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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 July 2015 (16.07.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/105618 A1

(51) International Patent Classification:
F16H 45/02 (2006.01) ***F16H 41/04*** (2006.01)

(21) International Application Number:
PCT/US2014/069781

(22) International Filing Date:
11 December 2014 (11.12.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/925,913 10 January 2014 (10.01.2014) US

(71) Applicant: **SCHAEFFLER TECHNOLOGIES GMBH & CO. KG** [DE/DE]; Industriestrasse 1-3, 91074 Herzogenaurach (DE).

(72) Inventor; and
(71) Applicant *(for US only)*: **BLOUGH, Gregory** [US/US]; 5112 Sarah Circle, Wooster, OH 44691 (US).

(74) Agent: **MALISZEWSKI, Chester, Paul**; Simpson & Simpson, PLLC, 5555 Main Street, Williamsville, NY 14221-5406 (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,

[Continued on next page]

(54) Title: TORQUE CONVERTER WITH PARALLEL TORSIONAL VIBRATION DAMPERS

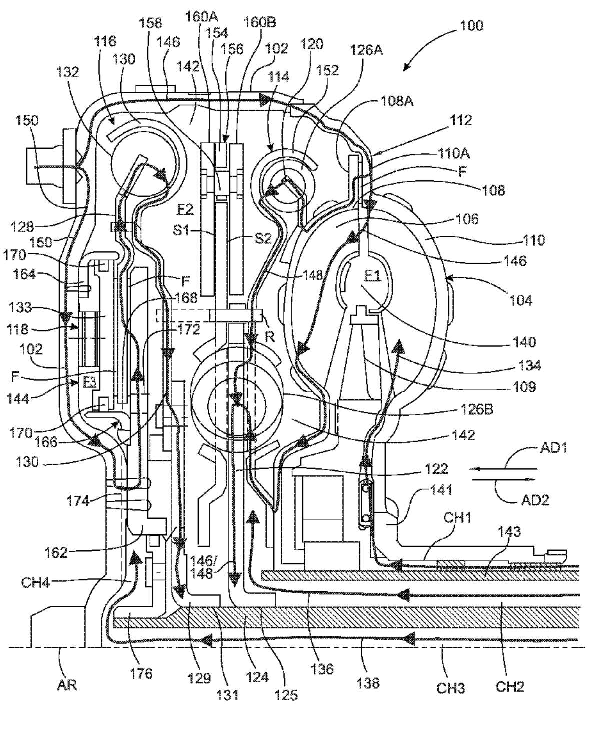

Fig. 2

(57) Abstract: A torque converter, including: a cover for receiving torque; a pump non-rotatably connected to the cover; a turbine including a turbine shell; a turbine clutch including a portion of the turbine shell; a first torsional vibration damper including a first input plate non-rotatably connected to the turbine shell, a cover plate, an output flange arranged to non-rotatably connect to an input shaft for a transmission, and a plurality of springs, each spring in the plurality of springs engaged with the first input plate, the cover plate, or the output flange; a second torsional vibration damper including a second input plate, an output plate arranged to non-rotatably connect to the input shaft, and a spring engaged with the second input plate and the output plate; and a lock-up clutch including an axially displaceable piston plate arranged to non-rotatably connect the cover and the second input plate.

WO 2015/105618 A1

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))*

TORQUE CONVERTER WITH PARALLEL TORSIONAL VIBRATION DAMPERS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Patent Application No. 61/925,913, filed January 10, 2014, which application is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to a torque converter having parallel torsional vibration dampers and associated clutches. Via the associated clutches, torque is transmitted through the dampers singly or in parallel. The torque converter includes three fluid circuits arranged to enable independent operation of the associated clutches.

BACKGROUND

[0003] It is known to use a single torsional vibration damper or a series torsional vibration damper in a torque converter. The preceding configuration provides a torque path from a cover of the torque converter to an output of the torque converter through the damper configuration. In general, dampers are tuned according to the expected torque loads on the dampers. For example, the spring rates for the springs in a damper are selected according to the expected torque load. For lower torque loads, for example associated with two-cylinder mode, the spring rates must be relatively low and for greater torque loads, for example, for a four cylinder engine, the spring rates must be relatively higher. However, the preceding requirements create a conflict when the expected torque load on the damper includes too broad a range. For example, a four cylinder engine with a two cylinder mode requires the relatively higher spring rates noted above for operation in four-cylinder mode. However, the higher spring rates render the damper ineffectual for the two-cylinder mode. That is, due to the higher spring rates, the damper is too stiff in the two-cylinder mode and an undesirable amount of vibration passes through the damper.

[0004] U.S. Patent No. 7,044,279 teaches the use of two clutches in a torque converter. However, U.S. Patent No. 7,044,279 teaches a single damper. Therefore, regardless of the clutch closed, all vibration attenuation is linked to the spring rates of the single damper.

SUMMARY

[0005] According to aspects illustrated herein, there is provided a torque converter, including: a cover arranged to receive torque; a pump; a turbine hydraulically coupled to the pump and including a turbine shell; a turbine clutch including a radially outermost portion of the turbine shell; a first torsional vibration damper with a first input plate non-rotatably connected to the turbine shell, an output flange arranged to non-rotatably connect to an input shaft for a transmission, and a plurality of springs engaged with the first input plate or the output flange; a second torsional vibration damper including a second input plate, an output plate arranged to non-rotatably connect to the input shaft for the transmission, and at least one first spring engaged with the second input plate and the output plate; a lock-up clutch including an axially displaceable piston plate arranged to non-rotatably connect the cover and the second input plate; a first fluid circuit arranged to supply first pressurized fluid to open the turbine clutch; a second fluid circuit arranged to supply second pressurized fluid to close the turbine clutch or open the lock-up clutch; and a third fluid circuit arranged to supply third pressurized fluid to close the lock-up clutch.

[0006] According to aspects illustrated herein, there is provided a torque converter, including: a cover arranged to receive torque; a pump non-rotatably connected to the cover; a turbine including a turbine shell; a turbine clutch including a radially outermost portion of the turbine shell; a first torsional vibration damper including a first input plate non-rotatably connected to the turbine shell, a first cover plate, an output flange arranged to non-rotatably connect to an input shaft for a transmission, and a plurality of springs, each first spring in the plurality of springs engaged with at least one of the first input plate, the first cover plate, or the first output flange; a second torsional vibration damper including a second input plate, an output plate arranged to non-rotatably connect to the input shaft for the transmission, and a second spring engaged with the second input plate and the output plate; and a lock-up clutch including an axially displaceable piston plate arranged to non-rotatably connect the cover and the second input plate.

[0007] According to aspects illustrated herein, there is provided a torque converter, including: a cover arranged to receive torque; a pump non-rotatably connected to the cover; a turbine including a turbine shell; a turbine clutch including a radially outermost portion of the turbine shell; a first torsional vibration damper including a plurality of springs and an output flange arranged to non-rotatably connect to an input shaft for a transmission; a second torsional vibration damper including at least one spring and an output plate arranged to non-rotatably connect to the input shaft; a lock-up clutch; when the turbine clutch is closed, a first torque path from the turbine shell to the output flange through the first vibration damper; and when the lock-up clutch is closed, a second torque path, separate from the first torque path, from the cover to the output plate through the second vibration damper. The turbine clutch is arranged to be opened or closed while the lock-up clutch is open or closed or the lock-up clutch is arranged to be opened or closed while the turbine clutch is open or closed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, 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; and,

Figure 2 is a partial cross-sectional view of a torque converter with parallel torsional vibration dampers.

DETAILED DESCRIPTION

[0009] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the disclosure. It is to be understood that the disclosure as claimed is not limited to the disclosed aspects.

[0010] Furthermore, it is understood that this disclosure is not limited to the particular methodology, materials and modifications described 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 disclosure.

[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 disclosure belongs. It should be understood that any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the disclosure.

[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. Axial direction **AD** is parallel to axis **81**. Radial direction **RD** is orthogonal to axis **81**. Circumferential direction **CD** is defined by an endpoint of radius **R** (orthogonal to axis **81**) rotated about axis **81**.

[0013] To clarify the spatial terminology, objects **84**, **85**, and **86** are used. Surface **87** of object **84** forms an axial plane. For example, axis **81** is congruent with surface **87**. Surface **88** of object **85** forms a radial plane. For example, radius **82** is congruent with surface **88**. Surface **89** of object **86** forms a circumferential surface. For example, circumference **83** is congruent with surface **89**. As a further example, axial movement or disposition is parallel to axis **81**, radial movement or disposition is orthogonal to axis **82**, and circumferential movement or disposition is parallel to circumference **83**. Rotation is with respect to axis **81**.

[0014] 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.

[0015] 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 and surface **92** is part of a radial plane.

[0016] Figure 2 is a partial cross-sectional view of torque converter **100** with parallel torsional vibration dampers. Torque converter **100** includes: cover **102** arranged to receive torque, for example from an engine (not shown); pump **104** arranged to receive the torque from cover **102**; turbine **106** including turbine shell **108**; and stator **109** axially located between pump **104** and turbine **106**. In an example embodiment, pump shell **110** for pump **104** is non-rotatably connected to cover **102**. Torque converter **100** includes turbine clutch **112**, torsional vibration damper **114**, torsional vibration damper **116**, and lock-up clutch **118**. As is further described below, dampers **114** and **116** operate in parallel. That is, torque from cover **102** can be directed through damper **114** only, damper **116** only, or both dampers **114** and **116**.

[0017] By "non-rotatably connected" components we mean that a first component is connected to a second component so that any time the first component rotates, the second component rotates with the first component, and any time the second component rotates, the first component rotates with the second component. Axial displacement between the first and second components is possible.

[0018] Clutch **112** includes radially outermost portion **108A** of turbine shell **108**, portion **110A** of pump shell **110**, and friction material **F** between portions **108A** and **110A**. Portion **108A** is integrally formed with shell **108** as shown in Figure 2 or in an embodiment not shown, is separate from shell **108** and non-rotatably connected to shell **108**. Damper **114** includes: input plate **120** non-rotatably connected to turbine shell **108**; output flange **122** arranged to non-rotatably connect to input shaft **124** for a transmission, for example, via spline connection **125**; and springs **126A** and **126B** engaged with plate **120** or output flange **122**. Damper **116** includes: input plate **128**; output plate **130** arranged to non-rotatably connect to input shaft **124**, for example via spline connection **131**; and at least one spring **132** engaged with input plate **128** and output plate **130**. In an example embodiment, output plate **130** is non-rotatably connected to connection plate **129**. Lock-up clutch **118** includes axially displaceable piston plate **133** arranged to non-rotatably connect cover **102** and input plate **128**.

[0019] Operation of turbine clutch **112** is independent of operation of lock-up clutch **118** and operation of lock-up clutch **118** is independent of operation of turbine clutch **112**. For example, clutch **112** can be closed or opened while clutch **118** is open or closed, and clutch **118** can be closed or opened while clutch **112** is open or closed.

[0020] Torque converter **100** is a three-pass torque converter, for example, converter **100** includes three separately controllable fluid circuits **134**, **136**, and **138**. Fluid circuit **134** is arranged to supply pressurized fluid **F1** to torus/chamber **140** and to open turbine clutch **112**. Fluid circuit **136** is arranged to supply pressurized fluid **F2** to close turbine clutch **112** or open lock-up clutch **118**. Fluid circuit **138** is arranged to supply pressurized fluid **F3** to close lock-up clutch **118**.

[0021] As further described below, circuits **134**, **136**, and **138** are controllable to: open or close turbine clutch **112** while opening or closing clutch **118** or while keeping lock-up clutch **118** open or closed; keep turbine clutch **112** open or closed while opening or closing clutch **118** or while keeping lock-up clutch **118** open or closed; open or close lock-up clutch **118** while opening or closing turbine clutch **112** or while keeping turbine clutch **112** open or closed; and keep lock-up clutch **118** open or closed while opening or closing turbine clutch **112** or while keeping turbine clutch **112** open or closed. In an example embodiment, circuits **134**, **136**, and **138** include channels **CH1**, **CH2**, and **CH3**, respectively. Channel **CH1** is formed by pump hub **141** and stator shaft **143**. Channel **CH2** is formed primarily by shafts **124** and **143**. **CH3** is formed by a center bore in shaft **124**.

[0022] In an example embodiment, torque converter **100** includes chambers **140**, **142**, and **144**. Chamber **140** is a torus at least partially formed by pump **104** and turbine **106**. Circuit **134** provides fluid **F1** to chamber **140**. Chamber **142** is at least partially formed by cover **102** and shell **108**. Circuit **136** provides fluid **F2** to chamber **142**. Chamber **144** is at least partially formed by cover **102** and piston **133**. Circuit **138** provides fluid **F3** to chamber **144**.

[0023] An example operation of torque converter **100** is as follows. To operate in torque converter mode, that is, to transmit torque from cover **102** to input shaft **124** through the fluid coupling of pump **104** and turbine **106** (create torque path **146**), circuits **134**, **136**, and **138** are operated as follows. Pressure in chamber **140** is greater than pressure in chamber **142**, displacing turbine **108** in axial direction **AD1** and opening clutch **112**. Pressure in chamber **142** is greater than pressure in chamber **144**, displacing piston **133** in direction **AD1** and opening clutch **118**.

[0024] To operate in a first lock-up mode, that is, to transmit torque from cover **102** to input shaft **124** through damper **114** (create torque path **148**), circuits **134**, **136**, and **138** are operated as follows. Pressure in chamber **142** is greater than pressure in chamber **140**, displacing turbine **108** in axial direction **AD2**, frictionally engaging portions **108A** and **110A** and friction material **F**, and closing clutch **112**. Pressure in chamber **142** is greater than pressure in chamber **144**, displacing piston **133** in direction **AD1** and opening clutch **118**.

[0025] To operate in a second lock-up mode, that is, to transmit torque from cover **102** to input shaft **124** through damper **116** (create torque path **150**), circuits **134**, **136**, and **138** are operated as follows. Pressure in chamber **140** is greater than pressure in chamber **142**, displacing turbine **108** in axial direction **AD1** and opening clutch **112**. Pressure in chamber **144** is greater than pressure in chamber **142**, displacing piston **133** in direction **AD2** and closing clutch **118**. In the second lock-up mode relative rotation between shell **108** and cover **102** is possible.

[0026] To operate in a combined first and second lock-up mode, that is, to simultaneously create torque paths **148** and **150**, circuits **134**, **136**, and **138** are operated as follows. Pressure in chamber **142** is greater than pressure in chamber **140**, displacing turbine **108** in axial direction **AD2** and closing clutch **112**. Pressure in chamber **144** is greater than pressure in chamber **142**, displacing piston **133** in direction **AD2** and closing clutch **118**.

[0027] In an example embodiment, damper **114** includes cover plate **152** engaged with springs **126A** and **126B**. In torque converter mode, torque path **146** passes through shell **108** to shaft **124** through cover plate **152**, spring **126B**, and flange **122**. In the first lock-up mode, torque path **148** passes from portion **108A** to shaft **124** through plate **120**, spring **126A**, plate **152**, spring **126B**, and flange **122**.

[0028] In an example embodiment, damper **114** includes: cover plate **154** non-rotatably connected to cover plate **152**; and pendulum assembly **156** connected to plate **154**. Assembly **156** includes: connecting element **158** passing through cover plate **154** and limitedly displaceable with respect to cover plate **154**; and pendulum masses **160A** and **160B**. Masses **160A** and **160B** are disposed on opposite radial sides **S1** and **S2** of cover plate **154**, connected to each other by element **158**, and are displaceable with respect cover plate **154** by virtue of the connection to element **158**.

[0029] In an example embodiment, clutch **118** includes friction material **F** and pressure plate **162** non-rotatably connected to cover **102**. Input plate **128** is axially disposed between piston **133** and plate **162**. Friction material **F** is located between piston **133** and plate **128** and between plates **128** and **162**. When piston **133** is displaced in direction **AD1**, plate **128** is rotatable with respect to plate **162** and cover **102** (clutch **118** is open). When piston **133** is displaced in direction **AD2**, plate **128** and piston **133** are frictionally engaged via friction material **F**, plates **128** and **162** are frictionally engaged via friction material **F**, and plate **128** rotates with cover **102** (clutch **118** is closed).

[0030] In an example embodiment, clutch **118** includes outer carrier **164** non-rotatably connected to cover **102** and inner carrier **166** non-rotatably connected to plate **162**. Piston **133** and input plate **128** are axially displaceable with respect to carrier **166**, and rotationally fixed with respect to carrier **166**, for example via spline connection **168**. In an example embodiment, seals **170** seal chamber **144** from chamber **142** while enabling axial displacement of piston **133**. In an example embodiment, plate **162** includes bore **172** to enable a quicker and more uniform distribution of fluid within chamber.

[0031] In an example embodiment, plate **130** is non-rotatably connected to damper **114**, for example, rivet **R** is extended to plate **130**. With the preceding arrangement, torque from plate **130** also passes through spring **126B** and flange **122**. That is, torque passing through either of clutches **112** or **118** passes through spring **126B**. Thus, the combination of damper **116** and plate **152**, spring **126B** and flange **122** essentially operates as a conventional series damper.

[0032] In an example embodiment, torque converter **100** includes plate **176**. Plate **176** and cover **102** form chamber **CH4** connecting channel **CH3** and chamber **144**.

[0033] In an example embodiment (not shown), plate **129** is non-rotatably connected to flange **122** rather than terminating in a direct connection to input shaft **124**. In an example embodiment (not shown), flange **122** is non-rotatably connected to plate **129** rather than terminating in a direct connection to input shaft **124**.

[0034] Advantageously, the parallel operation capability enabled by clutch **112** and damper **114** and by clutch **118** and damper **116** resolve the problem noted above regarding vibration dampening for different torque loads, for example as associated with two-cylinder mode and four- cylinder operation. For example, the spring rates in one of damper **114** or **116** can be selected to be relatively lower to provide optimal dampening for lower torque loads, while the spring rates for the other of damper **114** or **116** can be selected to be higher for heavier torque loads. Further, a still higher torque load can be accommodated by operating both damper **114** and **116** in parallel. Fluid circuits **134**, **136**, and **138** and fluid chambers **140**, **142**, and **144** enable the independent operation of clutches **112** and **118**, which enables the independent or parallel implementation of torque paths **148** and **150**.

[0035] In addition, dampers **114** and **116** can be staged according to throttle positions for an engine supplying torque to converter **100** to accommodate the particular torque load associated with the throttle positions.

[0036] It will be appreciated that various of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations, or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

CLAIMS

What I Claim Is:

1. A torque converter, comprising:

a cover arranged to receive torque;

a pump;

a turbine hydraulically coupled to the pump and including a turbine shell;

a turbine clutch including a radially outermost portion of the turbine shell;

a first torsional vibration damper with:

a first input plate non-rotatably connected to the turbine shell;

an output flange arranged to non-rotatably connect to an input shaft for a transmission; and,

a plurality of springs engaged with the first input plate or the output flange;

a second torsional vibration damper including:

a second input plate;

an output plate arranged to non-rotatably connect to the input shaft for the transmission; and,

at least one first spring engaged with the second input plate and the output plate;

a lock-up clutch including an axially displaceable piston plate arranged to non-rotatably connect the cover and the second input plate;

a first fluid circuit arranged to supply first pressurized fluid to open the turbine clutch;

a second fluid circuit arranged to supply second pressurized fluid to close the turbine clutch or open the lock-up clutch; and,

a third fluid circuit arranged to supply third pressurized fluid to close the lock-up clutch.

2. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to:

close the turbine clutch while keeping the lock-up clutch open or closed; or,

open the turbine clutch while keeping the lock-up clutch open or closed.

3. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to:

close the lock-up clutch while keeping the turbine clutch open; or,

open the lock-up clutch while keeping the turbine clutch closed.

4. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to:

close the turbine clutch while closing the lock-up clutch or opening the lock-up clutch; or,

open the turbine clutch while closing the lock-up clutch or opening the lock-up clutch.

5. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to:

close the lock-up clutch while closing the turbine clutch or opening the turbine clutch; or,

open the lock-up clutch while closing the turbine clutch or opening the turbine clutch.

6. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to:

simultaneously open or close the turbine clutch and the lock-up clutch; or,

keep the turbine clutch and the lock-up clutch simultaneously open or closed.

7. The torque converter of claim 1, wherein:

the first, second, and third fluid circuits are controllable to create a torque path from the cover to the output flange while isolating the second input plate from the cover; or,

the first, second, and third fluid circuits are controllable to create a torque path from the cover to the output plate while enabling relative rotation between the turbine shell and the cover.

8. The torque converter of claim 1, wherein the first, second, and third fluid circuits are controllable to simultaneously create:

a first torque path from the cover to the first output flange through the turbine clutch; and,

a second torque path, separate from the first torque path, from the cover to the output plate through the lock-up clutch.

9. The torque converter of claim 1, further comprising:

a first chamber at least partially formed by the pump and the turbine; and,

a second chamber at least partially formed by the cover and the turbine shell, wherein:

the first fluid circuit is arranged to provide the first pressurized fluid to the first chamber; and,

the second fluid circuit is arranged to provide the second pressurized fluid to the second chamber.

10. The torque converter of claim 1, further comprising:

a first chamber at least partially formed by the cover and the turbine shell; and,

a second chamber at least partially formed by the cover and the piston, wherein:

the second fluid circuit is arranged to provide the second pressurized fluid to the first chamber; and,

the third fluid circuit is arranged to provide the third pressurized fluid to the second chamber.

11. The torque converter of claim 10, wherein the second chamber is sealed from the first chamber.

12. The torque converter of claim 1, wherein:

the first torsional vibration damper includes a first cover plate;

the plurality of springs includes second and third springs;

first input plate and the first cover plate are engaged with the second spring; and,

the first cover plate and the output flange are engaged with the third spring.

13. The torque converter of claim 1, wherein:

the second torsional vibration damper includes a pressure plate non-rotatably connected to the cover; and,

at least a portion of the first input plate is axially located between the piston and the pressure plate.

14. A torque converter, comprising:

a cover arranged to receive torque;

a pump non-rotatably connected to the cover;

a turbine including a turbine shell;

a turbine clutch including a radially outermost portion of the turbine shell;

a first torsional vibration damper including:

a first input plate non-rotatably connected to the turbine shell;

a first cover plate;

an output flange arranged to non-rotatably connect to an input shaft for a transmission; and,

a plurality of springs, each first spring in the plurality of springs engaged with at least one of the first input plate, the first cover plate, or the first output flange;

a second torsional vibration damper including:

a second input plate;

an output plate arranged to non-rotatably connect to the input shaft for the transmission; and,

a second spring engaged with the second input plate and the output plate; and,

a lock-up clutch including an axially displaceable piston plate arranged to non-rotatably connect the cover and the second input plate.

15. The clutch of claim 14, wherein:

operation of the turbine clutch is independent of operation of the lock-up clutch; and,

operation of the lock-up clutch is independent of operation of the turbine clutch.

16. The clutch of claim 14, further comprising:

a first fluid circuit arranged to supply pressurized fluid to open the turbine clutch;

a second fluid circuit arranged to supply pressurized fluid to close the turbine clutch or open the lock-up clutch; and,

a third fluid circuit arranged to supply pressurized fluid to close the lock-up clutch.

17. The torque converter of claim 16, wherein the first, second, and third fluid circuits are controllable to:

create a first torque path from the cover to the output flange while isolating the second input plate from the cover; or,

create a first torque path from the cover to the output plate while enabling relative rotation between the turbine shell and the cover; or,

simultaneously create:

a first torque path from the cover to the output flange through the first vibration damper; and,

a second torque path from the cover to the output plate through the second vibration damper.

18. The torque converter of claim 16, further comprising:

a first chamber at least partially formed by the pump and the turbine and connected to the first fluid circuit;

a second chamber at least partially formed by the cover and the turbine shell and connected to the second fluid circuit; and,

a third chamber at least partially formed by the cover and the piston and connected to the third fluid circuit.

19. A torque converter, comprising:

a cover arranged to receive torque;

a pump non-rotatably connected to the cover;

a turbine including a turbine shell;

a turbine clutch;

a first torsional vibration damper including a plurality of springs and an output flange arranged to non-rotatably connect to an input shaft for a transmission;

a second torsional vibration damper including at least one spring and an output plate arranged to non-rotatably connect to the input shaft;

a lock-up clutch;

when the turbine clutch is closed, a first torque path from the turbine shell to the output flange through the first vibration damper; and,

when the lock-up clutch is closed, a second torque path, separate from the first torque path, from the cover to the output plate through the second vibration damper.

20. The torque converter of claim 19, wherein:

the turbine clutch and the lock-up clutch are arranged to be simultaneously open or simultaneously closed; or,

the turbine clutch is arranged to be opened or closed while the lock-up clutch is open or closed; or,

the lock-up clutch is arranged to be opened or closed while the turbine clutch is open or closed.

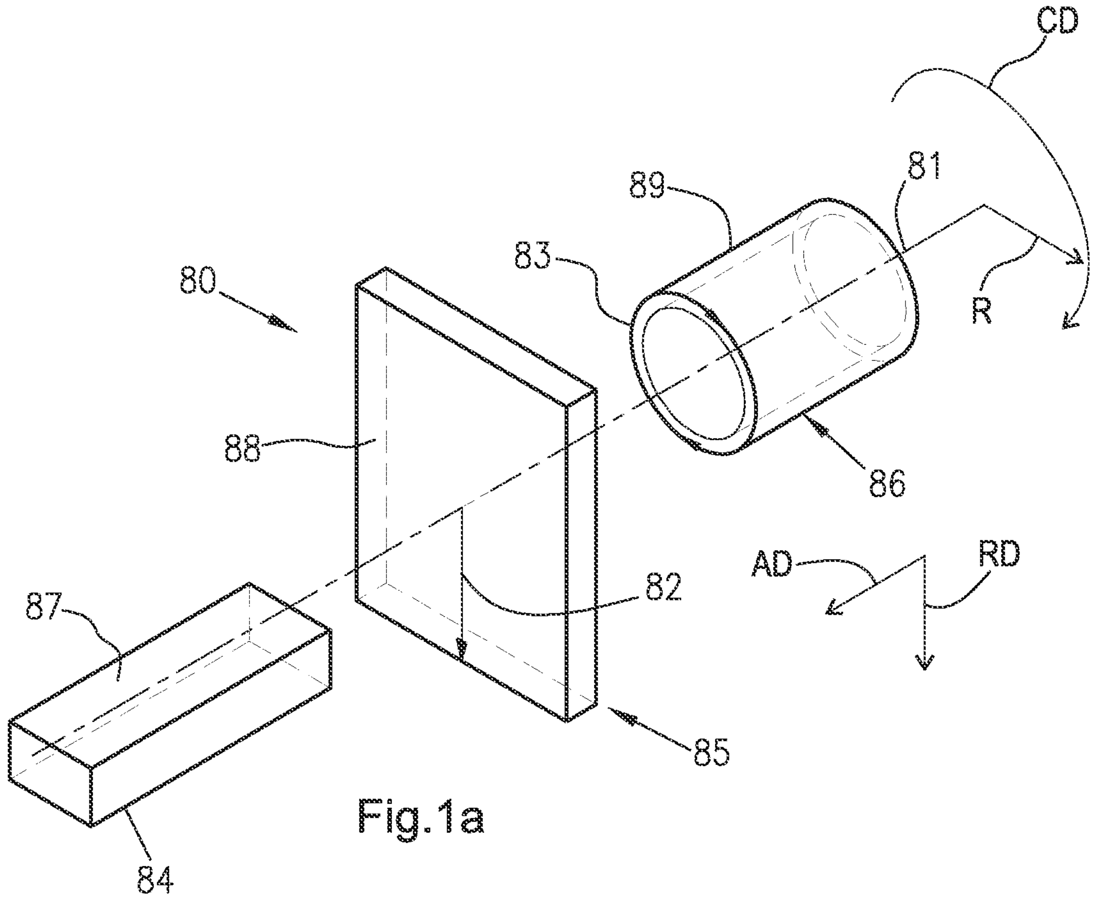

Fig.1a

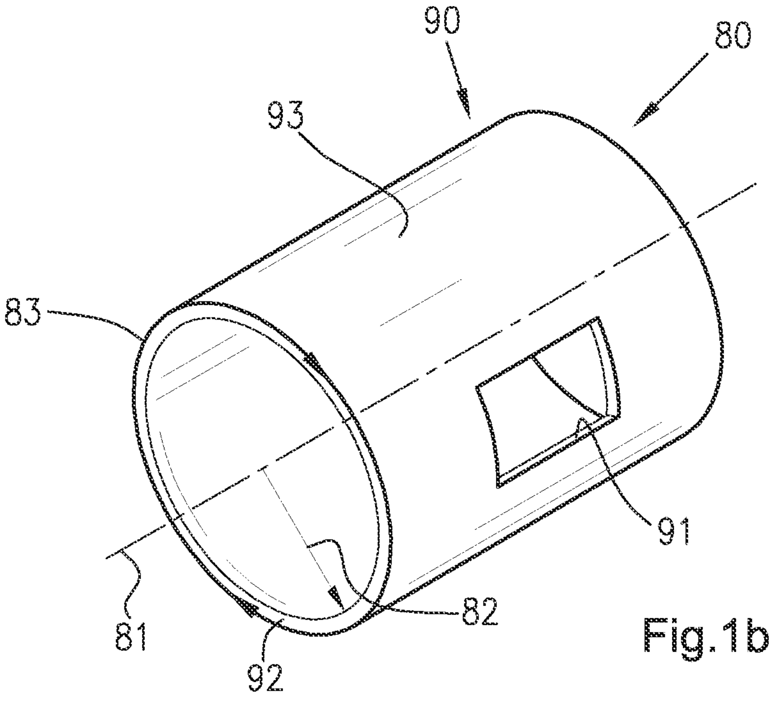

Fig.1b

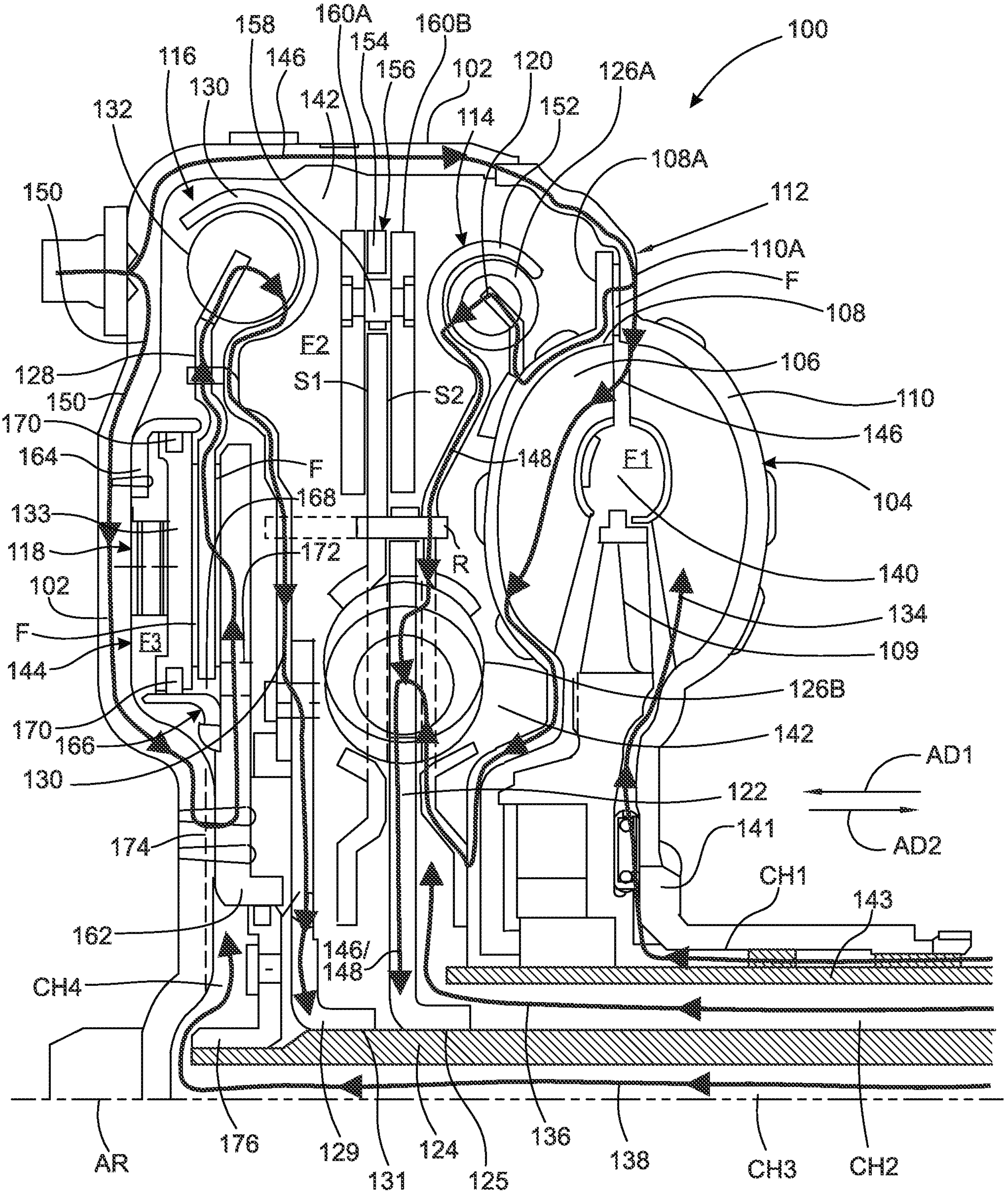
100
158
160A
154
160B
116
146
156
102
120
126A
130
142
114
152
132
108A
150
112
110A
F
108
E2
128
S1
S2
106
150
110
170
146
164
F
148
E1
104
168
133
118
172
R
140
102
134
F
E3
109
144
126B
170
166
142
130
122
AD1
174
141
AD2
CH1
143
162
146/
148
CH4
176
129
131
124
125
136
138
AR
CH3
CH2

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/069781

A. CLASSIFICATION OF SUBJECT MATTER

F16H 45/02(2006.01)i, F16H 41/04(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 33/00; F16D 33/18; F16D 31/02; F16H 41/04

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, turbine clutch, lock-up clutch and damper

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008-0149440 A1 (STURGIN, TODD) 26 June 2008 See abstract, paragraphs [0049]-[0066] and figure 8.	1-20
A	US 2007-0181395 A1 (MUELLER et al.) 09 August 2007 See abstract, paragraphs [0012], [0016] and figure 1.	1-20
A	US 2011-0099992 A1 (MAGERKURTH et al.) 05 May 2011 See abstract, paragraphs [0015]-[0018] and figure 1.	1-20
A	US 2013-0291528 A1 (STRONG et al.) 07 November 2013 See abstract, paragraphs [0021]-[0025] and figures 2, 3.	1-20
A	US 6070704 A (SASSE, CHRISTOPH) 06 June 2000 See abstract, column 3, line 55-column 4, line 52 and figure 2.	1-20

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
03 April 2015 (03.04.2015)	**03 April 2015 (03.04.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. ++82 42 472 7140

Authorized officer
PARK, Tae Wook
Telephone No. +82-42-481-3405

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/069781

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008-0149440 A1	26/06/2008	US 7980992 B2	19/07/2011
US 2007-0181395 A1	09/08/2007	CN 101356390 A	28/01/2009
		DE 112006003626 A5	02/10/2008
		EP 1984652 A1	29/10/2008
		JP 2009-523220 A	18/06/2009
		US 7975817 B2	12/07/2011
		WO 2007-079714 A1	19/07/2007
US 2011-0099992 A1	05/05/2011	DE 102009024743 A1	07/01/2010
		DE 112009001493 A5	24/03/2011
		EP 2300736 A1	30/03/2011
		EP 2300736 B1	10/10/2012
		JP 05595390 B2	24/09/2014
		JP 2011-526344 A	06/10/2011
		US 8573374 B2	05/11/2013
		WO 2010-000220 A1	07/01/2010
US 2013-0291528 A1	07/11/2013	None	
US 6070704 A	06/06/2000	None	