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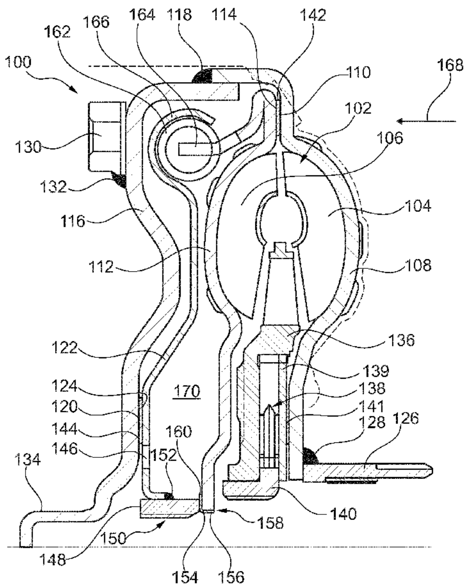

Fig. 2

(57) Abstract: A torque converter includes a torus with an impeller and a turbine having respective shells, a cover shell, and a first damper plate. The impeller shell has a radial wall disposed radially outside of the torus and the turbine shell has a radial wall arranged for frictionally engaging the impeller shell radial wall. The cover shell has a radial wall and the first damper plate has a radial wall for transmitting a turbine shell thrust force to the cover shell radial wall. In an example embodiment, the torque converter includes a friction material ring fixedly attached to the turbine shell radial wall or the impeller shell radial wall. In some example embodiments, the torque converter includes a friction material ring fixedly attached to the cover shell radial wall or the first damper plate radial wall.

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TURBINE PISTON THRUST PATH

FIELD

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

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 a torus with an impeller and a turbine having respective shells, a cover shell, and a first damper plate. The impeller shell has a radial wall disposed radially outside of the torus and the turbine shell has a radial wall arranged for frictionally engaging the impeller shell radial wall. The cover shell has a radial wall and the first damper plate has a radial wall for transmitting a turbine shell thrust force to the cover shell radial wall. In an example embodiment, the torque converter includes a friction material ring fixedly attached to the turbine shell radial wall or the impeller shell radial wall. In some example embodiments, the torque converter includes a friction material ring fixedly attached to the cover shell radial wall or the first damper plate radial wall. In an example embodiment, the friction material ring is fixedly attached to the first damper plate radial wall and the first damper plate includes an orifice disposed radially inside of the friction material ring.

[0004] In some example embodiments, the first damper plate includes a spline portion arranged for connecting to a transmission input shaft. In some example embodiments, the first damper plate includes a damper hub, the damper hub includes the spline portion, and the damper hub is arranged to receive a thrust force from the turbine shell. In an example embodiment, the torque converter has a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the damper hub. In some example embodiments, the torque converter has a first damper spring. The turbine shell includes an integrally formed drive tab extending from the radial wall and engaged with the first damper spring. In some example embodiments, the torque converter has a second damper plate. The second damper plate is fixed to the first damper plate, the first and second damper plates include respective integrally-formed spring retainer portions, and the first damper spring is disposed within the first and second damper plate spring retainer portions.

[0005] In some example embodiments, the torque converter has a third damper plate and a second damper spring. The third damper plate includes a spline portion arranged for connecting to a transmission input shaft, a spring window, and an orifice disposed radially inside of the spring window. The second damper spring is disposed within respective spring windows of the first, second, and third damper plates. The third damper plate is disposed between the first and second damper plates, and the third damper plate is arranged for transmitting a thrust force from the turbine shell to the first damper plate. In an example embodiment, the torque converter has a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the third damper plate.

[0006] Other example aspects broadly comprise a torque converter including a a torus including an impeller and a turbine with respective shells, a clutch plate, a cover shell, and a first damper plate. The impeller shell has a radial wall disposed radially outside of the torus. The clutch plate is fixed to the turbine shell and includes a radial wall arranged for frictionally engaging the impeller shell radial wall. The cover shell has a a radial wall and the first damper plate has a radial wall for transmitting a turbine shell thrust force to the cover shell radial wall. In an example embodiment, the torque converter has a friction material ring fixedly attached to the clutch plate radial wall or the impeller shell radial wall. In an example embodiment, the torque converter has a friction material ring fixedly attached to the cover shell radial wall or the first damper plate radial wall.

[0007] In some example embodiments, the torque converter has a first damper spring. The clutch plate includes a circumferential wall radially aligned with the first damper spring. In some example embodiments, the clutch plate radial and circumferential walls form at least a portion of an integrally-formed spring retainer portion and the first damper spring is disposed within the first damper plate spring retainer portion. In some example embodiments, the torque converter includes second and third damper plates. The second damper plate is fixed to the clutch plate and includes a first drive tab at least partially axially aligned with the clutch plate radial wall and engaged with the first damper spring. The third damper plate is fixed to the first damper plate and includes a second drive tab at least partially axially aligned with the clutch plate radial wall and engaged with the first damper spring.

[0008] In some example embodiments, the torque converter has a second damper spring disposed within respective spring windows of the first and third damper plates, and a fourth damper plate disposed between the first and third damper plates and arranged for transmitting a thrust force from the turbine shell to the first damper plate. In an example embodiment, the fourth damper plate includes a spring window, the second damper spring is disposed within the fourth damper plate spring window, and the fourth damper plate includes an orifice disposed radially inside of the spring window. In an example embodiment, the torque converter has a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the fourth damper plate.

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 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 cross section view of a torque converter with a turbine piston thrust path according to an example aspect;

Figure 3 is a cross section view of a torque converter with a turbine piston thrust path according to an example aspect;

Figure 4 is a cross section view of a torque converter with a turbine piston thrust path 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] 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**.

[0013] 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.

[0014] 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.

[0015] The following description is made with reference to Figure 2. Figure 2 is a cross section view of torque converter **100** with a turbine piston thrust path according to an example aspect. Torque converter **100** includes torus **102** with impeller **104** and turbine **106**. Impeller shell **108** includes radial wall **110** disposed radially outside of torus **102**, and turbine shell **112** includes radial wall **114** arranged for frictionally engaging impeller shell radial wall **110** as described below. Cover shell **116**, fixed to impeller shell **108** at weld **118**, includes radial wall **120**. Damper plate **122** includes radial wall **124** for transmitting a turbine shell thrust force to cover shell radial wall **120** as described below.

[0016] Impeller shell **108** includes hub **126** fixed to shell **108** by weld **128**. Hub **126** is for interfacing with a transmission (not shown). Cover shell **116** includes lug **130** fixed to shell **116** by weld **132** and integrally formed pilot area **134**. Lug **130** and pilot **134** are for interfacing with an engine (not shown). Lug **130** may be fixed to a flexplate attached to an engine crankshaft, for example. Pilot **134** may center converter **100** relative to the crankshaft, for example. Stator **136** includes wedge one way clutch assembly **138** with inner race **140** for interfacing with a transmission stator shaft (not shown) and side plate **139** with friction material ring **141**, fixedly attached to side plate **139** by adhesive bonding, for example, for transmitting a turbine and/or stator thrust load to the impeller.

[0017] Friction material ring **142** is fixedly attached to the turbine shell radial wall by adhesive bonding, for example. Although ring **142** is shown fixed to radial wall **114**, other embodiments (not shown) may include ring **142** fixed to radial wall **110**. Friction material ring **144** is fixedly attached to radial wall **124** by adhesive bonding, for example. Although ring **144** is shown fixed to radial wall **124**, other embodiments (not shown) may include ring **144** fixed to radial wall **120**. Plate **122** includes orifice **146** disposed radially inside of the friction material ring. Plate **122** includes damper hub **148** with spline portion **150** arranged for connecting to a transmission input shaft (not shown). Although hub **148** is shown fixed to plate **122** by weld

152, other embodiments of plate **122** (not shown) may include an integrally formed hub with spline portion. Hub **148** receives the thrust force from turbine shell **112** as described below.

[0018] Converter **100** includes bushing **154** with circumferential portion **156** disposed within circumferential bore **158** of turbine shell **112**, and radial portion **160** disposed between the turbine shell and damper hub **148**. Portion **156** is for sealing shell **112** to a transmission input shaft (not shown).

[0019] Converter **100** includes damper spring **162**. Turbine shell **112** includes integrally formed drive tab **164**. Tab **164** extends from radial wall **114** and is engaged with damper spring **162**. Damper plate **122** includes integrally-formed spring retainer portion **166**. Spring **162** is disposed within spring retainer portion **166**. Plate **122** also includes a spring driving portion (not shown in the section cut of Figure 2) so that torque from shell **112** is transmitted from tab **164** through spring **162** to the spring driving portion of plate **122**. Spring **162** advantageously provides damping to converter **100** so that torsional vibrations from the engine are at least partially isolated from the transmission.

[0020] During operation of converter **100**, turbine **106** may thrust in direction **168** towards cover shell **116**. Thrust force from the turbine is transmitted from shell **112**, through bushing **154** to hub **148**, plate **122**, and ring **144** to wall **120** of shell **116**. This thrust path advantageously limits axial displacement of shell **112** to control “liftoff”, or an axial gap, between ring **142** and impeller shell **108**, improving engagement characteristics of the friction interface, or clutch, between radial walls **114** and **110**. Ring **144** advantageously prevents metal-on-metal (or steel-on-steel) contact between plate **122** and shell **116**.

[0021] Pressure in chamber **170**, disposed between cover **116** and turbine shell **112** may be increased above a pressure in torus **102** to engage the clutch and bypass the torus fluid circuit. That is, torque from cover **116** transmitted to torus **108** is directly transmitted to turbine shell **112** without operation of the fluid circuit. Depending on the operating condition of converter **100** prior to an attempted engagement of the clutch, imprecise control of liftoff may prevent clutch engagement due to hydrodynamic forces within the converter.

[0022] The following description is made with reference to Figure 3. Figure 3 is a cross section view of torque converter **200** with a turbine piston thrust path according to an example aspect. Torque converter **200** includes torus **202** with impeller **204** and turbine **206**. Impeller shell **208** includes radial wall **210** disposed radially outside of torus **202**, and turbine shell **212** includes radial wall **214** arranged for frictionally engaging impeller shell radial wall **210** in a manner similar to walls **110** and **114** described above. Cover shell **216**, fixed to impeller shell **208** at weld **218**, includes radial wall **220**. Damper plate **222** includes radial wall **224** for transmitting a turbine shell thrust force to cover shell radial wall **220** similar to walls **124** and **120** described above.

[0023] Impeller shell **208** includes hub **226** fixed to shell **208** by weld **228**. Hub **226** is for interfacing with a transmission (not shown). Cover shell **216** includes stud **230** fixed to shell **216** by a projection weld, for example, and integrally formed pilot area **234**. Stud **230** and pilot **234** are for interfacing with an engine (not shown). Stud **230** may be fixed to a flexplate attached to an engine crankshaft, for example. Pilot **234** may center converter **200** relative to the crankshaft, for example. Stator **236** includes one way clutch assembly **238** with inner race **240** for interfacing with a transmission stator shaft (not shown). Stator **236** includes radial wall **239** with friction material ring **241**, fixedly attached to wall **239** by adhesive bonding, for example, for transmitting a turbine and/or stator thrust load to the impeller.

[0024] Friction material ring **242** is fixedly attached to the turbine shell radial wall by adhesive bonding, for example. Although ring **242** is shown fixed to radial wall **214**, other embodiments (not shown) may include ring **242** fixed to radial wall **210**. Friction material ring **244** is fixedly attached to radial wall **224** by adhesive bonding, for example. Although ring **244** is shown fixed to radial wall **224**, other embodiments (not shown) may include ring **244** fixed to radial wall **220**.

[0025] Converter **200** includes damper spring **262**. Turbine shell **212** includes integrally formed drive tab **264**. Tab **264** extends from radial wall **214** and is engaged with damper spring **262**. Converter **200** includes damper plate **272** including integrally formed spring retainer portion **274**. Plate **272** is fixed to plate **222** by sheet metal rivet **276**. Although plates **222** and **272** are shown fixed together by riveting, other methods such as welding may be used to fix the plates together. Spring **262** is disposed within the spring retainer portion **266**. Plate **272** also includes a spring driving portion (not shown in the section cut of Figure 3) so that torque from shell **212** is transmitted from tab **264** through spring **262** to the spring driving portion to plate **222**.

[0026] Plates **222** and **272** include respective spring windows **278** and **280**. Spring **282** is at least partially disposed within window **278** and **280**. That is, the spring is at least partially retained within the windows. Converter **200** includes damper plate **284** disposed between plates **222** and **272**. Plate **284** is arranged for transmitting a thrust force from the turbine shell to damper plate **222** as described below. Plate **284** includes spring window **286**. Spring **282** is at least partially disposed within window **286**. Springs **262** and **282** advantageously provide damping so that torsional vibrations from the engine are at least partially isolated from the transmission.

[0027] Plate **284** includes orifice **288** disposed radially inside of the spring window and spline portion **290** arranged for connecting to a transmission input shaft. Converter **100** includes bushing **254** with circumferential portion **256** disposed within circumferential bore **258** of turbine shell **212**, and radial portion **260** disposed between the turbine shell and damper plate **284**. Portion **256** is for sealing shell **112** to a transmission input shaft (not shown).

[0028] During operation of converter **200**, turbine **206** may thrust in direction **268** towards cover shell **216**. Thrust force from the turbine is transmitted from shell **212**, through bushing **254** to plate **284**, plate **222**, and ring **244** to wall **220** of shell **216**. This thrust path advantageously limits axial displacement of shell **212** to control "liftoff" as described above.

[0029] Pressure in chamber **270**, disposed between cover **216** and turbine shell **212** may be increased above a pressure in torus **202** to engage the clutch and bypass the torus fluid circuit. That is, torque from cover **216** transmitted to torus **208** is directly transmitted to turbine shell **212** without operation of the fluid circuit. Depending on the operating condition of converter **200** prior to an attempted engagement of the clutch, imprecise control of liftoff may prevent clutch engagement due to hydrodynamic forces within the converter.

[0030] Torque converter **300** includes torus **302** with impeller **304** and turbine **306**. Impeller shell **308** includes radial wall **310** disposed radially outside of the torus. Clutch plate **312** is fixed to turbine shell **314** at weld **316**, for example, and includes radial wall **318** arranged for frictionally engaging the impeller shell radial wall. Cover shell **320** includes radial wall **322**

and damper plate **324** includes radial wall **326** for transmitting a turbine shell thrust force to the cover shell radial wall. Friction material ring **328** is fixedly attached by bonding, for example, to clutch plate radial wall **318**. In other embodiments (not shown), ring **328** may be fixed ti impeller shell radial wall **310**. Friction material ring **330** is fixedly attached to damper plate radial wall **326**. In other embodiments (not shown), ring **330** is fixed to cover shell radial wall **322**.

[0031] Converter **300** includes damper spring **332** and clutch plate **312** includes circumferential wall **334** radially aligned with the first damper spring. In an example embodiment, walls **318** and **334** form at least a portion of integrally-formed spring retainer portion **336** and damper spring **332** is disposed within retainer portion **336**. Converter **300** includes damper plates **338** and **340**. Plate **338** is fixed to clutch plate **312** at rivet **339**, for example, and includes drive tab **342** at least partially axially aligned with clutch plate radial wall **318**. Tab **342** is engaged with damper spring **332**. Plate **340** is fixed to plate **324** by sheet metal rivet **343**, for example, and includes drive tab **344** at least partially axially aligned with the clutch plate radial wall and engaged with damper spring **332**.

[0032] Converter **300** includes damper spring **346** at least partially disposed within respective spring windows **348** and **350** of damper plates **324** and **340**. Damper plate **352**, disposed between plates **324** and **340**, is arranged for transmitting a thrust force from the turbine shell to damper plate **324** in a manner similar to plate **284** described above. Plate **352** includes spring window **354**, orifice **356** disposed radially inside of window **354**, and spline portion **358** arranged for connecting to a transmission input shaft. Spring **346** is at least partially disposed within window **354**. In an example embodiment, converter **300** includes pendulum damper **360** fixed to damper plate **324** as is commonly known in the art.

[0033] Bushing **362** has circumferential portion **364** disposed within circumferential bore **366** of the turbine shell and radial portion **368** disposed between the turbine shell and damper plate **352**. During operation of converter **300**, turbine **306** may thrust in direction **370** towards cover shell **320**. Thrust force from the turbine is transmitted from shell **314**, through bushing **362** to plate **352**, plate **324**, and ring **330** to wall **322** of shell **320**. This thrust path advantageously limits axial displacement of shell **314** and clutch plate **312** to control "liftoff" as described above.

[0034] Pressure in chamber **372**, disposed between cover **320** and clutch plate **312** may be increased above a pressure in torus **202** to engage the clutch and bypass the torus fluid circuit. That is, torque from cover **320** transmitted to impeller **308** is directly transmitted to turbine shell **314** through plate **312** without operation of the fluid circuit. Depending on the operating condition of converter **300** prior to an attempted engagement of the clutch, imprecise control of liftoff may prevent clutch engagement due to hydrodynamic forces within the converter.

[0035] 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 torus including an impeller and a turbine;

an impeller shell including a radial wall disposed radially outside of the torus;

a turbine shell including a radial wall arranged for frictionally engaging the impeller shell radial wall;

a cover shell including a radial wall; and,

a first damper plate including a radial wall for transmitting a turbine shell thrust force to the cover shell radial wall.

2. The torque converter of claim 1 further comprising a friction material ring fixedly attached to the turbine shell radial wall or the impeller shell radial wall.

3. The torque converter of claim 1 further comprising a friction material ring fixedly attached to the cover shell radial wall or the first damper plate radial wall.

4. The torque converter of claim 3 wherein the friction material ring is fixedly attached to the first damper plate radial wall and the first damper plate includes an orifice disposed radially inside of the friction material ring.

5. The torque converter of claim 1 wherein the first damper plate includes a spline portion arranged for connecting to a transmission input shaft.

6. The torque converter of claim 5 wherein the first damper plate includes a damper hub, the damper hub includes the spline portion, and the damper hub is arranged to receive a thrust force from the turbine shell.

7. The torque converter of claim 6 further comprising a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the damper hub.

8. The torque converter of claim 1 further comprising a first damper spring, wherein the turbine shell includes an integrally formed drive tab extending from the radial wall and engaged with the first damper spring.

9. The torque converter of claim 8, further comprising a second damper plate, wherein:

the second damper plate is fixed to the first damper plate;

the first and second damper plates include respective integrally-formed spring retainer portions; and,

the first damper spring is disposed within the first and second damper plate spring retainer portions.

10. The torque converter of claim 9 further comprising:

a third damper plate including:

a spline portion arranged for connecting to a transmission input shaft;

a spring window; and,

an orifice disposed radially inside of the spring window; and,

a second damper spring disposed within respective spring windows of the first, second, and third damper plates; wherein:

the third damper plate is disposed between the first and second damper plates; and,

the third damper plate is arranged for transmitting a thrust force from the turbine shell to the first damper plate.

11. The torque converter of claim 10 further comprising a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the third damper plate.

12. A torque converter comprising:
a torus including an impeller and a turbine;
an impeller shell including a radial wall disposed radially outside of the torus;
a turbine shell;
a clutch plate, fixed to the turbine shell, and including a radial wall arranged for frictionally engaging the impeller shell radial wall;
a cover shell including a radial wall; and,
a first damper plate including a radial wall for transmitting a turbine shell thrust force to the cover shell radial wall.

13. The torque converter of claim 12 further comprising a friction material ring fixedly attached to the clutch plate radial wall or the impeller shell radial wall.

14. The torque converter of claim 12 further comprising a friction material ring fixedly attached to the cover shell radial wall or the first damper plate radial wall.

15. The torque converter of claim 12 further comprising a first damper spring, wherein the clutch plate includes a circumferential wall radially aligned with the first damper spring.

16. The torque converter of claim 15, wherein the clutch plate radial and circumferential walls form at least a portion of an integrally-formed spring retainer portion and the first damper spring is disposed within the first damper plate spring retainer portion.

17. The torque converter of claim 16 further comprising:

a second damper plate fixed to the clutch plate and including a first drive tab at least partially axially aligned with the clutch plate radial wall and engaged with the first damper spring; and,

a third damper plate, fixed to the first damper plate and including a second drive tab at least partially axially aligned with the clutch plate radial wall and engaged with the first damper spring.

18. The torque converter of claim 17 further comprising:

a second damper spring disposed within respective spring windows of the first and third damper plates; and,

a fourth damper plate disposed between the first and third damper plates and arranged for transmitting a thrust force from the turbine shell to the first damper plate.

19. The torque converter of claim 18 wherein the fourth damper plate includes a spring window, the second damper spring is disposed within the fourth damper plate spring window, and the fourth damper plate includes an orifice disposed radially inside of the spring window.

20. The torque converter of claim 18 further comprising a bushing with a circumferential portion disposed within a circumferential bore of the turbine shell and a radial portion disposed between the turbine shell and the fourth damper plate.

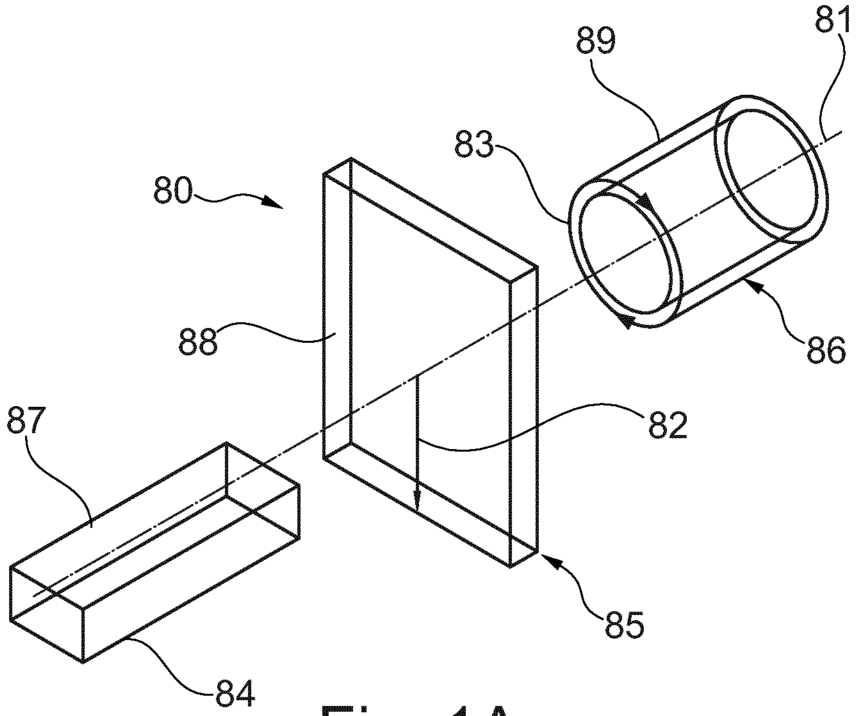

Fig. 1A

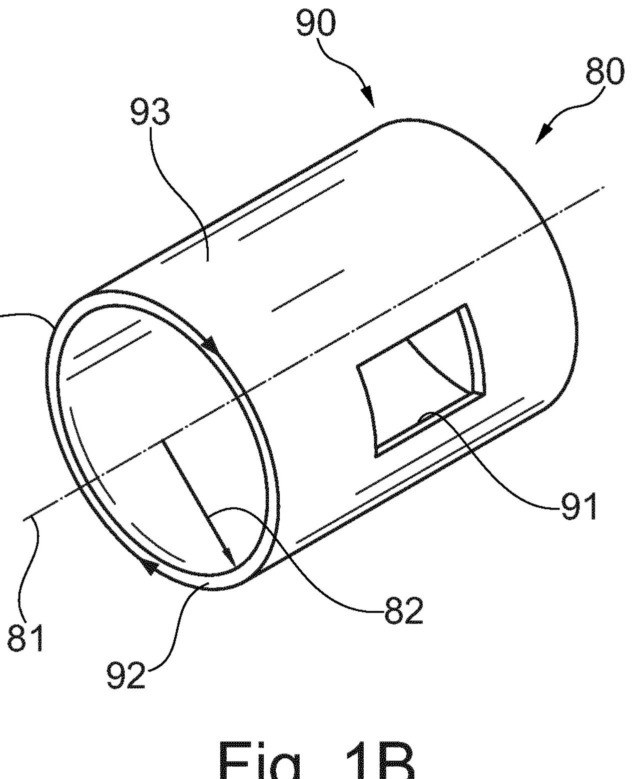

Fig. 1B

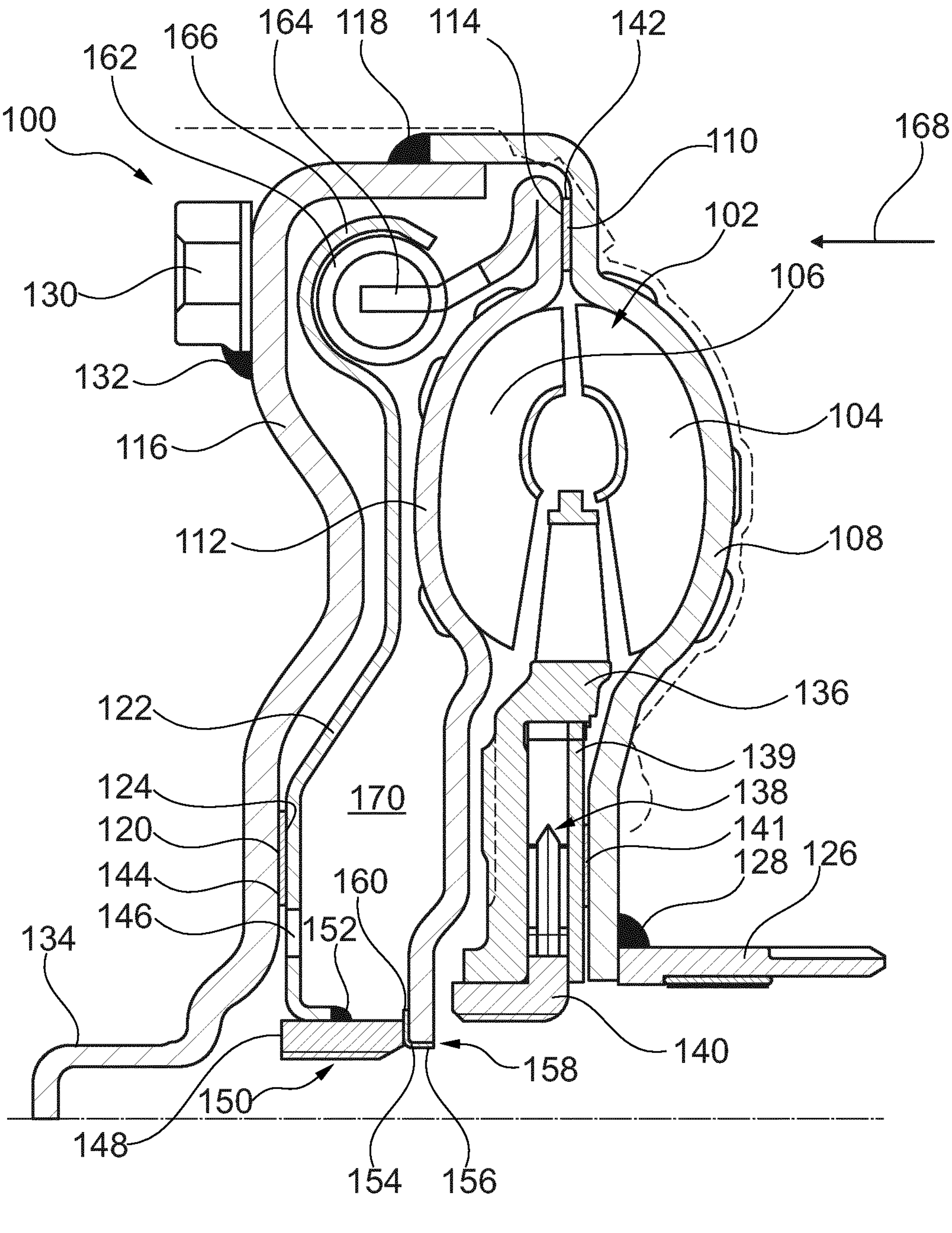
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Fig. 2

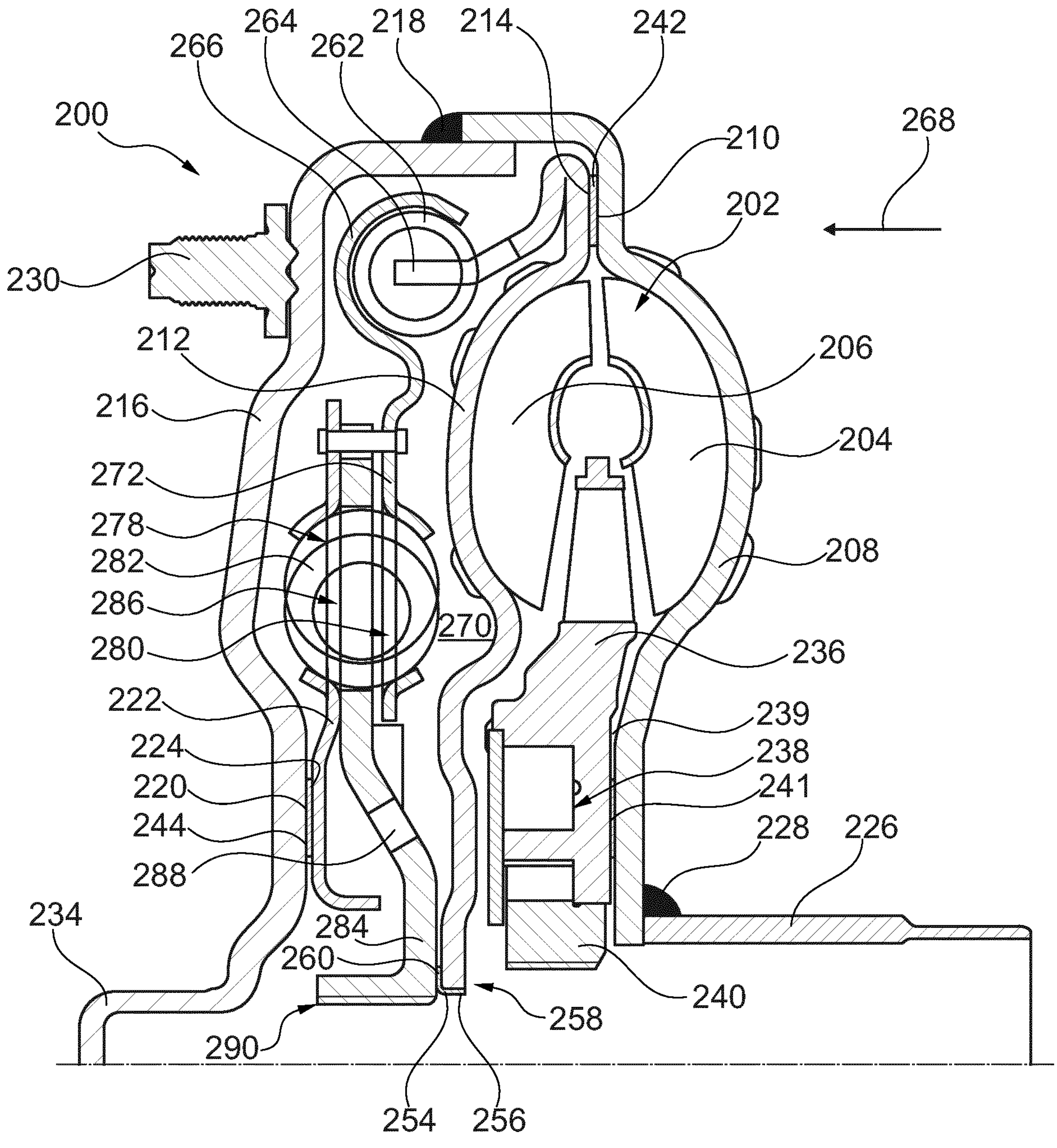
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Fig. 3

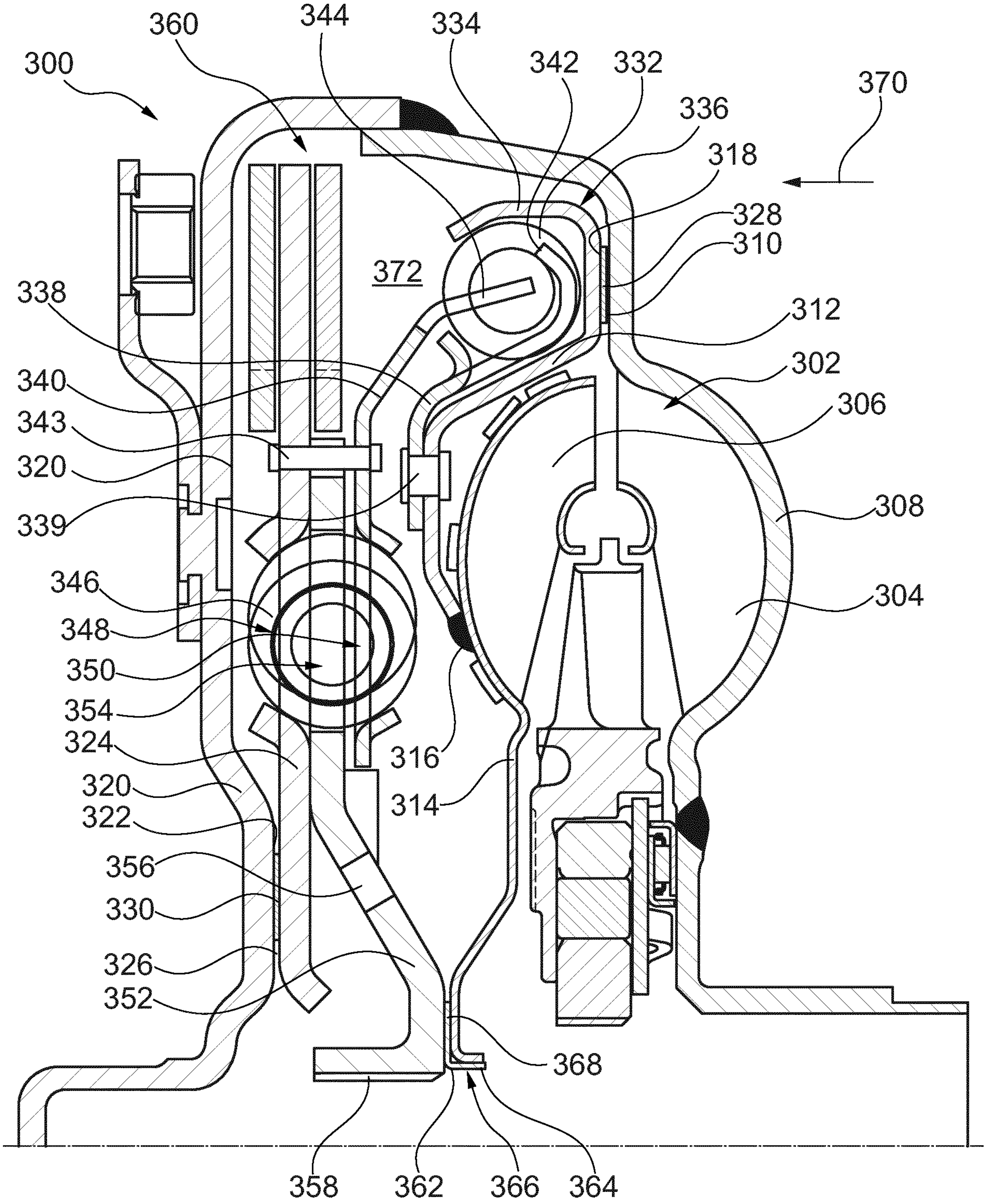
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Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/070068

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16H45/02
ADD. F16D47/06

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 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2011 069464 A (JATCO LTD) 7 April 2011 (2011-04-07) the whole document -----	1,2,5,6, 8,9,12, 13,17
A	JP 2004 332801 A (TOYOTA MOTOR CORP) 25 November 2004 (2004-11-25) the whole document -----	1,2,12
A	DE 197 54 650 A1 (MANNESMANN SACHS AG [DE]) 17 June 1999 (1999-06-17) the whole document -----	1,12
A	EP 1 211 438 A2 (FORD WERKE AG [DE]; THYSSEN KRUPP AUTOMOTIVE AG [DE] FORD WERKE AG [DE) 5 June 2002 (2002-06-05) the whole document -----	1,12
	-/--	

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

[X] See patent family annex.

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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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2013	03/01/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Masset, Candie

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/070068

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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