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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 August 2016 (18.08.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/130269 A1

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

(21) International Application Number:
PCT/US2016/013344

(22) International Filing Date:
14 January 2016 (14.01.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/113,966 9 February 2015 (09.02.2015) US

(71) Applicant *(for all designated States except US)*: **SCHAEFFLER TECHNOLOGIES AG & CO. KG** [DE/DE]; Industriestrasse 1-3, 91074 Herzogenaurach (DE).

(72) Inventors; and
(71) Applicants *(for US only)*: **AVINS, David** [US/US]; 52 West Britton Road, Burbank, Ohio 44214 (US). **CERRETA, Joshua** [US/CN]; 555 Nanchang Road, Room 2702, Block 2, Zuhui District, Shanghai, 200031 (CN).

(74) Agent: **PARKS, Kevin**; Schaeffler Group USA, 1750 E. Big Beaver Road, Troy, Michigan 48083 (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, 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))*

(54) **Title**: TURBINE PISTON

(57) **Abstract**: A torque converter includes a cover assembly, an impeller assembly, a turbine assembly and a damper assembly. The impeller assembly includes an impeller shell drivingly connected with the cover assembly. The turbine assembly includes a shell with a clutch portion for selective driving engagement with the impeller shell. The damper assembly includes at least one cover plate, a flange for driving engagement with a transmission input shaft, and a first resilient element drivingly engaged with the at least one cover plate and the flange. The torque converter has a second resilient element for urging the turbine assembly away from the cover assembly.

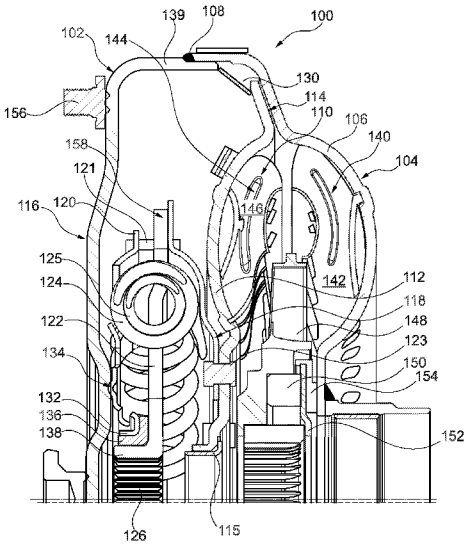


Fig. 1

WO 2016/130269 A1

TURBINE PISTON

FIELD

[0001] The invention relates generally to a turbine piston, and more specifically to a turbine piston preloaded against an impeller shell.

BACKGROUND

[0002] Turbine pistons are known. One example is shown in commonly-assigned United States Patent Publication No. 2013/0230385.

BRIEF SUMMARY

[0003] Example aspects broadly comprise a torque converter with a cover assembly, an impeller assembly, a turbine assembly and a damper assembly. The impeller assembly includes an impeller shell drivingly connected with the cover assembly. The turbine assembly includes a shell with a clutch portion for selective driving engagement with the impeller shell. The damper assembly includes at least one cover plate, a flange for driving engagement with a transmission input shaft, and a first resilient element drivingly engaged with the at least one cover plate and the flange. The torque converter has a second resilient element for urging the turbine assembly away from the cover assembly.

[0004] In some example embodiments, the at least one cover plate is fixed to the turbine shell and the resilient element urges the at least one cover plate away from the cover assembly. In some example embodiments, the cover assembly includes a centering plate and a bushing press-fitted into the centering plate. The flange includes a hub portion installed into the bushing and rotatable relative to the bushing. In some example embodiments, the second resilient element is a diaphragm spring disposed axially between the centering plate and the flange.

[0005] In an example embodiment, the bushing includes flanged portion with a first plurality of radial castellations and the diaphragm spring includes a second plurality of radial castellations drivingly engaged with the first plurality of radial castellations for preventing relative rotation between the diaphragm spring and the bushing. In an example embodiment, the torque converter has a hardened washer disposed axially between the diaphragm spring and the flange. In an example embodiment, the torque converter has a hardened washer disposed axially between the diaphragm spring and the bushing. The bushing includes a first annular portion and the flange includes a plurality of cutouts. The hardened washer has a second annular portion

matingly engaged with the bushing annular portion and a plurality of tabs installed in the flange cutouts for preventing relative rotation between the hardened washer and the flange.

[0006] In some example embodiments, the second resilient element is a diaphragm spring disposed axially between the cover plate and the flange. In an example embodiment, the at least one cover plate includes a radially inwardly extending portion and the diaphragm spring is disposed axially between the inwardly extending portion and the flange. In an example embodiment, the radially inwardly extending portion includes a plurality of first tabs and the diaphragm spring includes a plurality of second tabs engaged with the plurality of first tabs for preventing relative rotation between the diaphragm spring and the cover plate.

[0007] In some example embodiments, the second resilient element is disposed axially between the flange and the turbine shell. In an example embodiment, the second resilient element is fixed to the turbine shell. In an example embodiment, the torque converter has a thrust washer disposed axially between the at least one cover plate and the cover assembly.

[0008] Other example aspects broadly comprise a torque converter with an outer shell including a cover fixed to an impeller shell and a turbine shell including a clutch portion preloaded against the impeller shell. In an example embodiment, the impeller shell and the turbine shell comprise respective torus portions and the clutch portion is disposed radially outside of the torus portions. In an example embodiment, the torque converter has a stator disposed axially between the impeller shell and the turbine shell. In an example embodiment, the torque converter has a damper assembly disposed in a torque path between the turbine shell and a transmission input shaft. In some example embodiment, the cover shell is arranged for driving engagement with a prime mover. In an example embodiment, the turbine shell clutch portion is preloaded against the impeller shell by a resilient element. In an example embodiment, the resilient element reacts against the cover shell.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] 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 top half cross-section view of a torque converter according to an example aspect;

Figure 2 is a detail view of a torque converter showing an alternative embodiment;

Figure 3 is a perspective view of a bushing of the torque converter of Figure 2;

Figure 4 is a perspective view of a resilient element of the torque converter of Figure 2;

Figure 5 is a perspective view of the torque converter of Figure 2 with the flange removed for clarity;

Figure 6 is a detail view of a torque converter showing an alternative embodiment;

Figure 7 is a detail view of a torque converter showing an alternative embodiment;

Figure 8 is a detail view of a torque converter showing an alternative embodiment;

Figure 9 is a top half cross sectional view of a torque converter according to an example aspect.

DETAILED DESCRIPTION

[0010] 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.

[0011] 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.

[0012] The following description is made with reference to Figure 1. Figure 1 is a top half cross-section view of torque converter 100 according to an example aspect. Torque converter 100 includes cover assembly 102, impeller assembly 104 including impeller shell 106 drivingly connected with the cover assembly at weld 108, and turbine assembly 110 including shell 112 with clutch portion 114 for selective driving engagement with the impeller shell. Clutch portion 114 operates in a manner similar to that shown and described in commonly-assigned United States Patent Publication No. 2013/0230385, hereby incorporated by reference as if set forth fully herein. Turbine assembly 110 further includes bushing 115 for sealing engagement with a transmission input shaft (not shown).

[0013] Converter 100 also includes damper assembly 116 disposed in a torque path between the turbine shell and a transmission input shaft (not shown). The damper assembly includes cover plates 118 and 120 fixed together at rivet 121, flange 122, and resilient elements (i.e., coil springs) 124 and 125. Flange 122 is for driving engagement with a transmission input shaft (not shown) at spline portion 126, for example. Springs 124 and 125 are drivingly engaged with cover plates 118 and 120, and flange 122. That is, the springs transfer torque between the cover plates and flange. Cover plate 118 is fixed to the turbine shell at rivet 123.

[0014] Torque converter 100 further includes resilient element (i.e., diaphragm spring) 130 for urging turbine assembly 110 away from cover assembly 102. In other words, clutch portion 114 is preloaded against impeller shell 106. Cover assembly 102 includes centering plate 132, fixed to the cover assembly at projection weld 134, and bushing 136 press-fitted into the centering plate. That is, the bushing must be forcefully installed into the centering plate such that the two are fixed together. Flange 122 includes hub portion 138 installed into the bushing and rotatable relative to the bushing.

[0015] Cover assembly 102 includes outer shell 139. Impeller shell 106 and cover shell 139 form an outer shell for torque converter 100. Element 130 reacts against the cover shell. Impeller shell 106 includes torus portion 140 with blades 142. Turbine shell 112 includes torus portion 144 with blades 146. Clutch portion 114 is disposed radially outside of the torus portions. Stator 148 is disposed axially between the impeller shell and the turbine shell. Stator 148 includes one-way clutch assembly 150, side plate 152, and thrust washer, or hydrodynamic bearing, 154 fixed to the side plate. Cover shell 139 is arranged for driving engagement with a prime mover at stud 156, for example.

[0016] The following description is made with reference to Figures 1-5. Figure 2 is a detail view of torque converter 200 showing an alternative embodiment. Figure 3 is a perspective view of bushing 236 of Figure 2. Figure 4 is a perspective view of resilient element 230 of Figure 2. Figure 5 is a perspective view of torque converter 200 of Figure 2 with the flange removed for clarity. Resilient element 230 is a diaphragm spring disposed between centering plate 134 and flange 222. Element 230 urges flange 130 away from cover assembly 202. The flange urges the cover plate away from the cover through contact at portion 158 (ref. Figure 1). Bushing 236 includes flanged portion 260 with radial castellations 262. Diaphragm

spring 230 includes radial castellations 264 drivingly engaged with radial castellations 262 for preventing relative rotation between the diaphragm spring and the bushing.

[0017] The following description is made with reference to Figures 1-6. Figure 6 is a detail view of torque converter 300 showing an alternative embodiment. Torque converter 300 includes hardened washer 366 disposed axially between diaphragm spring 330 and flange 322.

[0018] The following description is made with reference to Figures 1-7. Figure 7 is a detail view of torque converter 400 showing an alternative embodiment. Torque converter 400 includes bushing 436, flange 422, and hardened washer 466 disposed axially between diaphragm spring 430 and bushing 436. The bushing includes annular portion 460 and the flange 422 includes cutouts 468. The hardened washer includes annular portion 470 matingly engaged with the bushing annular portion and tabs 472 installed in the flange cutouts for preventing relative rotation between the hardened washer and the flange.

[0019] The following description is made with reference to Figures 1-8. Figure 8 is a detail view of torque converter 500 showing an alternative embodiment. Torque converter 500 includes diaphragm spring 530 disposed axially between cover plate 518 and flange 522. Cover plate 518 includes radially inwardly extending portion 574. Diaphragm spring 530 is disposed axially between the inwardly extending portion and the flange. The radially inwardly extending portion includes tabs 576 and the diaphragm spring includes tabs 578 engaged with tabs 576 for preventing relative rotation between the diaphragm spring and the cover plate.

[0020] The following description is made with reference to Figures 1-9. Figure 9 is a top half cross sectional view of torque converter 600 according to an example aspect. Torque converter 600 includes cover assembly 602, impeller assembly 604 including impeller shell 606 drivingly connected with the cover assembly at weld 608, and turbine assembly 610 including shell 612 with clutch portion 614 for selective driving engagement with the impeller shell. Clutch portion 614 operates in a manner similar to that shown and described in commonly-assigned United States Patent Publication No. 2013/0230385, hereby incorporated by reference as if set forth fully herein. Turbine assembly 610 further includes bushing 615 for sealing engagement with a transmission input shaft (not shown).

[0021] Converter 600 also includes damper assembly 616 disposed in a torque path between the turbine shell and a transmission input shaft (not shown). The damper assembly includes cover plates 618 and 620 fixed together at rivet 621, flange 622, and resilient element

(i.e., coil spring) 124. Flange 622 is for driving engagement with a transmission input shaft (not shown) at hub portion 626, for example. Spring 624 is drivingly engaged with cover plates 618 and 620, and flange 622. That is, the springs transfer torque between the cover plates and flange. Cover plate 618 is drivingly engaged with the turbine shell at spring 623.

[0022] Torque converter 600 further includes resilient element 630 for urging turbine assembly 610 away from cover assembly 602. In other words, clutch portion 614 is preloaded against impeller shell 606. Resilient element 630 is disposed axially between the flange and the turbine shell, and fixed to the turbine shell at rivet 680. Torque converter 600 includes thrust washer 682 disposed axially between cover plate 620 and the cover assembly.

[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 We Claim Is:

1. A torque converter comprising:

a cover assembly;

an impeller assembly including an impeller shell drivingly connected with the cover assembly;

a turbine assembly including a shell with a clutch portion for selective driving engagement with the impeller shell;

a damper assembly including:

at least one cover plate;

a flange for driving engagement with a transmission input shaft; and,

a first resilient element drivingly engaged with the at least one cover plate and the flange; and,

a second resilient element for urging the turbine assembly away from the cover assembly.

2. The torque converter assembly of claim 1 wherein the at least one cover plate is fixed to the turbine shell and the resilient element urges the at least one cover plate away from the cover assembly.

3. The torque converter assembly of claim 2 wherein:

the cover assembly includes:

a centering plate; and,

a bushing press-fitted into the centering plate; and,

the flange includes a hub portion installed into the bushing and rotatable relative to the bushing.

4. The torque converter of claim 1 wherein the second resilient element is disposed axially between the flange and the turbine shell.

5. The torque converter of claim 4 wherein the second resilient element is fixed to the turbine shell.

6. The torque converter of claim 4 further comprising a thrust washer disposed axially between the at least one cover plate and the cover assembly.

7. A torque converter comprising:
an outer shell including a cover fixed to an impeller shell; and,
a turbine shell including a clutch portion preloaded against the impeller shell.

8. The torque converter of claim 7 wherein:
the impeller shell and the turbine shell comprise respective torus portions; and,
the clutch portion is disposed radially outside of the torus portions.

9. The torque converter of claim 7 further comprising a damper assembly disposed in a torque path between the turbine shell and a transmission input shaft.

10. The torque converter of claim 7 wherein the turbine shell clutch portion is preloaded against the impeller shell by a resilient element.

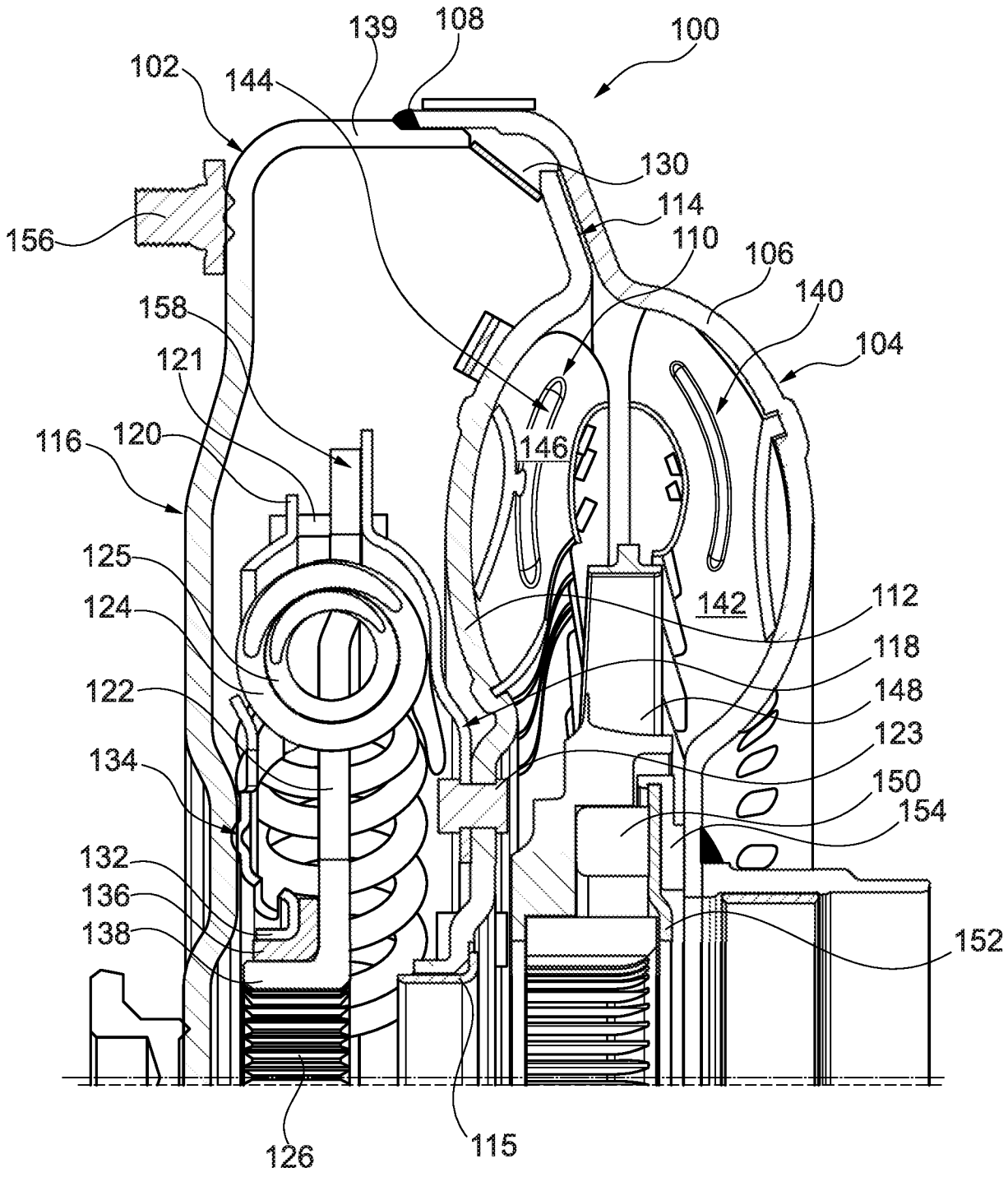

139
108
100
102
144
130
114
156
110
106
140
158
104
121
146
116
120
125
142
112
124
118
122
148
123
134
150
154
132
136
138
152
126
115

Fig. 1

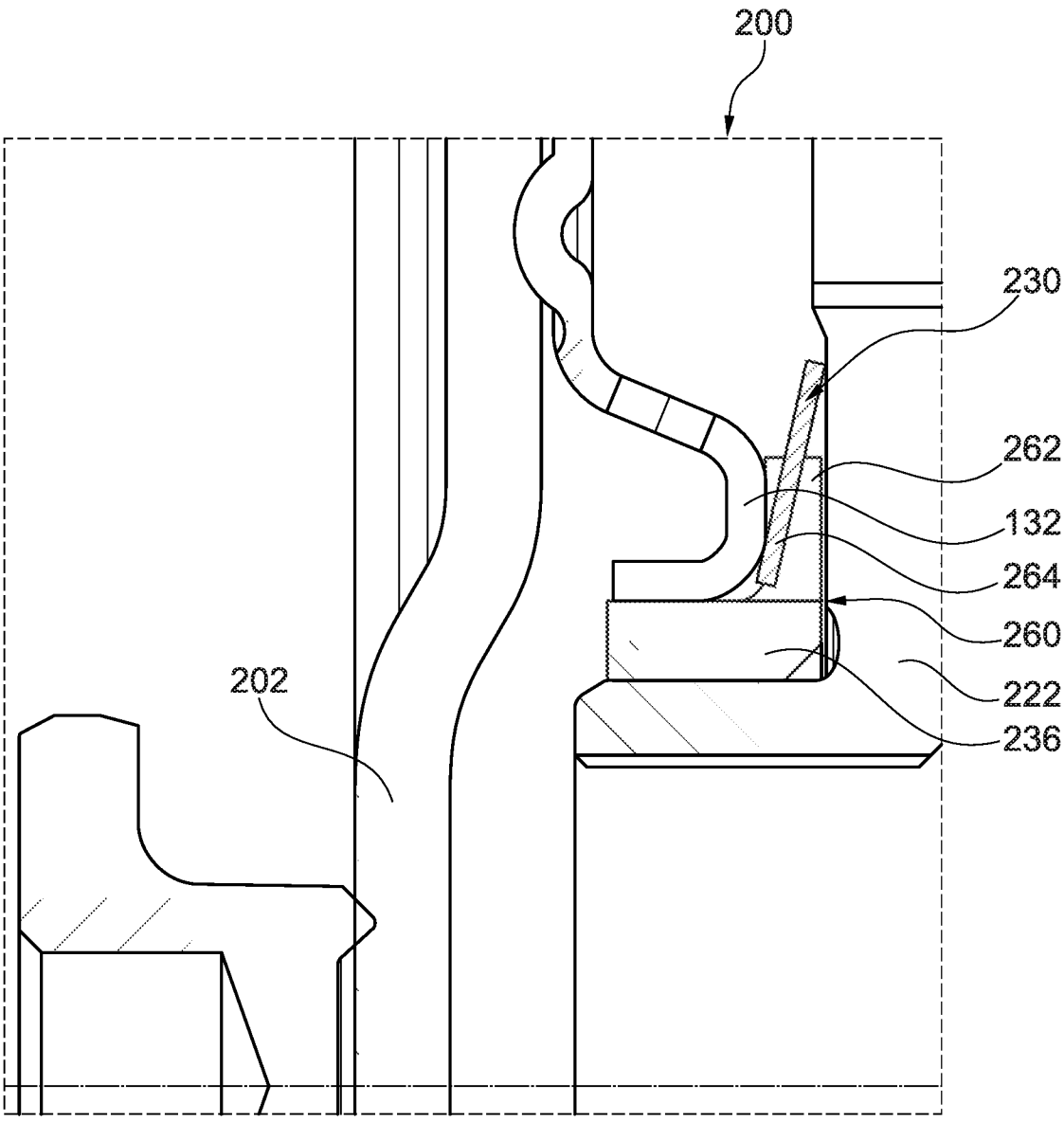


Fig. 2

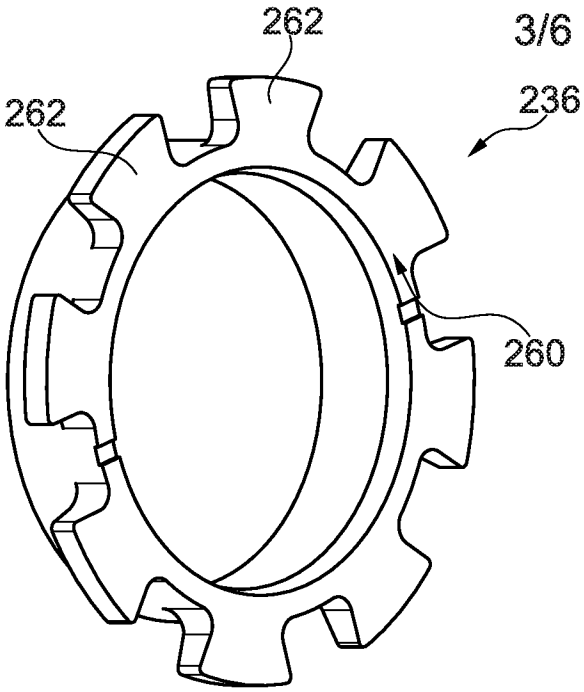


Fig. 3

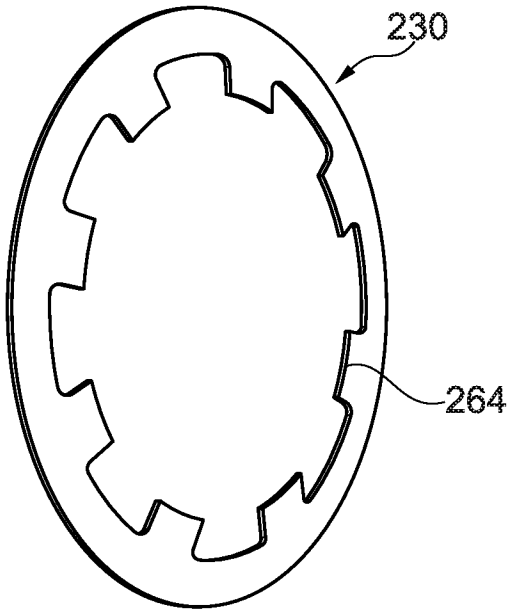


Fig. 4

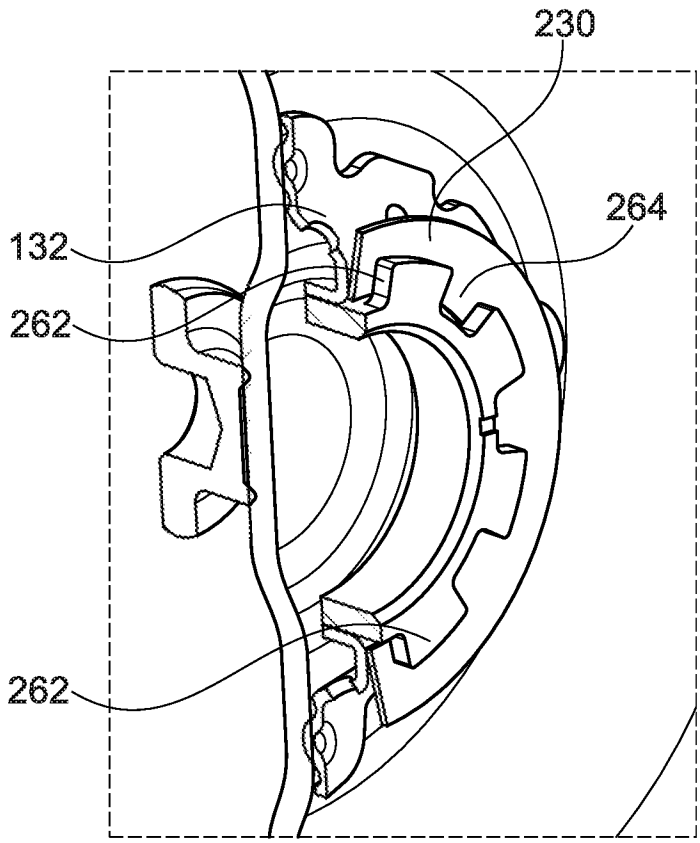


Fig. 5

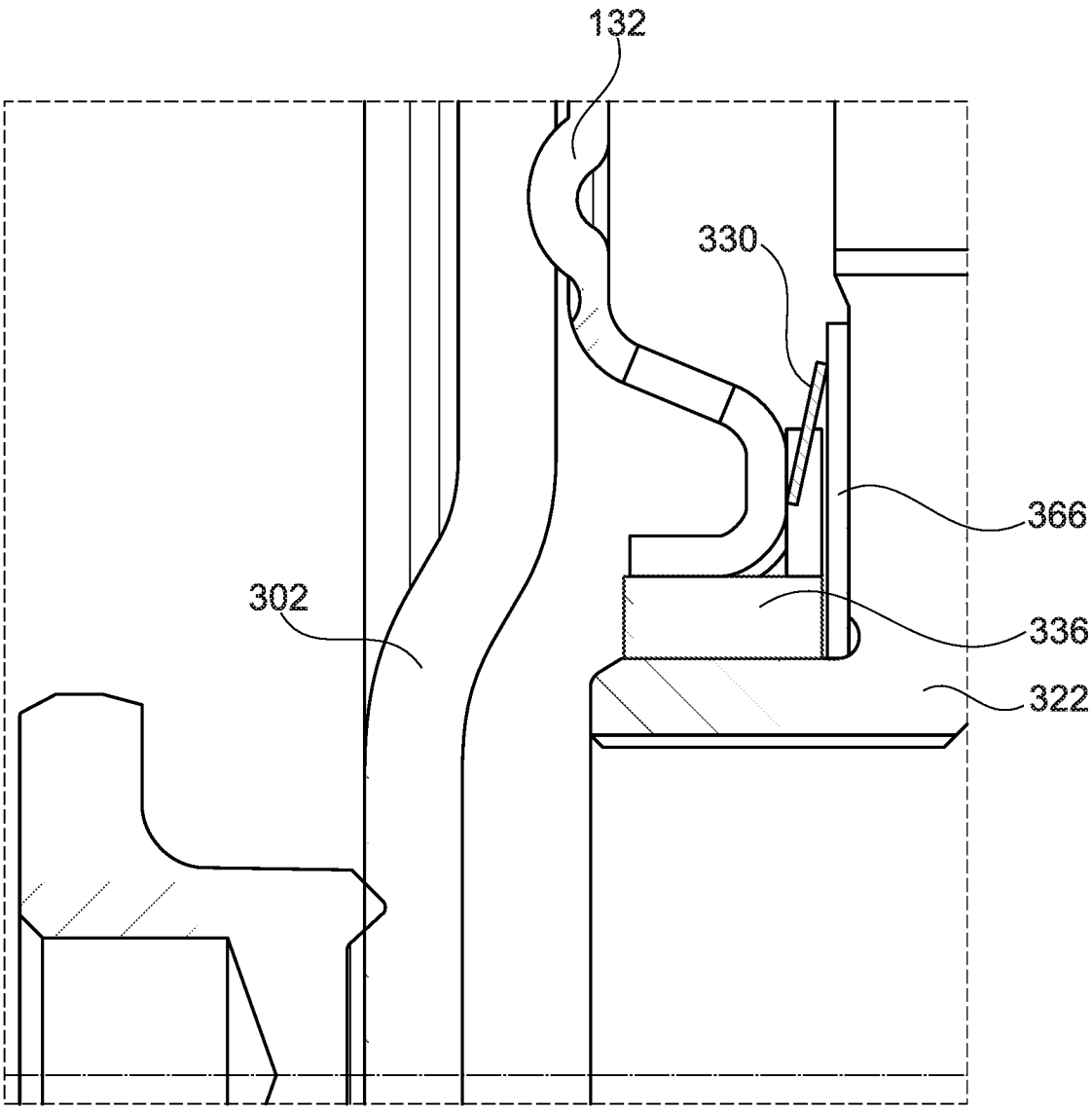


Fig. 6

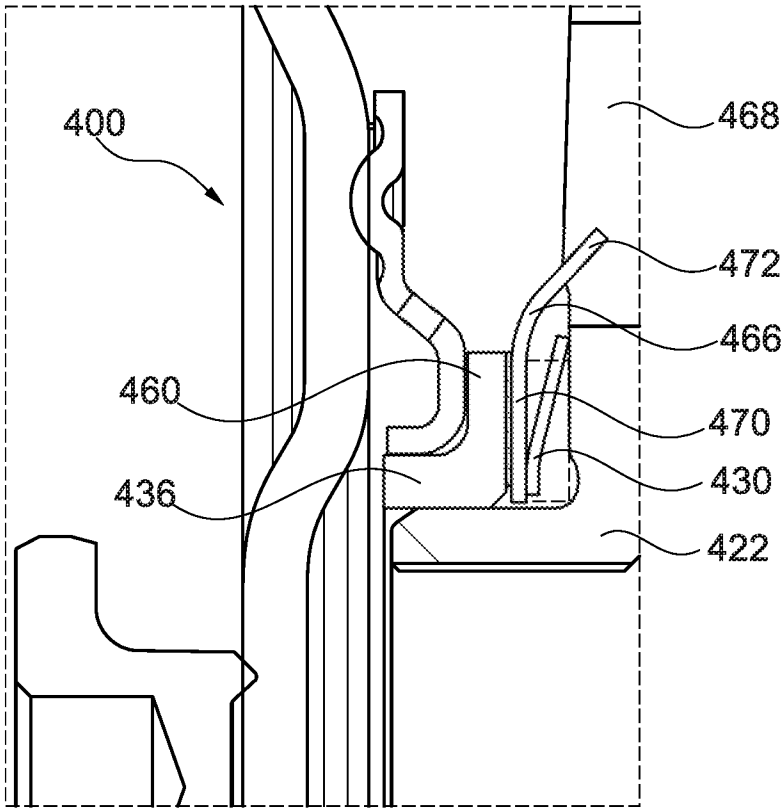


Fig. 7

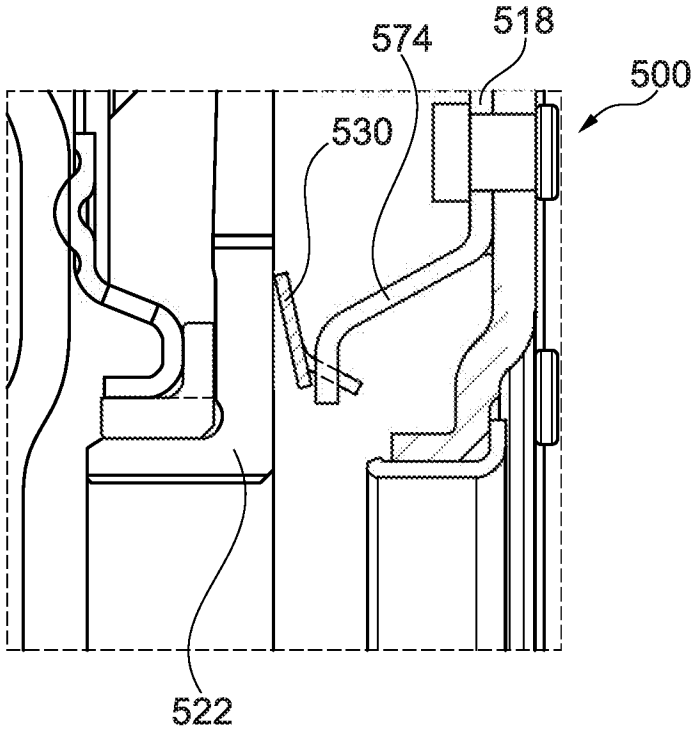


Fig. 8

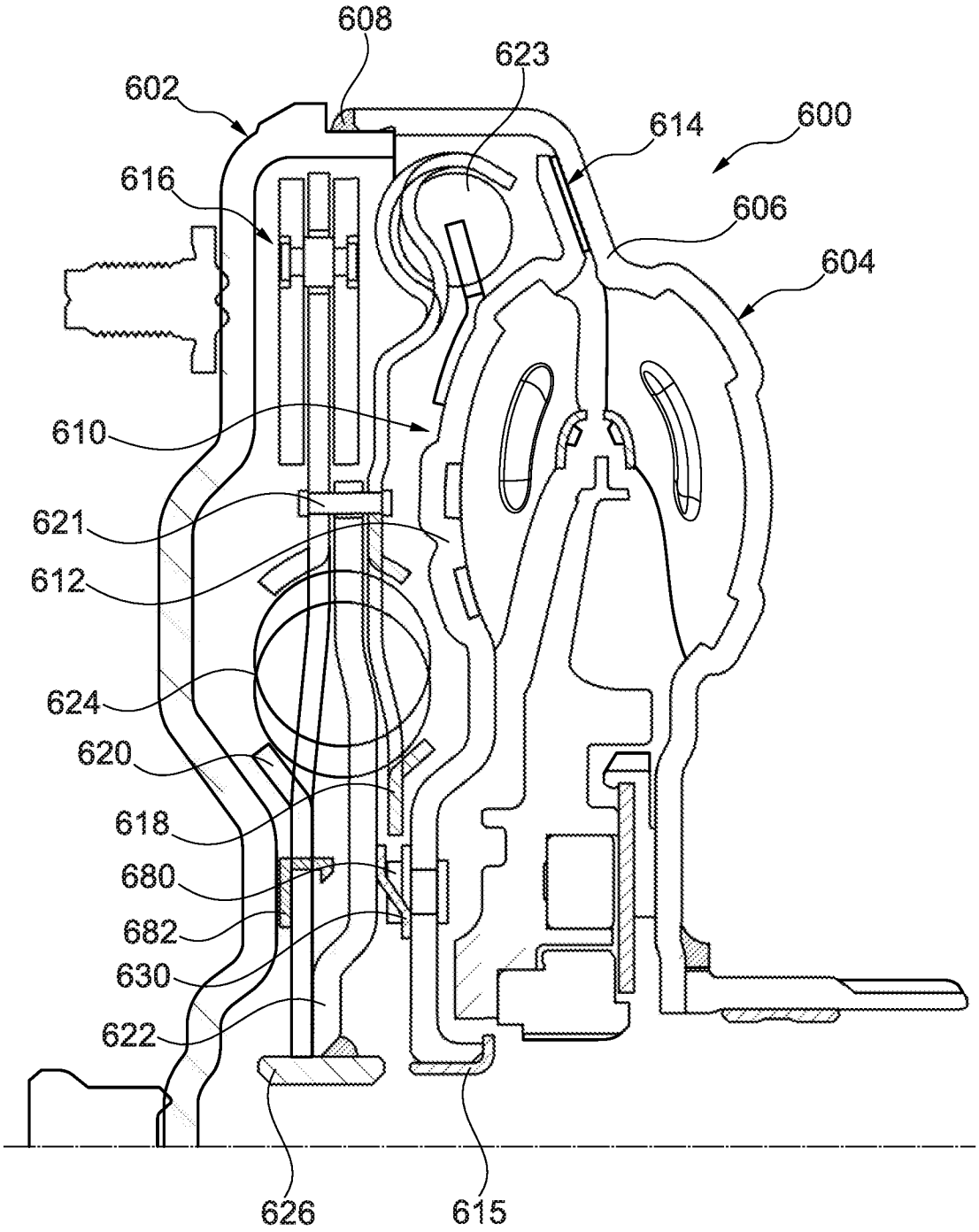

608
623
602
614
600
616
606
604
610
621
612
624
620
618
680
682
630
622
626
615

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/013344

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 3/14; F16D 31/08; F16H 41/24; F16F 15/12; F16D 47/06

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: bushing, damper, spring, clutch, impeller, turbine, torque converter, transmit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014-0097055 A1 (SCHAEFFLER TECHNOLOGIES AG & CO. KG) 10 April 2014 See paragraphs [0023], [0027]-[0036]; and figures 2-4.	7-10
Y		1-6
Y	WO 2013-130398 A1 (SCHAEFFLER TECHNOLOGIES AG & CO. KG) 06 September 2013 See paragraphs [0018], [0021]; and figure 2.	1-6
A	US 2012-0241271 A1 (STEINBERGER et al.) 27 September 2012 See paragraphs [0019]-[0027]; and figure 2.	1-10
A	US 2014-0202819 A1 (SCHAEFFLER TECHNOLOGIES GMBH & CO. KG) 24 July 2014 See paragraphs [0023]-[0030]; and figure 2.	1-10
A	US 6494303 B1 (REIK et al.) 17 December 2002 See column 3, lines 18-27; column 4, lines 14-37; 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
31 March 2016 (31.03.2016)	**01 April 2016 (01.04.2016)**

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. +82-42-481-8578

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2016/013344

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014-0097055 A1	10/04/2014	CN 104755813 A	01/07/2015
		JP 2015-530546 A	15/10/2015
		KR 10-2015-0092085 A	12/08/2015
		WO 2014-053388 A1	10/04/2014
WO 2013-130398 A1	06/09/2013	CN 104583648 A	29/04/2015
		DE 102013202661 A1	05/09/2013
		JP 2015-509579 A	30/03/2015
		KR 10-2015-0008847 A	23/01/2015
		US 2013-0230385 A1	05/09/2013
US 2012-0241271 A1	27/09/2012	JP 2012-202554 A	22/10/2012
		US 8708118 B2	29/04/2014
US 2014-0202819 A1	24/07/2014	US 2012-0043173 A1	23/02/2012
		US 8844691 B2	30/09/2014
		US 9074643 B2	07/07/2015
US 6494303 B1	17/12/2002	CN 1153015 C	09/06/2004
		CN 1274655 A	29/11/2000
		DE 10024191 A1	30/11/2000
		FR 2796436 A1	19/01/2001
		FR 2796436 B1	24/12/2004
		JP 04934890 B2	23/05/2012
		JP 2000-346135 A	12/12/2000
		KR 10-0675443 B1	26/01/2007
		KR 2001-0007098 A	26/01/2001