forms a line along the surface. As a further example, axial movement or disposition is parallel to axis **81**, radial movement or disposition is parallel to radius **82**, and circumferential movement or disposition is parallel to circumference **83**. Rotation is with respect to axis **81**.

[0012] The adverbs "axially," "radially," and "circumferentially" are with respect to an orientation parallel to axis **81**, radius **82**, or circumference **83**, respectively. The adverbs "axially," "radially," and "circumferentially" also are regarding orientation parallel to respective planes.

[0013] Figure **1B** is a perspective view of object **90** in cylindrical coordinate system **80** of Figure **1A** demonstrating spatial terminology used in the present application. Cylindrical object **90** is representative of a cylindrical object in a cylindrical coordinate system and is not intended to limit the present invention in any manner. Object **90** includes axial surface **91**, radial surface **92**, and circumferential surface **93**. Surface **91** is part of an axial plane, surface **92** is part of a radial plane, and surface **93** is part of a circumferential plane.

[0014] The following description is made with reference to Figure 2. Figure 2 is a top half cross section view of torque converter **100** with turbine piston **102**. Converter **100** includes impeller **104** with a plurality of impeller blades **106**, core ring **107**, and shell **108**. Blades **106** include tabs (not shown) installed in indented slots **110** of shell **108**. Blades **106** are fixed to the shell by brazing as is known in the art. Impeller **104** includes hub **112** fixed to shell **108** by weld **114**. Hub **112** is arranged for driving engagement with a hydraulic pump of a transmission (not shown).

[0015] Shell **108** includes radial wall **116** disposed radially outside of blades **106**. Converter **100** includes cover **118** fixed to shell **108** at weld **120** to form a housing as is known in the art. Cover **118** includes stud **122** arranged for driving engagement with an engine flexplate (not shown) and pilot extrusion **124** arranged for centering converter **100** with regards to a crankshaft for the engine (not shown). Cover may include balance weight **126** for balancing converter **100** about axis **128**.

[0016] Converter **100** includes turbine **130** with a plurality of turbine blades **132**, core ring **133**, and shell **134**. Shell **134** is generally thicker than typical turbine shells to withstand pressure forces as described below. In an example embodiment, blades **132** include tabs (not shown) installed in indented slots **136** of shell **134**. In an example embodiment, blades **132** are fixed to the shell by brazing. Shell **134** includes radial wall **138** disposed radially outside of blades **132**. Wall **138** is arranged to frictionally engage wall **116**. That is, upon application of a pressure force to shell **134** in direction **140**, wall **138** is pressed against wall **116** so that torque received by shell **108** through cover **118** from the engine (not shown) is transmitted directly to turbine shell **134**, bypassing the fluid circuit partially formed by blades **106** and **132**. Walls **116** and **138** may be jointly referred to as a lockup clutch.

[0017] In an example embodiment, wall **138** includes friction material ring **142** for improved frictional performance. Ring **142** prevents metal-on-metal contact between walls **116**

and **138**, reducing contamination produced by the frictional engagement. Friction characteristics of ring **142** may further improve the engagement by increasing a friction coefficient between the clutch components or altering the friction coefficient gradient so that the clutch is more controllable and does not shudder. Although ring **142** is shown fixed to wall **138**, other embodiments (not shown) may include ring **142** fixed to wall **116**.

[0018] Converter **100** includes stator assembly **144** with housing **146**, one way clutch outer race **148** press-fit into housing **146**, inner race **150**, and roller **152**, and side plate **154**. In an example embodiment, the lockup clutch is axially aligned with the stator assembly. Side plate **154** axially retains the one-way clutch components within housing **146**. Thrust bearing **156** operates between housing **146** and shell **108**. In an example embodiment, release spring **158** is disposed between turbine shell **134** and stator assembly **144**, specifically side plate **154**, to urge turbine **130** away from impeller **104**. Release spring **158** may be a diaphragm spring, for example. Side plate **154** includes tab **160** and spring **158** includes tab **162** engaged with tab **160** for rotationally fixing the spring relative to the side plate.

[0019] Converter **100** includes damper assembly **164** with spring retainer **166**, spring **168**, drive plate **170**, and flange **172**. In an example embodiment, drive plate **170** is fixed to flange **172** by rivet **174**. In an example embodiment, damper spring retainer **166** is fixed to turbine shell **134** by weld **176**, for example, and damper spring **168** is disposed in the spring retainer. By disposed in, we mean the the spring retainer at least partially surrounds and retains the spring. In an example embodiment, the damper spring is radially aligned with the lockup clutch.

[0020] Damper flange **172** is arranged for driving and sealing engagement with a transmission input shaft at spline **178** and seal **180**, for example. Turbine shell **134** is sealed to flange **172** at seal **182**. That is, flange **172** includes groove **184** for receiving seal **182** and shell **134** includes cylindrical protrusion **186** engaged with the seal, effectively sealing the shell to the input shaft through seals **180** and **182**, and flange **172**.

[0021] In some embodiments, flange **172** includes thrust plate **188** axially disposed between the flange and the turbine shell for transferring a thrust load from the turbine shell to the cover. That is, thrust from turbine **130** is reacted by plate **188** to cover **118**. Thrust plate **188** may be integral with drive plate **170** and includes tab **190** engaged with spring **168**. In an example embodiment, the thrust plate includes friction material ring **192** and the flange includes

friction material ring **194**. The rings prevent steel-on-steel contact to reduce contamination as described for ring **142** above. Although rings **192** and **194** are shown fixed to the thrust plate and flange, respectively, ring **192** may be fixed to shell **134** and ring **194** may be fixed to cover **118**.

[0022] The following description is made with reference to Figure 3. Figure 3 is a top half cross section view of torque converter **200** with turbine piston **202**. In general, the description of torque converter **100** above is applicable to torque converter **200** by replacing **1XX** reference numerals with **2XX** reference numerals considering the exceptions noted below. Flange **172** extends radially outward for driving engagement with spring **269**. Drive plate **270** is engaged with spring **268** at tab **290** and fixed to cover plate **271** via rivet **275**. Plates **270** and **271** are drivingly engaged with spring **269** so that torque from shell **234** is transmitted to flange **272** through retainer **266**, spring **268**, plates **270** and **271**, and spring **269**.

[0023] The following description is made with reference to Figure 4. Figure 4 is a top half cross section view of torque converter **300** with turbine piston **302**. In general, the description of torque converter **100** above is applicable to torque converter **300** by replacing **1XX** reference numerals with **2XX** reference numerals considering the exceptions noted below. Torque converter **300** includes damper spring retainer **367** arranged for driving engagement with a transmission input shaft (not shown) and damper spring **368** disposed in the spring retainer. In an example embodiment, damper hub **373** is fixed to retainer **367** by compressive engagement. That is, hub **373** and retainer **367** are fixed together using the method described in commonly-assigned pending United States Provisional Patent Application No. 61/548,424, hereby incorporated by reference as if set forth fully herein.

[0024] Hub **373** includes spline **379** for driving engagement with the transmission input shaft and friction material rings **393** and **395**. Together hub **373** and rings **393** and **395** provide a thrust path to the cover similar to flange **172**, plate **188**, and rings **192** and **194** in Figure 2. Spring **158** is replaced by friction material ring **359** so that shell **335** is released by a pressure force acting in direction **341**, opposite direction **340**, alone. Ring **359** prevents steel-on-steel contact between the shell and side plate **354** during a clutch engaged condition when shell **335** is urged in direction **340** or when stator **345** thrusts towards shell **335** in direction **341**. In an example embodiment, bearing **156** is replaced by friction material ring **357** to prevent direct

contact between aluminum stator housing **347** and steel impeller shell **108**. Ring **357** may be fixed to shell **308** or housing **347**, though it is likely easier to bond to the steel housing.

[0025] Turbine shell **335** includes axial tab **391** engaged with the damper spring. Tab **391** is radially aligned with radial wall **338**. That is, radius **R1** of tab **391** is between inner radius **R2** and outer radius **R3** of wall **338**. Turbine shell **335** includes bushing **396** arranged for sealing engagement with the transmission input shaft. That is, instead of sealing through a flange as described in the example embodiments shown in Figures 2 and 3, shell **335** is directly sealed to the input shaft through bushing **396**.

[0026] The following description is made with reference to Figure 5. Figure 5 is a top half cross section view of torque converter **400** with turbine piston **402**. In general, the description of torque converter **300** above is applicable to torque converter **400** by replacing **3XX** reference numerals with **4XX** reference numerals considering the exceptions noted below. Converter **400** includes stator assembly **449** with housing **441**, wedge one-way clutch outer race **449**, inner race **451**, and wedge plates **453**, and side plate **455**. Races **449** and **451** and plates **453** may be components of a friction one-way clutch as described in commonly-assigned United States Patent Application Publication No. 2009/0159390, hereby incorporated by reference as if set forth fully herein. Friction material ring **457** may be fixed to plate **455** or shell **408**. Ring **459** prevents contact between shell **435** and housing **441** during a clutch engaged condition when shell **435** is urged in direction **440** or when stator **449** thrusts towards shell **435** in direction **441**.

[0027] Of course, changes and modifications to the above examples of the invention should be readily apparent to those having ordinary skill in the art, without departing from the spirit or scope of the invention as claimed. Although the invention is described by reference to specific preferred and/or example embodiments, it is clear that variations can be made without departing from the scope or spirit of the invention as claimed.

CLAIMS

What We Claim Is:

1. A torque converter comprising:

an impeller comprising:

a plurality of impeller blades, and;

a shell with a radial wall disposed radially outside of the blades

a cover fixed to the impeller shell to form a housing; and,

a turbine comprising:

a plurality of turbine blades, and;

a shell with a radial wall disposed radially outside of the turbine blades and arranged to frictionally engage the impeller shell radial wall.

2. The torque converter of claim 1 wherein the turbine shell includes indented slots and the turbine blades include tabs disposed in the slots.

3. The torque converter of claim 2 wherein the turbine blades are fixed to the turbine shell by brazing.

4. The torque converter of claim 1 wherein the impeller shell radial wall or the turbine shell radial wall includes a friction material ring for frictional engagement with the other of the impeller shell radial wall or the turbine shell radial wall.

5. The torque converter of claim 1 further comprising:

a stator assembly; and,

a release spring disposed between the turbine shell and the stator assembly to urge the turbine away from the impeller.

6. The torque converter of claim 1 further comprising a damper spring retainer fixed to the turbine shell and a damper spring disposed in the spring retainer.

7. The torque converter of claim 1 further comprising a damper flange arranged for driving and sealing engagement with a transmission input shaft, wherein the turbine shell is sealed to the damper flange.

8. The torque converter of claim 7 wherein the damper flange comprises a thrust plate axially disposed between the flange and the turbine shell for transferring a thrust load from the turbine shell to the cover.

9. The torque converter of claim 8 wherein the thrust plate or the turbine shell comprises a friction material ring and the flange or the cover comprises a friction material ring.

10. The torque converter of claim 8 wherein the thrust plate includes a tab drivingly engaged with the damper spring.

11. The torque converter of claim 1 further comprising a damper spring retainer arranged for driving engagement with a transmission input shaft and a damper spring disposed in the spring retainer, wherein the turbine shell includes an axial tab engaged with the damper spring.

12. The torque converter of claim 11 wherein the axial tab is radially aligned with the turbine shell radial wall.

13. The torque converter of claim 11 further comprising a damper hub fixed to the spring retainer by compressive engagement.

14. The torque converter of claim 1 further comprising a turbine shell bushing arranged for sealing engagement with a transmission input shaft.

15. A torque converter assembly comprising:
a torus portion including an impeller, a turbine, and a stator; and,
a lockup clutch for connecting the impeller and the turbine axially aligned with the stator.

16. The torque converter of claim 15 wherein the lockup clutch is disposed radially outside of the torus portion.

17. The torque converter of claim 16 wherein the lockup clutch comprises respective impeller and turbine radial walls.

18. The torque converter of claim 15 further comprising a damper with a damper spring radially aligned and axially offset from the lockup clutch.

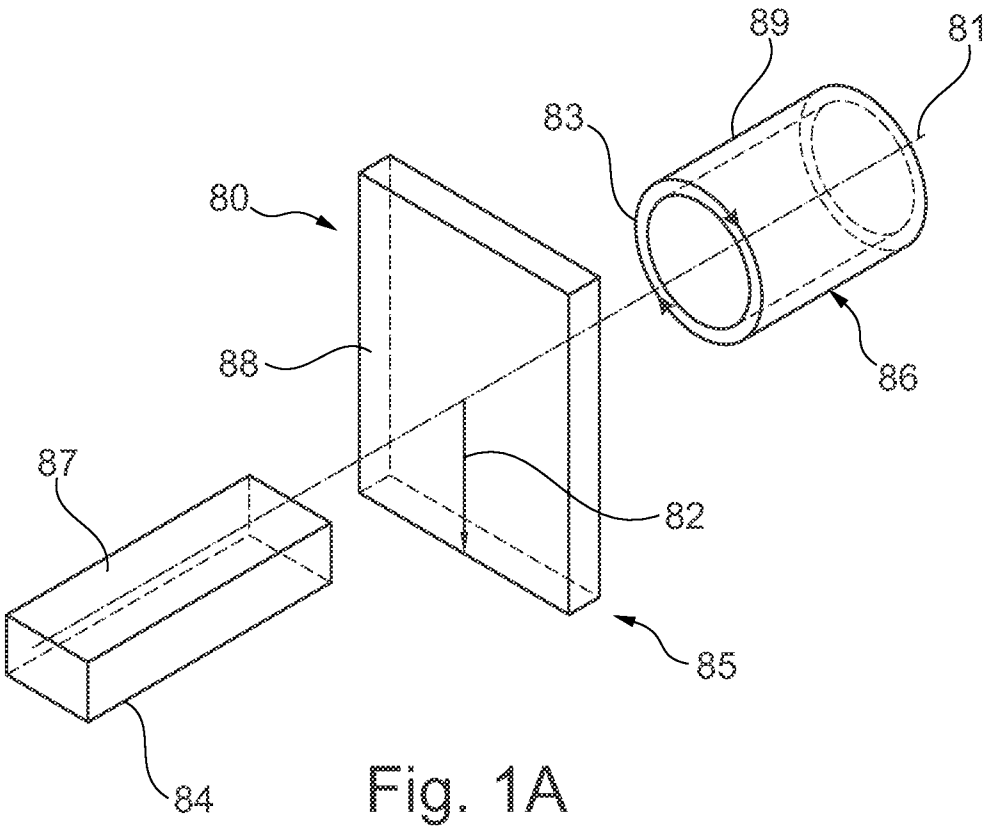

Fig. 1A

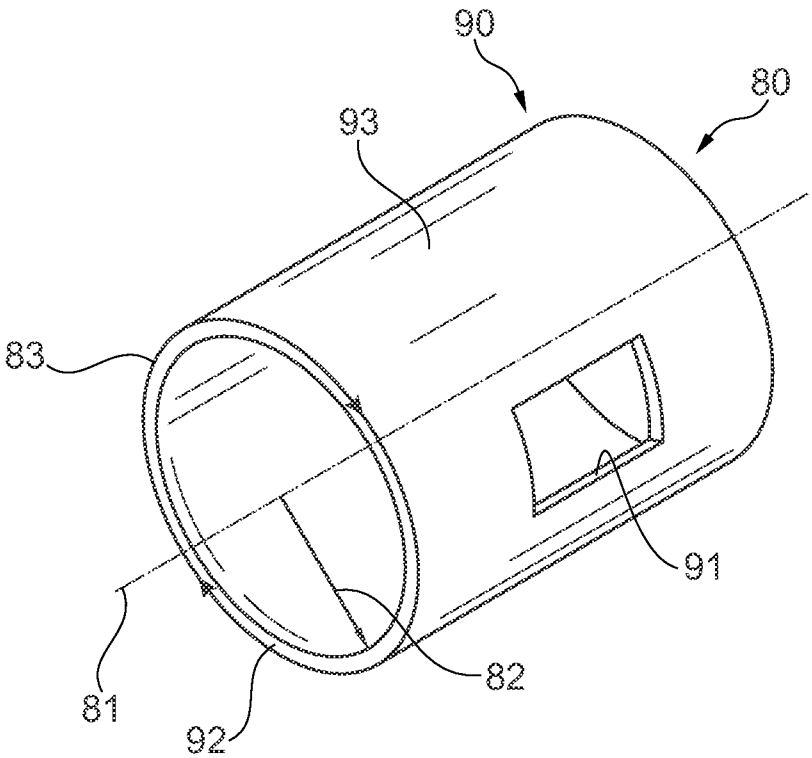

Fig. 1B

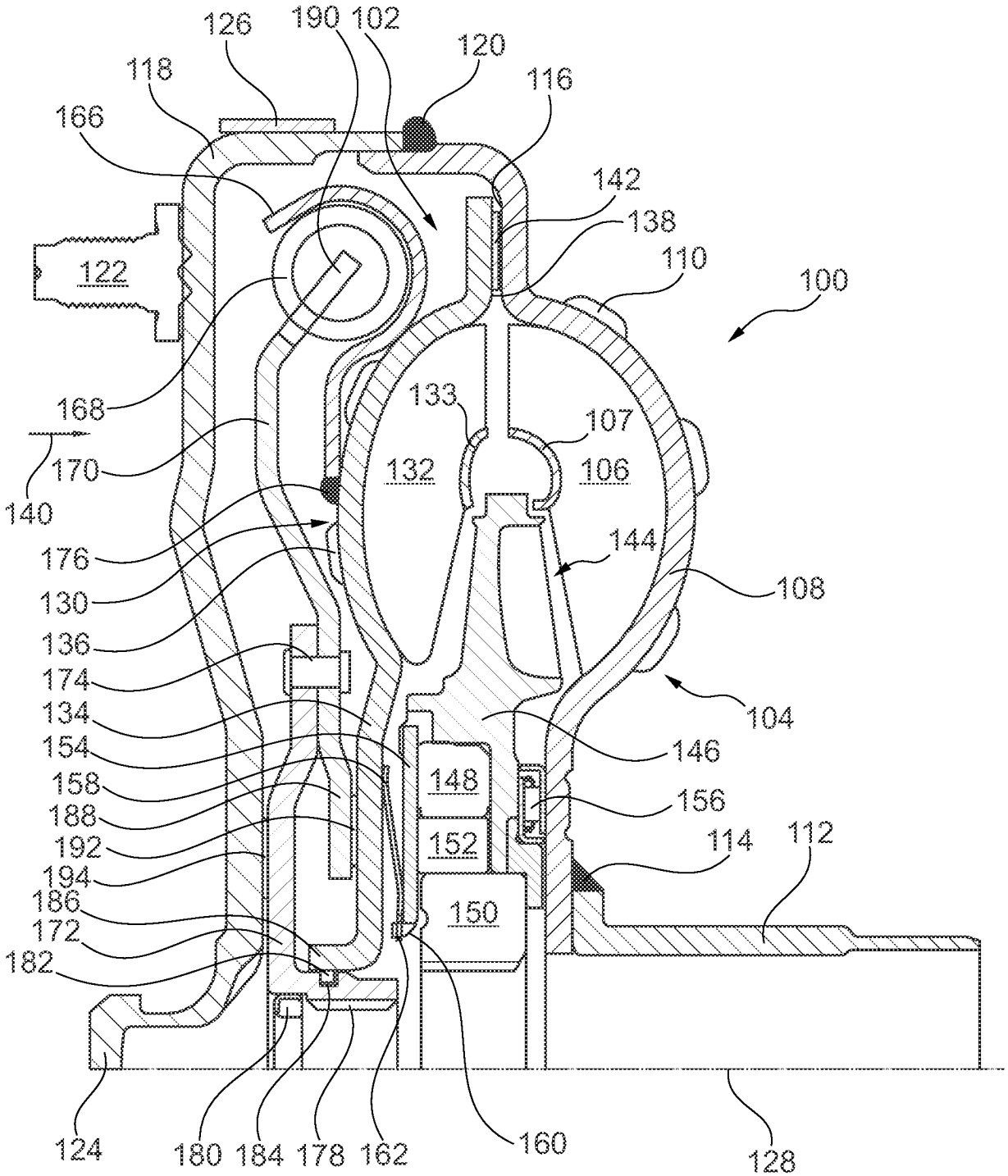
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Fig. 2

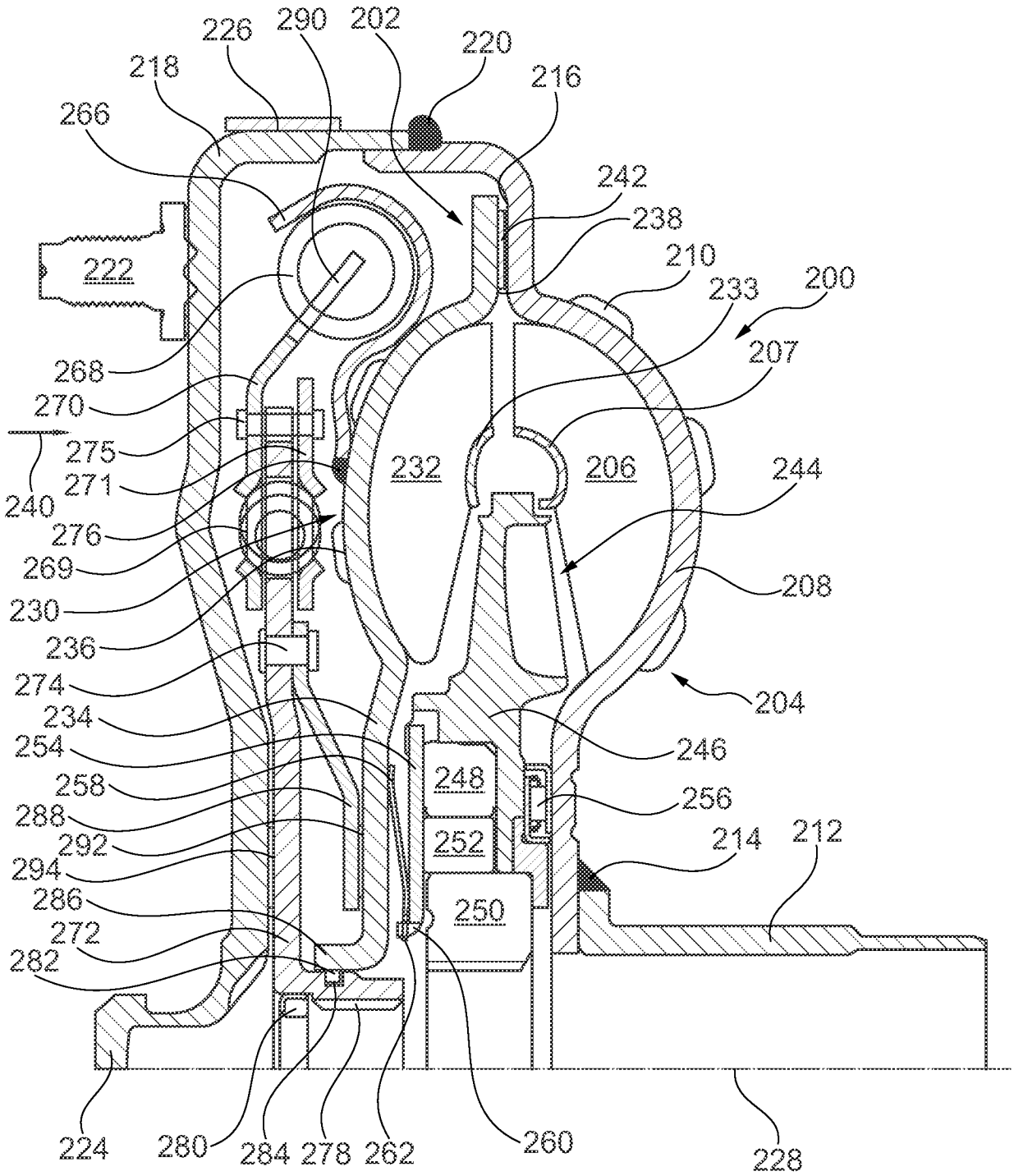
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Fig. 3

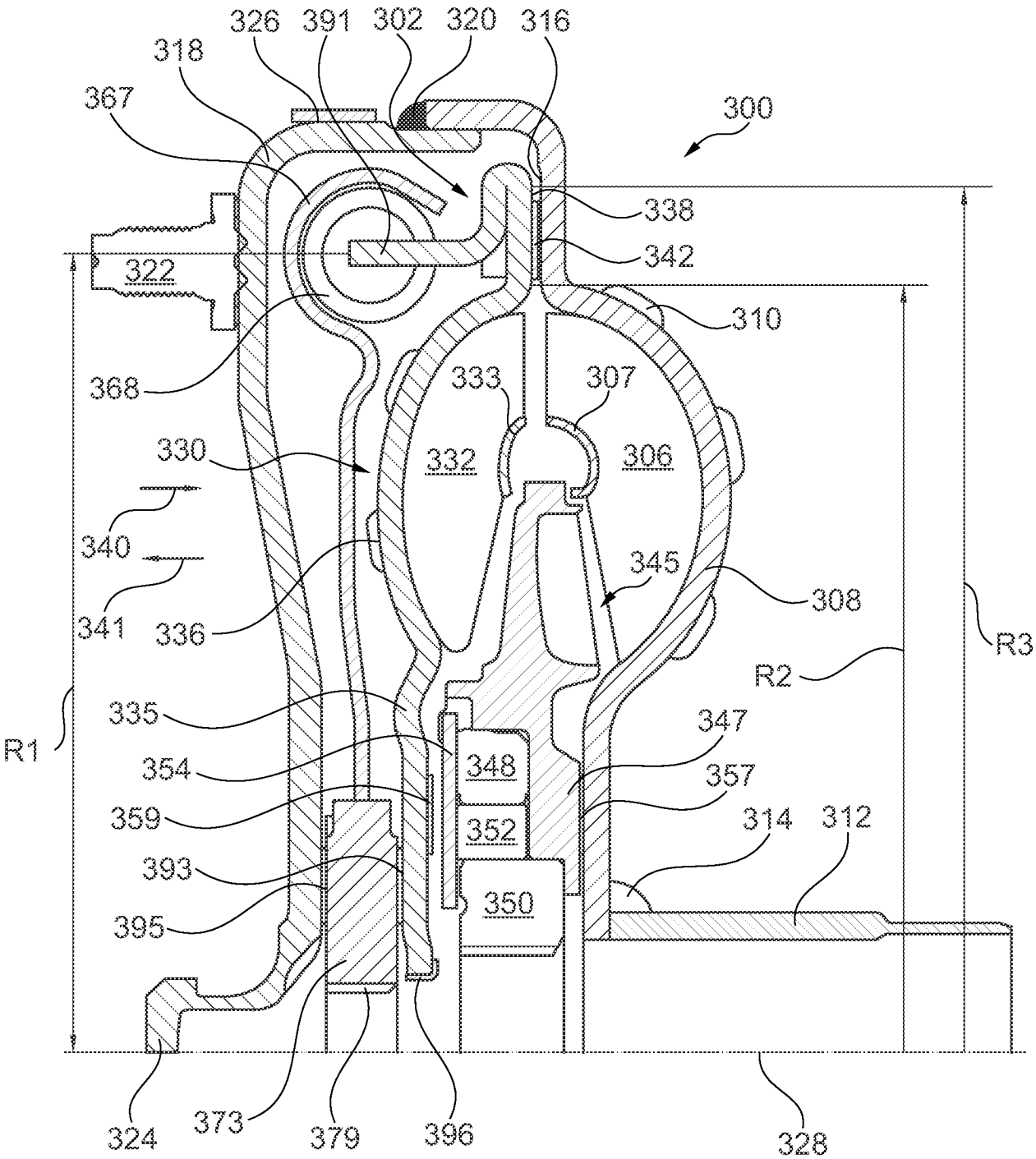
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Fig. 4

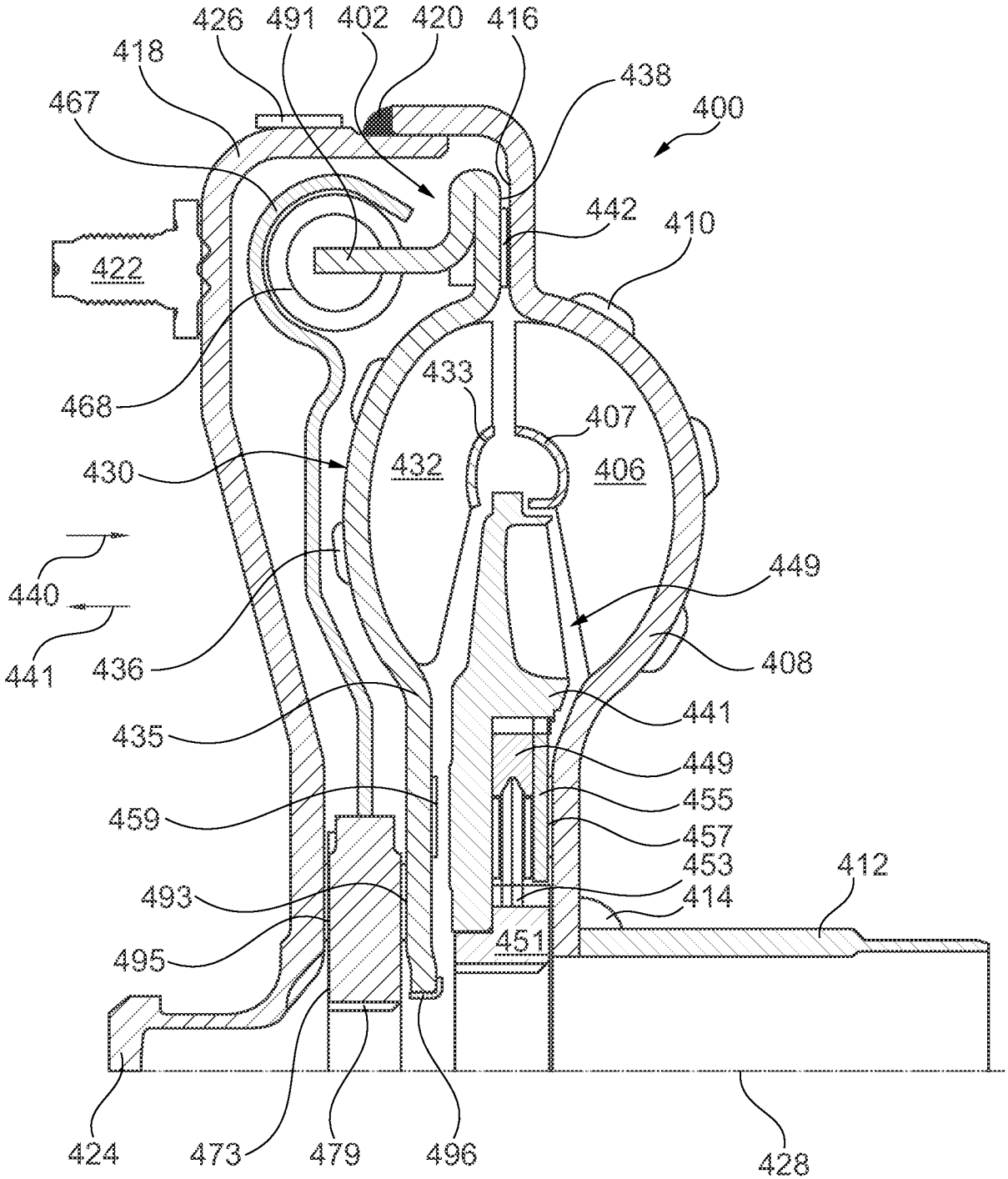
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Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/027637

A. CLASSIFICATION OF SUBJECT MATTER

F16H 41/24(2006.01)i, F16F 15/12(2006.01)i, F16H 45/02(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)
F16D 33/00; F16D 13/18; F16H 45/02; F16H 41/24

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: torque converter, friction ring, turbine radial wall, impeller radial wall, and engage

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012-0043173 A1 (JAMESON et al.) 23 February 2012 See paragraphs [0022]-[0025]; figure 2.	1-18
A	US 6,494,303 B1 (REIK et al.) 17 December 2002 See column 3 lines 18-27; column 4 lines 14-37; figure 1.	1-18
A	KR 10-082206 B1 (HYUNDAI MOTOR COMPANY) 07 April 2008 See paragraphs -; figure 2.	1-18
A	US 7,883,322 B2 (WANG et al.) 08 February 2011 See column 3 lines 6-51; figure 1.	1-18
A	US 5,195,621 A (DULL et al.) 23 March 1993 See column 4 lines 24-43; figure 1.	1-18

☐ 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
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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
14 June 2013 (14.06.2013)	**14 June 2013 (14.06.2013)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/027637

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