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(54) Title: TORQUE CONVERTER HAVING CONTROLLABLE DUAL CLUTCHES

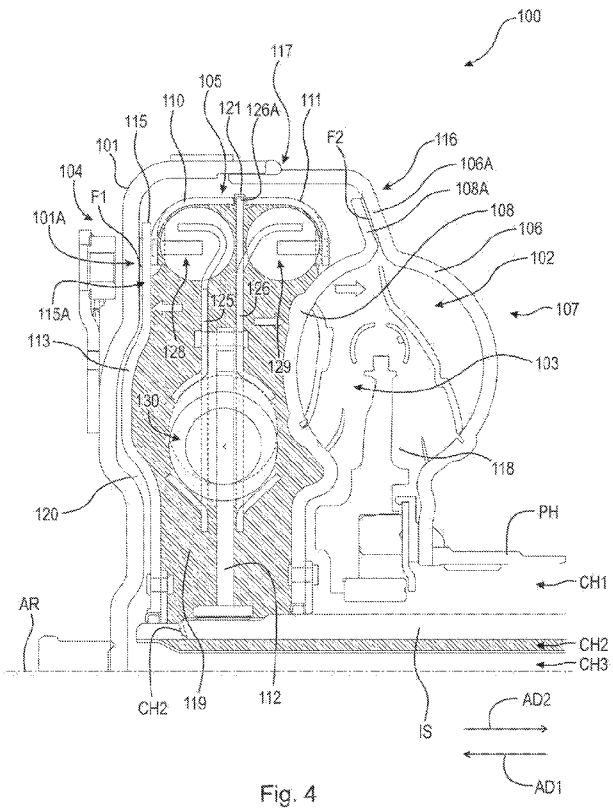


Fig. 4

(57) Abstract: A torque converter including a cover arranged to receive torque; an impeller including an impeller shell non-rotatably connected to the cover; a turbine in fluid communication with the impeller and including a turbine shell; a first clutch axially displaceable to engage the cover; a second clutch axially displaceable to engage the impeller shell; and, a vibration damper including: a first input component non-rotatably connected to a component of the first clutch; a second input component non-rotatably connected to a component of the second clutch; and, an output flange arranged to non-rotatably connect to an input shaft for a transmission. For a first lock-up mode, the first and second clutches are arranged to close to transmit torque from the cover to the first and second input components, respectively.

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TORQUE CONVERTER HAVING CONTROLLABLE DUAL CLUTCHES

TECHNICAL FIELD

[0001] The present disclosure relates broadly to a torque converter including dual clutches to increase torque-carrying capacity of the torque converter, and a seal to increase controllability of the clutches and reduce energy losses.

BACKGROUND

[0002] Figure 11, from U.S. Patent Pre-Grant Publication No. US 2015/0198227 A1 (Blough), illustrates prior art torque converter **420**. Prior art torque converter **420** includes cover **421** arranged to receive torque, pump **422** non-rotatably connected to cover **421**, turbine **423** including turbine shell **424**, stator **425**, turbine clutch **426**, torsional vibration dampers **428** and **429**, and torque converter clutch **430**. Torque converter clutch **430** includes piston **437** arranged to be displaced in axial direction **AD2** away from cover **421**. Dampers **428** and **329** include output flanges **431** and **432**, respectively, arranged to connect to an input shaft for a transmission. Torque converter **420** is a three-pass torque converter, with chambers **433**, **434**, and **435** controlling operation of clutches **426** and **430**.

[0003] Torque converter **420** is designed to enable torque transmission through either clutch **426** or clutch **430**. However, it is inefficient to simultaneously transmit torque through clutches **426** and **430**, for example by simultaneously closing the clutches. To close clutch **426**, chamber **434** is pressurized to displace turbine shell **424** in axial direction **AD2**. To minimize the amount of pressure needed to close clutch **426**, pressure in chamber **433** is kept low. However, pressurizing chamber **434** urges piston **437** in direction **AD1**, which opens clutch **426**. To close clutch **430**, chamber **435** is pressurized to displace piston **437** in direction **AD2**. To simultaneously close clutches **426** and **430**, chambers **434** and **435** must both be pressurized. Thus, chamber **434** is pressurized to obtain the desired clamping of clutch **426** and chamber **435** must be pressurized to obtain the desired clamping of clutch **430** plus counteract the pressure in chamber **434**. This leads to an undesirable increase in the energy output of the pump supplying fluid pressure to torque converter **420**. Further, the fluid pressure available to a torque converter is typically supplied by a pump in a transmission and is limited due to operating requirements for the transmission. Therefore, there may not be sufficient fluid pressure available to properly pressurize both chambers **434** and **435**. In addition, when clutch **326** is closed, there are energy losses due to the cooling flow from

chamber **434** to chamber **433** through cooling channels typically found in clutch friction material. Specifically, pressure in chamber **433** is kept deliberately low to reduce pressure needed in chamber **434**, but the pressure differential between chambers **433** and **434** undesirably increases flow out of chamber **334**, which must be replenished by the pump.

SUMMARY

[0004] According to aspects illustrated herein, there is provided a torque converter including an axis of rotation; a cover arranged to receive torque; an impeller including an impeller shell non-rotatably connected to the cover; a turbine in fluid communication with the impeller and including a turbine shell; a first clutch; a second clutch; a vibration damper including: a first input component non-rotatably connected to a component of the first clutch; a second input component non-rotatably connected to a component of the second clutch; and, an output flange arranged to non-rotatably connect to an input shaft for a transmission. For a first lock-up mode, the first and second clutches are arranged to close to transmit torque from the cover to the first and second input components, respectively

[0005] According to aspects illustrated herein, there is provided a torque converter including an axis of rotation; a cover arranged to receive torque; an impeller including an impeller shell non-rotatably connected to the cover; a turbine in fluid communication with the impeller and including a turbine shell; a first clutch axially displaceable to engage the cover; a second clutch axially displaceable to engage the impeller shell; and, a vibration damper including: a first input component non-rotatably connected to a component of the first clutch; a second input component non-rotatably connected to a component of the second clutch; and, an output flange arranged to non-rotatably connect to an input shaft for a transmission. For a first lock-up mode, the first and second input components are arranged to transmit torque from the cover to the output flange. The component for the second clutch includes the turbine shell; or, the second clutch includes a piston separate from the turbine shell, and the component for the second clutch includes the piston.

[0006] According to aspects illustrated herein, there is provided a torque converter including an axis of rotation; a cover arranged to receive torque; an impeller including an impeller shell non-rotatably connected to the cover; a turbine in fluid communication with the impeller and including a turbine shell; a first clutch; a second clutch; a vibration damper including: a first input component non-rotatably connected to a component of the first clutch;

a second input component non-rotatably connected to a component of the second clutch; a seal element sealed against the first and second input components; and, an output flange arranged to non-rotatably connect to an input shaft for a transmission; a first chamber at least partially formed by the impeller and the component of the second clutch; a second chamber at least partially formed by the component of the first clutch, the seal element, and the first and second input components; and, a third chamber at least partially formed by the cover and the component of the first clutch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] 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 1 is a perspective of a cylindrical coordinate system used to demonstrate spatial terminology used in the present application;

Figure 2 is a partial cross-sectional view of a torque converter including dual clutches, a simplified vibration damper, and a seal element, in a first lock-up mode;

Figure 3 is a partial cross-sectional view of the torque converter of Figure 2 in a second lock-up mode;

Figure 4 is a partial cross-sectional view of the torque converter of Figure 2 in a third lock-up mode;

Figure 5 is a partial cross-sectional view of a torque converter including dual clutches and a simplified vibration damper without a seal element, in a first lock-up mode;

Figure 6 is a partial cross-sectional view of the torque converter of Figure 5 in a second lock-up mode;

Figure 7 is a partial cross-sectional view of the torque converter of Figure 5 in a third lock-up mode;

Figure 8 is a partial cross-sectional view of a torque converter including dual clutches and a simplified vibration damper, in a first lock-up mode;

Figure 9 is a partial cross-sectional view of the torque converter of Figure 8 in a second lock-up mode;

Figure 10 is a partial cross-sectional view of the torque converter of Figure 8 in a third lock-up mode; and,

Figure 11 is a partial cross-section of a prior art torque converter.

DETAILED DESCRIPTION

[0008] 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.

[0009] 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.

[0010] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this 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. By "non-rotatably connected" components we mean that a first component is connected to a second component so that anytime the first component rotates, the second component rotates with the first component, and anytime the second component rotates, the first component rotates with the second component. Axial displacement between the first and second component is possible.

[0011] Figure 1 is a perspective view of cylindrical coordinate system **10** demonstrating spatial terminology used in the present application. The present application is at least partially described within the context of a cylindrical coordinate system. System **10** includes longitudinal axis **11**, used as the reference for the directional and spatial terms that follow. Axial direction **AD** is parallel to axis **11**. Radial direction **RD** is orthogonal to axis **11**. Circumferential direction **CD** is defined by an endpoint of radius **R** (orthogonal to axis **11**) rotated about axis **11**.

[0012] To clarify the spatial terminology, objects **12**, **13**, and **14** are used. An axial surface, such as surface **15** of object **12**, is formed by a plane parallel to axis **11**. Axis **11** is coplanar with planar surface **15** however, it is not necessary for an axial surface to be coplanar with axis **11**. A radial surface, such as surface **16** of object **13**, is formed by a plane orthogonal to axis **11** and coplanar with a radius, for example, radius **17**. Surface **18** of object **14** forms a circumferential, or cylindrical, surface. For example, circumference **19** forms a

circle on surface **18**. As a further example, axial movement is parallel to axis **11**, radial movement is orthogonal to axis **11**, and circumferential movement is parallel to circumference **19**. Rotational movement is with respect to axis **11**. The adverbs "axially," "radially," and "circumferentially" refer to orientations parallel to axis **11**, radius **17**, and circumference **19**, respectively.

[0013] Figure 2 is a partial cross-sectional view of torque converter **100** including dual clutches, a simplified vibration damper, and a seal element, in a first lock-up mode.

[0014] Figure 3 is a partial cross-sectional view of torque converter **100** of Figure 2 in a second lock-up mode.

[0015] Figure 4 is a partial cross-sectional view of torque converter **100** of Figure 2 in a third lock-up mode. The following should be viewed in light of Figures 2 through 4. Torque converter **100** includes axis of rotation **AR**, cover **101**, impeller **102**, turbine **103**, clutches **104** and **116** and simplified vibration damper **105**. Cover **101** is arranged to receive torque from an engine (not shown). Impeller **102** includes impeller shell **106** non-rotatably connected to cover **101**. Turbine **103** is in fluid communication with impeller **102** and turbine **103** includes turbine shell **108**. Vibration damper **105** includes input components **110** and **111** and output flange **112**. Input component **110** is non-rotatably connected to a component of clutch **104** and input component **111** is non-rotatably connected to a component of clutch **116**. Input components **110** and **111** are arranged to transmit torque from cover **101** to output flange **112**.

[0016] Output flange **112** is arranged to non-rotatably connect to input shaft **IS** for a transmission (not shown). In the lock-up mode shown in Figure 2, clutch **104** is closed while clutch **116** is open. Clutch **104** is arranged to close to transmit torque from cover **101** to input component **110**.

[0017] In the lock-up mode shown in Figure 3, clutch **104** is open and clutch **116** is closed. Clutch **116** is arranged to close to transmit torque from cover **101** to input component **111**. In the lock-up mode shown in Figure 4, clutches **104** and **116** are both closed. Clutches **104** and **116** are arranged to close to transmit torque from cover **101** to input components **110** and **111**, respectively.

[0018] In an example embodiment, clutch **104** includes axially displaceable piston **115** and the component of clutch **104** non-rotatably connected to input component **110**

includes piston **115**, which is arranged to non-rotatably connect to cover **101**. For the lock-up mode shown in Figure 2, piston **115** is axially displaceable to frictionally engage cover **101** and piston **115** is arranged to transmit torque to input component **110**. Friction material **F1** is arranged between portion **115A** of piston **115** and portion **101A** of cover **101** proximate input component **110**.

[0019] In an example embodiment, the component of clutch **116** connected to input component **111** is turbine shell **108**. Clutch **116** includes radially outermost portion **108A** of turbine shell **108**, portion **106A** of impeller shell **106** and friction material **F2** between portions **106A** and **108A**. In an example embodiment, portion **108A** is integrally formed with turbine shell **108**. In an example embodiment, clutch **116** is an integrated turbine clutch arranged between torus **107** and radially outermost part **117** of cover **101**. For the lock-up mode shown in Figure 3, turbine shell **108** is arranged to axially displace to frictionally engage impeller shell **106**.

[0020] Torque converter **100** includes separately controllable chambers **118**, **119** and **120** arranged to be pressurized to open and close clutches **104** and **116**. In an example embodiment, torque converter **100** includes seal element **121** sealing input components **110** and **111** against a component of damper **105**, for example plate **126** described below. Chamber **118** is at least partially formed by impeller **102** and a component of clutch **116**, for example, turbine shell **108**. Chamber **119** is at least partially formed by input components **110** and **111**, seal element **121**, and respective components of clutches **104** and **116**, for example, piston **115** and turbine shell **108**. Chamber **120** is at least partially formed by cover **101** and a component of clutch **104**, for example, piston **115**.

[0021] For the lock-up mode shown in Figure 2, fluid pressure in chamber **118** is higher than respective fluid pressures in chambers **119** and **120**. In an example embodiment, only chamber **118** is pressurized. Turbine shell **108** and input component **111** are urged in axial direction **AD1**. Clutch **116** is opened and input component **111** applies a force to input component **110** to close clutch **104**. Clutch **104** is arranged to close to transmit torque from cover **101** to input component **110**. In an example embodiment, lining **F1** includes grooves to enable a cooling flow through lining **F1**.

[0022] In the lock-up mode shown in Figure 3, turbine shell **108** is arranged to axially displace in axial direction **AD2**, opposite axial direction **AD1**, to frictionally engage impeller

shell **106**. Friction material **F2** is arranged between portion **106A** of impeller shell **106** and portion **108A** of turbine shell **108**. For the lock-up mode shown in Figure 3, fluid pressure in chamber **120** is higher than respective fluid pressures in chambers **118** and **119**. Chambers **118** and **119** are pressurized at lower levels or are vented. Turbine shell **108** is arranged to frictionally engage impeller shell **106** to transmit torque from impeller shell **106** to input component **111**.

[0023] In the lock-up mode shown in Figure 3, the displacement of piston **115** in direction **AD2** generates an axial force in axial direction **AD2** on input component **110**. Component **110** transmits the force to input component **111** to displace turbine shell **108** in direction **AD2**.

[0024] In the lock-up mode shown in Figure 4, fluid pressure in chamber **119** is higher than respective fluid pressures in chambers **118** and **120** and input components **110** and **111** are arranged to transmit torque, respectively, from cover **101** and impeller shell **106**, respectively, to output flange **112**. Chambers **118** and **120** are pressurized at lower levels or are vented. In the example of Figure 4, piston **115** is displaced in axial direction **AD1** and turbine shell **108** is displaced in axial direction **AD2**. Due to seal element **121**, energy losses caused by fluid leaking from high pressure chamber **119** to lower pressure chambers **118** and **120** via cooling grooves in clutches **116** and **104**, respectively, are prevented and controllability of clutches **104** and **116** is improved. A lower pressure cooling flow, by-passing chamber **119**, can be provided between chambers **118** and **120**.

[0025] In an example embodiment, vibration damper **105** includes cover plates **125** and **126**, and springs **128**, **129** and **130**. Cover plates **125** and **126** are non-rotatably connected. Spring **128** is engaged with input component **110** and cover plate **125**. Spring **129** is engaged with input component **111** and cover plate **126**. Spring **130** is engaged with cover plate **125**, cover plate **126**, and output flange **112**. In an example embodiment, spring **128** is radially aligned and axially offset with respect to spring **129**.

[0026] For the lock-up modes shown in Figures 2 and 3, input components **110** and **111**, respectively, are arranged to transmit torque from cover **101** to cover plates **125** and **126**, respectively. Cover plates **125** and **126** transmit the torque to flange **112**. For the lock-up mode shown in Figure 4, input components **110** and **111**, respectively, are arranged to transmit torque from cover **101** to cover plates **125** and **126**, respectively. Cover plates **125**

and **126** are arranged to transmit the torque to output flange **112**. In an example embodiment, output flange **112** is located in chamber **119**.

[0027] In an example embodiment, cover plate **126** includes radially outermost distal portion **126A** and seal element **121** is fixed to radially outermost portion **126A** and seals input components **110** and **111** against cover plate **126**.

[0028] Channels **CH1**, **CH2** and **CH3** are connected to chambers **118**, **119** and **120**, respectively, and are hydraulically isolated from each other. Channel **CH1** is formed by the pump hub **PH** and input shaft **IS**. Channels **CH2** and **CH3** are within input shaft **IS**. Channels **CH1**, **CH2** and **CH3** are arranged to hydraulically connect to a pump for the transmission. In an example embodiment, channels **CH1**, **CH2** and **CH3** are all controlled using a hydraulic valve which is able to distribute pressure flow from the transmission pump.

[0029] Figure 5 is a partial cross-sectional view of torque converter **200** including dual clutches and a simplified vibration damper without a seal element, in a first lock-up mode.

[0030] Figure 6 is a partial cross-sectional view of torque converter **200** of Figure 5 in a second lock-up mode.

[0031] Figure 7 is a partial cross-sectional view of torque converter **200** of Figure 5 in a third lock-up mode. The discussion above pertaining to torque converter **100** applies to torque converter **200** except as noted below. Chamber **119** is at least partially formed by piston **115** and turbine shell **108**. Torque converter **200** does not include a seal element sealing chamber **119** with respect to chambers **118** and **120**. Instead, opening **201** is present between input components **110** and **111**. Chamber **119** is hydraulically connected to chambers **118** and **120** when clutches **116** and **104**, respectively, are open, since opening **201** enables pressurized fluid to pass between chamber **119** and chambers **118** and **120**. In an example embodiment, when clutches **104** and **116** are closed, pressurized fluid from chamber **119** flows to chambers **118** and **120** through grooves in the respective friction material for clutches **104** and **116**.

[0032] For the lock-up mode of Figure 5, chambers **118** and **119** are pressurized with respect to chamber **120** to close clutch **104**. Pressurized fluid in chambers **118** and **119** mixes through opening **201** to keep clutch **116** open. For the lock-up mode of Figure 6, chambers **119** and **120** are pressurized with respect to chamber **118** to close clutch **116**. Pressurized

fluid in chambers **119** and **120** mixes through opening **201** to keep clutch **104** open. For the lock-up mode of Figure 7, chamber **119** is pressurized with respect to chambers **118** and **120**.

[0033] Advantageously, torque converter **200** provides a cost savings since seal element **121** is an expensive component.

[0034] Vibration damper **105** shown in Figures 2 through 7 is less complex, requires less space in the torque converter, has a small parts count, and has a smaller cost in comparison to the dual vibration damper configuration discussed above due to the use of a single output flange **112** to connect input components **110** and **111** to input shaft **IS**.

[0035] Figure 8 is a partial cross-sectional view of torque converter **300** including dual clutches and a simplified vibration damper in a first lock-up mode. The discussions above regarding the structure and function of torque converter **100** in Figures 2 through 4 applies to torque converter **300** except as noted. Clutch **116** includes axially displaceable piston **302**. Piston **302** is separate from turbine shell **108** and non-rotatably connected to input component **111**. Chamber **118** includes a portion bounded by piston **302** and shell **108**. For the lock-up mode of Figure 8, chamber **118** is pressurized to urge piston **302** in direction **AD1**, which urges input components **111** and **110** and piston **115** in direction **AD1** to close clutch **104**.

[0036] Figure 9 is a partial cross-sectional view of torque converter **300** including dual clutches and a simplified vibration damper in a second lock-up mode. In the lock-up mode shown in Figure 9, chamber **120** is pressurized to displace piston **115** in direction **AD2** to open clutch **104** and displace input components **110** and **111** and piston **302** in direction **AD2** to close clutch **116**.

[0037] Figure 10 is a partial cross-sectional view of torque converter **300** including dual clutches and a simplified vibration damper in a third lock-up mode. In the lock-up mode shown in Figure 10, chamber **119** is pressurized to displace piston **115** in direction **AD1** to close clutch **104** and displace piston **302** in direction **AD2** to close clutch **116**.

[0038] Advantageously, chamber **119** is sealed with respect to chambers **118** and **120** by seal element **121**. Clutch gain, which is calculated by dividing clutch capacity by clutch apply pressure, is manipulated and improved through use of clutch **104**, clutch **116** and sealed chamber **119** of torque converters **100** and **300**. For example, as noted above, the supply of pressurized fluid to torque converters **100** and **300** is limited; and therefore, the apply

pressure noted above can be considered constant at the limited pressure available. For the lock-up mode shown in Figures 4 and 10, chamber **119** is pressurized to close clutches **104** and **116** to increase the clutch capacity of torque converters **100** and **300**. Advantageously, chamber **119** is pressurized without the losses to chambers **118** and **120** noted above. Thus, the pressure available for clamping clutches **104** and **116** is increased. Thus, clutch gain can be increased by the use of dual clutches and the positioning (diameter) of seal element **121**.

[0039] Advantageously, the example embodiment of torque converters **100** and **300** in Figures 2 through 4 and 8 through 10, respectively, simplifies the control schemes needed to control clutches **104** and **116**. For example, for the lock-up modes shown in Figures 2 and 3, and 8 and 9, only chambers **118** and **120**, respectively, need to be pressurized. In the prior art, two chambers, including a chamber with the vibration dampers, needed to be pressurized to close one of the clutches and keep the other of the clutches open. As noted above, in the lock-up mode shown in Figures 4 and 10, energy losses due to flow of fluid from a high pressure chamber **119** to lower pressure chambers **118** and **120** are avoided.

[0040] 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 Is Claimed Is:

1. A torque converter, comprising:

an axis of rotation;

a cover arranged to receive torque;

an impeller including an impeller shell non-rotatably connected to the cover;

a turbine in fluid communication with the impeller and including a turbine shell;

a first clutch;

a second clutch;

a vibration damper including:

a first input component non-rotatably connected to a component of the first clutch;

a second input component non-rotatably connected to a component of the second clutch; and,

an output flange arranged to non-rotatably connect to an input shaft for a transmission, wherein for a first lock-up mode, the first and second clutches are arranged to close to transmit torque from the cover to the first and second input components, respectively.

2. The torque converter recited in Claim 1, wherein:

for a second lock-up mode, the first clutch is arranged to close to transmit torque from the cover to the first input component, while the second clutch is open; and,

for a third lock-up mode, the second clutch is arranged to close to transmit torque from the cover to the second input component, while the first clutch is open.

3. The torque converter recited in Claim 2, wherein:

for the first lock-up mode, the torque converter has a first torque capacity;

for the second lock-up mode, the torque converter has a second torque capacity less than the first torque capacity; and,

for the third lock-up mode, the torque converter has a third torque capacity different from the second torque capacity and less than the first torque capacity.

4. The torque converter recited in Claim 1, wherein:

the first clutch includes a piston;

the component of the first clutch includes the piston; and,

for the first and second lock-up modes:

the piston is axially displaceable to frictionally engage the cover; and,

the piston is arranged to transmit torque to the first input component.

5. The torque converter recited in Claim 1, wherein for the first and third lock-up modes, the component of the second clutch is arranged to axially displace to frictionally engage the impeller shell.

6. The torque converter recited in Claim 5, wherein the component of the second clutch includes the turbine shell.

7. The torque converter recited in Claim 5, wherein:

the second clutch includes a piston rotatable with respect to the turbine shell; and,

the component of the second clutch includes the piston.

8. The torque converter recited in Claim 1, wherein:

the vibration damper includes:

first and second cover plates;

a first spring engaged with the first input component and the first cover plate;

a second spring engaged with the second input component and the second cover plate; and,

a third spring engaged with the first cover plate, the second cover plate, and the output flange, wherein:

for the first, second and third lock-up modes, the first and second cover plates are arranged to transmit torque from the cover to the output flange.

9. The torque converter recited in Claim 1, further comprising:

a first chamber at least partially formed by the component of the second clutch and the impeller;

a second chamber at least partially formed by the first and second input components and the component of the second clutch; and,

a third chamber at least partially formed by the cover and the component of the first clutch, wherein for the first lock-up mode:

fluid pressure in the second chamber is higher than respective fluid pressures in the first and third chambers; and,

the first and second input components are arranged to transmit torque from the cover to the output flange.

10. The torque converter recited in Claim 2, further comprising:

a first chamber at least partially formed by the component for the second clutch and the impeller;

a second chamber at least partially formed by the first and second input components and the component of the second clutch; and,

a third chamber at least partially formed by the cover and the component of the first clutch, wherein for the second lock-up mode:

fluid pressure in the first chamber is higher than fluid pressure in the third chamber; and,

the first component of the first clutch is arranged to frictionally engage the cover to transmit torque from the cover to the first input component.

11. The torque converter recited in Claim 2, further comprising:

a first chamber at least partially formed by the component for the second clutch and the impeller;

a second chamber at least partially formed by the first and second input components and the component of the second clutch; and,

a third chamber at least partially formed by the cover and the component of the first clutch, wherein for the third lock-up mode:

fluid pressure in the third chamber is higher than fluid pressure in the first chamber; and,

the second clutch is arranged to close to transmit torque from the cover to the second input component.

12. The torque converter recited in Claim 1, further comprising:

a first chamber at least partially formed by the component for the second clutch and the impeller;

a second chamber at least partially formed by the first and second input components and the component of the second clutch; and,

a third chamber at least partially formed by the cover and the component of the first clutch, wherein the output flange is located in the second chamber.

13. The torque converter recited in Claim 1, further comprising:

a first chamber at least partially formed by the component for the second clutch and the impeller;

a second chamber at least partially formed by the first and second input components and the component of the second clutch;

a third chamber at least partially formed by the cover and the component of the first clutch; and,

first, second, and third channels:

connected to the first, second, and third chambers, respectively; and,

hydraulically isolated from each other, wherein:

the first channel is arranged to connect to a pump for the transmission; and,

the second and third channels are arranged to hydraulically connect to the pump via fourth and fifth hydraulically isolated channels, respectively, in the transmission shaft.

14. The torque converter recited in Claim 1, wherein the vibration damper includes:

a spring engaged with the first or second input component;

a cover plate engaged with the spring and including a radially outermost distal end; and,

a seal element:

fixed to the radially outermost end; and,

sealing the first and second input components against the cover plate.

15. A torque converter, comprising:

an axis of rotation;

a cover arranged to receive torque;

an impeller including an impeller shell non-rotatably connected to the cover;

a turbine in fluid communication with the impeller and including a turbine shell;

a first clutch axially displaceable to engage the cover;

a second clutch axially displaceable to engage the impeller shell; and,

a vibration damper including:

a first input component non-rotatably connected to a component of the first clutch;

a second input component non-rotatably connected to a component of the second clutch; and,

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

wherein for a first lock-up mode, the first and second input components are arranged to transmit torque from the cover to the output flange; and,

wherein:

the component for the second clutch includes the turbine shell; or,

the second clutch includes a piston separate from the turbine shell, and the component for the second clutch includes the piston.

16. The torque converter recited in Claim 15, wherein:

the vibration damper includes first and second cover plates;

the first or second cover plate includes a radially outermost distal end; and,

the vibration damper includes a seal element:

fixed to the radially outermost end; and,

sealing the first and second input components against the first or second cover plate.

17. The torque converter recited in Claim 15, wherein:

for a second lock-up mode, the second clutch is open and the first clutch is arranged to close to transmit torque from the cover to the first input component; and,

for a third lock-up mode, the first clutch is open and the second clutch is arranged to close to transmit torque from the cover to the second input component.

18. The torque converter recited in Claim 17, wherein:

for the first lock-up mode, the torque converter has a first torque capacity;

for the second lock-up mode, the torque converter has a second torque capacity different from the first torque capacity; and,

for the third lock-up mode, the torque converter has a third torque capacity greater than the first torque capacity and greater than the second torque capacity.

19. A torque converter, comprising:

an axis of rotation;

a cover arranged to receive torque;

an impeller including an impeller shell non-rotatably connected to the cover;

a turbine in fluid communication with the impeller and including a turbine shell;

a first clutch;

a second clutch;

a vibration damper including:

a first input component non-rotatably connected to a component of the first clutch;

a second input component non-rotatably connected to a component of the second clutch;

a seal element sealed against the first and second input components; and,

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

a first chamber at least partially formed by the impeller and the component of the second clutch;

a second chamber at least partially formed by the component of the first clutch, the seal element, and the first and second input components; and,

a third chamber at least partially formed by the cover and the component of the first clutch.

20. The torque converter recited in Claim 19, wherein for a lock-up mode, the first and second clutches are arranged to close to transmit torque from the cover to the first input component.

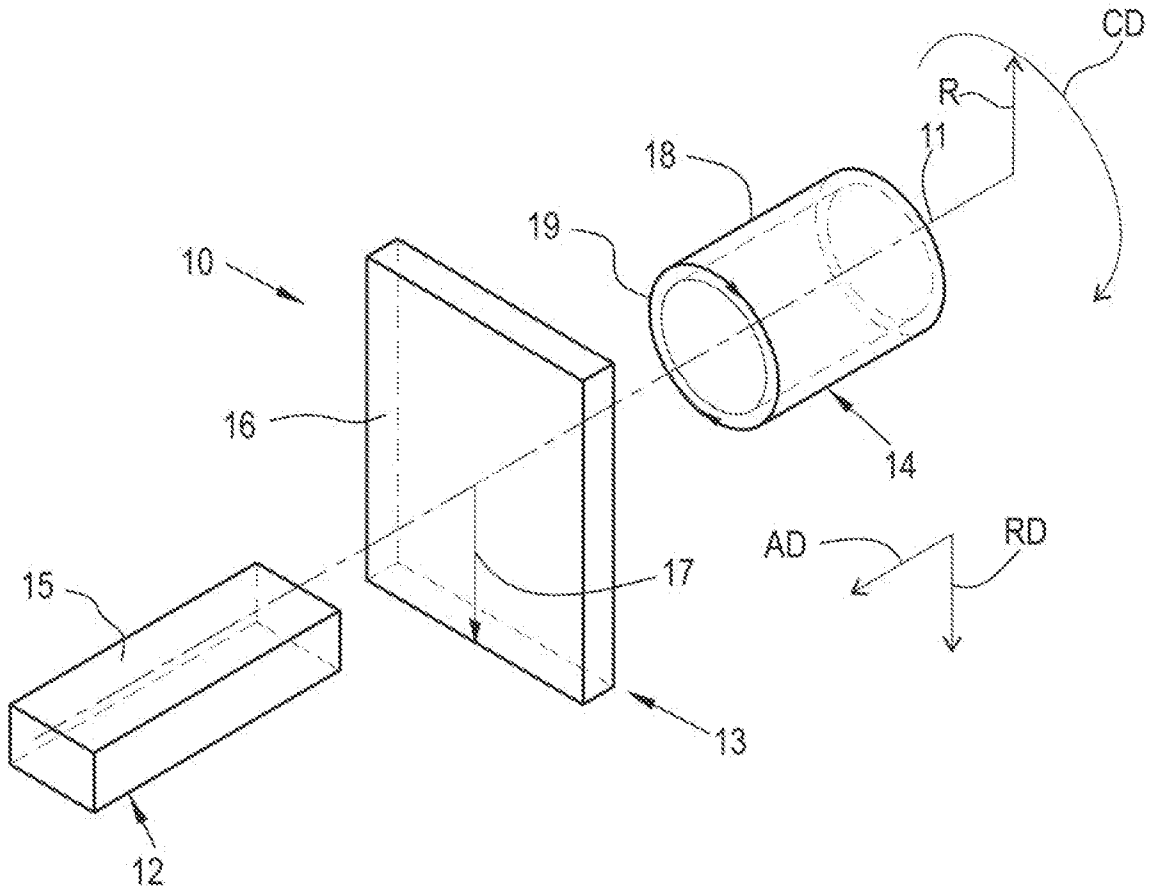


Fig. 1

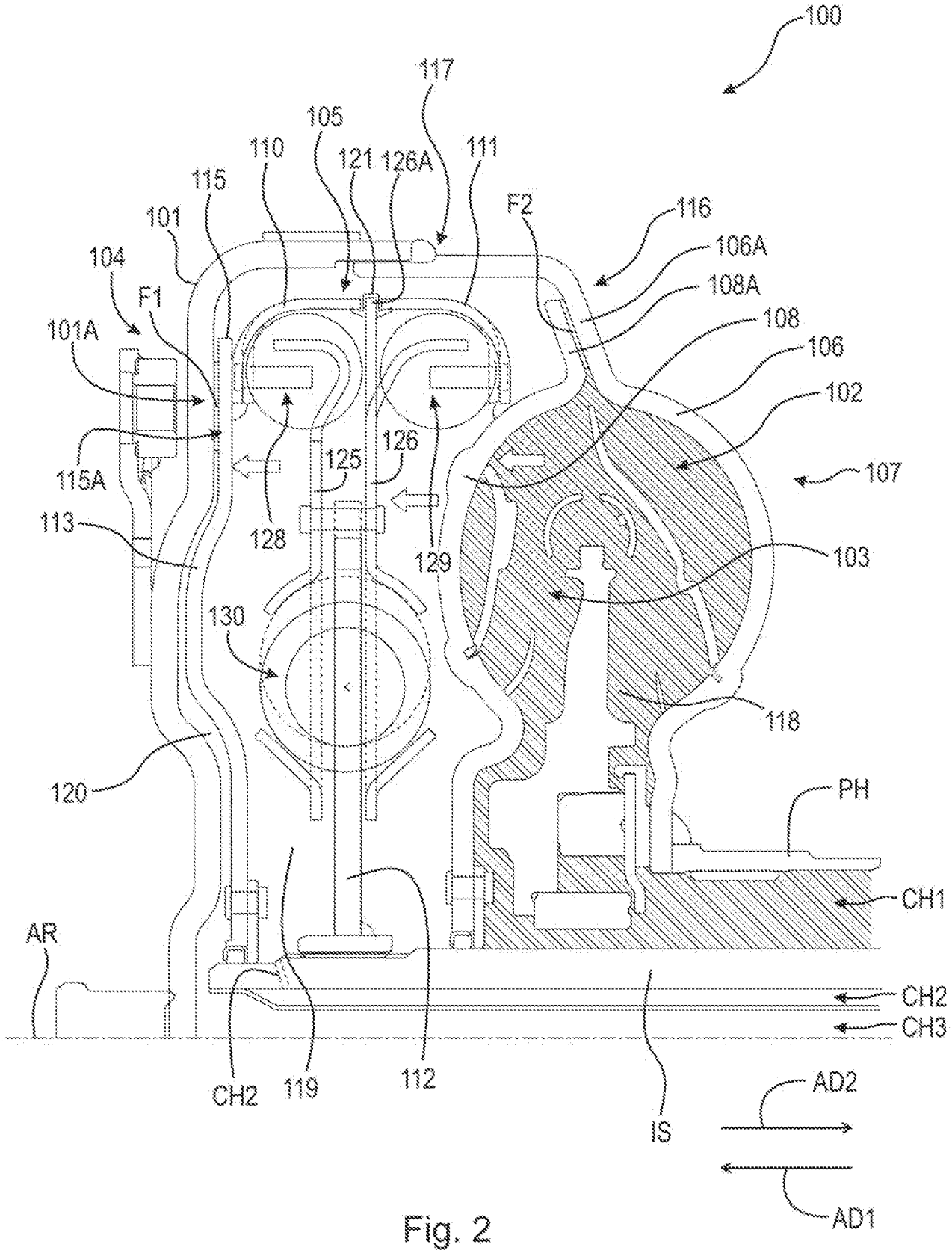

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Fig. 2

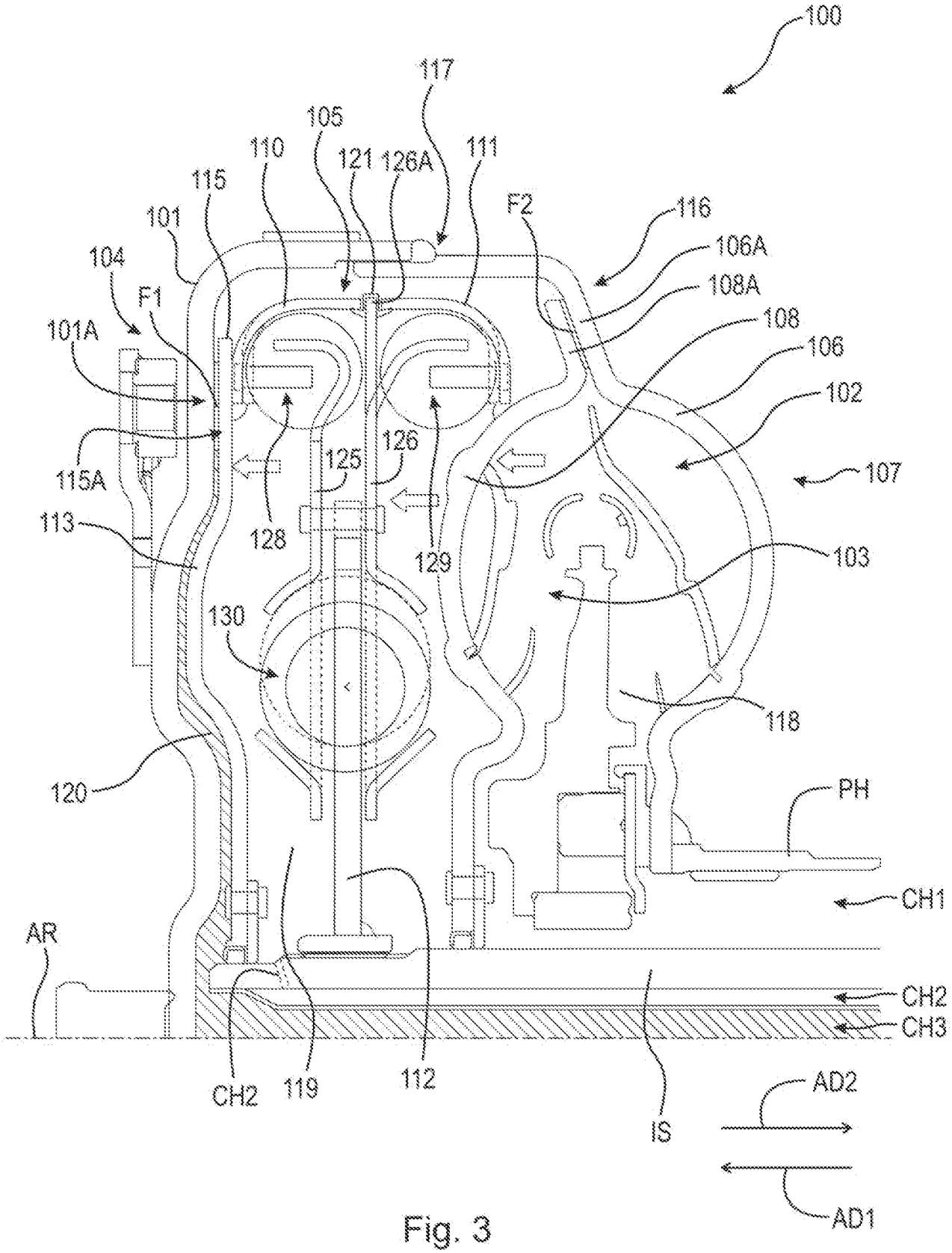

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Fig. 3

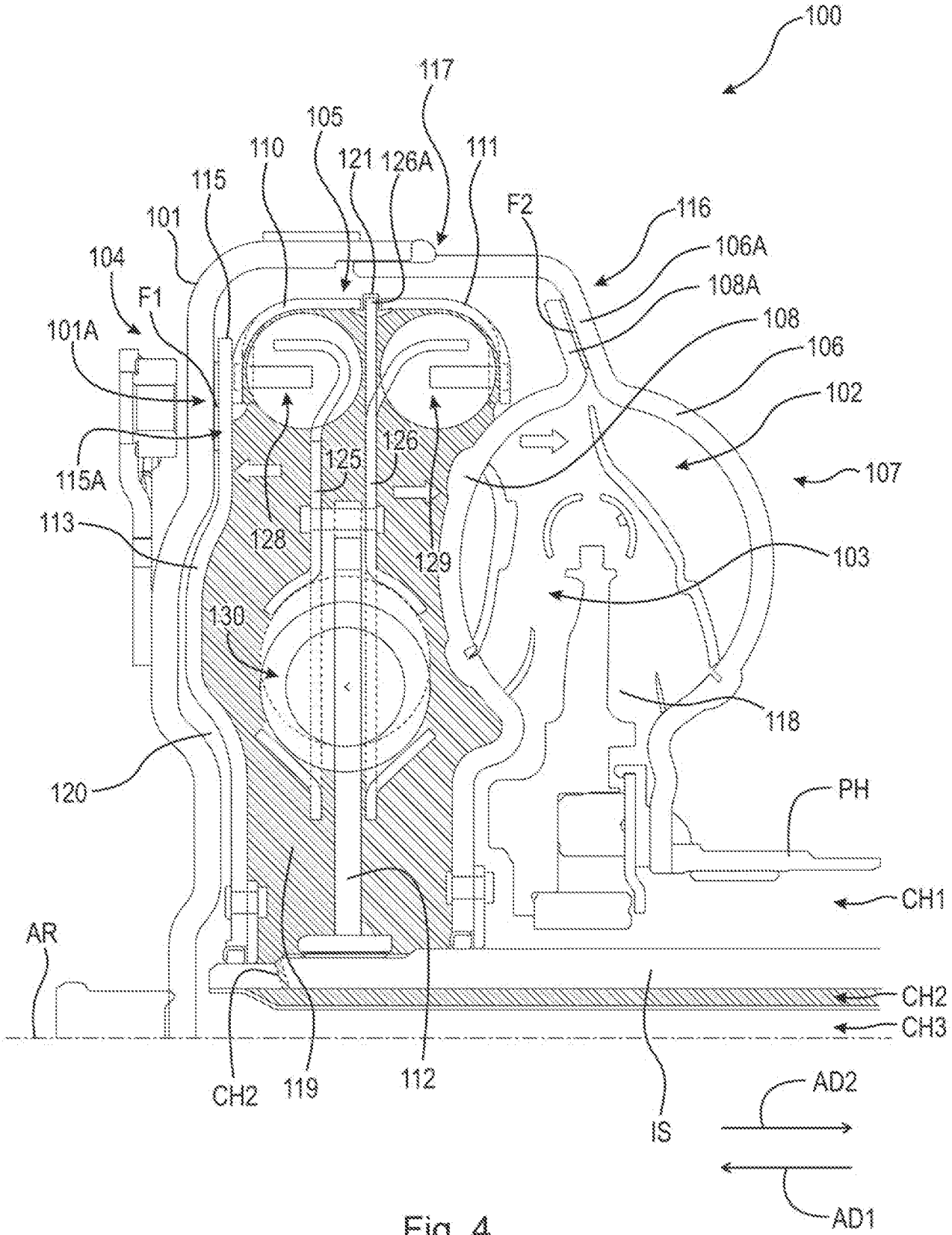

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Fig. 4

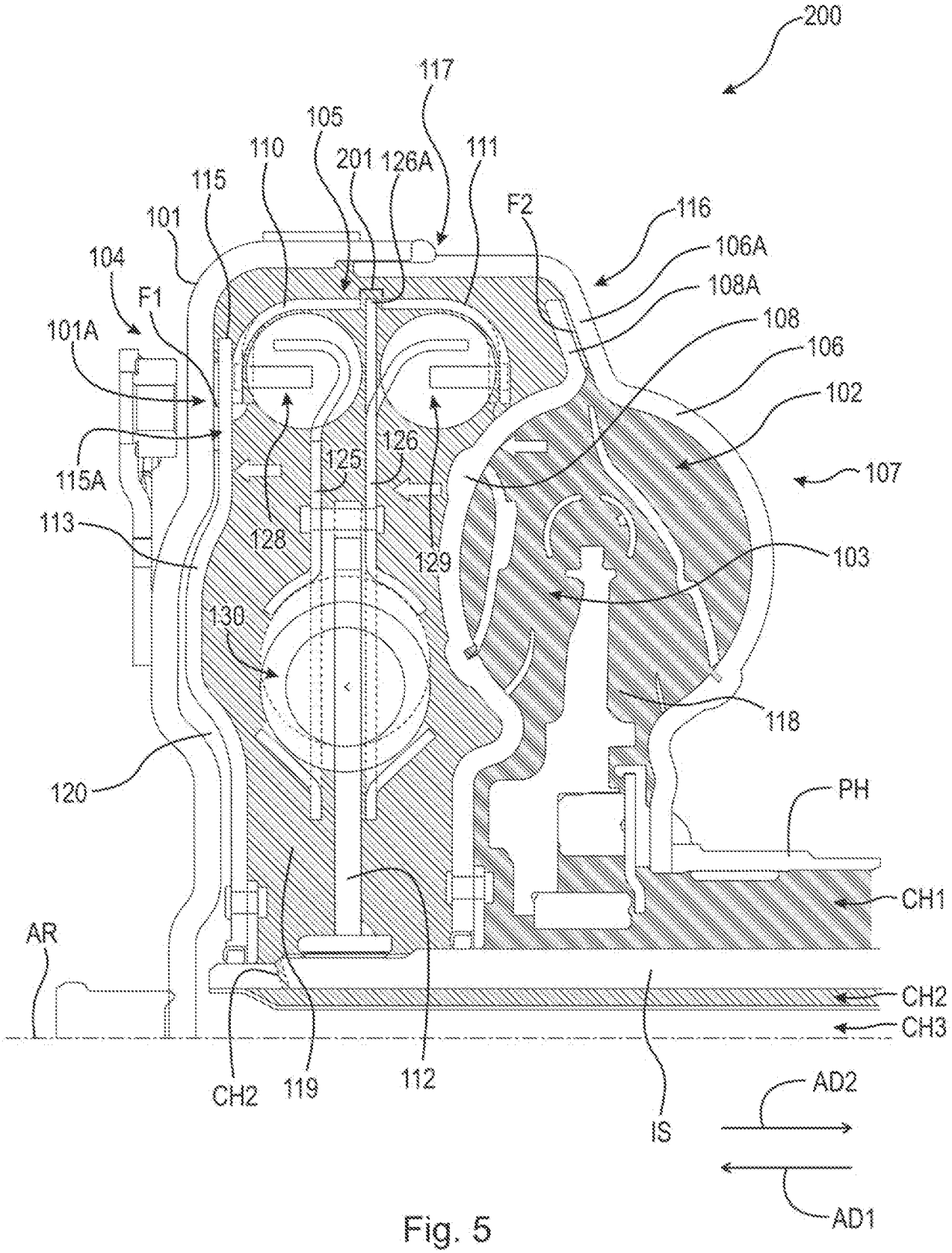

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Fig. 5

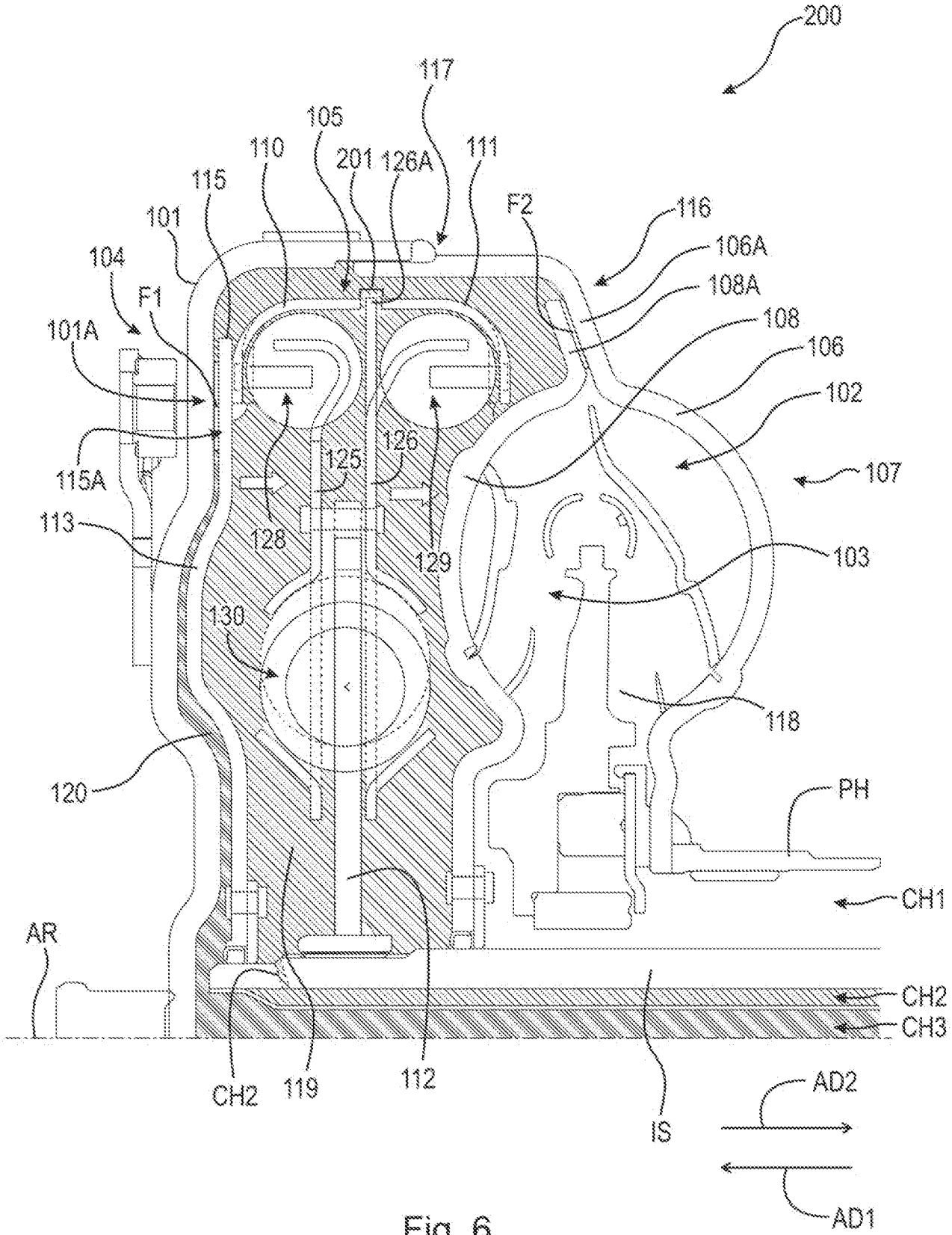

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Fig. 6

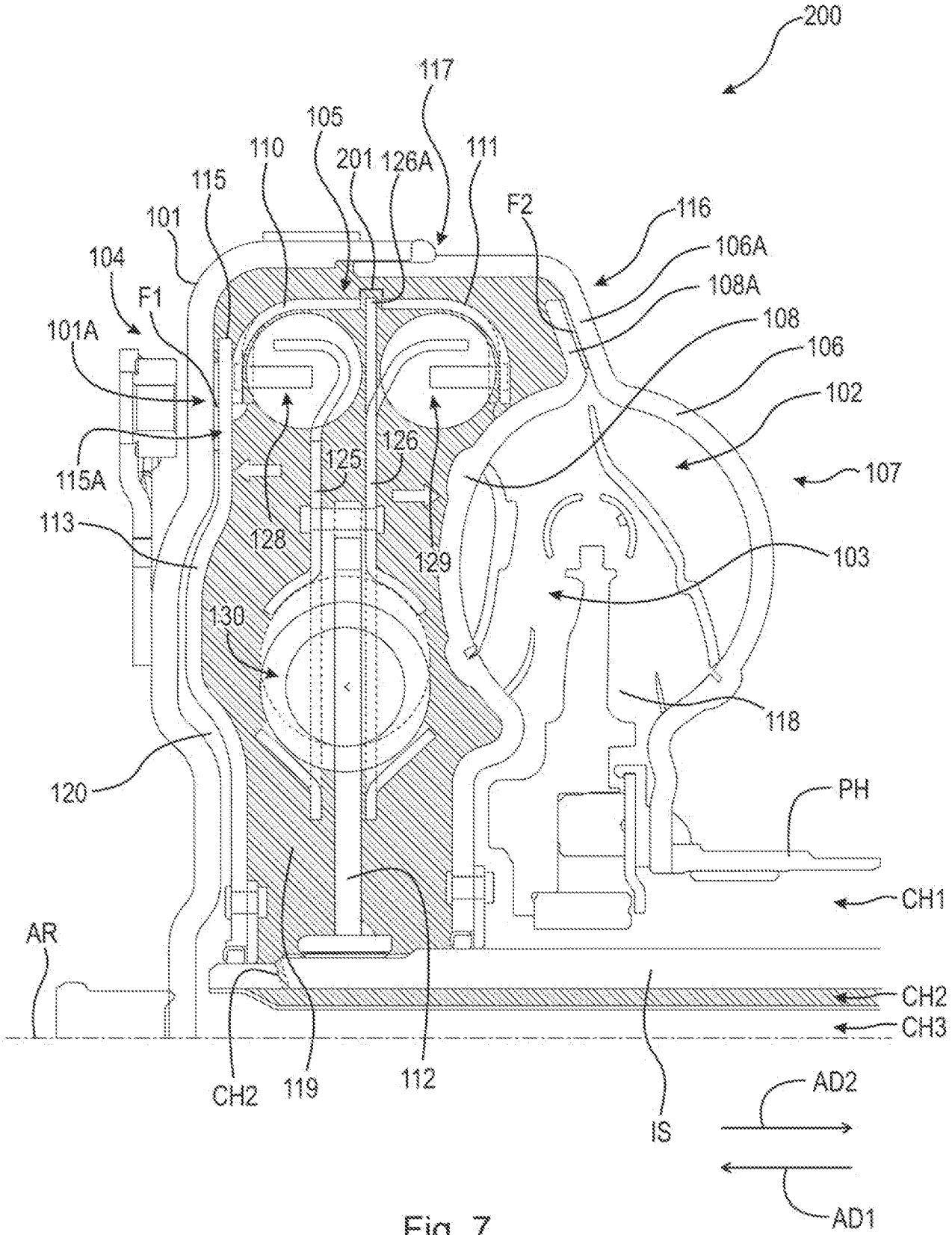

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Fig. 7

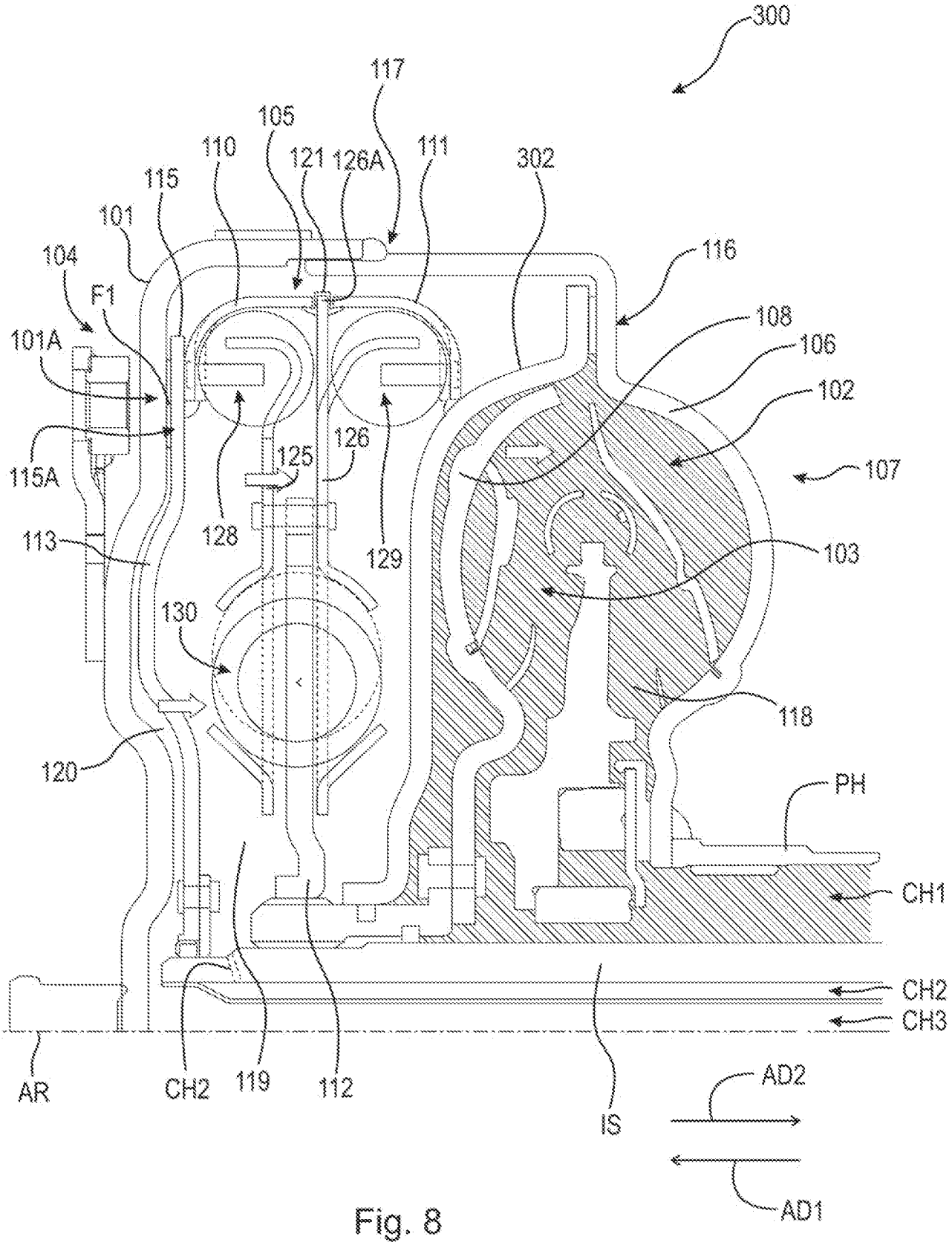

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Fig. 8

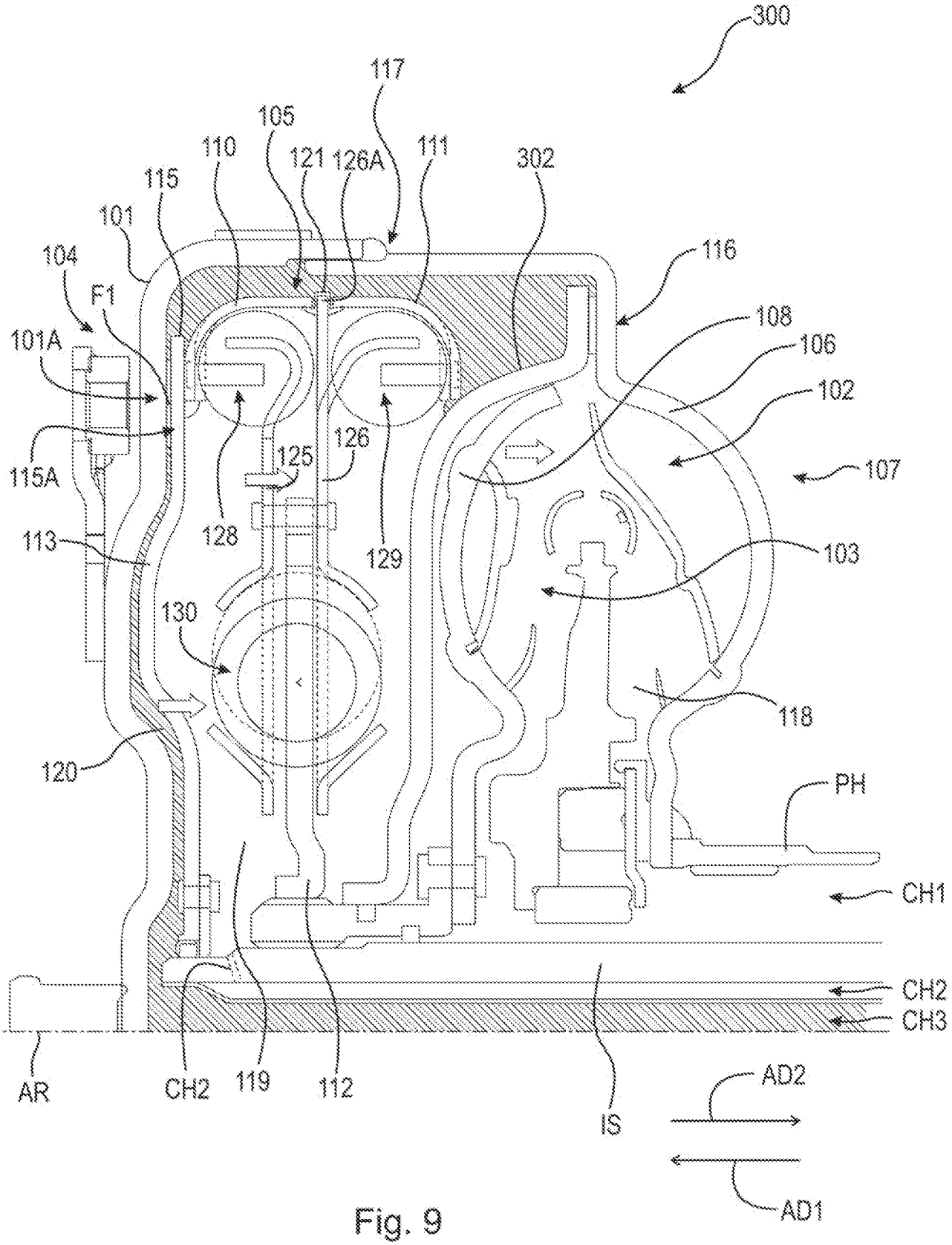

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Fig. 9

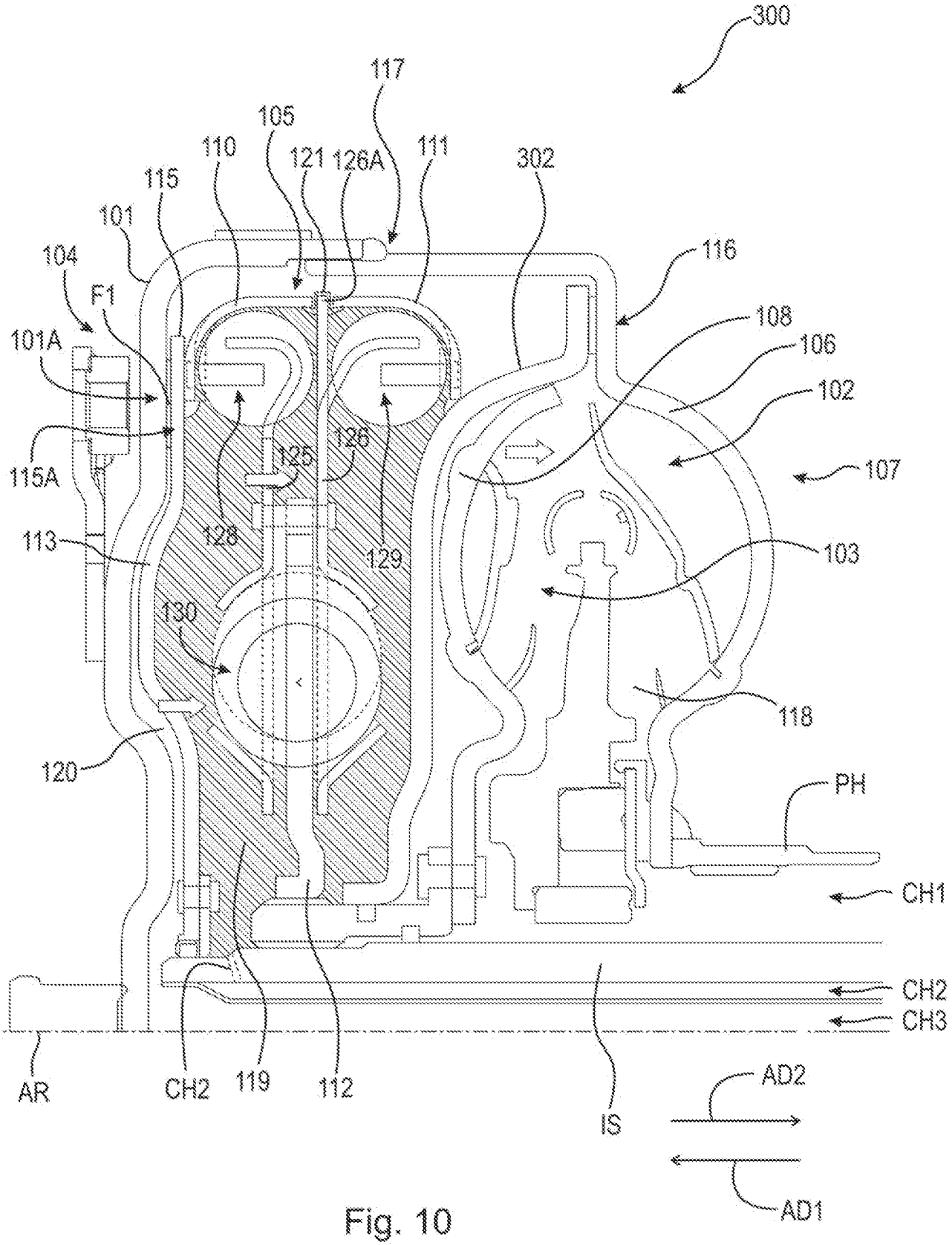
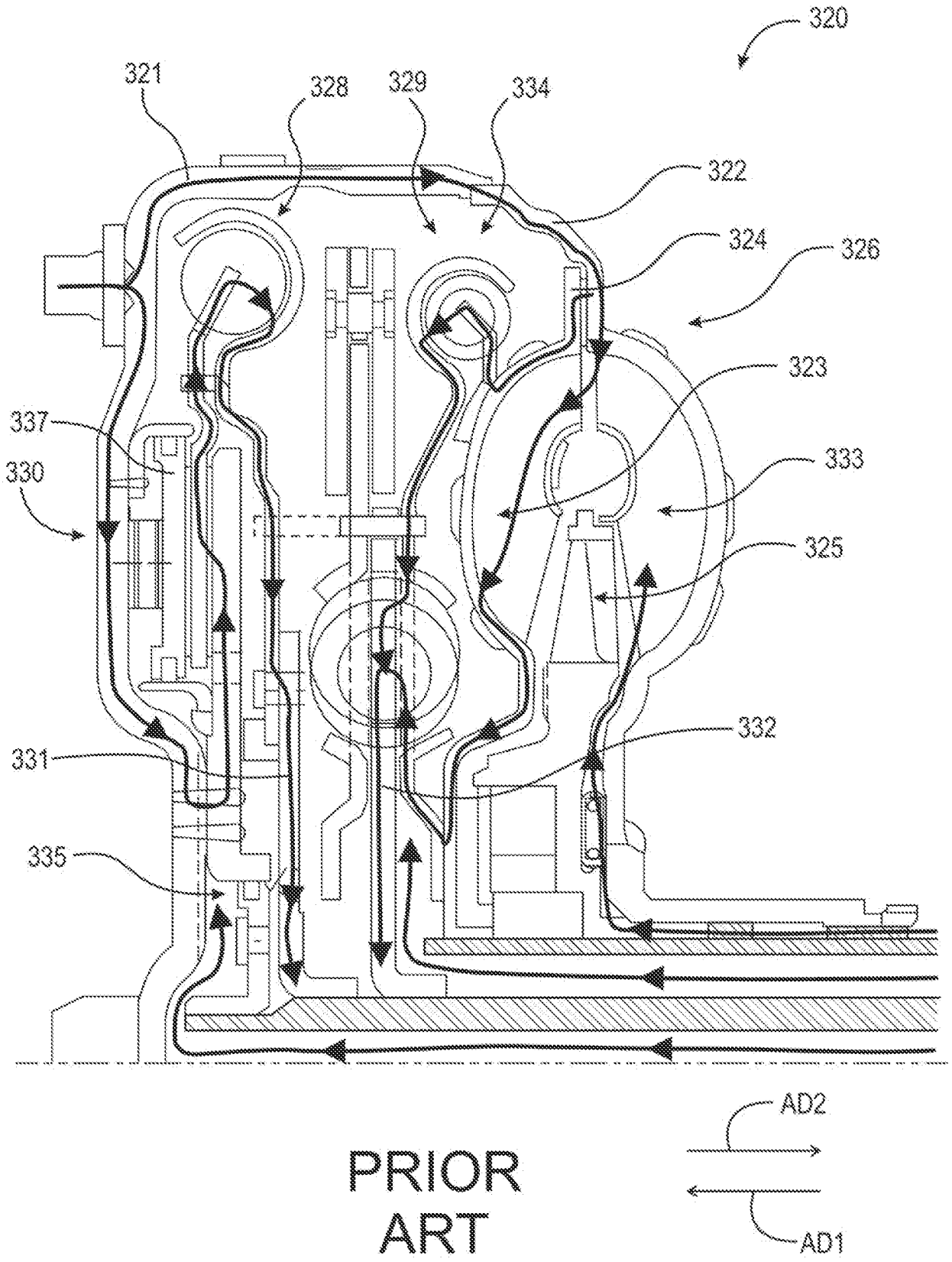

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Fig. 10



PRIOR ART

Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/059952

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; B60W 10/08; F16D 25/10; F16H 41/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: torque converter, lockup clutch, dual clutch, piston, chamber, impeller, turbine, vibration damper and seal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010-0105519 A1 (KASUYA et al.) 29 April 2010 See paragraphs [0038], [0047], [0074]-[0078] and figure 3.	1-3,8
Y		5,6,15,17,18
A		4,7,9-14,16,19,20
Y	US 2015-0198227 A1 (SCHAEFFLER TECHNOLOGIES G.M.B.H. & CO., KG.) 16 July 2015 See paragraph [0021] and figure 2.	5,6,15,17,18
A	US 7926635 B2 (KOMBOWSKI, EUGEN) 19 April 2011 See column 4, line 16 - column 8, line 34 and figure 1.	1-20
A	US 5669475 A (MATSUOKA, YOSHIHIRO) 23 September 1997 See column 4, line 19 - column 6, line 40 and figure 1.	1-20
A	US 2012-0181130 A1 (FUKUNAGA, TAKAO) 19 July 2012 See paragraphs [0024]-[0040] and figure 1.	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"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
04 August 2016 (04.08.2016)	**05 August 2016 (05.08.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2015/059952

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