(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 June 2016 (09.06.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/089591 A1

(51) International Patent Classification:
F16H 45/02 (2006.01) *F16H 41/24* (2006.01)

(21) International Application Number:
PCT/US2015/061021

(22) International Filing Date:
17 November 2015 (17.11.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/086,465 2 December 2014 (02.12.2014) US

(71) Applicants: **SCHAEFFLER TECHNOLOGIES AG & CO. KG** [DE/DE]; Industriestrasse 1-3, 91074 Herzogenaurach (DE). **SCHAEFFLER GROUP USA, INC.** [US/US]; 308 Springhill Farm Road, Fort Mill, South Carolina 29715 (US).

(72) Inventor: **LINDEMANN, Patrick**; 4400 Woodlake Trail, Wooster, Ohio 44691 (US).

(74) Agent: **PARKS, Kevin**; Schaeffler Group USA, Inc., 1750 E. Big Beaver Road, Troy, Michigan 48843 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,

[Continued on next page]

(54) Title: NORMALLY ENGAGED TURBINE CLUTCH

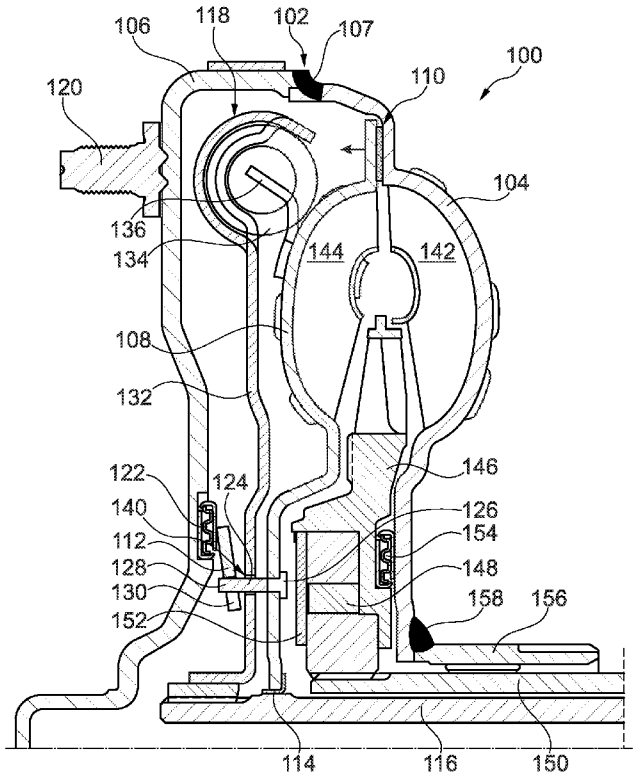


Fig. 1

(57) Abstract: A torque converter includes a housing, a turbine shell, and a spring. The housing includes an impeller shell and a cover. The turbine shell includes a clutch portion. The spring is disposed axially between the cover and the turbine shell, and is arranged for urging the turbine clutch portion into driving engagement with the impeller shell. In an example embodiment, the spring is a diaphragm spring. In an example embodiment, the turbine shell is arranged for sealing to and driving engagement with a transmission input shaft. In some example embodiments, the torque converter includes a bearing disposed axially between the cover and the turbine shell, and arranged for rotationally disconnecting the spring from the cover. In an example embodiment, the bearing is a ball bearing or a needle roller bearing.

WO 2016/089591 A1

LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

NORMALLY ENGAGED TURBINE CLUTCH

FIELD

[0001] The invention relates generally to a turbine clutch, and more specifically to a normally engaged turbine clutch.

BACKGROUND

[0002] It is known to use a spring to engage an impeller clutch as shown and described in commonly assigned United States Patent Application Serial No. 14/458,851, for example, hereby incorporated by reference as if set forth fully herein. It is also known to use a single pressure chamber to apply an impeller clutch and a torque converter clutch, keeping the torque converter clutch disengaged by a spring during torque converter operation, as shown and described in commonly assigned United States Patent No. 8,607,948 and United States Patent Application Publication No. 2013/0140122, for example, both hereby incorporated by reference as if set forth fully herein.

BRIEF SUMMARY

[0003] Example aspects broadly comprise a torque converter including a housing, a turbine shell, and a spring. The housing includes an impeller shell and a cover. The turbine shell includes a clutch portion. The spring is disposed axially between the cover and the turbine shell, and is arranged for urging the turbine clutch portion into driving engagement with the impeller shell. In an example embodiment, the spring is a diaphragm spring. In an example embodiment, the turbine shell is arranged for sealing to and driving engagement with a transmission input shaft. In some example embodiments, the torque converter includes a bearing disposed axially between the cover and the turbine shell, and arranged for rotationally disconnecting the spring from the cover. In an example embodiment, the bearing is a ball bearing or a needle roller bearing.

[0004] In some example embodiments, the torque converter has a drive ring fixed to the turbine shell. In an example embodiment, the drive ring is drivingly engaged with the spring or an output hub. In an example embodiment, the spring is arranged for urging the drive ring towards the impeller shell. In some example embodiments, the torque converter has a damper drivingly engaged with the turbine shell and arranged for driving connection to a transmission input shaft. The damper includes a damper plate and the drive ring includes an axial protrusion extending through the damper plate. In an example embodiment, the damper plate includes a

slot and the drive ring axial protrusion is at least partially rotationally displaceable within the damper plate slot.

[0005] In an example embodiment, the torque converter has respective pluralities of blades fixed to the impeller shell and the turbine shell. In an example embodiment, the torque converter has a thrust plate fixed to the impeller shell, a first clutch plate drivingly engaged with the turbine shell, and a second clutch plate drivingly engaged with the thrust plate.

[0006] Other example aspects broadly comprise a torque converter including an impeller fixed to a cover housing, a turbine arranged for driving engagement with a transmission input shaft, and a first resilient element compressed between the cover housing and the turbine shell. In an example embodiment, the turbine shell is arranged for sealing to a transmission input shaft. In an example embodiment, the torque converter has a bearing or bushing for rotationally disconnecting the resilient element from the cover housing or the turbine shell. In some example embodiments, the torque converter has a damper. The damper includes a drive tab fixed to the turbine shell, a spring retainer arranged for driving engagement with a transmission input shaft, and a second resilient element for transmitting torque between the drive tab and the spring retainer. In an example embodiment, the first resilient element is disposed axially between the cover housing and the spring retainer and the second resilient element is disposed radially outside of the first resilient element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] 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 1 is a cross-section view of a torque converter with a normally engaged turbine clutch according to an example aspect;

Figure 2 is a cross-section view of a torque converter with a normally engaged turbine clutch according to an example aspect.

.

DETAILED DESCRIPTION

[0008] 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.

[0009] 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.

[0010] The following description is made with reference to Figure 1. Figure 1 is a cross section view of torque converter 100 including a normally engaged turbine clutch according to an example aspect. Torque converter 100 includes housing 102 with impeller shell 104 fixed to cover 106 at weld 107, for example, turbine shell 108 with clutch portion 110, and spring, or resilient element, 112. In an example embodiment, spring 112 is a diaphragm spring. Spring 112 is disposed axially between cover 106 and turbine shell 108.

[0011] The spring is arranged for urging the turbine clutch portion into driving engagement with the impeller shell. That is, when installed in the torque converter, the spring is compressed between the cover housing and the turbine shell, and exerts a spring force which acts against the turbine shell to close the turbine clutch. The turbine clutch may be released using hydraulic pressure acting on the turbine shell to overcome the spring force, axially displacing the turbine shell and opening the turbine clutch so that the torque converter operates in a fluid circuit mode as is known in the art.

[0012] Turbine shell 108 is arranged for sealing to and driving engagement with transmission input shaft 116. That is, turbine shell 108 includes bushing or seal 114 that seals to input shaft 116 after installation with a transmission (not shown). Turbine shell 108 is drivingly engaged with the input shaft through damper 118 as will be described in further detail below.

[0013] Torque converter 100 may be drivingly connected to a prime mover, such as a vehicle engine, at studs 120, and the transmission at input shaft 116, for example, and installed in a vehicle (not shown). Torque converter 100 includes bearing, or bushing, 122 disposed axially between the cover and the turbine shell. Bearing 122 is arranged for rotationally disconnecting the spring from the cover. That is, the bearing permits relative rotational motion between the

spring and the cover without friction or drag. In other words, when the cover is rotating and the turbine is not, when the vehicle is stopped at a traffic light, for example, bearing 122 permits the cover to spin and the spring to remain stationary without drag or wear in either component. Bearing 122 may be a ball bearing or a needle roller bearing, as shown in Figure 1, for example.

[0014] Torque converter 100 includes drive ring 124 fixed to turbine shell 108 at integral expanded portion 126, for example. Ring 124 is drivingly engaged with spring 112 at respective protrusions, or tabs, 128 and 130. Spring 112 is arranged for urging the drive ring towards the impeller shell. That is, spring tab 130 is presses against ring 124 which, in turn, pulls the turbine shell towards the impeller via fixed connection 126.

[0015] Damper 118 includes damper plate, or spring retainer, 132, spring, or resilient element, 134, and drive tab 136 fixed to the turbine shell. Damper 118 is drivingly engaged with the turbine shell at tab 136 and arranged for driving connection to a transmission input shaft through plate 132 fixed to splined hub 138. Resilient element 134 is for transmitting torque between the drive tab and the spring retainer. Resilient element 134 is disposed radially outside of resilient element 112. Drive ring axial protrusion 128 extends through the damper plate. That is, damper plate 132 includes slot 140 and the drive ring protrusion is at least partially rotationally displaceable within the damper plate slot.

[0016] Torque converter 100 includes respective pluralities of blades 142 and 144 fixed to the impeller shell and the turbine shell. Torque converter 100 further includes stator 146 with one way clutch 148, arranged for installation on transmission stator shaft 150, and side plate 152. Converter 100 further includes bearing 154 and hub 156 is fixed to the impeller shell by weld 158.

[0017] The following description is made with reference to Figure 2. Figure 2 is a cross section view of torque converter 200 including a normally engaged turbine clutch according to an example aspect. Torque converter 200 includes housing 202 with impeller shell 204 fixed to cover 206 at fastener 207, for example, turbine shell 208 with clutch portion 210, and spring, or resilient element, 212. In an example embodiment, spring 212 is a plurality of diaphragm springs. Spring 212 is disposed axially between cover 206 and turbine shell 208.

[0018] The spring is arranged for urging the turbine clutch portion into driving engagement with the impeller shell. That is, when installed in the torque converter, the spring is compressed between the cover housing and the turbine shell, and exerts a spring force which acts

against the turbine shell to close the turbine clutch. The turbine clutch may be released using hydraulic pressure acting on the turbine shell to overcome the spring force, axially displacing the turbine shell and opening the turbine clutch so that the torque converter operates in a fluid circuit mode as is known in the art.

[0019] Turbine shell 208 is arranged for sealing to and driving engagement with a transmission input shaft (not shown). That is, turbine shell 208 includes bushing or seal 214 that seals to the input shaft after installation with a transmission (not shown). Turbine shell 208 is drivingly engaged with the input shaft through output hub 218 as will be described in further detail below.

[0020] Torque converter 200 may be drivingly connected to a prime mover, such as a vehicle engine, at studs 220, and the transmission at the input shaft, for example, and installed in a vehicle (not shown). Torque converter 200 includes bearing, or bushing, 222 disposed axially between the cover and the turbine shell. Bearing 222 is arranged for rotationally disconnecting the spring from the cover. That is, the bearing permits relative rotational motion between the spring and the cover without friction or drag. In other words, when the cover is rotating and the turbine is not, when the vehicle is stopped at a traffic light, for example, bearing 222 permits the cover to spin and the spring to remain stationary without drag or wear in either component. Bearing 222 may be a ball bearing as shown in Figure 2, or a needle roller bearing, for example.

[0021] Torque converter 200 includes drive ring 224 fixed to turbine shell 208 at rivet 226, for example. Ring 224 is drivingly engaged with output hub 218 at respective protrusions, or tabs, 228 and 230. Spring 212 is arranged for urging the drive ring towards the impeller shell. That is, spring 212 presses against ring 224 which, in turn, pushes the turbine shell towards the impeller.

[0022] Torque converter 200 includes respective pluralities of blades 242 and 244 fixed to the impeller shell and the turbine shell. Torque converter 200 further includes stator 246 with one way clutch 248, arranged for installation on a transmission stator shaft (not shown), and side plate 252. Converter 200 further includes bearing 254 and hub 256 is fixed to the impeller shell by weld 258. Torque converter 200 includes thrust plate 260 fixed to the impeller shell via fastener 262, clutch plate 264 drivingly engaged with the turbine shell, and clutch plate 266 drivingly engaged with the thrust plate. The clutch plates are attached via respective tabs installed in complementary slots in the turbine shell and thrust plates.

[0023] 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 I Claim Is:

1. A torque converter comprising:
a housing comprising an impeller shell and a cover;
a turbine shell including a clutch portion; and,
a spring:
disposed axially between the cover and the turbine shell; and,
arranged for urging the turbine clutch portion into driving engagement with the impeller shell.

2. The torque converter of claim 1, wherein the spring is a diaphragm spring.

3. The torque converter of claim 1, wherein the turbine shell is arranged for sealing to and driving engagement with a transmission input shaft.

4. The torque converter of claim 1 further comprising a bearing:
disposed axially between the cover and the turbine shell; and,
arranged for rotationally disconnecting the spring from the cover.

5. The torque converter of claim 1 further comprising a drive ring fixed to the turbine shell.

6. The torque converter of claim 1 further comprising:
a thrust plate fixed to the impeller shell;
a first clutch plate drivingly engaged with the turbine shell; and,
a second clutch plate drivingly engaged with the thrust plate.

7. A torque converter comprising:
an impeller fixed to a cover housing;
a turbine arranged for driving engagement with a transmission input shaft; and,
a first resilient element compressed between the cover housing and the turbine shell.

8. The torque converter of claim 7 wherein the turbine shell is arranged for sealing to a transmission input shaft.

9. The torque converter of claim 7 further comprising a bearing or bushing for rotationally disconnecting the resilient element from the cover housing or the turbine shell.

10. The torque converter of claim 7 further comprising a damper, the damper comprising:
a drive tab fixed to the turbine shell;
a spring retainer arranged for driving engagement with a transmission input shaft; and,
a second resilient element for transmitting torque between the drive tab and the spring retainer.

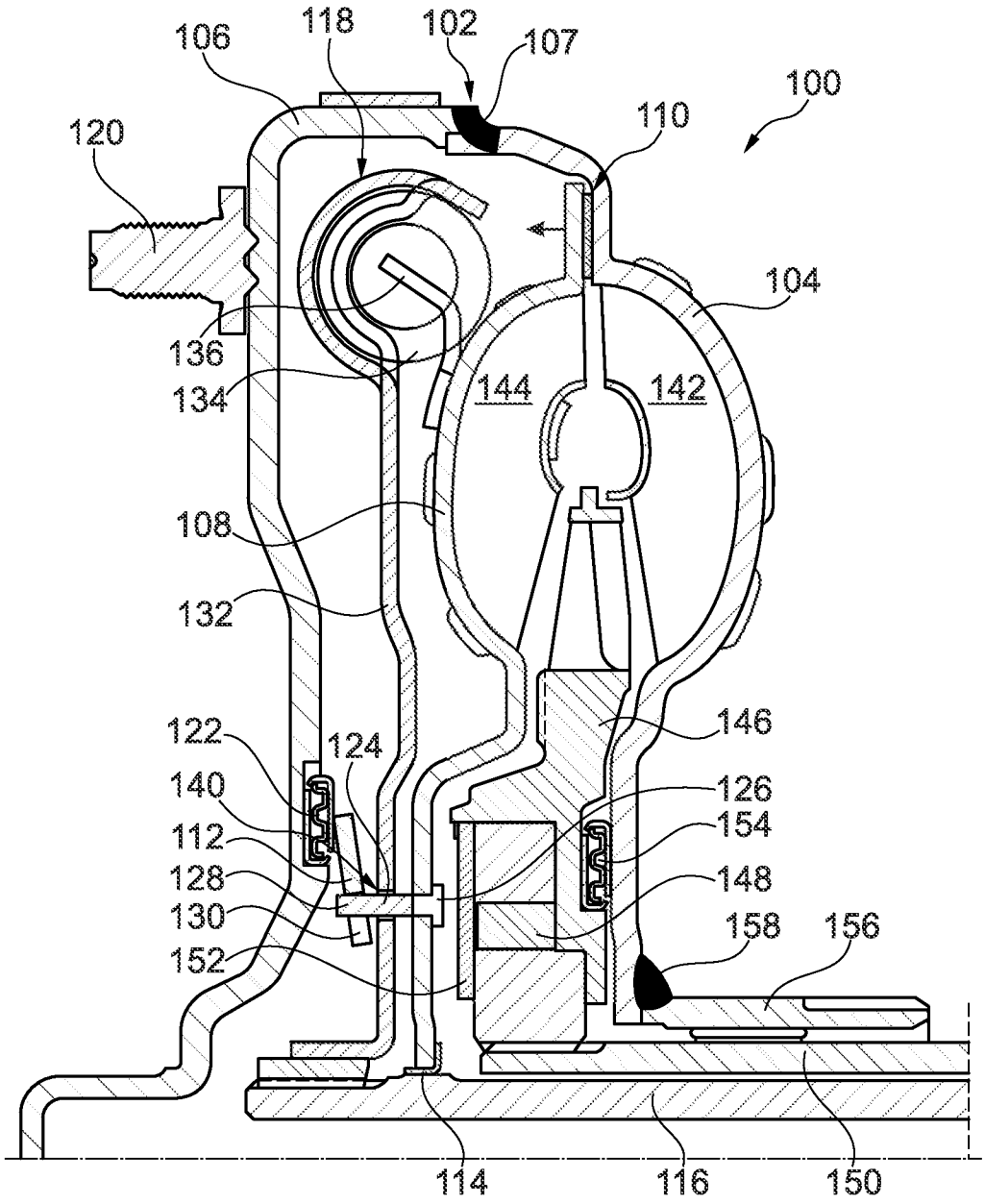

106
118
102
107
100
110
120
104
136
134
144
142
108
132
122
124
146
140
126
112
154
128
148
130
158
156
152
114
116
150

Fig. 1

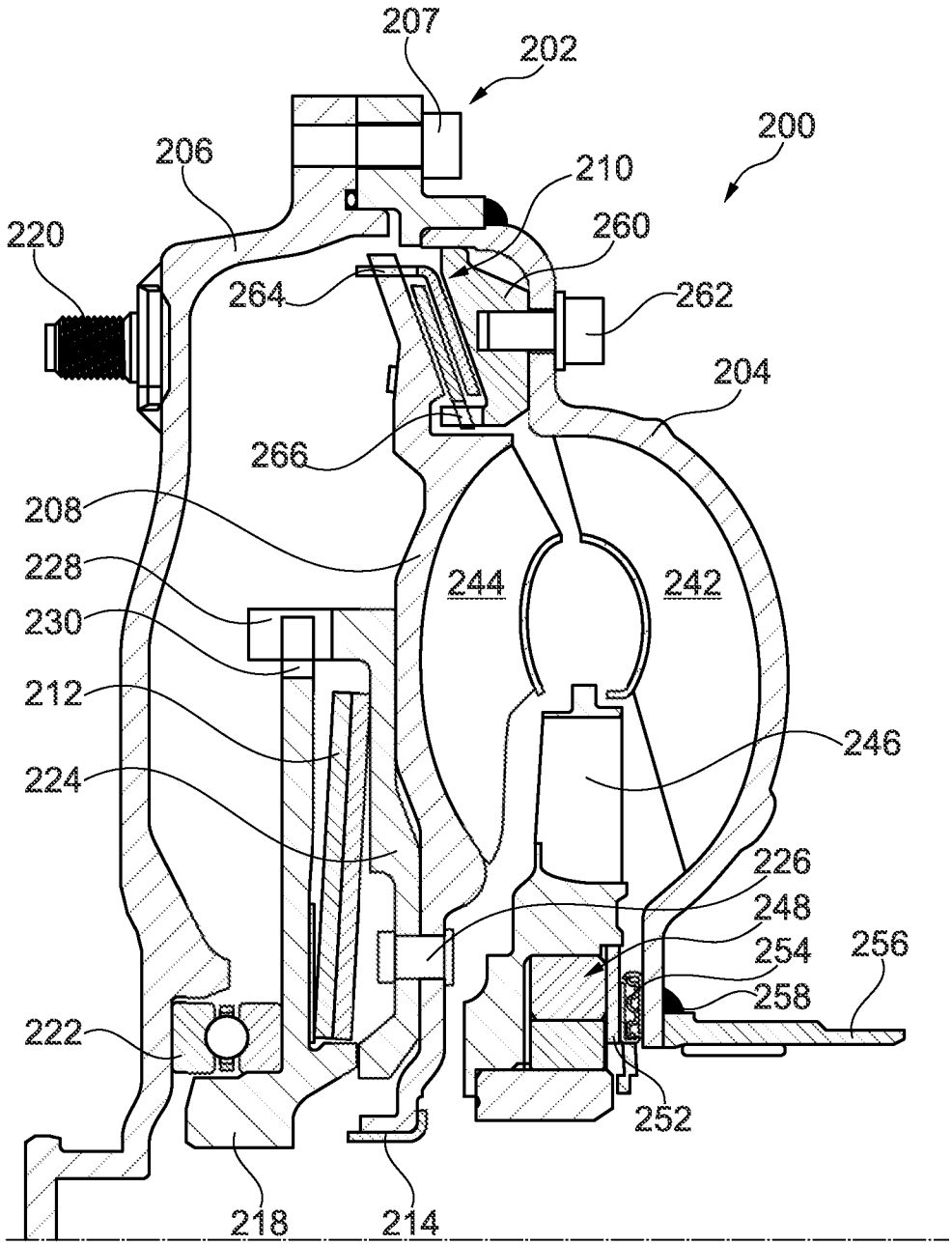

207
202
200
206
210
220
260
264
262
204
266
208
228
244
242
230
212
246
224
226
248
254
256
258
222
252
218
214

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/061021

A. CLASSIFICATION OF SUBJECT MATTER

F16H 45/02(2006.01)i, F16H 41/24(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)
F16H 45/02; F16D 33/18; F16D 43/14; F16H 41/18; F16D 33/08; F16D 33/06; 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: turbine, impeller, lockup clutch, bearing, spring, and torque converter

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013-0230385 A1 (LINDEMANN et al.) 05 September 2013 See paragraphs [0020]-[0032] and figure 2.	1-10
Y	US 2008-0078638 A1 (DEGLER et al.) 03 April 2008 See paragraphs [0039]-[0043], claim 13 and figures 2, 4a.	1-10
A	US 2009-0014269 A1 (ARI et al.) 15 January 2009 See paragraphs [0048]-[0056] and figure 8.	1-10
A	JP 09-100894 A (TOYOTA MOTOR CORP.) 15 April 1997 See paragraphs [0007]-[0013] and figure 1.	1-10
A	US 4113075 A (WALKER, FRANK H.) 12 September 1978 See abstract and figure 1.	1-10

☐ 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)
"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	Date of mailing of the international search report
26 January 2016 (26.01.2016)	**26 January 2016 (26.01.2016)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
KIM, Jin Ho
Telephone No. +82-42-481-8699

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2015/061021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0230385 A1	05/09/2013	CN 104583648 A	29/04/2015
		JP 2015-509579 A	30/03/2015
		KR 10-2015-0008847 A	23/01/2015
		WO 2013-130398 A1	06/09/2013
US 2008-0078638 A1	03/04/2008	DE 102007039856 A1	03/04/2008
		JP 05238961 B2	17/07/2013
		JP 2008-082552 A	10/04/2008
		US 7513346 B2	07/04/2009
US 2009-0014269 A1	15/01/2009	DE 102008031010 A1	15/01/2009
		JP 2009-019772 A	29/01/2009
		JP 5645354 B2	24/12/2014
		US 8348036 B2	08/01/2013
JP 09-100894 A	15/04/1997	EP 0769639 A2	23/04/1997
		EP 0769639 A3	02/05/1997
		KR 10-0205727 B1	01/07/1999
US 4113075 A	12/09/1978	None	